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I. KRUGER INC.
4001 WESTON PARKWAY
CARY, NC 27513

TELEPHONE 919-677-8310
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TRANSMITTAL LETTER

DATE: September 21, 2015

TO: O'Brien & Gere
4201 Mitchellville Road, Suite 500
Bowie, MD 20716

ATTN: Kristin Waller/Isaac Katz

Transmittal #: 5700235402-E
Page 1 **of** 1
Sent Via: File Share Upload

Project Name: Massillon WWTP
Installation Location: Massillon, OH
Customer P.O. No:
Job No.: 5700235402

We are sending you ☒ Attached, ☐ Under separate cover via _____

☒ Submittals ☐ Schedule ☐ O&M Manuals ☐ Prints ☐ Change Order
☐ Product Data Sheets ☐ Disk ☐ Specifications ☐ Plans ☐ Sketches
☐ Copy of Letter ☐ Brochures ☐ Contracts ☐ Other _____

Number/ Type Copies (Note 1)	Drawing/ Document #	Drawing	Transmittal Code (Note 2)	Required Return Date
Electronic		Kruger IFAS Submittal, Rev 4	FA	
RECIPIENT IS RESPONSIBLE FOR DESTROYING OR RETURNING SUPERSEDED DOCUMENTS				

Note 1: Type: FO = Full Sized Original, RC = Reduced Copy, FC = Full Sized Copy
Note 2: Transmittal Code:

FA= For Approval
FI = For Your Information And Use
FC = For Review and Comment
FR = For Record
AR = As Requested
RFC = Release For Construction
RFD = Release For Design
AN = Approved As Noted
RA = Resubmit _____ Copies For Approval
RR = Resubmit _____ Copies For Record
A = Approved As Submitted
AP = Approved For Production
RFQ = For Quote Due _____
O = _____

Remarks:

Signed: Greg Smith, Project Manager **cc:**

VEOLIA WATER Solutions & Technologies

IFAS

Kruger Project 5700235402

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Submittal

Volume I of I

Integrated Fixed-Film Activated Sludge Equipment
Massillon, OH

Prepared By:

Greg Smith
I. Kruger Inc.
4001 Weston Parkway
Cary, NC 27513
919-677-8310

Submitted To:

Kristin Waller/Isaac Katz
CTI - O'Brien & Gere JV
220 Market South, Suite 750
Canton, OH 44702
443-474-7332

Prepared: September 21, 2015, Rev. 4



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SECTION 1

STATEMENT OF CONFIDENTIALITY

VEOLIA WATER
Solutions & Technologies

I. KRUGER INC.
4001 Weston Parkway
CARY, NC 27513

TELEPHONE 919-677-8310
FACSIMILE 919-677-0082

STATEMENT OF CONFIDENTIALITY

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SECTION 2

CLARIFICATIONS AND EXCEPTIONS

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Clarifications & Exceptions

Kruger Project No.:	5700235402	**Submitted On:**	September 14, 2015
Kruger Project Name:	Massillon	**Comments Date:**	September 16, 2015
Product Line:	IFAS	**Engineer:**	O'Brien & Gere
Submittal Revision:	3	**Response Date:**	September 17, 2015
Submittal No.:	46 53 33-001-1 IFAS Submittal	**Specification No.:**	46 53 33

Item	Comment Date	Comments	Response
		Process Mechanical	
2	9/16/15	*Response Noted on An/Ax tank depth.* *However, note that the Rev 0 process design calcs are included in the Rev 3 PDF. Rev 4 calcs were provided via email September 16, 2015. Please update the combined PDF with the updated Rev 4 process calcs that show the revised calculations and notes achieving the ≤ 10 mg/L TN effluent (six month summer average, six month winter average), ≤ 0.5 mg/L PO4-P, and ≤ 1.0 mg/L (monthly summer average)/ 2.9 mg/L (monthly winter average) NH3-N and included in the revised Performance Guarantee (Dated September 14, 2015).*	**The correct revision of the process design calcs are provided.**
6	9/16/15	*Responses noted; however, the combined PDF does not include the most up to date version. Please update the combined PDF to include the revised version of the Performance Guarantee (dated September 14, 2015) provided by email September 16, 2015.*	**The correct revision of the Performance Guarantee is provided.**
7	9/16/15	*Response noted that manual vavles will be provided, however, P&ID still shows motorized valves on Air sparge – please revise.*	**Kruger has update the P&ID's.**
8	9/16/15	*Refer to Comment 1 above.*	**See response to Comment 1 above.**
13	9/16/15	*Confirm design and inclusion of expansion and fixed joints where necessary. Each pipe section shall have at least two supports and support spacing shall not exceed 9-ft.* ***OBG Response:** Still No response provided, please confirm.*	**Straub couplings and flexible anchor rods are used to allow deflection in the air grids. Max spacing is limited to 9'**
21	9/16/15	*Response noted; however, note that Sheet 3 is missing (looks like there are two Sheet 2s?) – please revise.*	**The missing sheet is provided.**
		Electrical	
1	9/16/15	*Response letter clarified that the blowers are constant speed; however for consistency and further clarification for future reviewers, please revise page 16 of the submittal to read "Blower Operation: Constant Speed" under additional information.*	**This has been revised.**
7	9/16/15	*Are the Square D Combination starters (Class 8538) still being used for the blowers, it appears that TeSys motor starters are being provided, if so, please delete the Class 8538 motor starter information from the submittal.*	**The Class 8538 Combination Starters are NOT being provided. The TeSys motor starters are being provided. Kruger will remove references to Class 8538 starters.**
9	9/16/15	*Confirm Overload Protection is suitable for 20HP Blower Motor being provided.*	**Kruger confirmed the Overload Protection is suitable for the 20HP Blower Motor being provided.**
15	9/16/15	*Loop Drawings show circuit breakers in MCC, please show as fused switches (Typical for all Mixers)*	**This has been revised.**
16	9/16/15	*On the Loop Wiring Diagram the Air Sparge Blower 1 does not show the motor starter, please show as the motor starter is part of this submittal. The Air Sparge Blower Local Control Panel Power Distribution Drawing Sheet 3 of 4 shows 40A Class J Fuses, please change to 45A Class J Fuses.*	**This has been revised.**
		I&C	
1	9/16/15	*Response Noted. Please coordinate Ethernet messaging with CSI during construction.*	**Kruger will coordinate with CSI.**
2	9/16/15	*Level Detection. Provide alarming for Low, Hi1, Hi2, Hi3 and High-High alarms (see draft spec 40 95 00, note that since not all equipment is furnished by Kruger/Contract 1A, set points will be furnished during construction/Contract 2). High-High is to be generated from either the level transmitter as well as the LSHH. IR pumps shall shut down above level Hi3 setpoint, NOT high-high alarm.* *Please clarify where the control screens are located;*	**Kruger can comply with this request.**

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		Main Control Screen – is this the "IFAS Control Panel PEPS" (as shown on contract drawings) main screen? *Blower Control Screen – Blower Control Panel (by others)?* *IMLR Pump Control Screens – is this a separate screen on the same "IFAS Control Panel PEPS"?*	**All these screens will be displayed separately on the IFAS Control Panel HMI.**
6	9/16/15	*Acknowledged. Please note the loop numbers in the attached P&ID set ("51633_Massillon_I_150729.dwf")*	**Noted**
7	9/16/15	*Although a disagreement alarm generally okay for valve open/close fail, a common valve trouble/fault alarm is required to alarm at SCADA; this trouble alarm (configurable at the valve) may include valve O/L, jam, over-torque, over-temp, lost phase, etc. Please provide common alarm.*	**The valves include a trouble alarm for PLC monitoring as requested.**
9	9/16/15	*There still appears to be a typo on DO Instrument Data Sheet (pages 486/487/488 of the submittal), where the accuracy of the transmitter is stated in pH (+/- 0.02 pH). Please revise.*	**This has been corrected.**
11	9/16/15	*Response noted. However, please note that the flow meter is installed in the vertical, flow down in 20" SS pipe.*	**Noted**
12	9/16/15	*Response noted. The orientation of the tanks and air header does not allow for ideal upstream/downstream pipe lengths; however, long radius elbows are included at the closest turns to minimize turbulence prior to measurement. Additionally the straightening veins shall limit swirling flow profiles. Upstream/downstream pipe diameters are approximately 5/4 feet respectively. [Veins to be installed 3 diam downstream of FM].*	**Noted.**
13	9/16/15	*The Data sheet on page 529 of the submittal appears to still indicate Integral Mount. Please revise all references to remote mount.*	**This has been corrected.**
16		*Refer to Process Mechanical Comment No. 7*	**Kruger will proceed with manual Air Sparge Valves.**
18		*The intent here is to prevent single point failure; a single card failure should not take down control of a single train. [For example, Loop drawings 2 thru 4, show trains 1, 2 and 3 pH, DO and Flow all wired to the same analog card.]*	**Kruger is adding an Analog Input Card in order to prevent a single point failure as described above.**
19		*Although a disagreement alarm generally okay for valve open/close fail, a common valve trouble/fault alarm is required to alarm at SCADA; this trouble alarm (configurable at the valve) may include valve O/L, jam, over-torque, over-temp, lost phase, etc. Please provide common alarm.*	**The valves include a trouble alarm for PLC monitoring as requested.**

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SECTION 3

EQUIPMENT

3.1 BLOWERS
3.2 MIXESRS
3.3 MEDIA
3.4 AERATION GRID, SCREENS & SYSTEM DRAWINGS
3.5 VALVES

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SECTION 3.1

BLOWERS

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Equipment Data Sheet

Project Name: Massillon OH | **Project Number: 5700235402**
Date: 01-23-2015 | **Author: Walt Medlock**
Revision: 4 / TTP | **Tag Number:**

ITEM: Air Scour Blower for Top Row Cylindrical Screens in IFAS Basin
LOCATION: TBD

General Information	
Blower Type	Regenerative
Drive Type	Belt
Model Information	
Manufacturer	Republic
Model #	HRB1200 Blower
Rated Discharge Flow	See Below
Discharge Pressure	See Below
Motor Rated Power	20 HP
Applicable Drawings	Data Sheet and Cutsheets Attached
Weight of Each Blower Package	1200 lbs

Additional Information

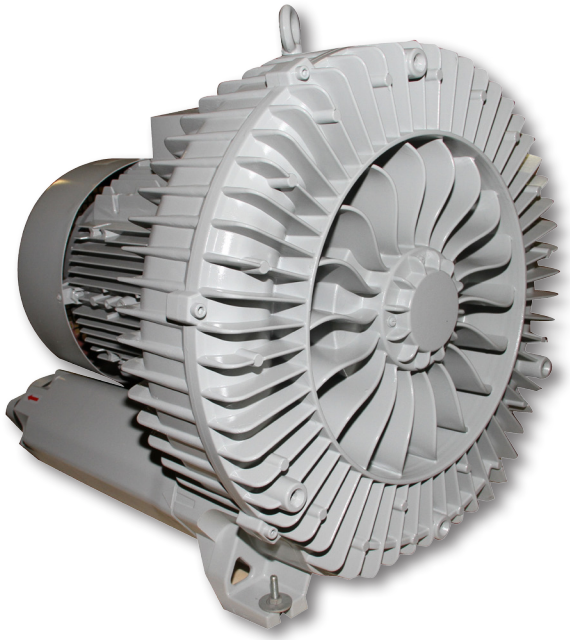
- See Project Specifications and Drawings
- Blower Operation: Constant Speed
- Design Condition:
  - 396 scfm
  - 3 psig at the blower package discharge flange (Note 1)
- Site Conditions
  - Maximum Ambient Temperature 95°F
  - Relative Humidity 75%
  - Elevation 1000 ft
- Blower packages should include:
  - Motor (20 HP, 460V/60Hz/3 ph)
  - Check valve
  - Pressure Gauges
  - Pressure Relief Valve
  - Enclosure
  - Inlet Filter – Reusable/Washable, 5um.
  - Motor Starter

Note 1: Discharge pressure does not include pressure losses through inlet filters, silencers, check valves, or other manufacturer's appurtenances. Manufacturer shall account for such losses in blower selection.

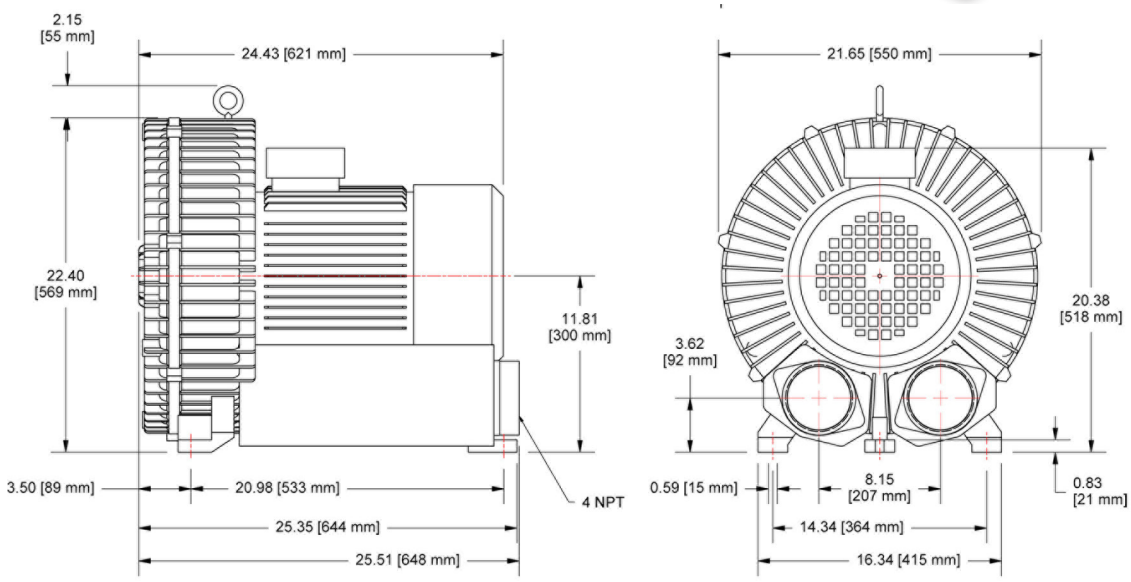
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Republic Regenerative Blower
HRB 1200



Republic offers a complete line of regenerative blowers for high vacuum or compressed air applications in both horizontal and vertical mounted postions. TEFC motors are CE certified. The impeller is directly connected to the motor shaft, providing powerful air force without undue friction. The bearings are outside the compression chamber, ensuring maximum operational reliability under high differential pressure. This low-maintenance, oil-free design provides continuous, dependable service to our customers.



Advantages

- Low noise 82dB
- Continuous, low-maintenance operation
- Saves space and electricity
- Trouble-free installation
- Easy replacement of parts
- Outboard bearings yielding longer life
- Dual voltage 220/440

Product Options

- 4” Relief Valve (recommended)
- Inlet Filter (recommended)
- Liquid filled gauge
- Check Valve
- Belt-driven bare shaft blowers are available
- Explosion proof motors available
  (Class 2/Groups E,F,G/Division 1 Certified)

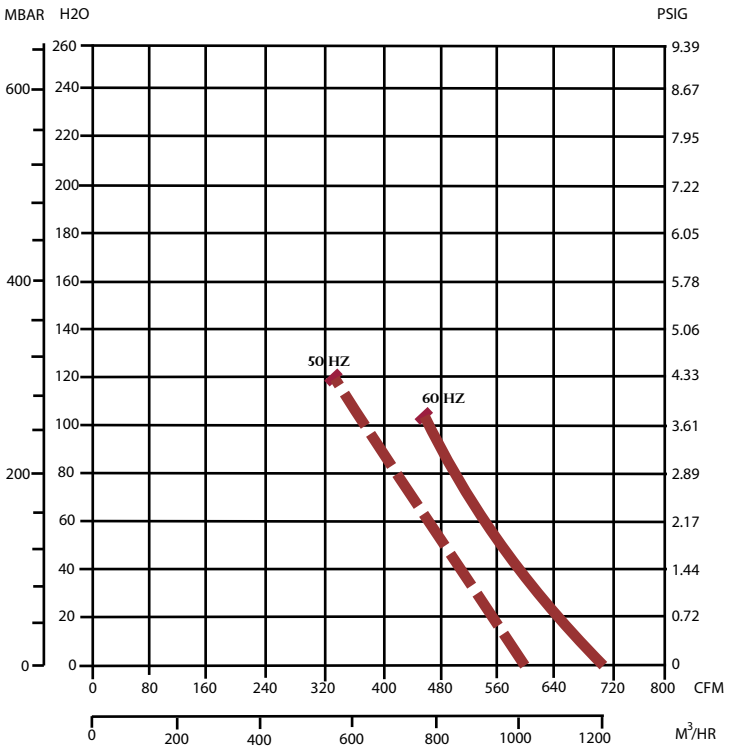
Phase	Motor (HP)	Current @220 V	Current @440 V	Sounds Level (dB)	Rated Pressure (in. H2O)		Rated Vacuum (in. H2O)		Air Flow (cfm)		Weight (lbs)
					60 Hz	50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	
3	20.0	59.7	32.2	82	106	118	114	122	706	600	476

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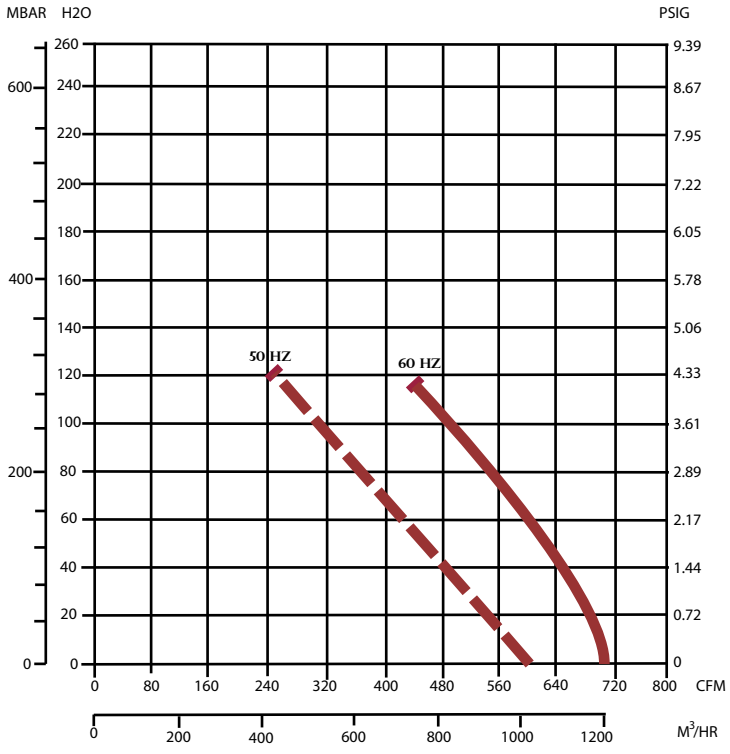
Republic Regenerative Blower
HRB 1200

REPUBLIC
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Pressure vs. CFM

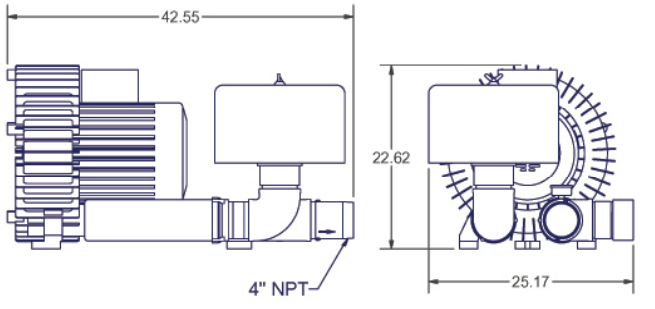


Vacuum vs. CFM



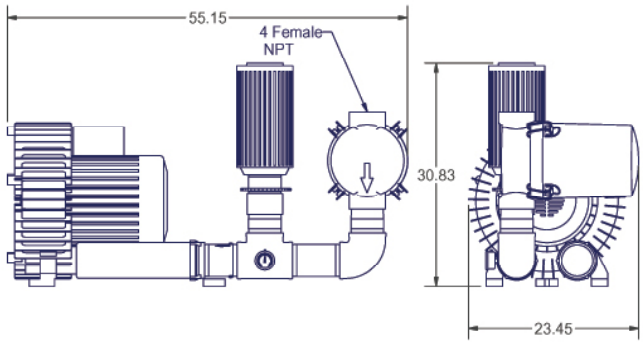
All Republic Regenerative Blowers are available in preassembled kits for either pressure or vacuum applications. These kits include an inlet filter and relief valve, and have been tested prior to shipment. Optional items for these kits include check valve and gauge.

KPHRB1200 - Pressure Kit Drawing



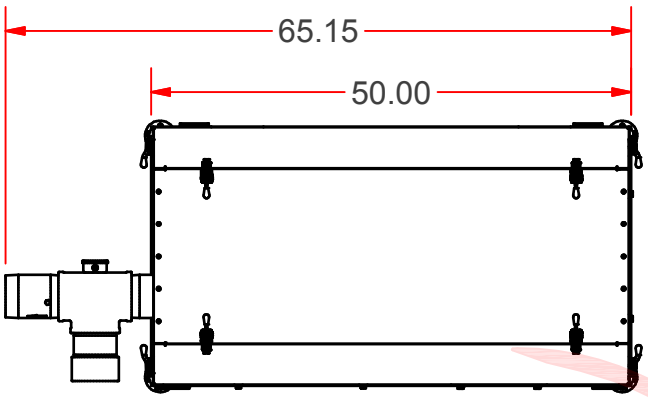
Kit Pressure Pump 4" NPT	KPHRB1200

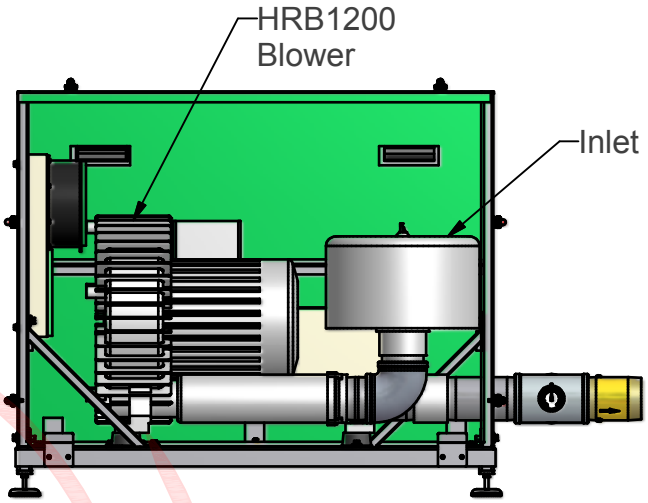
KVHRB1200 - Vacuum Kit Drawing



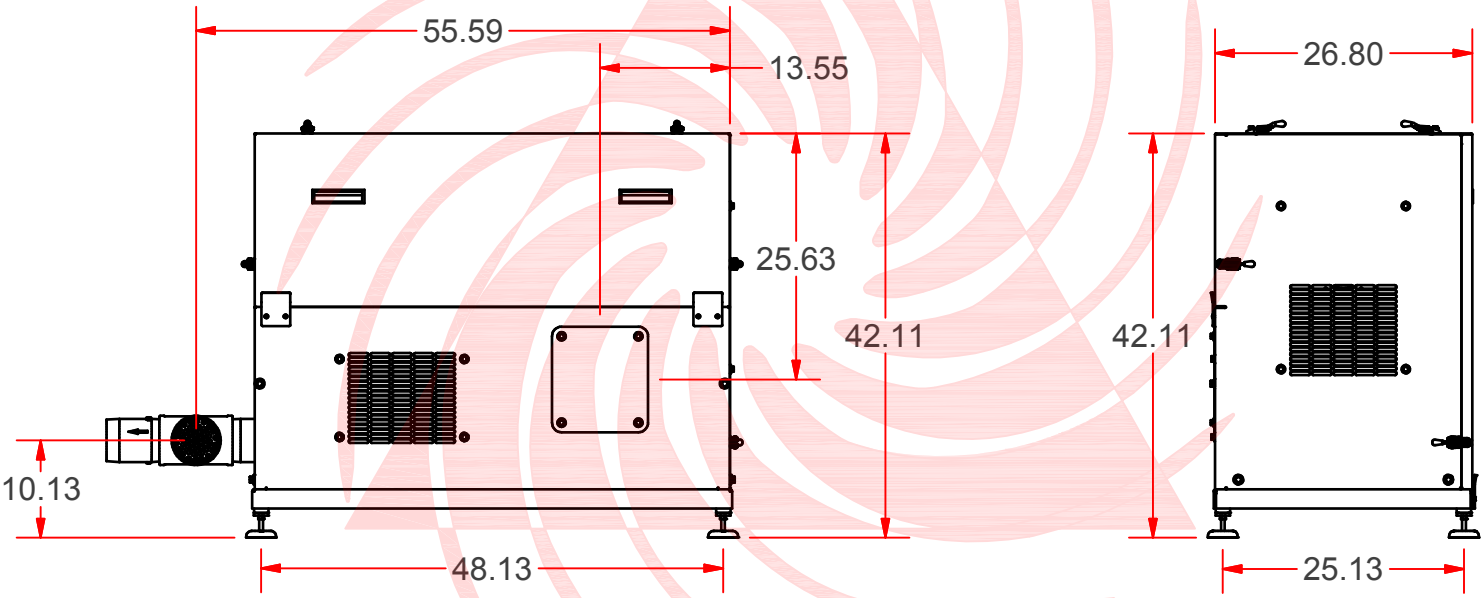
Kit Vacuum Pump 4" NPT	KVHRB1200

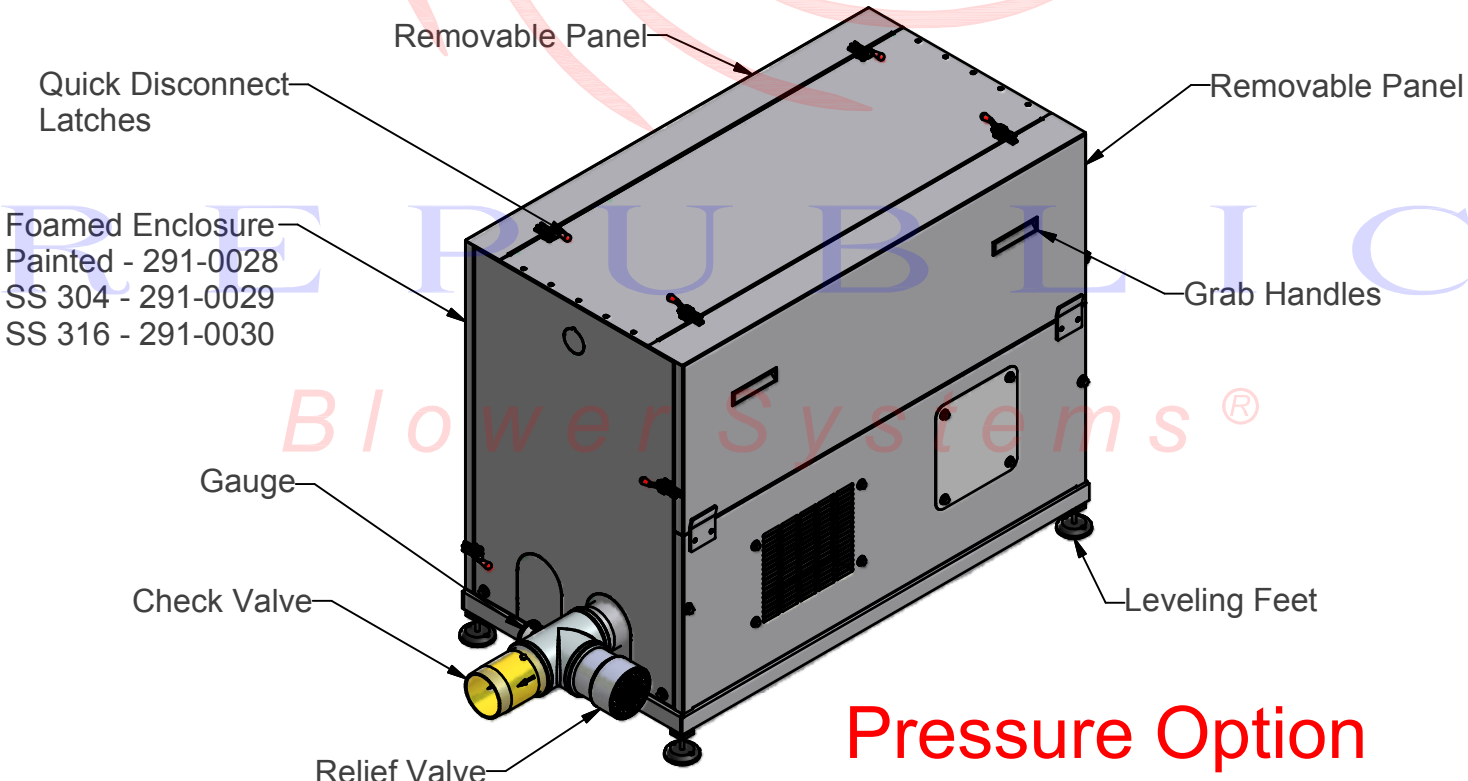
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Removable Panel Not Shown





Pressure Option

HRB1200 Regen with Enclosure (Pressure)	KENCHRB1200

Replacement Elements
60 - 11200 m^3/h Flow Range



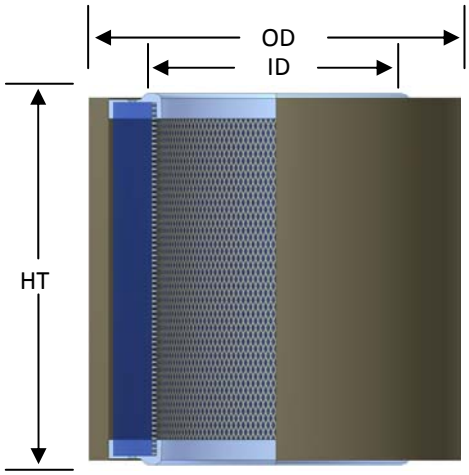
Small Elements
with Molded Endcaps



Compact & Large Elements
with Metal Endcaps

Features

- Pleated media for high dirt holding capacity
- Polyester: Reinforced with epoxy coated steel wire on both sides of cloth
- ~~Paper: Heavy duty industrial strength paper surrounded by heavy gauge galvanized expanded metal~~
- 40 - 50% increased dust loading capacity with prefilter (part number suffix P)
- Optimal surface area per given size



Technical Specifications

- Polyester: 99%+ removal efficiency to 5 micron
- ~~Paper: 99%+ removal efficiency to 2 micron~~
- Temp (continuous): min -26°C (-15°F) max 104°C (220°F)
- Filter change out differential: 37-50 mbar over initial Δ P

Polyester Media Benefits

- Washable with lukewarm water & mild detergent
- Less maintenance due to longer durability
- Moisture resistant
- Handles hot air and oil mist from unload cycle of reciprocating/piston compressor

~~*Paper Media Benefits*~~

- Optimal surface area per given size
- Higher efficiency than many alternative media
- Cost effective

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Replacement Elements
60 - 11200 m³/h Flow Range

Replacement Elements—up to 510 m³/h flow

Element Part Number		Element m³/h	Surface Area m²		Dimensions - mm			STD Endcap
Polyester	Paper	Rating	Polyester	Paper	ID	OD	HT	Features
15P	14P	60	0.05	0.10	76	111	59	M
19P	18P	170	0.14	0.28	76	111	121	M
31P	30P	335	0.21	0.58	92	146	121	M
35P	34P	470	0.37	1.02	121	200	122	M
231P	230P	510	0.42	1.1	92	146	241	M

Note: Also available in wire mesh. Example part number for wire mesh: 230S

Dimension tolerance ± 6 mm

See Element Technical Data section for maintenance guidelines

Replacement Elements—up to 11220 m³/h flow

Element Part Number		Element m³/h	Surface Area m²		Dimensions - mm			STD Endcap
Polyester	Paper	Rating	Polyester	Paper	ID	OD	HT	Features
235P	234P	970	0.8	2.1	121	200	244	M
335P	334P	1360	1.1	3.2	121	200	368	M
237	236	935	0.8	2.1	119	197	216	GBN
239P	238P	970	1.1	4.8	124	235	254	GBN
245P	244P	1500	1.3	3.3	152	248	244	GN | M
345P	344P	1870	2.1	5.3	152	248	368	GN
275P	274P	1870	1.8	4.2	203	298	244	GN
375P	374P	2550	2.6	6.3	203	298	368	GN
377P	376P	3105	4.6	12	229	371	368	GN
385P	384P	5610	4.6	13	356	498	368	GN
485P	484P	8000	7.0	19	356	498	546	GN
685P	--	11220	9.3	--	356	498	724	GN

Note: Most are available in wire mesh. Example part number for wire mesh: 244S

Dimension tolerance ± 6 mm

See Element Technical Data section for maintenance guidelines

Endcap Information

M = Molded plastisol

B = Closed one end with **b**olt hole, open on other end

G = **G**alvanized metal endcaps

N = Neoprene gaskets on open end(s)

Additional Media Options

- 1, 4, 25, and 100 micron Polyester
- HEPA
- Stainless steel wire mesh
- High temperature Nomex
- Stainless steel Nomex reinforced by stainless steel wire mesh & expanded metal
- Polypropylene
- Activated carbon

Note: Model offerings and design parameters may change without notice. See www.solbergmfg.com for most current offering.

Republic Blowers

Ring Blower • Side Channel Blower • Regenerative Blower

Owner's Manual

REPUBLIC
Blower Systems®



Republic Blower Systems®

www.republicsales.com

Revised 7.08

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Use Criteria

- Use only clean, dry air.
- Do not use flammable or explosive gases or atmosphere that contains such gases.
- Operate at 0°C – 40°C (32°F – 104°F).
- Protect unit from contaminants and moisture.
- Protect all surrounding items from exhausted air. This exhausted air can be very hot.
- Air particles, water vapor, oil based contaminants or other liquids must be filtered out.
- This blower must be installed with the proper sized inlet and inline filter, gauge and relief valve to protect the blower from contaminants and over-heating.
- When using the blower at a high altitude or high temperatures, please consult with Republic Blower Systems prior to use.

Safety Notice

To insure safe operation, we have provided many important safety guidelines in this manual for the Republic Regenerative Blower. Please read this instruction manual carefully and pay particular attention to instructions with the following signs:

DANGER: Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING: Indicates a potentially hazardous situation, which, if not avoided, could result in death or serious injury.

Installation



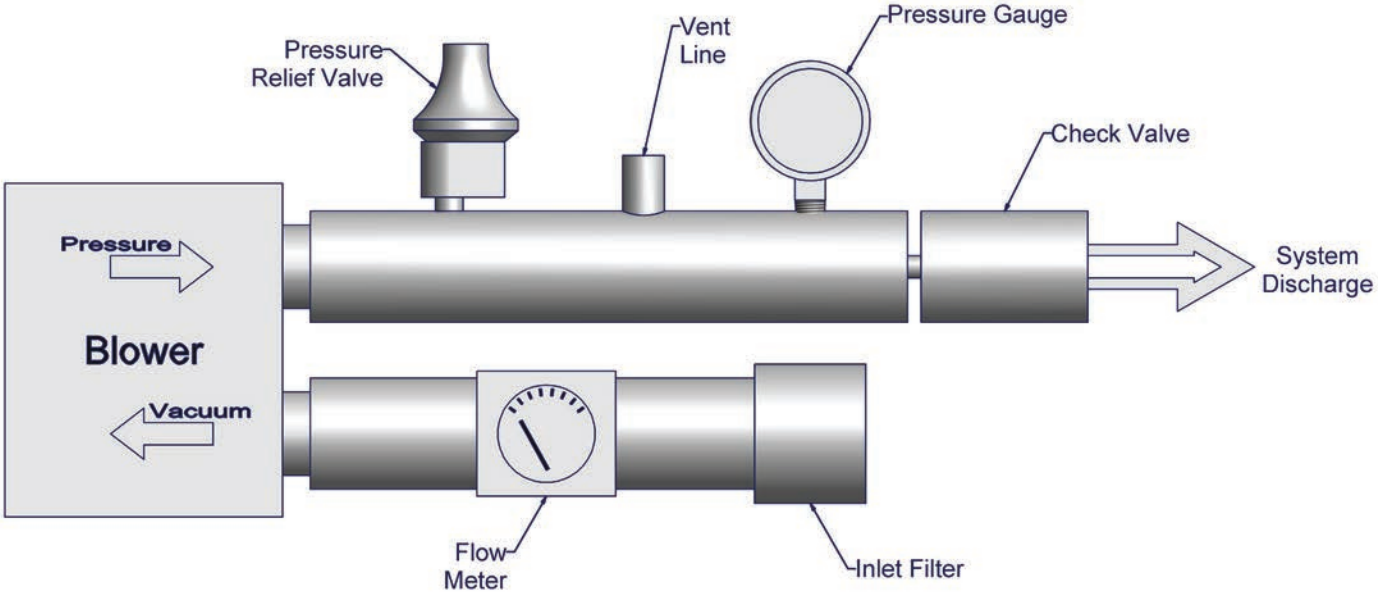
Electrical Shock Hazard

- Disconnect electrical power at the circuit breaker or fuse box before installing this product.
- Install the blower in a location where it will not come into contact with water or other liquids.
- Install the blower in a location protected from the weather.
- Electrically ground the blower.
- Failure to follow these instructions can result in death, fire or electrical shock.

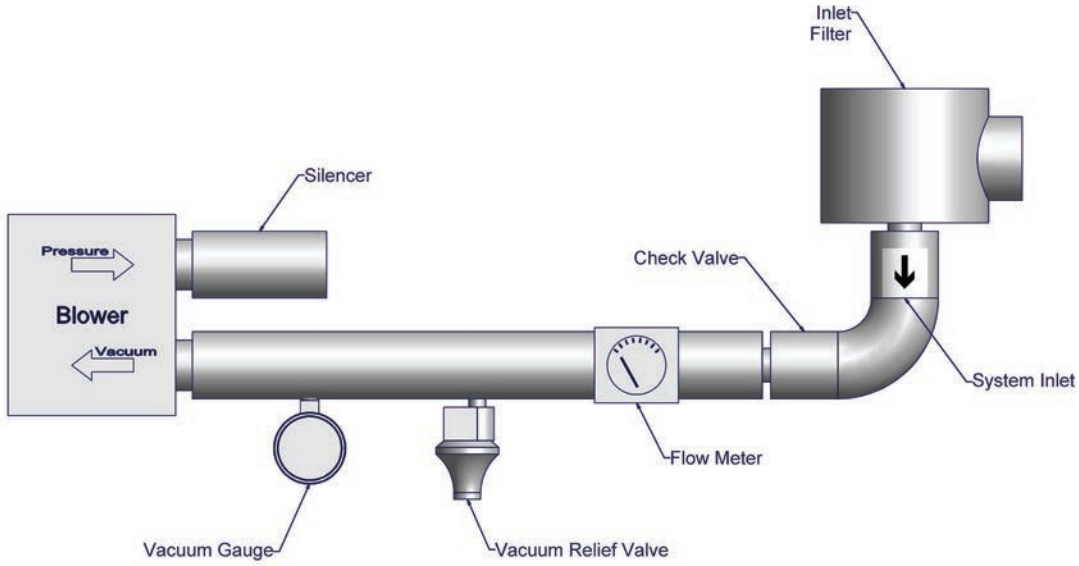
Notice of Installation

- Correct installation is your responsibility.
- Make sure you have the proper installation conditions and that installation clearances do not block air flow.
- Blocking air flow over the blower in any way can cause the product to overheat.
- The blower must be installed with the proper sized inlet filter, gauge and relief valve to protect the product from contaminants and over-heating.

Standard Installation Layout



Typical Vacuum Arrangement



1. Recommended piping should be, at minimum, the same size as the inlet and outlet ports.
2. Metal piping is recommended for the first five (5') to eight (8') feet from the blower on pressure systems.
3. Elbows increase friction. Minimizing the amount of elbows in the piping run will decrease friction loss.
4. Pressure or relief valves should be installed in a "T" that is at least one (1) pipe size larger than the port diameter.
5. Exhaust air temperature increases significantly above 65" of water column. Discharged air is typically too hot for most plastic piping. Therefore, metal piping is recommended for at least the first five (5') to eight (8') feet from the blower on the discharge side. In addition, this piping MUST be guarded and marked "DANGER–HOT–DO NOT TOUCH."

1-1. Installation

Install the blower on a level, stable operating surface and use the isolation pads provided to reduce noise and vibration.



Horizontal Position



Vertical Position



Position Unapproved

1-2. Rotation

From the motor side of the blower, verify the blower is rotating in the direction indicated by the arrow on the motor. (The motor side is marked with an arrow on most models.) Proper rotation can also be checked by the air flow at the inlet and outlet ports. On blowers powered by a 3-phase motor, change the connection of any two (2) wires to reverse blower rotation.

1-3. Plumbing

Remove any foreign material (burrs, chips, welding drops, slag, pipe cuttings, excess sealant, sand or lime) from plumbing.

Verify the motor is securely mounted and proper blower rotation before connecting to plumbing. The inlet and outlet port are not designed to support the plumbing without proper supporting elements. Remove safety rubber plugs from the inlet and outlet ports. Connect the plumbing with properly sized fittings.

Use a relief valve to discharge excess air beyond the preset level on pressure applications. Use a vacuum relief valve to draw in excess air when preset vacuum level is achieved.

Install an intake filter to prevent foreign material from entering the blower. In applications where there is high humidity or liquids being used in the process, install a moisture separator with a drain valve.

1-4. Accessories

Install two gauges (vacuum or pressure), one before and one after the filter, to monitor differential through the filter element. As filters become clogged, performance efficiency will be reduced. Filters should be checked periodically and replaced when necessary. The recommended check valves provide minimal pressure drop, positive sealing, and are resistant to the high discharge temperatures of the blowers. (Refer to Republic Regenerative Blower Check Valves List)

1-5. Motor Control

It is your responsibility to contact a qualified electrician and assure that the electrical installation is adequate and in compliance with all national and local electrical codes.

Select fuses, motor protective switches, or thermal protective switches to provide protection. Fuses act as short circuit protection for the motor, not as protection against overload. Incoming line fuses must be able to withstand the motor's starting current. Motor starters with thermal magnetic overload or circuit breakers protect motor from overload or reduced voltage conditions. Motors without automatic restart require thermal protection or magnetic over-current cutout to prevent motor overloading from single phasing in a 3-phase circuit, high starting frequency, or locked blower.

1-6. Electrical Connection



Electrical Shock Hazard

▲ This product must be properly grounded.

▲ Do not modify the plug provided. If it will not fit the outlet, have the proper outlet installed by a qualified electrician.

▲ If repairing the cord or plug, do not connect the ground wire (green or green with yellow stripes) to either terminal.

▲ Check the condition of the power supply wires.

Connection

HRB100,101,102,102/ 1,200,201,202,202/1,300,301,302,302/ 1,400,401,402,402S,500,502,600,602,700,702,802				HRB800,900,902,1000,1002,1100,1102,1200,1202, 1300,1302,1402,1502				
6 cable		Y 9 cable		Δ 9 cable		12 cable		High Voltage 440
Low Voltage 220-220	High Voltage 380-440	Low Voltage 220	High Voltage 440	Low Voltage 220	High Voltage 440	Low Voltage 220	Middle Voltage 380	L_1 L_2 L_3
L_1 L_2 L_3 1 2 3 6 4 5	L_1 L_2 L_3 1 2 3 6 – 4 – 5	L_1 L_2 L_3 1 2 3 7 8 9 4 – 5 – 6	L_1 L_2 L_3 1 2 3 4 5 6 7 8 9	L_1 L_2 L_3 1 2 3 6 4 5 7 8 9	L_1 L_2 L_3 1 2 3 4 5 6 7 8 9	L_1 L_2 L_3 1 2 3 6 4 5 7 8 9 12 10 11	L_1 L_2 L_3 1 2 3 7 8 9 4 5 6 12–10–11	1 2 3 12 10 11 4 5 6 7 8 9

Connection	
Low Voltage (2Y)	High Voltage (Y)
110V R S 1 2 3 4 6 5	230V R S 4 1 5 2 – 3 – 6
Reverse: R-1-3-5 S-2-4-6	Reverse: R-4 S-1-5 2-3-6
Connect hot lead to 1. Connect neutral lead to 4.	

- Do not permanently connect this product to wiring not in good condition or that is inadequately sized for the requirements of this blower.
- Failure to follow these instructions can result in death, fire or electrical shock.
- This product must be grounded. In the event of an electrical short circuit, grounding reduces the risk of electric shock by providing an escape wire for the electric current.
- Check with a qualified electrician or serviceman if the grounding instructions are not completely understood, or if you are not sure whether the product is properly grounded.

2. Operation

Operation

⚠ WARNING

Injury Hazard

- Install proper safety guards as needed to prevent any close contact with blower suction area.
- Keep fingers and objects away from openings and rotating parts.
- Blower surfaces become very hot during operation. Allow these surfaces to cool before handling.
- Wear proper eye protection. Air stream from product may contain solid or liquid material that can result in eye or skin damage.
- Wear hearing protection. Sound level from some models may exceed 85 dBA.
- Failure to follow these instructions can result in burns, eye injury or other serious injury.
- It is your responsibility to operate this product at recommended pressures or vacuum duties and room ambient temperatures. Do not throttle discharge or suction pipe to reducer capacity. Throttle will increase differential pressure causing increasing power absorption and working temperatures.

Start Up

Operate blower for an hour and then check:

1. **Ambient temperature –** Increased room temperatures may require stronger ventilation especially for larger blowers. Room temperature should not exceed 100°F.
2. **Pressure and vacuum valves –** Adjust relief valve pressure or vacuum setting, if needed.
3. **Motor current -** Check that supply current matches recommended current rating on blower nameplate.
4. **Electrical overload cutout –** Check that current matches rating on blower nameplate.

If motor fails to start or slows down significantly under load, shut off and disconnect from power supply. Check that the voltage is correct for the motor and that the motor is turning in the proper direction.

3. Maintenance



Electrical Shock Hazard

- Disconnect electrical power supply cord before performing maintenance on the blower.
- If product is hard wired into system, disconnect electrical power at the circuit breaker or fuse box before performing maintenance on the blower.
- Failure to follow these instructions can result in death, fire or electrical shock.

WARNING

Injury Hazard

- Blower surfaces become very hot during operation. Allow blower surfaces to cool before handling.
- Wear proper eye protection. Air stream from product may contain solid or liquid material that can result in eye or skin damage.
- Failure to follow these instructions can result in burns, eye injury or other serious injury.
- It is the customer's responsibility to regularly inspect and make necessary repairs to the blower in order to maintain proper operation. Make sure that pressure and vacuum is released from product before starting maintenance.

Preventive Maintenance

- After the first 500 hours of operation, the following need to be checked:
  - filter elements
  - noise absorbing foam used in mufflers
  - clean motor and blower
- Replace filter elements as needed. Mufflers should be checked on a monthly basis.

Lubrication Interval

To lubricate the bearings, the roller contact bearings and adjacent bearing housing should have the used grease removed and replaced with fresh grease. About 50 percent of the roller balls should be filled. No more than 65 percent of the adjacent bearing housing should be filled. Sealed bearings should be replaced within the listed conditions below with new bearings or as conditions warrant.

Hours of Service Per Year	Relubrication Intervals
5,000	3 years
Continual Normal Services	1 year
Seasonal Service (motor idle for 6+ months)	1 year at beginning of season
Continuous–high ambients, dirty or moist applications	6 months

Bearing Types

A variety of types and lubricants are used in all Republic Regenerative Blowers. A summary of data is included in the Bearing Specification Table. Greasable bearings are supplied with a sufficient amount of lubricant at the factory to permit initial operation. The frequency of replacing the grease depends upon the conditions and application.

Grease Types

Republic Regenerative Blowers utilize proprietary lubricants from long experience. These lubricants are available from Esso or Exxon. You can check with your local supplier for a recommended equivalent. (High temperature resistance and high speed: NLGI N3 Grade). Lubricants of different manufacturers should not be mixed. If changing lubricant types, the bearing and housing should be thoroughly cleaned to remove all lubricant before adding grease from a new supplier.

Bearing Specification (Recommendable Bearing: NSK C3 Grade)

Single Stage			Double Stage		
Item	**Front**	**Rear**	**Item**	**Front**	**Rear**
HRB-101	6203z	6203zz	HRB-102/1	6203z	6203zz
HRB-201	6204z		HRB-202/1		
HRB-301	6205z	6205zz	HRB-302/1		
HRB-401			HRB-402/1	6204z	6205z
HRB-100	6203z	6203zz	HRB-102	6203z	6203zz
HRB-200	6204z	6203zz	HRB-202		
HRB-300	6205z	6205zz	HRB-302		
HRB-400			HRB-402,S	6204z	6205z
HRB-500	6206z		HRB-502	6205z	
HRB-600			HRB-602		
HRB-700			HRB-702		
HRB-800	6207z	6207zz	HRB-802	6206z	6208z
HRB-900			HRB-902		
HRB-1000		6208zz	HRB-1002		
HRB-1100	6208z		HRB-1102	6207z	
HRB-1200			HRB-1202		
HRB-1300			HRB-1302	6308z	6308z
			HRB-1402		
			HRB-1502		

Trouble-Shooting Chart

Problem	Reason	Remedy
Increased sound	Noise absorbing foam is damaged Impeller rubbing inside	Replace foam Send unit to Republic Authorized Repair Facility
Excessive vibration	Damaged impeller Motor and/or impeller are dirty	Replace impeller Clean motor and impeller periodically
Ambient and exhaust temperature increases	Motor and/or blower are dirty Filters are dirty	Clean motor and blower periodically Replace filters
Decreased inlet air pressure	Inlet air filter is clogged	Clean inlet filter Replace cartridge
Unit is very hot	Wrong wiring Low voltage Inlet air filter is clogged Motor and/or blower are dirty Operating pressure or vacuum is too high	Check wiring Supply proper voltage Clean inlet filter Replace cartridge Clean motor and blower periodically Install a relief valve and pressure or vacuum gauge
Unusual sound	Impeller is damaged or dirty Bearing failure	Clean or replace impeller Send unit to Republic Authorized Repair Facility
Motor overload	Low voltage	Check power source Check wire size and wire connections
Unit does not start	Incorrect electrical connection or power source Impeller is damaged	Check wiring diagram, circuit fusing and circuit capacity Clean or replace impeller Install proper filtration

Warranty

Republic Regenerative Blowers, when properly installed and operated under normal conditions of use, are warranted by Republic to be free from defects in material and workmanship for a period of twelve (12) months from the date of purchase from Republic or an authorized Republic Representative or Distributor. In order to obtain performance under this warranty, the buyer must promptly (in no event later than 30 days after discovery of the defect) give written notice of the defect to Republic Blower Systems (Fax: 214-631-3673 or E-mail: warranty@republicsales.com) or a representative in your country. Customer is responsible for freight charges to Republic in all cases.

This warranty does not apply to electrical controls and gasoline engines not supplied by Republic and does not extend to any goods or parts which have been subjected to misuse, lack of maintenance, neglect, damage by accident or transit damage.

This express warranty excludes all other warranties or representations expressed or implied by any literature, date or person. Republic's maximum liability under this exclusive remedy shall never exceed the cost of the subject product. Republic reserves the right, at its sole discretion, to refund the purchase price in lieu of repair or replacement.

Republic is not responsible or liable for indirect or consequential damages of any kind however, including but not limited to those for use of any products, loss of time, inconvenience, lost profit, labor charges, or other incidental or consequential damages with respect to persons, business, or property, whether as a result of breach of warranty, negligence or otherwise.

Notwithstanding any other provision of this warranty: **Customer's remedy against Republic for goods supplied or for non-deliverable goods or failure to furnish goods, whether or not based on negligence, strict liability or breach of express or implied warranty is limited solely to Republic's option, to replacement of or cure of such nonconforming or non-deliverable goods or return of the purchase price for such goods and in no event shall exceed the price or charge for such goods. Republic expressly disclaims any warranty of merchantability or fitness for a particular use or purpose with respect to the goods sold. There are no warranties that extend beyond the descriptions set forth in this warranty,** notwithstanding any knowledge of Republic regarding the use or uses intended to be made of goods, proposed changes or additions to goods, or any assistance or suggestions that may have been made by Republic's personnel. Unauthorized extensions of warranties by the customer shall remain the customer's responsibility.

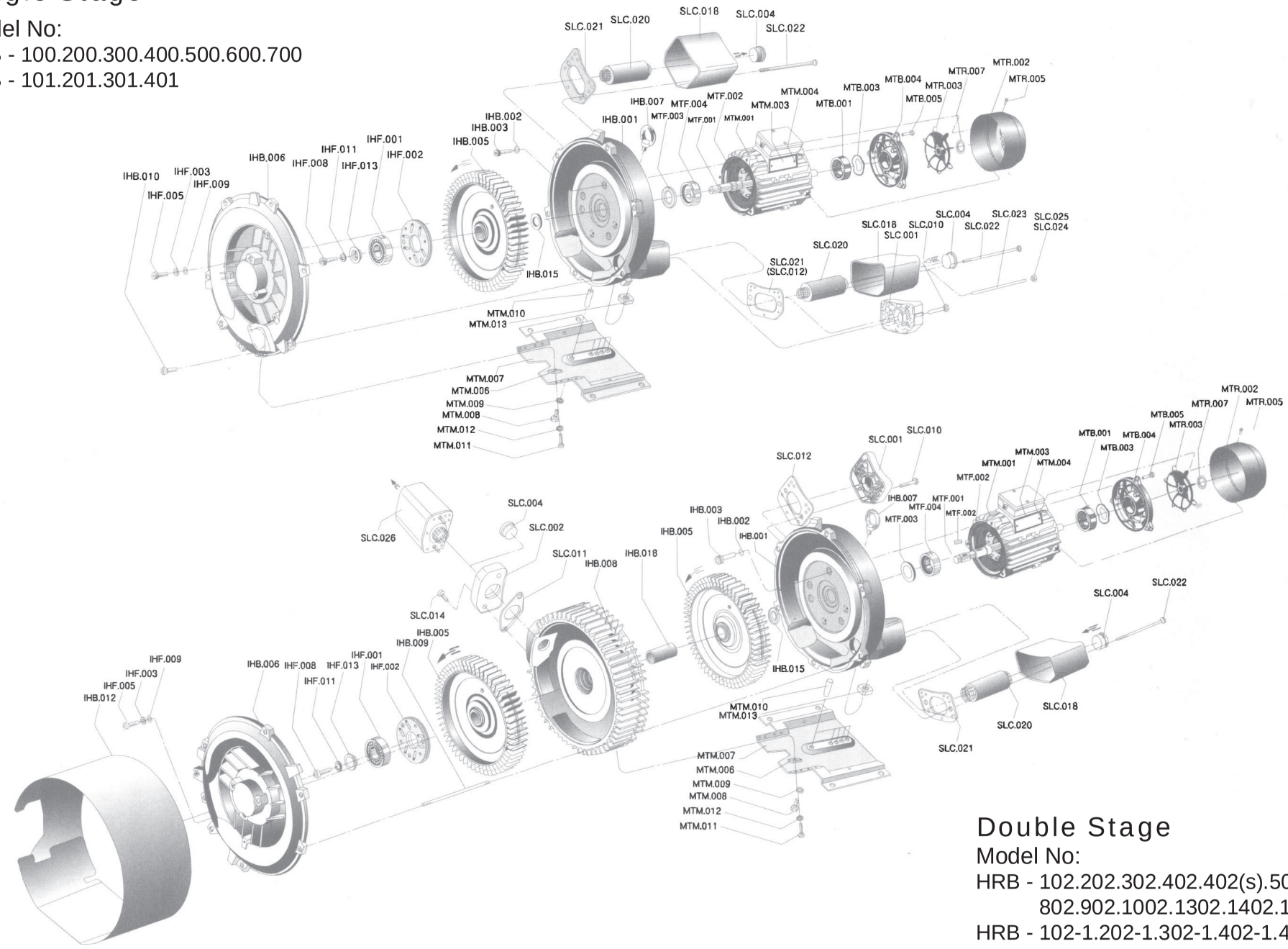
Customer is responsible for determining the suitability of Republic's products for customer's use or resale, or for incorporating them into objects or applications which customer designs, assemblies, constructs or manufacturers.

This warranty can be modified only by authorized Republic personnel, by signing a specific written description of any modifications.

Exploded View

Single Stage

Model No:
HRB - 100.200.300.400.500.600.700
HRB - 101.201.301.401



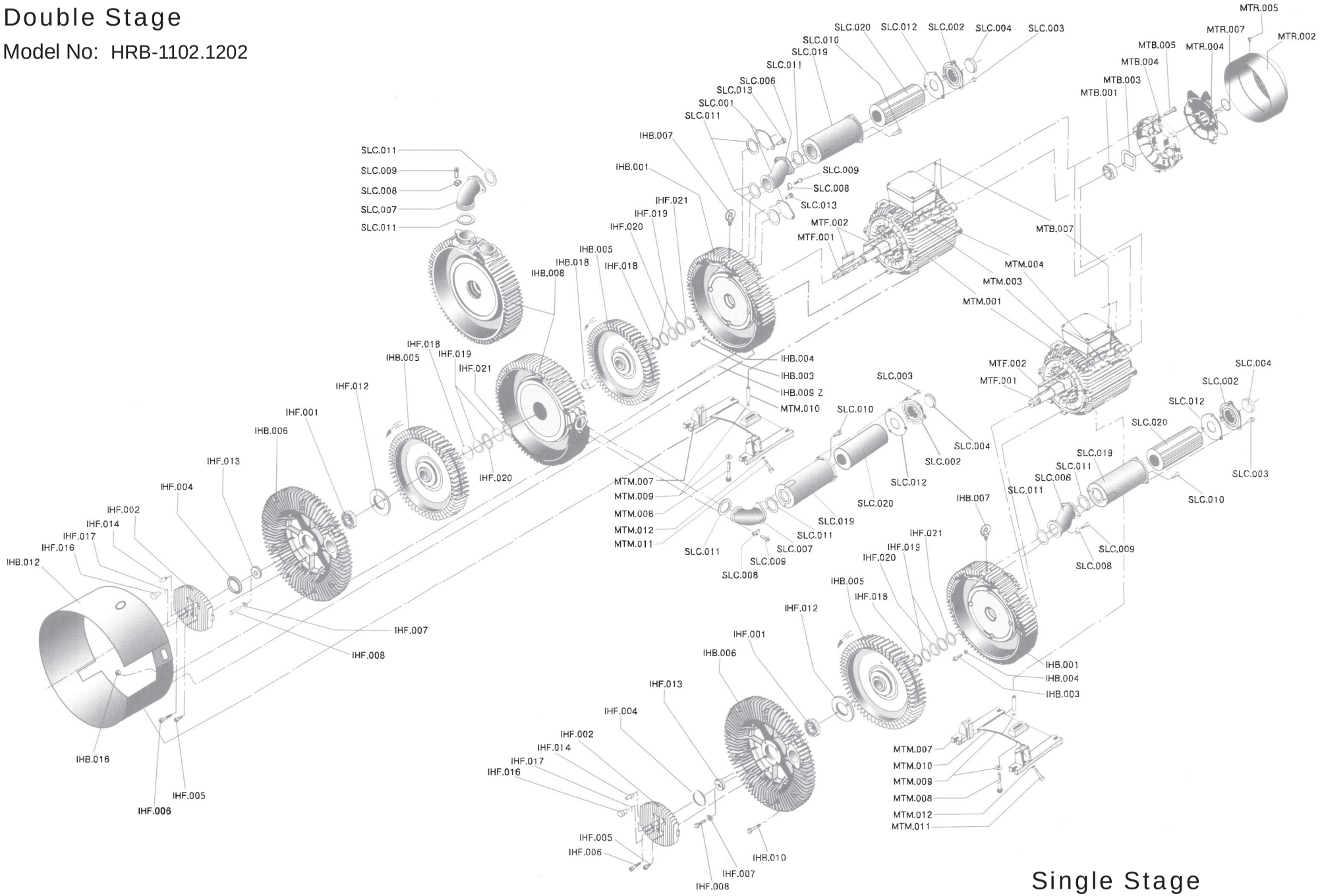
Double Stage

Model No:
HRB - 102.202.302.402.402(s).502.602.702.
802.902.1002.1302.1402.1502.1602
HRB - 102-1.202-1.302-1.402-1.402(s)-1

Exploded View

Double Stage

Model No: HRB-1102.1202



Single Stage

Model No: HRB-800.900.1000

Part List

Ring Blower Part List

Part Number	Part Name
IHF.001	Bearing
IHF.002	Bearing Cover
IHF.003	Plain Washer
IHF.004	Spacer Washer
IHF.005	Cheese Head Screw
IHF.006	Socket Head Cap Screw
IHF.007	Lock Plate
IHF.008	Cap Bolt
IHF.009	O-Ring Seal
IHF.011	Spring Washer
IHF.012	Mating Ring
IHF.013	Disc
IHF.014	Grease Nipple
IHF.016	Hexa Head Bolt
IHF.017	Plain Washer
IHF.018	Internal Retaining Ring
IHF.019	Compensate Ring
IHF.020	Spring Washer
IHF.021	Sealing Ring

Part Number	Part Name
IHB.001	Compressor Housing
IHB.002	Spring Washer
IHB.003	Cap Bolt
IHB.004	Spring Washer
IHB.005	Impeller
IHB.006	Compressor Cover
IHB.007	Eye Bolt
IHB.008	Center Section
IHB.009	Threaded Rod
IHB.010	Cheese Head Screw
IHB.012	Compressor Cowl
IHB.015	Disc
IHB.016	Plain washer
IHB.018	Sleeve

Part Number	Part Name
MTF.001	Compressor Housing
MTF.002	Spring Washer
MTF.003	Cap Bolt
MTF.004	Spring Washer

Part Number	Part Name
MTB.001	Bearing
MTB.003	Resilent Preloading Plate
MTB.004	Endshield
MTB.005	Cheese Head Screw
MTB.007	Hexagonal Nut

Part Number	Part Name
MTM.001	Stator
MTM.003	Rating Plate
MTM.004	Screw
MTM.006	Square Nut
MTM.007	Foot
MTM.008	Hexagonal Head Screw
MTM.009	Spring Washer
MTM.010	Sleeve
MTM.011	Cap Bolt
MTM.012	Spring Washer
MTM.013	Square Nut

Part Number	Part Name
MTR.002	Fan Cowl
MTR.003	External Fan
MTR.004	External Fan
MTR.005	Screw
MTR.007	Circlip

Part Number	Part Name
SLC.001	Plug
SLC.002	Flange
SLC.003	Cap Bolt
SLC.004	Plug
SLC.005	Hexagonal Nut
SLC.006	Graded Tube
SLC.007	Graded Tube
SLC.008	Clip
SLC.009	Cap Bolt
SLC.010	Cap Bolt
SLC.011	Gasket
SLC.012	Gasket
SLC.013	Cap Bolt
SLC.014	Cap Bolt
SLC.015	Cap Bolt
SLC.016	Cap Bolt
SLC.017	Silencer Casing
SLC.018	Silencer Casing
SLC.019	Silencer Insert
SLC.020	Gasket
SLC.021	Flat Head Screw
SLC.022	Threaded Rod
SLC.023	Hexagon Nut
SLC.024	Hexagon Cap Nut
SLC.025	Silencer



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REPUBLIC

Blower Systems®

KRÜGER

SECTION 3.2

MIXERS

VEOLIA WATER
Solutions & Technologies

KRÜGER

I. Kruger Inc.
4001 Weston Parkway
Cary, NC 27513

TELEPHONE 919-677-8310
FACSIMILE 919-677-0082

EQUIPMENT DATA SHEET

Project Name: Massillon OH
Project Number: 5700235402
Date Prepared: 01/07/2015
Prepared By: Walt Medloc
Revision Number/Revised By: 2 / GJS per WM

Submersible Mixer

Manufacturer		ABS Pumps Inc.
Model		RW4031 A46/8 CR (All Stainless Steel)
Quantity		9 Complete Mixer Systems each with 32 ft of Power Pilot Cable/Support Kit; 3 Hoists Assemblies (1 per train)
Hoist		9 Hoist Platforms (1 per Mixer) and 3 Manual Hoist Assemblies (1 per Train)
Seal		Double; Mechanical & Radial
Thermal Protection		Stator Temperature Monitor
Moisture Protection		Moisture Sensor with Seal Detection Relay
Propeller Diameter		15.8
Mixing Flow		5000 gpm
Propeller Speed		841 rpm
Motor		Squirrel-cage, Induction, Shell Type NEMA B Design, Housed in an air filled watertight chamber.
Motor (Voltage/Phase/Hertz)		460/3/60
Insulation		Moisture Resistant Class F
Rated Power		6.2 HP
Motor Efficiency		76.5 %
Power Factor		0.74
Mixer Weight (lbs)		198
Mixer Guide Assembly Weight (lbs)		168
Hoist Assembly Weight (lbs)		130
Materials	Motor Housing	316 SS
	Mixer Guide Bracket	Polyurethane Liner and Guide Rollers
	Shock Absorber Support Bracket	316 SS
	Motor Shaft	316 SS
	Propeller	316 SS
	2” Square Guide Rail	304 SS

I. Kruger Inc.
4001 Weston Parkway
Cary, NC 27513

TELEPHONE 919-677-8310
FACSIMILE 919-677-0082

	Assembly with Intermediate Bracket and Floor Mount	
	Hoist	304 SS
	Lifting Cable	30 ft 316 SS

Additional Items:

1. Spare items include shelf spare mixer, double mechanical seal, and shock absorber.

SULZER

Submittal Document

Customer:	Veolia Water Technologies
Project:	City of Massillon, OH- Anaerobic Zone Mixers
Quote #:	2014-OEM-32B1
Date:	21 January 2015
Author:	Dante Cimadamore

Anaerobic Tank Mixers

SULZER

Sulzer Pumps

Mixer Selection System

Blending & Suspension

Printout for Mixer

RW 4031 - A 46/8, 60 Hz



Calculation for

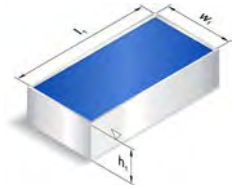
Customer:	Veolia
Project name:	City of Massillon
Project no:	2014-OEM-032
Project note:	Anaerobic Mixer

Application	Phosphat removal
Mixing process	Solid Suspension

Process description

Tank data

Tank shape	rectangular
Width W_1	18.50 ft
Length L_1	43.50 ft
Liquid depth h_1	25.00 ft
Volume	150,499.17 gal



Type of Liquid	Activated sludge - anaerobic (screener smaller 5 mm - with pre sedimentation)
MLSS	0.5 %
Sludge volume index SVI	125 ml/g
Density	62.43 lb/ft³
Viscosity	10 cp
Temperature	77 °F

Liquid data

Mixer data

Mixer	RW 4031 - A 46/8, 60 Hz
No of Mixer	1
Rated motor power (P2)	6.17 hp
Propeller diameter	16 in
Propeller thrust – ISO 21630	254.71 lbf
Propeller speed	841 rpm
Note	

Motor duty point (P1)	6.24 hp
Motor duty point (P2)	5.90 hp
Total power consumption (P1)	6.24 hp
Specific power consumption (P1)	10.95 hp/M gal
Specific energy input (P2)	7.72 hp/M gal
Required mixer ID-figure	1615 for Mixing grade 2.5
Selected mixer ID-figure	2000

Calculation data

SCOPE

Furnish ABS RW400 series submersible direct drive mixer(s). Each mixer shall be equipped with a submersible electric motor that is an integral part of the mixing unit. The mixer motor shall be equipped with a power and control cable sized in accordance with NEC standards. Each mixer shall be furnished with the accessories necessary for a complete installation. Typical accessories include a lifting cable, a hoist of sufficient capacity to permit raising and lowering of the mixer, a power cable support system with a kellum grip and sway clamps every 5 feet to relieve power cable strain, and a mounting system specifically designed for the mixer that resist all loads produced by the mixer with 150° horizontal adjustment in 15° increments for performance optimization while providing easy installation and removal without emptying the tank contents or entering the tank.

DESIGN

The mixer(s) shall be able to be easily raised, lowered and removed for inspection or service without the need for personnel to enter the mixing vessel. A cast slide bracket shall be an integral part of the mixer unit. The entire weight of the mixer unit shall be guided by a single cast slide bracket that is an integral part of the mixer and must be able to handle all forces created by the mixer. The mixer and power cable shall be capable of continuous submergence under water without loss of watertight integrity to a depth of 130 feet (40m).

CONSTRUCTION

Each mixer shall be of the close-coupled, submersible type design. All components of the mixer, including the motor shall be capable of continuous underwater operation while the mixer propeller is completely submerged. In addition, all components of the mixer shall be capable of operation in air, completely unsubmerged for two (2) hours.

All exposed hardware shall be 316 stainless steel. All surfaces coming into contact with the mixing liquid other than stainless steel shall be protected by two-part epoxy paint.

Propeller

The propeller shall be self cleaning backward curved design preventing material buildup on the blades that decreases mixer performance and increases vibration. Each blade shall be precision cut and welded to the hub. Each propeller shall be dynamically balanced so its imbalance is less than ISO 1940 G6.3 tolerances preventing excessive vibration or other unsatisfactory characteristics when the mixer is operating.

The propeller shall be capable of handling solids, fibrous materials, sludge and other matter normally found in sewage, water, wastewater, etc. applications.

Cable Entry

The cable entry shall be an integral part of the upper lid. The cable entry shall be comprised of a single cylindrical elastomer grommet flanked by stainless steel sealing washers designed with a close tolerance fit against the cable outside diameter and the entry inside diameter. This will provide a leak proof, watertight seal at the cable entrance without the need for specific torque requirements. The assembly shall be supported by a shoulder in the upper lid and be evenly compressed by four (4) socket head screws threaded into the upper lid. The connection chamber and motor compartment shall be isolated from each other. Isolation and sealing shall be accomplished through the use of O-rings and compression grommets, providing a watertight seal. Electrical connections between the mixer cable and the motor leads shall be made via a post type terminal board located in the connection chamber.

Shaft

The propeller and motor shaft shall be an integral unit. The shaft shall be stainless steel and designed to resist the maximum forces generated by the mixer. The mixer shaft shall have machined shoulders to permit exact bearing, seal and propeller placement.

Shaft Seals

The mixer shall be provided with a double seal system consisting of a mechanical seal on the outer side and a radial shaft seal on the inner side, each working independently of the other. The mechanical seal shall contain both stationary and rotary silicon carbide faced rings. Each mixer shall be equipped with a solids deflection ring to prevent seal failure due to interference from solids contained in the mixed liquid and to minimize solids that come into contact with the seals. Only the seal faces of the outer mechanical seal assembly and its retaining clips shall be exposed to the mixed liquid.

The seals shall require neither routine maintenance nor adjustment and shall not be damaged when the mixer is run dry or run in reverse rotation. The seals shall not rely on the mixing liquid as a lubricant.

Oil Chamber

The oil chamber located between the outer and inner seals shall hold a sufficient quantity of oil to provide lubrication and cooling for the shaft seals. The oil shall also act as a sensing medium for the seal monitoring system to detect the presence of moisture.

Bearings
The mixer shall rotate on two (2) permanently lubricated bearings. Bearings shall be of single row, deep grooved design and sized to transfer all radial and axial loads to the mixer housing and minimize shaft deflection for increased bearing and seal life. Bearings shall not require a pre-load and be maintenance free with a minimum L-10 bearing life of 100,000 hours at design conditions.

Flow Ring Assembly (Optional)
The mixer shall incorporate a 360-degree flow ring around the propeller. A close clearance shall be maintained between the propeller tip and the flow ring in order to maintain high hydraulic efficiency and low power consumption.

Elastomers
All mating part surfaces of the mixer shall be machined and fitted with static O-rings providing watertight sealing. Mating surfaces shall be designed to provide watertight seals when metal to metal contact is made resulting in controlled compression of the O-rings without special torque requirements. No secondary sealing compounds, rectangular gaskets, elliptical O-rings, grease or other devices shall be used.

MOTOR
The motor shall be of the squirrel-cage, induction, shell type NEMA B design, housed in an air filled watertight chamber. Stator windings and leads shall be insulated with moisture resistant Class F insulation which will resist a temperature of 155° C (311°F). The stator shall be dipped and baked three (3) times in Class F varnish. The motor shall be designed for continuous duty, capable of sustaining (10) evenly spaced starts per hour. The rotor bars and short circuit rings shall be constructed of aluminum. Mixers with an optional explosion proof design shall be FM approved for use in NEC Class I, Division I, Groups C & D hazardous locations.

Thermal Protection
Each motor shall contain a set of three bi-metallic temperature monitors in the stator windings; one in each phase. The monitors shall be connected in series and coupled to the contactor in the control panel to provide over temperature shutdown of the motor. The temperature setting shall be 140°C ± 5°C (284°F± 9°F). The temperature monitors shall automatically reset once the stator temperature returns to normal.

An electrical probe shall be provided in the oil chamber to detect the presence of water in the oil. This probe shall be provided for both standard and explosion proof mixers. A solid-state device mounted in the mixer control panel or in a separate enclosure shall send a low voltage, low amperage signal to the probe. If water enters the oil chamber, the probe shall signal the solid state relay in the control panel. The relay shall then energize a warning light on the control panel, or cause the mixer to be shut down. Float switches, dual probes, or any other monitoring devices located in the stator housing are not considered to be early warning systems, and shall not be considered equal.

INSPECTION
The following inspections shall be performed as a routine quality check on each mixer prior to shipment from the factory:

1. Propeller size, motor rating, voltage, phase and frequency will be checked for compliance with customer purchase order and specifications.
2. Motor and power cable shall be checked before submergence for insulation defects and moisture content.
3. Pressurize the motor with dry air and check for leaks at all joints and seals.
4. Before submergence run the mixer to check for correct rotation and ensure mechanical integrity.
5. The mixer shall be submerged in a tank containing water on a guide tube assembly and run completely submerged to check amp readings under load.
6. Motor and power cable shall be checked after submergence for insulation defects and moisture content after the mixer is removed from the tank.

A quality control check sheet showing that the above has been accomplished shall be completed and kept on file for each mixer.

Seal Failure Warning System

Specification subject to change without notice

PROPELLER DATA WITHOUT FLOW RING, 60Hz, 3 PHASE

MIXER HYDRAULIC NUMBER	NUMBER OF BLADES	PROP DIA IN (mm)	PROP ANGLE (°)	PROP SPEED ① (RPM)	MIXING CAPACITY ② GPM (m^3/s)	HYDRAULIC POWER ③ HP (KW)
4021	2	15.8 (400)	10.5	880	3700 (0.23)	2.5 (1.9)
4022	2	15.8 (400)	12.0	880	4000 (0.25)	3.0 (2.2)
4023	2	15.8 (400)	13.5	880	4200 (0.26)	3.6 (2.7)
4024	2	15.8 (400)	15.8	880	4500 (0.28)	4.6 (3.4)
4031	3	15.8 (400)	16.4	880	5000 (0.32)	5.9 (4.4)

PROPELLER DATA WITH FLOW RING, 60Hz, 3 PHASE

MIXER HYDRAULIC NUMBER	NUMBER OF BLADES	PROP DIA IN (mm)	PROP ANGLE (°)	PROP SPEED ① (RPM)	MIXING CAPACITY ② GPM (m^3/s)	HYDRAULIC POWER ③ HP (KW)
4041	2	15.8 (400)	10.5	880	3600 (0.22)	2.0 (1.5)
4042	2	15.8 (400)	12.0	880	3800 (0.24)	2.3 (1.7)
4043	2	15.8 (400)	13.5	880	4000 (0.25)	2.8 (2.1)
4044	2	15.8 (400)	15.8	880	4300 (0.27)	3.5 (2.6)
4051	3	15.8 (400)	16.4	880	4900 (0.30)	4.6 (3.4)

① Nominal speed at full load
② Flow rate in clean water at 68° F (20° C)
③ Power in clean water at 68° F (20° C)

Maximum liquid mixing temperature: 104° F (40° C)

MOTOR SPECIFICATIONS 60Hz, 3 PHASE

MOTOR DESIGN	NEMA design B, induction squirrel cage motor, air filled
MOTOR TYPE	Enclosed submersible
INSULATION CLASS	Class F, rated at 155° C (311° F), 40° C (104° F) ambient plus 115° C (207° F) rise
MOTOR PROTECTION	ABS DI-sealminder detects moisture in the oil chamber. Bimetallic switches in each phase of the stator windings provide thermal protection. Motor and cable protection shall conform to the latest N.E.C. standards - article 430 (1990).
BI METALLIC TEMP TRIP	140° C ± 5° C (284° F ± 9° F)
SERVICE FACTOR	1.10
VOLTAGE TOLERANCE	± 5%

MOTOR DATA 60Hz, 3 PHASE

MIXER MOTOR SIZE	OUTPUT POWER BHP (KW)	VOLTS	FULL LOAD AMPS	LOCKED ROTOR AMPS	NEMA CODE LETTER	INPUT POWER KW	POLE/ SPEED (RPM)
A35/8	4.7 (3.5)	208	19.4	87.3	H	4.6	8 / 880
		230	17.6	79.0	H	4.6	8 / 880
		460	8.7	38.0	H	4.6	8 / 880
		575	7.0	31.6	H	4.6	8 / 880
A46/8	6.2 (4.6)	208	22.7	87.3	F	6.0	8 / 880
		230	20.6	79.0	F	6.0	8 / 880
		460	10.3	38.0	F	6.0	8 / 880
		575	8.2	31.6	F	6.0	8 / 880

MOTOR SIZE	POWER FACTOR			MOTOR EFFICIENCY		
	100% FL	75% FL	50% FL	100% FL	75% FL	50% FL
A35/8	0.66	0.56	0.43	76.0	74.3	69.6
A46/8	0.74	0.65	0.52	76.5	76.6	73.0

CABLE SPECIFICATIONS

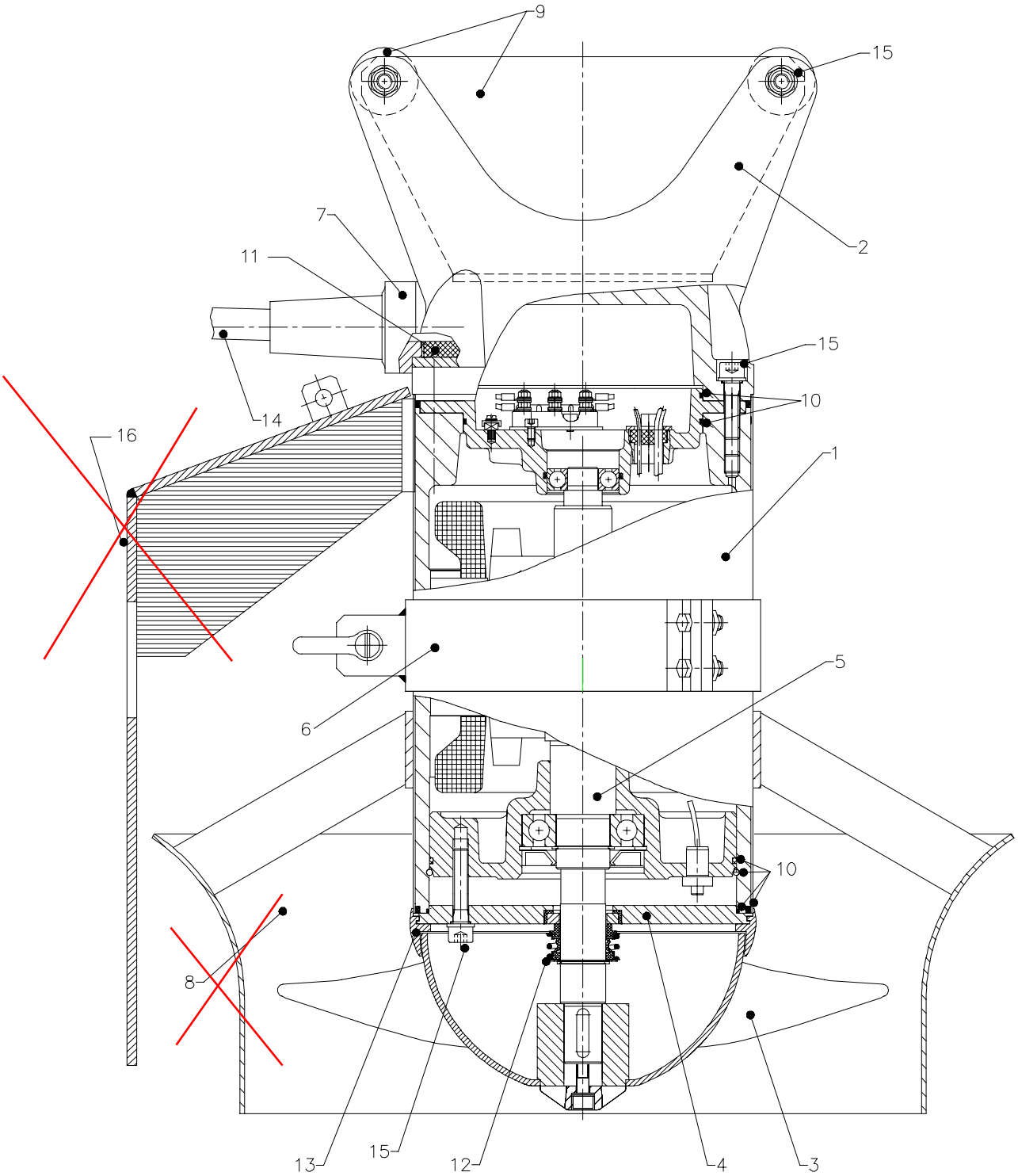
			CABLE #1			CABLE #2		
MOTOR SIZE	VOLTAGE	STARTING METHOD	CABLE TYPE	OD Inch	OD mm	CABLE TYPE	OD Inch	OD mm
A35/8	208V	DOL	7GX1.5	0.64	16.2	None	None	None
	230V	DOL	7GX1.5	0.64	16.2			
	460V	DOL	7GX1.5	0.64	16.2			
	575V	DOL	7GX1.5	0.64	16.2			
A46/8	208V	STAR/DELTA	10GX1.5	0.75	19.1	None	None	None
	230V	STAR/DELTA	10GX1.5	0.75	19.1			
	460V	STAR/DELTA	10GX1.5	0.75	19.1			
	575V	STAR/DELTA	10GX1.5	0.75	19.1			

Standard cable length is 30 ft (10 m)

CROSS SECTION

RW400

Dwg: DS-M04-008 **Rev:** A **Date:** 01/05 **Tab** _____ **Page** _____



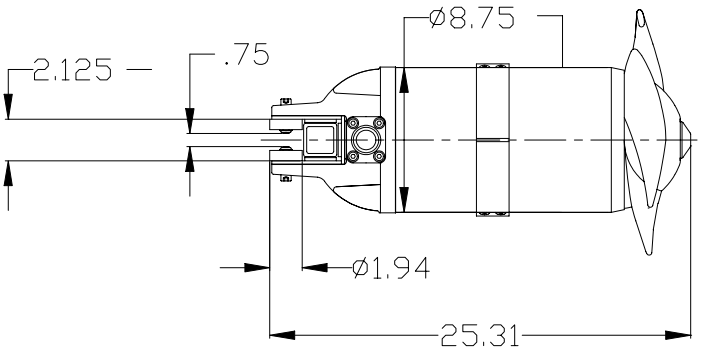
Specifications subject to change without notice

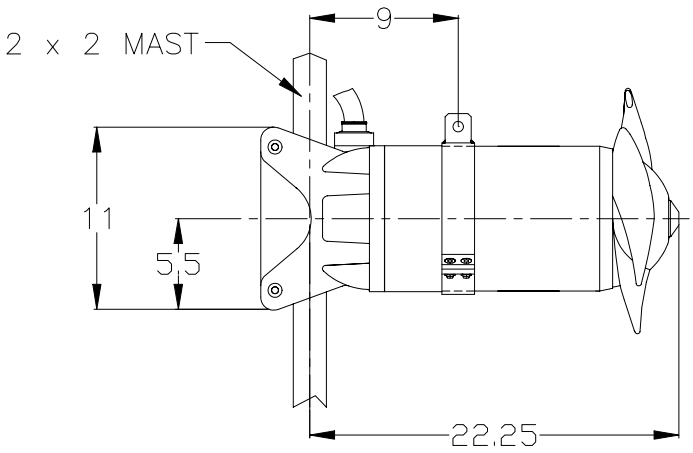
REF NO.	MAJOR COMPONENTS	EC VERSION (CAST IRON/CARBON STEEL)	CR VERSION (STAINLESS STEEL)
1	Motor Housing	Cast iron - ASTM A48 35/40B	316 Stainless Steel
2	Slide Bracket	Ductile Iron ASTM A536 60-40-18	316 Stainless Steel
3	Propeller	316 Stainless Steel	316 Stainless Steel
4	Oil Chamber Cover	Cast Iron ASTM 536 60-40-18	316 Stainless Steel
5	Shaft	420 Stainless Steel	316 Stainless Steel
6	Lifting Clamp	316 Stainless Steel	316 Stainless Steel
7	Cable Gland	Cast Iron ASTM A48 35/40B	316 Stainless Steel
8	Flow Ring (Optional)	Galvanized Steel	316 Stainless Steel
9	Slide Bracket Liner & Guide Rollers	Polyurethane	Polyurethane
10	O-Rings	Nitrile (Buna-N) Viton (Optional)	Nitrile (Buna-N) Viton (Optional)
11	Cable Seal	Nitrile (Buna-N) Viton (Optional)	Nitrile (Buna-N) Viton (Optional)
12	Mechanical Seal	Silicon Carbide / Nitrile (Buna-N) Silicon Carbide / Viton (Optional)	Silicon Carbide / Nitrile (Buna-N) Silicon Carbide / Viton (Optional)
13	Deflection Ring	Nitrile (Buna-N) Viton (Optional)	Nitrile (Buna-N) Viton (Optional)
14	Power & Control Cable	Chloroprene Jacket *	Chloroprene Jacket *
15	Fasteners	316 Stainless Steel	316 Stainless Steel
16	Vortex Breaker (Optional)	316 Stainless Steel	316 Stainless Steel

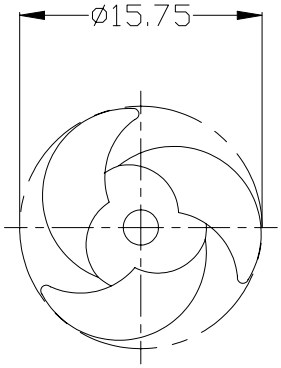
* Other jacket materials are available upon request (DR25, Viton, etc.).

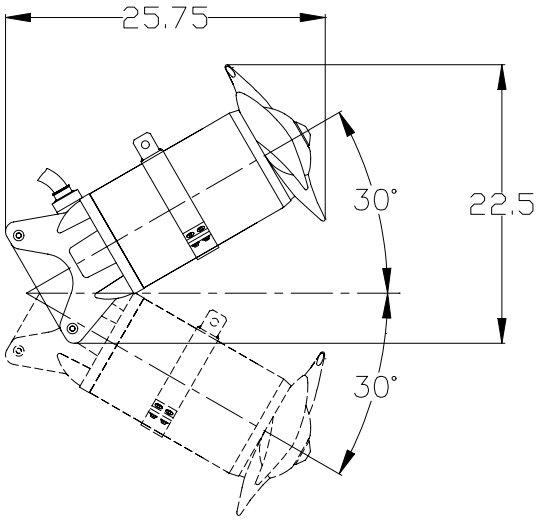
OUTLINE DIMENSIONS	RW400
Dwg: DS-M04-005 **Rev:** D **Date:** 1/05	**Tab** _____ **Page** _____

2” SQ. GUIDE RAIL
MIXER WITHOUT FLOW RING





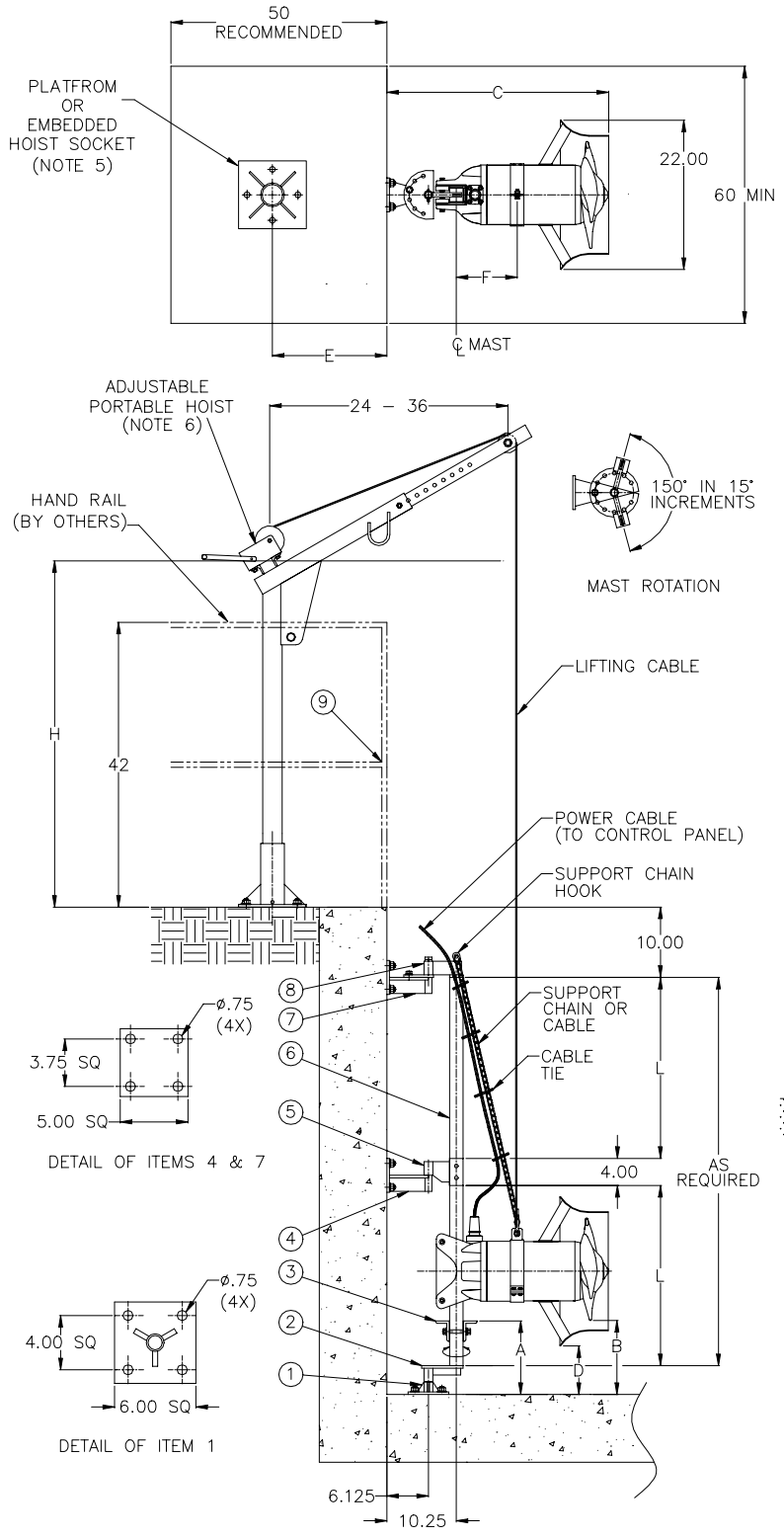




	MOTOR SIZE	
	A35/8	**A46/8**
WT (LBS)	192	195

NOTE: Optional mounting bracket required for 30° vertical adjustment

2" SQ. GUIDE RAIL
PLATFORM or WALL MOUNTED HOIST



ITEM	DESCRIPTION	QTY
1	FLOOR MOUNT BRACKET	1
2	LOWER GUIDE BRACKET	1
3	SAFETY STOP	1
4	INTERMEDIATE WALL BRACKET	*
5	INTERMEDIATE GUIDE BRACKET	*
6	GUIDE RAIL (NOTE 1)	*
7	UPPER WALL BRACKET	1
8	UPPER GUIDE BRACKET	1
9	LIFT CABLE STORAGE STRAP	1

* As required

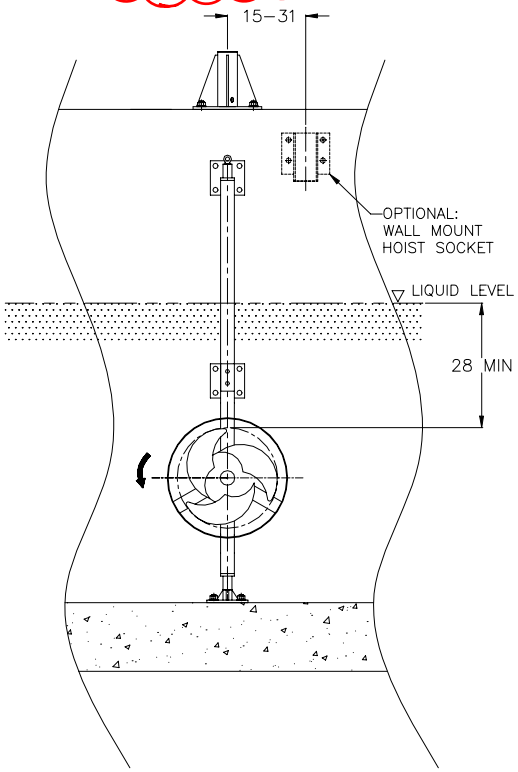
	DIMENSIONS			
	WITHOUT FLOW RING		WITH FLOW RING	
	A35/8	A46/8	A35/8	A46/8
A	14	14	14	14
B**	15	15	--	--
C	32.63	32.63	32.75	32.75
D**	--	--	9	9
E	14.5	14.5	13.5	13.5
F	9	9	10.38	10.38
L max*	120	120	120	120
HOIST HEIGHT (H)				
42 , 60, 55.5 & 74.5 (NOTE 4)				

- Maximum allowable length based on maximum deflection of approximately 1/300 of the length. Results based on maximum thrust of biggest mixer of each range in clean water.

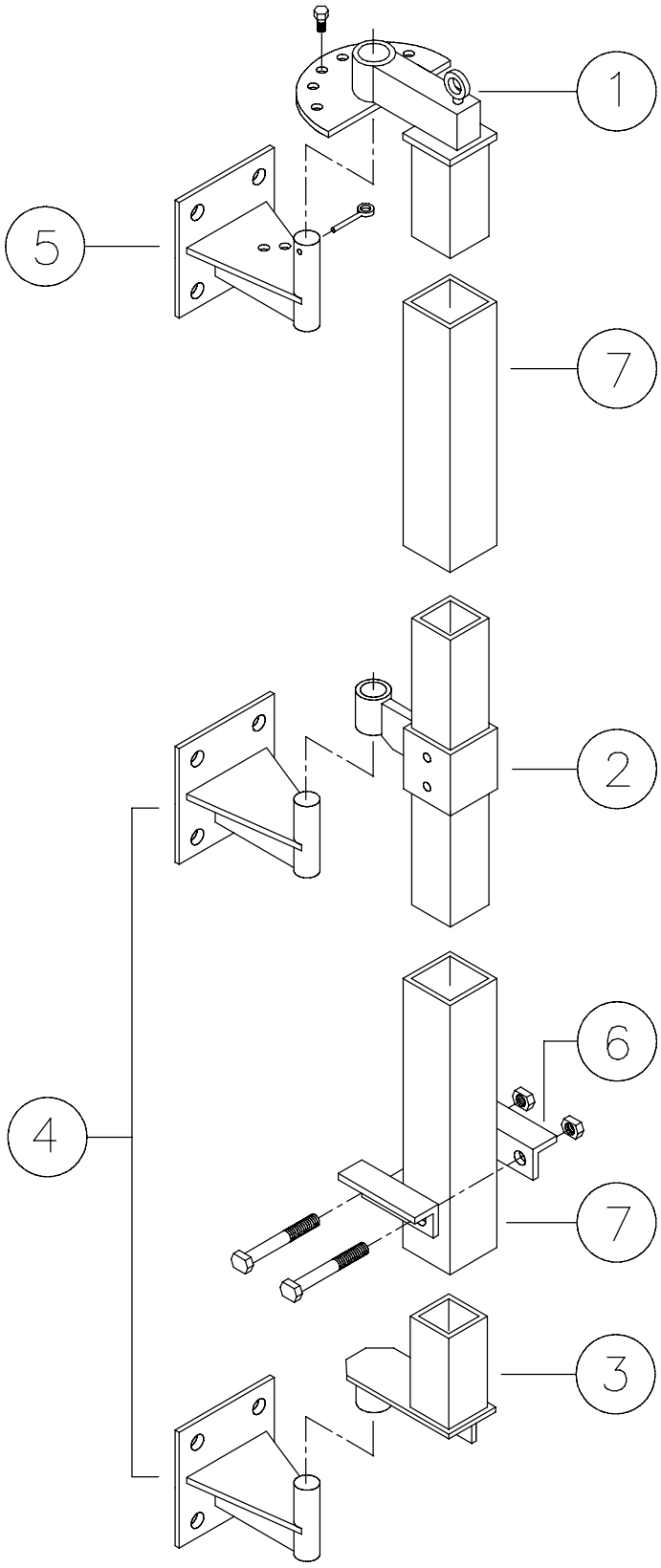
** Minimum is 2 inches.

NOTES:

1. GUIDE RAIL IS 2 X 2 X 3/16 WALL THICKNESS CUT TO LENGTH BY OTHERS.
2. ALL ANCHOR BOLTS REQUIRED FOR INSTALLATION ARE TO BE SUPPLIED BY OTHERS.
3. KEEP POWER CABLE CLEAR OF PROPELLER AND ALL SHARP EDGES.
4. MIXER WILL CLEAR HANDRAIL.
5. MINIMUM SUBMERGENCE IS 6" IN CLEAN WATER WITH VORTEX BREAKER.
6. SEE HOIST DRAWING FOR HOIST AND HOIST MOUNTING DETAILS.



2" SQ. GUIDE RAIL – BOTTOM WALL MOUNT – w/ INTERMEDIATE BRACKET



316 STAINLESS STEEL		
2" GUIDE RAIL ASSEMBLY PART # 64136047		
ITEM #	**DESCRIPTION**	**PART #**
1	UPPER GUIDE RAIL BRACKET	44136071
2	INTERMEDIATE GUIDE RAIL BRACKET	44136061
3	LOWER GUIDE RAIL BRACKET	44136091
4	WALL MOUNT BRACKET	44136101
5	UPPER WALL BRACKET ASSEMBLY	64136044
6	SAFETY STOP CLAMP ASSEMBLY	64136016
7	GUIDE RAIL*	44136281

304 STAINLESS STEEL		
2" GUIDE RAIL ASSEMBLY PART # 64146112		
ITEM #	**DESCRIPTION**	**PART #**
1	UPPER GUIDE RAIL BRACKET	44136070
2	INTERMEDIATE GUIDE RAIL BRACKET	44136060
3	LOWER GUIDE RAIL BRACKET	44136090
4	WALL MOUNT BRACKET	44136100
5	UPPER WALL BRACKET ASSEMBLY	64146114
6	SAFETY STOP CLAMP ASSEMBLY	64136962
7	GUIDE RAIL*	44136284

*** USUALLY SUPPLIED BY OTHERS**

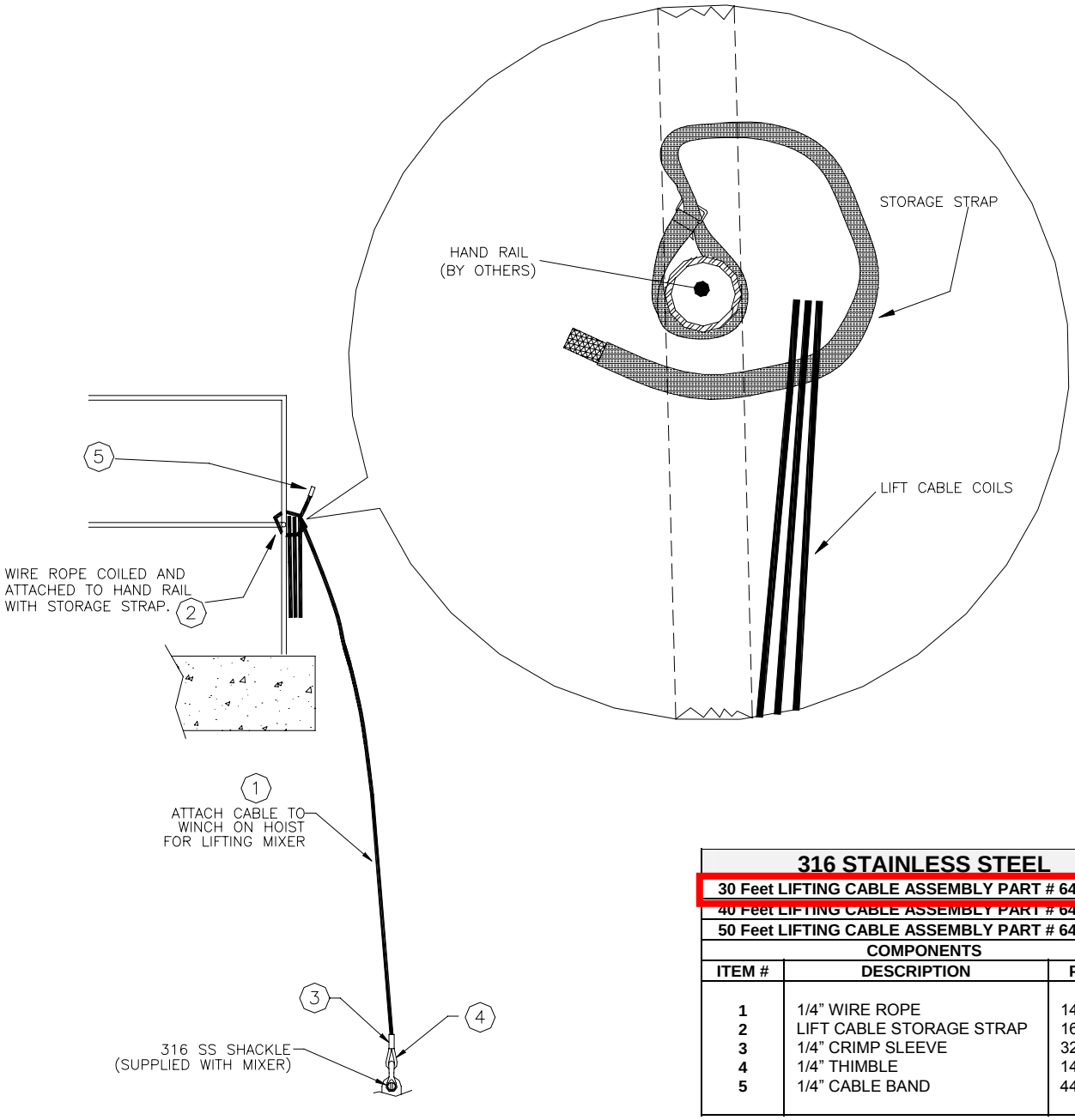
LIFTING CABLE ASSEMBLY

RW200 - RW650

Dwg: DS-M01-076 **Rev:** C **Date:** 12/04

Tab Accessories

¼“ DIA. WIRE ROPE



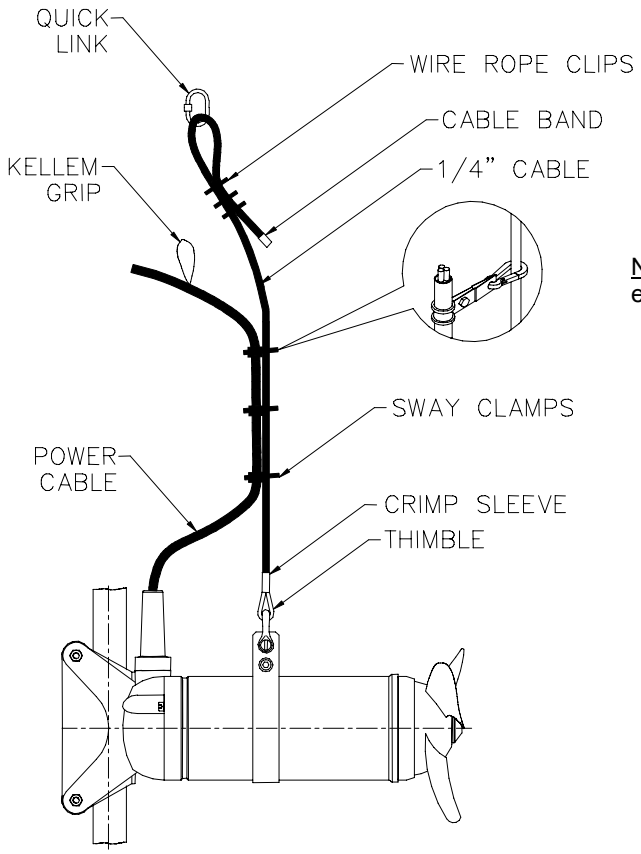
316 STAINLESS STEEL		
30 Feet LIFTING CABLE ASSEMBLY PART # 64136140		
40 Feet LIFTING CABLE ASSEMBLY PART # 64136141		
50 Feet LIFTING CABLE ASSEMBLY PART # 64136142		
COMPONENTS		
ITEM #	**DESCRIPTION**	**PART #**
1	1/4” WIRE ROPE	14816035
2	LIFT CABLE STORAGE STRAP	16506239
3	1/4” CRIMP SLEEVE	3265434Y
4	1/4” THIMBLE	14806065
5	1/4” CABLE BAND	44136493

POWER CABLE SUPPORT ASSY

RW200-RW650

Dwg: DS-M01-052 **Rev:** E **Date:** 12/04 **Tab** Accessories

¼" WIRE ROPE



NOTE: Cable sway clamps located every 5 feet.

MIXER TYPE	MOTOR SIZE	VOLT	316 STAINLESS STEEL ASSY # 20 FEET	ASSY # 30 FEET	ASSY # 40 FEET
RW200 and RW300	S16/4,S18/4, S28/4 & A17/6	208V 230V 460V 575V	64136152	64136153	64136154
	A32/6	208V 230V	64136143	64136144	64136145
		460V 575V	64136152	64136153	64136154
RW400	A35/8	208V 230V 460V 575V	64136152	64136153	64136154
	A46/8	208V 230V 460V 575V	64136143	64136144	64136145
RW650	A60/12	208V 230V	64136146	64136147	64136148
		460V 575V	64136143	64136144	64136145
	A90/12	208V 230V	64136146	64136147	64136148
		460V 575V	64136143	64136144	64136145
	A120/12	208V 230V	64136149	64136150	64136151
		460V 575V	64136143	64136144	64136145
RW900	A130/4	208V 230V	64136146	64136147	64136148
		460V 575V	64136143	64136144	64136145
	A170/4	208V	64136149	64136150	64136151
		230V	64136146	64136147	64136148
		460V 575V	64136143	64136144	64136145
	A250/4	208V 230V	64136149	64136150	64136151
		460V 575V	64136146	64136147	64136148

Specifications subject to change without notice

Workshopmanual
RW 400 / 650 / 900

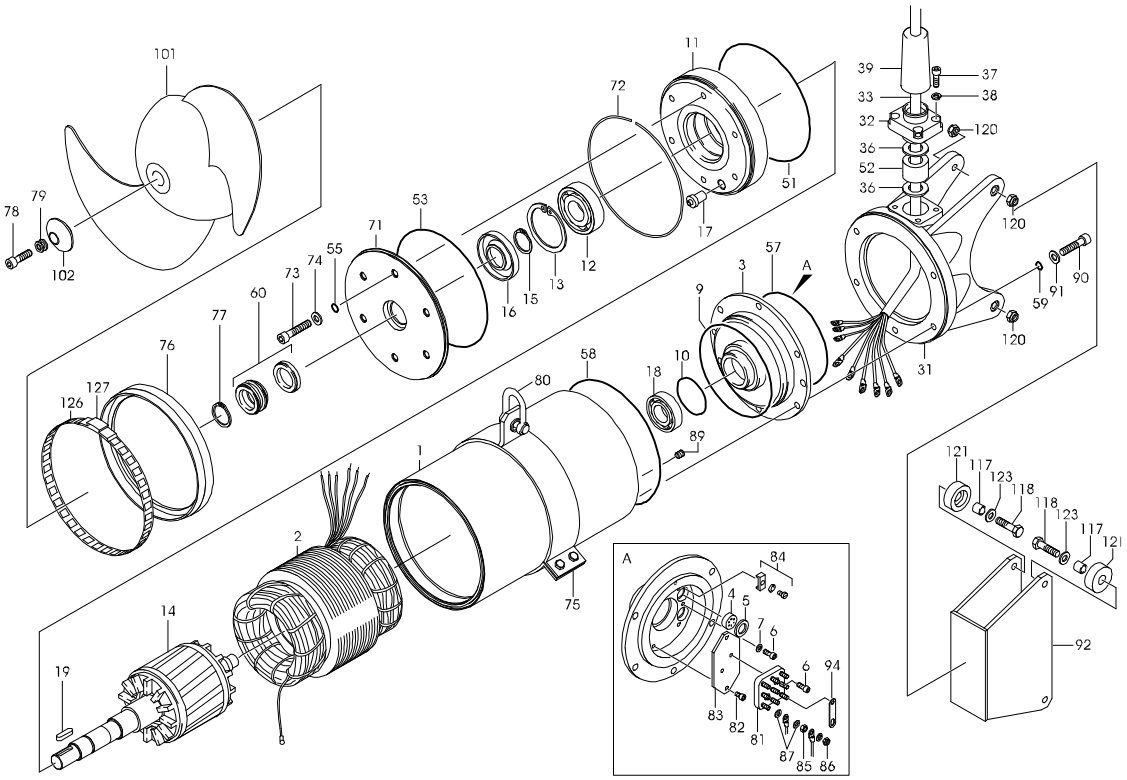


Bild 17 Complete explosive drawing RW 400 / 600

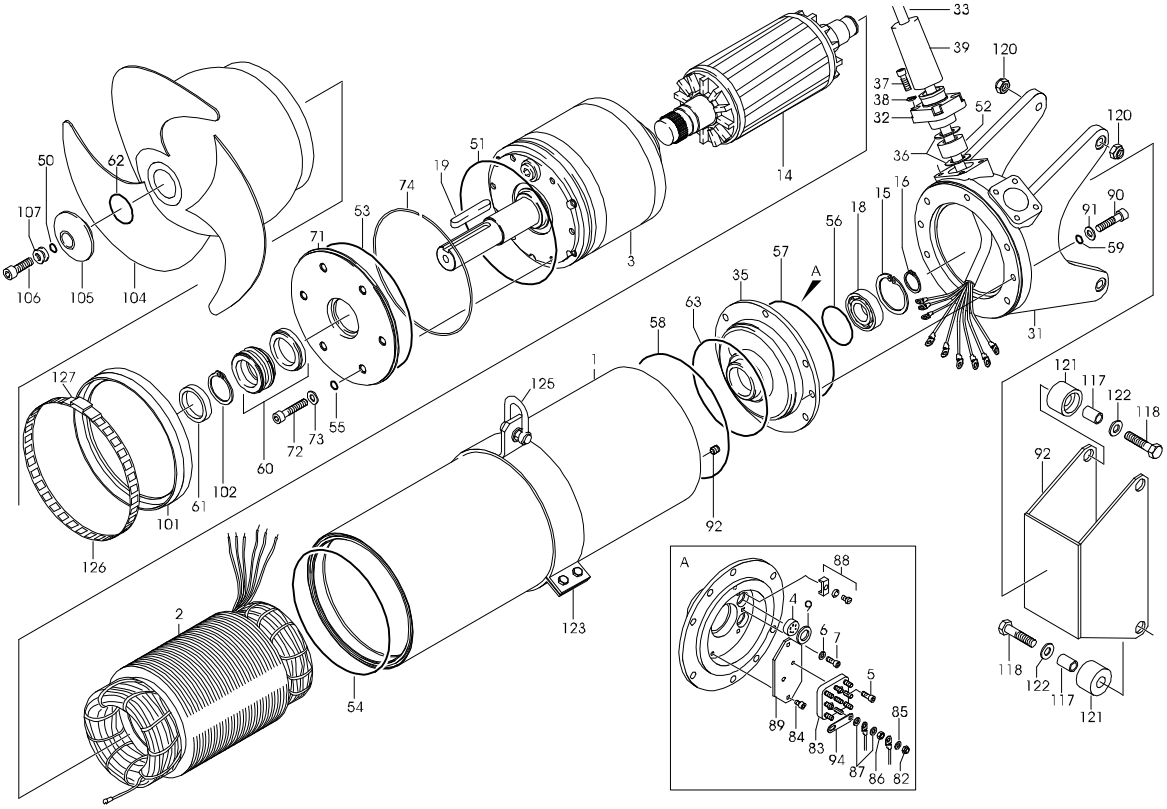


Bild 18 Complete explosive drawing RW 900

ABS Pump Center GmbH · Scheiderhöher Str. 30-38 • D-53797 Lohmar • Tel. Int.+49.2246.13-0 • Telefax +49.2246.13-200

Accessories

OPERATION

The ABS Sealminder system is a solid state device that provides a warning signal when the oil in the individual chamber (oil, motor, connection) reaches a certain level of contamination by water. The contamination level is determined by measuring the resistivity of the oil bath. The resistivity is measured from a probe (di-electrode), installed to extend into the oil, to ground or the motor case. The probe is connected to a lead which runs back through the motor cables and is connected to the #3 sensing lead from the Sealminder relay. The relay will "trip" at a resistance of 90K to 100K ohms or lower, activating a 24 volt DC output on the M (white) lead of the relay. This output can be used to activate a 24 volt DC pilot light or a 24 volt DC auxiliary relay, which in turn can provide multiple output signals. The auxiliary relay is shown below.

MOUNTING

The ABS Sealminder relay can be mounted in any position by means of the mounting lugs on either side. Approximate dimensions are shown below.

ELECTRICAL CONNECTIONS

The ABS Sealminder relay comes in 115 volt, 208/230 volt, 460 volt, or 575 volt models. The relay is CSA approved. A ground fault master unit is required for UL approval. The power (input) leads are the two black leads and are labeled on the package as to the correct line voltage, i.e. labeled as 460V at point where leads enter relay. The output lead (24 volt DC) is white and labeled (M). This should be connected to the line side of a pilot light or the (-) side of a 24 volt DC relay. The common lead is yellow and is labeled (+). The ground lead is green. The probe or sensing input lead is blue and is labeled as (3). This lead should be connected to the probe lead (#3) of the motor cable.

NOTE: The input power leads DO NOT require a transformer connection, using power from any two leads.

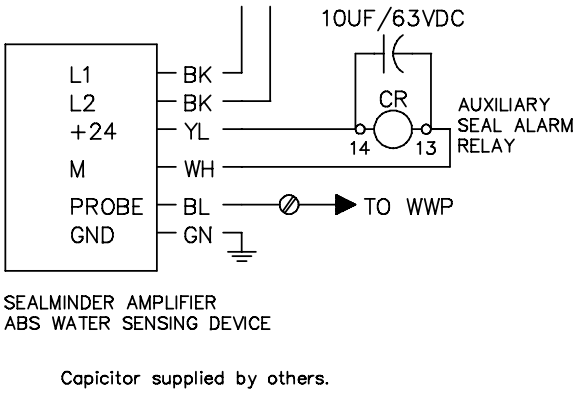
VOLTAGE	PART NUMBER
115V	61240170
208/230V	61240171
460V	61240172
575V	61240173

NOTE:

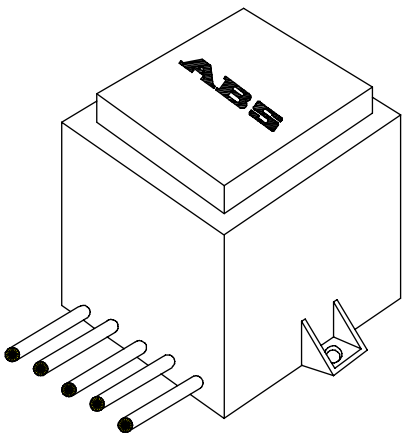
When coupling the output to a relay, use an IDEC DC relay, part number RH2B-U-DC24V, base part number SH2B-05 or equivalent.

SPECIFICATIONS

Signal strength:	24 volt DC, 5VA
Temperature range:	-20° to +60° C



Capicitor supplied by others.



UNIT MEASURES 2.00" WIDE X 2.00" DEEP X 1.88" HIGH

Warranty

ONE YEAR PRODUCT WARRANTY
XFP, AFP, AFL, VUP, Piranha, AS, Scavenger, RCP, & Robusta Series Pumps; Mixers, Aerators, Control Panels, Installation Accessories*

Manufacturer warrants the above referenced ABS brand equipment ("Products") to be free from defects in workmanship and materials as follows:

The warranty period shall expire on the earliest of the below dates:

i) one (1) year from date of installation of the Products; or

ii) eighteen (18) months from date of shipment of the Products from Manufacturer.

Products or parts thereof that are replaced or repaired under warranty during the original warranty period, shall be covered under this warranty until the expiration of the original warranty period or ninety (90) days from the date of such replacement or repair, whichever is later. In any event, such extended warranty period shall not exceed ninety (90) days after the expiration of the original warranty period.

The warranties stated above are contingent upon start-up of the equipment on site by an authorized Manufacturer's representative, as verified by receipt of start-up reports completed and signed by an authorized Manufacturer's representative. Robusta Series pumps and Piranha 09 Series pumps are exempt from this requirement, though any supporting documentation is requested for all warranty claims.

If during the warranty period, any Products fail to meet the requirements set out in this warranty, the purchaser or end user shall give written notification to Manufacturer stating the reasons therefor. Upon receipt of prior written authorization from Manufacturer, Products shall be transported to Manufacturer's authorized service center, prepaid, at purchaser or end-user's cost. Manufacturer's sole obligation shall be to repair, modify or replace Products or parts thereof, at Manufacturer's sole option. Products repaired under this warranty will be returned with freight prepaid. Products must be repaired by an authorized Manufacturer repair center for warranty coverage to be considered. Explosion Proof or other Agency Approved pumps must be repaired at a Manufacturer's authorized service center in order to retain the agency's approval rating.

All protection features (such as moisture sensors, bearing monitors, and thermal overloads) incorporated in the Products must be connected and operable for warranty coverage. This warranty is valid only if Manufacturer supplied or authorized alarm monitoring components, cables and control components/panels are used.

This warranty shall not apply to any Products or parts thereof which have been (i) subjected to misuse, misapplication, accident, alteration, neglect, failure to act in a timely manner to address alarms/warnings, or physical damage; (ii) installed, operated, and/or maintained in a manner which is contrary to Manufacturer's written instructions as it pertains to installation, operation and maintenance of the Products, including but without limitation to being operated without being connected to monitoring devices supplied with specific products for protection; (iii) used in an application or for pumping liquids other than the use for which it is intended as specified in Manufacturer's product literature; (iv) damaged due to a defective power supply, improper electrical protection, faulty repair, ordinary wear and tear, corrosion, erosion or chemical attack, an act of God, an act of war or by an act of terrorism; (v) damaged resulting from the use of accessory equipment not sold by Manufacturer or not approved by Manufacturer for use in connection with Manufacturer's products; or (vi) repaired or altered without Manufacturer's written consent.

This warranty does not cover costs for standard and/or scheduled maintenance that is performed, nor does it cover Manufacturer's parts that, by virtue of their operation, require replacement through normal wear (aka: Wear Parts), unless a defect in material or workmanship is determined by Manufacturer. Wear Parts are defined as cutters, cutting plates, seals, bearings, impellers/propellers, diffusers, wear rings (stationary or rotating), volutes (when used in an abrasive environment), oil, grease, cooling fluids and/or any items deemed necessary to perform and meet the requirements of normal maintenance on all Manufacturer's equipment.

Manufacturer shall not be liable for any special, indirect, consequential, or punitive damages, or profit loss of any kind. Major components not manufactured by the Manufacturer are covered by the original manufacturer's warranty in lieu of this warranty. In addition to any other special, indirect or consequential damages referenced above, Manufacturer shall not be responsible for travel expenses, rented (replacement) equipment, pump removal fees, installation fees, outside contractors fees, or unauthorized repair shop expenses.

This warranty shall extend only to the initial end user.

ALL OTHER WARRANTIES, CONDITIONS AND REPRESENTATIONS, EXPRESSED OR IMPLIED BY STATUTE, COMMON LAW OR OTHERWISE, IN RELATION TO THE SUPPLY OF THE PRODUCTS INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE EXCLUDED TO THE EXTENT PERMITTED BY LAW.

*This warranty is applicable to Products supplied by Sulzer Pump Solutions (US) Inc. or Sulzer Pumps Wastewater Canada, Inc. for installation in the U.S.A. or Canada, unless specifically indicated otherwise in writing by Manufacturer.

KRÜGER

SECTION 3.3

MEDIA

VEOLIA WATER Solutions & Technologies

KRÜGER

AnoxKaldnes™ Carrier Media Type Anox K5 and ~~K5 Heavy~~ Product Specification



Use
Carrier media for biofilm in biological wastewater treatment. For use in aerated reactors, with tank and reactor equipment designed for carrier media.

Production
Extrusion. The carriers are produced in several extrusion machines and with several molds. A combination of phenolic antioxidant and phosphite may be added to the material to improve stabilization for the extruding process. Minor differences can be seen between individual pieces but this does not influence performance.

Form and size
4 concentric tubes with internal spacing walls and external corrugated surface, with a nominal length of 3.5-4 mm and a nominal diameter of 25 mm.

Protected surface area for biofilm growth
Approximately 800 m^2/m^3 ± 1 %.

Number per m^3
Approximately 331,000.

Kruger Inc.
4001 Weston Parkway
Cary, NC 27513 USA
Tel: 919-677-8310 ● Fax: 919-677-0082
Web site: www.krugerusa.com

VEOLIA WATER
Solutions & Technologies

KRÜGER

Composition
High-density polyethylene. Virgin polymers are used.

Density
Adjustable. For most applications the carrier exists in density 0.95. K5 Heavy density is 0.98. The density tolerance is ±0.02 kg/dm^3.

Weight per m3
118 kg at a density of 0.95 kg/dm^3.

Handling
The carriers are packed and shipped in bags containing 1.0 m^3 of carriers in bulk volume.

When the carriers are emptied into the reactor, the reactor must already be filled with water and the aeration or mixing system must be running in order to minimize any impact damage to the carriers. Impact damages can be caused by a free fall of 5 feet or more and collisions with hard surfaces or other carriers. When filling, the suspended bags are usually cut open from the bottom with a utility knife.

If on-site storage is needed prior to installing the carriers in the basins, the carriers should be stored in the bags, and the bags should be protected from UV light to prevent their degradation and subsequent rupture. Bags of 1.0 m^3 can be stacked pyramid style up to three or four bags high. The base underneath the bags must be smooth and free from any debris or items that could puncture or rip the bags.

The carriers can be moved from one reactor to another using a solids handling pump, air lift pump, or conveyor belt.

Kruger Inc.
4001 Weston Parkway
Cary, NC 27513 USA
Tel: 919-677-8310 ● Fax: 919-677-0082
Web site: www.krugerusa.com

VEOLIA WATER
Solutions & Technologies

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SECTION 3.4

AERATION GRID, SCREENS & SYSTEM DRAWINGS

3.4.1 AERATION SYSTEM TABLE OF CONTENTS
3.4.2 AERATION SYSTEM BILL OF MATERIALS
3.4.3 AERATION SYSTEM DRAWINGS

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SECTION 3.4.1

AERATION SYSTEM TABLE OF CONTENTS

VEOLIA WATER
Solutions & Technologies

PACKAGE NAME: MD SUBMITTAL
PROJECT NUMBER: 5700235402
PROJECT NAME: MASSILLON, OH

MD TABLE OF CONTENTS

REVISION: 4
CREATED BY: CDP

ITEM	DRAWING NUMBER	DESCRIPTION	REVISION
1	930M-0001 BOM	MD BILL OF MATERIAL	4
2	930M-0001	DETAILS, MECHANICAL, PLAN & SECTIONS (7 SHEETS)	3
3	930F-1050	WLDMT, CYLINDRICAL SCREEN, PERFORATED, Ø23", 5'-0"LG, Ø5/8" HOLES, 13/16" CENTERS, STAGGERED, WITH FLG FLATS	1
4	930F-1230	WLDMT, CYLINDRICAL SCREEN, PERFORATED, Ø23", 5'-0"LG, Ø5/8" HOLES, 13/16" CENTERS, STAGGERED, WITH PIPE HANGERS	1
5	930F-1207	WLDMT, SPARGER, Ø23" X 5'-0"LG CYL SCREEN, Ø3" MANIFOLD, WITH TURN DOWN	1
6	930F-0701	ANG, 3" PIPE SUPPORT, 2" X 2" X 3/16" X 10.75"LG	1
7	930F-0703	ANG, 6" PIPE SUPPORT, 2" X 2" X 3/16" X 14"LG	2
8	930F-0779	FLASHING, PERFORATED, 14 GA, 2'-6 3/4" X 2'-8", L-SHAPED, Ø5/8" HOLES, 13/16" CENTERS, STAGGERED (2 SHEETS)	1
9	930F-1208	PIPE, 3", SCH10, 28.75"LG	0
10	930F-1209	ASSY, AERATION GRID, 6", (8) 1-1/4" LATS @ 30" O.C., 8'-0" W, 248 HOLES, VERT. FLG. INLET, OPEN OUTLET, RH	2
11	930F-1210	ASSY, AERATION GRID, 6", (8) 1-1/4" LATS @ 30" O.C., 8'-0" W, 248 HOLES, OPEN INLET, OPEN OUTLET, RH	2
12	930F-1211	ASSY, AERATION GRID, 6", (7) 1-1/4" LATS @ 30" O.C., 8'-0" W, 217 HOLES, OPEN INLET, CAPPED OUTLET, RH	2
13	930F-1212	ASSY, AERATION GRID, 6", (8) 1-1/4" LATS @ 30" O.C., 8'-0" W, 217 HOLES, VERT. FLG. INLET, OPEN OUTLET, LH	2
14	930F-1213	ASSY, AERATION GRID, 6", (7) 1-1/4" LATS @ 30" O.C., 8'-0" W, 217 HOLES, OPEN INLET, CAPPED OUTLET, LH	2
15	930F-1214	ASSY, AERATION GRID, 6", (8) 1-1/4" LATS @ 30" O.C., 8'-0" W, 176 HOLES, VERT. FLG. INLET, OPEN OUTLET, LH	2
16	930F-1215	ASSY, AERATION GRID, 6", (8) 1-1/4" LATS @ 30" O.C., 8'-0" W, 176 HOLES, OPEN INLET, OPEN OUTLET, LH	2
17	930F-1216	ASSY, AERATION GRID, 6", (7) 1-1/4" LATS @ 30" O.C., 8'-0" W, 154 HOLES, OPEN INLET, CAPPED OUTLET, LH	2
18	930F-1217	ASSY, AERATION GRID, 6", (8) 1-1/4" LATS @ 30" O.C., 8'-0" W, 176 HOLES, VERT. FLG. INLET, OPEN OUTLET, RH	2
19	930F-1218	ASSY, AERATION GRID, 6", (7) 1-1/4" LATS @ 30" O.C., 8'-0" W, 154 HOLES, OPEN INLET, CAPPED OUTLET, RH	2
20	930F-1219	ASSY, AERATION GRID, 6", (9) 1-1/4" LATS @ 30" O.C., 8'-0" W, 279 HOLES, OPEN INLET, CAPPED OUTLET, LH	2
21	930F-1220	ASSY, AERATION GRID, 6", (9) 1-1/4" LATS @ 30" O.C., 8'-0" W, 279 HOLES, OPEN INLET, CAPPED OUTLET, RH	2
22	930F-1221	WLDMT, DROP PIPE, 6", SCH10, FLG ONE END, 14'-11 1/4"LG	3
23	930F-1222	WLDMT, DROP PIPE, 3", SCH10, FLG BOTH ENDS, 15'-4"LG	2

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ITEM	DRAWING NUMBER	DESCRIPTION	REVISION
24	930F-1223	WLDMT, DROP PIPE, 3", SCH10, ELBOW, 6'-10 3/8"LG	2
25	930F-1224	WLDMT, AERATION GRID, 3", VERT FLG INLET, TEE W/OPEN OUTLET, 12'-5"LG	2
26	930F-1225	WLDMT, AERATION GRID, 3", OPEN INLET, OPEN OUTLET, 20'-0"LG	1
27	930F-1226	WLDMT, AERATION GRID, 3", OPEN INLET, CAPPED OUTLET, 20'-0"LG	2
28	930F-1227	WLDMT, AERATION GRID, 3", OPEN INLET w/ELBOW, OPEN OUTLET, 20'-4 1/2"LG	2
29			
30	930F-1229	SCREEN, PERFORATED, 14 GA, 2'-0" X 4'-0", Ø5/8" HOLES, 13/16" CENTERS, STAGGERED	1
31	930F-1231	WLDMT, SCREEN, GUIDED RADAR, 6", 4'-6" LG., PERF, Ø5/8" HOLES, 13/16" CENTERS	0
32	930F-1298	ASSY, AERATION GRID, 6", (10+6) 1-1/4" LATS @ 30" O.C., 274 HOLES, 11'-9" W, VERT. FLG. INLET, OPEN OUTLET, RH	1
33	930F-1299	ASSY, AERATION GRID, 6", (9+4) 1-1/4" LATS @ 30" O.C., 11'-9" W, 234 HOLES, OPEN INLET, CAPPED OUTLET, RH	1
34	930F-1300	ASSY, AERATION GRID, 6", (10+5) 1-1/4" LATS @ 30" O.C., 11'-9" W, 265 HOLES, VERT. FLG. INLET, OPEN OUTLET, RH	1
35	930F-1301	ASSY, AERATION GRID, 6", (9+7) 1-1/4" LATS @ 30" O.C., 11'-9" W, 261 HOLES, OPEN INLET, CAPPED OUTLET, RH	1
36	930F-1302	ASSY, AERATION GRID, 6", (9+6) 1-1/4" LATS @ 30" O.C., 11'-9" W, 252 HOLES, VERT. FLG. INLET, OPEN OUTLET, RH	1
37	930F-1303	ASSY, AERATION GRID, 6", (10+6) 1-1/4" LATS @ 30" O.C., 11'-9" W, 274 HOLES, OPEN INLET, OPEN OUTLET, RH	1
38	930F-1334	WLDMT, DROP PIPE, 6", SCH10, FLG. ONE END, 2X 45 DEG. OFFSET, 14'-11 1/4"LG	0
39	930P-0001	PIPING & INSTRUMENTATION DIAGRAM, TYPICAL REACTORS	1
40	930P-0002	PIPING & INSTRUMENTATION DIAGRAM, AIR SPARGE BLOWER STATION	0
41			
42		HILTI HIT-RE 500 ANCHORING SYSTEM SUBMITTAL	
43		SIKAFLEX-1A PRODUCT DATA SHEET	
44		STRAUB FLEX COUPLING DATA SHEET	
45		POWERS SPIKE ANCHOR DATA SHEET	

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PACKAGE NAME: MD SUBMITTAL
PROJECT NUMBER: 5700235402
PROJECT NAME: MASSILLON, OH

MD TABLE OF CONTENTS
REVISION TABLE

REVISION: 4
CREATED BY: CDP

REV	CREATED	APPR	DATE	DESCRIPTION
0	CDP	.	01.22.15	RELEASED FOR SUBMITTAL
1	CDP		03.18.15	REVISED ITEMS 1,2,22. ADDED ITEMS 8,31,32
2	CDP		03.31.15	REVISED ITEM 1
3	CDP		06.09.15	REVISED ITEMS 1,2,4,5,7,10-25,27,30, ADDED ITEMS 32-37
4	CDP		08.27.15	REVISED ITEMS 1,2, 21-28, 32,34,36. ADDED ITEM 38

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SECTION 3.4.2

AERATION SYSTEM BILL OF MATERIALS

VEOLIA WATER
Solutions & Technologies

DRAWING NUMBER: 930M-0001
PROJECT NUMBER: 5700235402
PROJECT NAME: MASSILLON, OH

MD BILL OF MATERIALS

REVISION: 4
CREATED BY: CDP

ITEM	QTY	MATERIAL	DRAWING NUMBER	DESCRIPTION
1	69	SEE BOM	930F-1050	WLDMT, CYLINDRICAL SCREEN, PERFORATED, Ø23", 5'-0"LG, Ø5/8" HOLES, 13/16" CENTERS, STAGGERED, WITH FLG FLATS
2	33	SEE BOM	930F-1230	WLDMT, CYLINDRICAL SCREEN, PERFORATED, Ø23", 5'-0"LG, Ø5/8" HOLES, 13/16" CENTERS, STAGGERED, WITH PIPE HANGERS
3	33	SEE BOM	930F-1207	WLDMT, SPARGER, Ø23" X 5'-0"LG CYL SCREEN, Ø3" MANIFOLD, WITH TURN DOWN
4	63	AISI 304L	930F-0701	ANG, 3" PIPE SUPPORT, 2" X 2" X 3/16" X 10.75"LG
5	453	AISI 304L	930F-0703	ANG, 6" PIPE SUPPORT, 2" X 2" X 3/16" X 14"LG
6	30	AISI 304L	930F-1208	PIPE, 3", SCH10, 28.75"LG
7	18	AISI 304	930F-0779	SCREEN, PERFORATED, 14 GA, 2'-0" X 2'-0", Ø5/8" HOLES, 13/16" CENTERS, STAGGERED
8	6	SEE BOM	930F-1209	ASSY, AERATION GRID, 6", (8) 1-1/4" LATS @ 30" O.C., 8'-0" W, 248 HOLES, VERT. FLG. INLET, OPEN OUTLET, RH
9	12	SEE BOM	930F-1210	ASSY, AERATION GRID, 6", (8) 1-1/4" LATS @ 30" O.C., 8'-0" W, 248 HOLES, OPEN INLET, OPEN OUTLET, RH
10	3	SEE BOM	930F-1211	ASSY, AERATION GRID, 6", (7) 1-1/4" LATS @ 30" O.C., 8'-0" W, 217 HOLES, OPEN INLET, CAPPED OUTLET, RH
11	12	SEE BOM	930F-1212	ASSY, AERATION GRID, 6", (8) 1-1/4" LATS @ 30" O.C., 8'-0" W, 217 HOLES, VERT. FLG. INLET, OPEN OUTLET, LH
12	9	SEE BOM	930F-1213	ASSY, AERATION GRID, 6", (7) 1-1/4" LATS @ 30" O.C., 8'-0" W, 217 HOLES, OPEN INLET, CAPPED OUTLET, LH
13	15	SEE BOM	930F-1214	ASSY, AERATION GRID, 6", (8) 1-1/4" LATS @ 30" O.C., 8'-0" W, 176 HOLES, VERT. FLG. INLET, OPEN OUTLET, LH
14	18	SEE BOM	930F-1215	ASSY, AERATION GRID, 6", (8) 1-1/4" LATS @ 30" O.C., 8'-0" W, 176 HOLES, OPEN INLET, OPEN OUTLET, LH
15	15	SEE BOM	930F-1216	ASSY, AERATION GRID, 6", (7) 1-1/4" LATS @ 30" O.C., 8'-0" W, 154 HOLES, OPEN INLET, CAPPED OUTLET, LH
16	3	SEE BOM	930F-1217	ASSY, AERATION GRID, 6", (8) 1-1/4" LATS @ 30" O.C., 8'-0" W, 176 HOLES, VERT. FLG. INLET, OPEN OUTLET, RH
17	3	SEE BOM	930F-1218	ASSY, AERATION GRID, 6", (7) 1-1/4" LATS @ 30" O.C., 8'-0" W, 154 HOLES, OPEN INLET, CAPPED OUTLET, RH
18	3	SEE BOM	930F-1219	ASSY, AERATION GRID, 6", (9) 1-1/4" LATS @ 30" O.C., 8'-0" W, 279 HOLES, OPEN INLET, CAPPED OUTLET, LH
19	3	SEE BOM	930F-1220	ASSY, AERATION GRID, 6", (9) 1-1/4" LATS @ 30" O.C., 8'-0" W, 279 HOLES, OPEN INLET, CAPPED OUTLET, RH

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MD BILL OF MATERIALS

ITEM	QTY	MATERIAL	DRAWING NUMBER	DESCRIPTION
20	13	SEE BOM	930F-1221	WLDMT, DROP PIPE, 6", SCH10, FLG. ONE END, 14'-11 1/4"LG
21	3	SEE BOM	930F-1222	WLDMT, DROP PIPE, 3", SCH10, FLG. ONE END, 15'-4"LG
22	3	SEE BOM	930F-1223	WLDMT, DROP PIPE, 3", SCH10, ELBOW, 6'-10 3/8"LG
23	3	SEE BOM	930F-1224	WLDMT, AERATION GRID, 3", VERT FLG INLET, TEE W/OPEN OUTLET, 12'-5"LG
24	3	SEE BOM	930F-1225	WLDMT, AERATION GRID, 3", OPEN INLET, OPEN OUTLET, 20'-0"LG
25	6	SEE BOM	930F-1226	WLDMT, AERATION GRID, 3", OPEN INLET, CAPPED OUTLET, 20'-0"LG
26	3	SEE BOM	930F-1227	WLDMT, AERATION GRID, 3", OPEN INLET w/ELBOW, OPEN OUTLET, 20'-4 1/2"LG
27	26	SEE BOM	930F-1334	WLDMT, DROP PIPE, 6", SCH10, FLG. ONE END, 2X 45 DEG. OFFSET, 14'-11 1/4"LG
28	3	AISI 304L	-	CAP, PIPE, 3", SCH40, BW, MCMASTER #45605K591OR EQUIV
29	84	SEE MFG SHT	-	COUPLING, PIPE, FLEXIBLE, 3", STRAUB-FLEX-L-3-IPS-SS-E-SI
30	108	SEE MFG SHT	-	COUPLING, PIPE, FLEXIBLE, 6", STRAUB-FLEX-L-6-IPS-SS-E-SI
31	9	SEE MFG SHT	-	MIXER, SUBMERSIBLE, ABS MODEL RW4031 A46/8 CR, 6.2 HP
32	3	SEE MFG SHT	-	ASSY, HOIST, MANUAL, 30' LIFTING CABLE
33	9	SEE MFG SHT	-	ASSY, GUIDERAIL/BRACKET, HOIST (FOR 26.5' SWD)
34	9	SEE MFG SHT	-	BASEPLATE, HOIST
35	15	AISI 304	930F-1229	SCREEN, PERFORATED, 14 GA, 2'-0" X 4'-0", Ø5/8" HOLES, 13/16" CENTERS, STAGGERED
36	-	-	-	-
37	-	-	-	-
38	-	-	-	-
39	3	SEE BOM	930F-1231	WLDMT, SCREEN, GUIDED RADAR, 6", 4'-6" LG., PERF, Ø5/8" HOLES, 13/16" CENTERS, MODEL 7AF-4100-A01-00-048
40	-	-	-	-
41	1	SEE BOM	930F-1298	ASSY, AERATION GRID, 6", (10+6) 1-1/4" LATS @ 30" O.C., 274 HOLES, 11'-9" W, VERT. FLG. INLET, OPEN OUTLET, RH
42	1	SEE BOM	930F-1299	ASSY, AERATION GRID, 6", (9+4) 1-1/4" LATS @ 30" O.C., 11'-9" W, 234 HOLES, OPEN INLET, CAPPED OUTLET, RH
43	1	SEE BOM	930F-1300	ASSY, AERATION GRID, 6", (10+5) 1-1/4" LATS @ 30" O.C., 11'-9" W, 265 HOLES, VERT. FLG. INLET, OPEN OUTLET, RH
44	1	SEE BOM	930F-1301	ASSY, AERATION GRID, 6", (9+7) 1-1/4" LATS @ 30" O.C., 11'-9" W, 261 HOLES, OPEN INLET, CAPPED OUTLET, RH
45	1	SEE BOM	930F-1302	ASSY, AERATION GRID, 6", (9+6) 1-1/4" LATS @ 30" O.C., 11'-9" W, 252 HOLES, VERT. FLG. INLET, OPEN OUTLET, RH
46	1	SEE BOM	930F-1303	ASSY, AERATION GRID, 6", (10+6) 1-1/4" LATS @ 30" O.C., 11'-9" W, 274 HOLES, OPEN INLET, OPEN OUTLET, RH

MD BILL OF MATERIALS

ITEM	QTY	MATERIAL	DRAWING NUMBER	DESCRIPTION
100	LABEL AND SHIP LOOSE - 1" SPARGER PIPE SUPPORT CONNECTION FASTENERS			
	66	AISI 304		U-BOLT, 1", 1/4-20, 1 3/8"ID, 2 1/4"LG, 1 1/8"LG THD, DALE CO. #US5 OR EQUIV
	132	AISI 304		WSHR, FLAT, 1/4", .313" ID, .625" OD, .051" THK, SAE
	132	AISI 304		NUT, HEX, NYLOCK, 1/4-20, ANSI
101	LABEL AND SHIP LOOSE - 3" SPARGER PIPE SUPPORT CONNECTION FASTENERS			
	66	AISI 304		U-BOLT, 3", 3/8-16, 3 9/16"ID, 4 3/4"LG, 2"LG THD, DALE CO. #US26 OR EQUIV
	132	AISI 304		WSHR, FLAT, 3/8", .438"ID, .812"OD, .064"THK, SAE
	132	AISI 304		NUT, HEX, NYLOCK, 3/8-16, ANSI
102	LABEL AND SHIP LOOSE - 6" PIPE SUPPORT CONNECTION FASTENERS			
	453	AISI 304		U-BOLT, 6", 3/8-16, 6 5/8"ID, 8"LG, 3"LG THD, DALE CO. #US30 OR EQUIV
	906	AISI 304		WSHR, FLAT, 3/8", .438"ID, .812"OD, .064"THK, SAE
	906	AISI 304		NUT, HEX, NYLOCK, 3/8-16, ANSI
103	LABEL AND SHIP LOOSE - 3" PIPE SUPPORT CONNECTION FASTENERS			
	63	AISI 304		U-BOLT, 3", 3/8-16, 3 9/16"ID, 4 3/4"LG, 2"LG THD, DALE CO. #US26 OR EQUIV
	126	AISI 304		WSHR, FLAT, 3/8", .438"ID, .812"OD, .064"THK, SAE
	126	AISI 304		NUT, HEX, NYLOCK, 3/8-16, ANSI
104	LABEL AND SHIP LOOSE - 3" PLATE FLANGE CONNECTION FASTENERS			
	3	EPDM	-	GSKT, FLG, FULL FACE, 3", 125/150 LB ANSI, 1/8" THK
	12	AISI 304	-	SCREW, HEX, 5/8-11 X 2 1/2"LG, ANSI
	24	AISI 304	-	WSHR, FLAT, 5/8", .656"ID, 1.3125"OD, .095"THK, SAE
	12	AISI 304	-	NUT, HEX, NYLOCK, 5/8-11, ANSI
105	LABEL AND SHIP LOOSE - 6" PLATE FLANGE CONNECTION FASTENERS			
	39	EPDM	-	GSKT, FLG, FULL FACE, 6", 125/150 LB ANSI, 1/8" THK
	312	AISI 304	-	SCREW, HEX, 3/4-10 X 2 1/2"LG, ANSI
	624	AISI 304	-	WSHR, FLAT, 3/4", .813"ID, 1.469"OD, .108"THK, SAE
	312	AISI 304	-	NUT, HEX, NYLOCK, 3/4-10, ANSI

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MD BILL OF MATERIALS

ITEM	QTY	MATERIAL	DRAWING NUMBER	DESCRIPTION
107	LABEL AND SHIP LOOSE - 3" WALL PIPE SUPPORT ANCHORING FASTENERS			
	36	AISI 304		ROD, THD, 5/8-11 X 12"LG, ANSI
	72	AISI 304		WSHR, FLAT, 5/8", .688"ID, 1.312"OD, .108"THK, SAE
	36	AISI 304		WSHR, LOCK, 5/8", ANSI
	108	AISI 304		NUT, HEX, 5/8-11, ANSI
108	LABEL AND SHIP LOOSE - 6" WALL PIPE SUPPORT ANCHORING FASTENERS			
	117	AISI 304		ROD, THD, 5/8-11 X 12"LG, ANSI
	234	AISI 304		WSHR, FLAT, 5/8", .688"ID, 1.312"OD, .108"THK, SAE
	117	AISI 304		WSHR, LOCK, 5/8", ANSI
	351	AISI 304		NUT, HEX, 5/8-11, ANSI
109	LABEL AND SHIP LOOSE - 3" AIR GRID SUPPORT ANCHORING FASTENERS			
	90	AISI 304		ROD, THD, 5/8-11 X 23"LG, ANSI
	180	AISI 304		WSHR, FLAT, 5/8", .688"ID, 1.312"OD, .108"THK, SAE
	90	AISI 304		WSHR, LOCK, 5/8", ANSI
	270	AISI 304		NUT, HEX, 5/8-11, ANSI
110	LABEL AND SHIP LOOSE - DIFFUSER SUPPORT ANCHORING FASTENERS			
	644	AISI 304		ROD, THD, 5/8-11 X 19"LG, ANSI
	1288	AISI 304		WSHR, FLAT, 5/8", .688"ID, 1.312"OD, .108"THK, SAE
	644	AISI 304		WSHR, LOCK, 5/8", ANSI
	1932	AISI 304		NUT, HEX, 5/8-11, ANSI

MD BILL OF MATERIALS

ITEM	QTY	MATERIAL	DRAWING NUMBER	DESCRIPTION
111	LABEL AND SHIP LOOSE - CYLINDRICAL SCREEN TO WALL ANCHORING FASTENERS			
	816	AISI 304		ROD, THD, 3/8-16 X 4" LG, ANSI
	816	AISI 304		WSHR, FLAT, 3/8", .438"ID, .812"OD, .064"THK, SAE
	816	AISI 304		WSHR, LOCK, 3/8", ANSI
	816	AISI 304		NUT, HEX, 3/8-16, ANSI
112	LABEL AND SHIP LOOSE - MUD VALVE SCREEN TO FLOOR ANCHORING FASTENERS			
	930	AISI 304		ANCHOR, SPIKE, 3/16", MSHRM HD, 1 1/2"LG, POWERS#6604
113	LABEL AND SHIP LOOSE - 6" AIR GRID SUPPORT ANCHORING FASTENERS			
	612	AISI 304		ROD, THD, 5/8-11 X 26"LG, ANSI
	1224	AISI 304		WSHR, FLAT, 5/8", .688"ID, 1.312"OD, .108"THK, SAE
	612	AISI 304		WSHR, LOCK, 5/8", ANSI
	1836	AISI 304		NUT, HEX, 5/8-11, ANSI
114	LABEL AND SHIP LOOSE - SPARES			
	8	SEE MFG SHT	-	COUPLING, PIPE, FLEXIBLE, 3", STRAUB-FLEX-L-3-IPS-SS-E-SI
	11	SEE MFG SHT	-	COUPLING, PIPE, FLEXIBLE, 6", STRAUB-FLEX-L-6-IPS-SS-E-SI
	3	AISI 304L	930F-0701	ANG, 3" PIPE SUPPORT, 2" X 2" X 3/16" X 10.75"LG
	23	AISI 304L	930F-0703	ANG, 6" PIPE SUPPORT, 2" X 2" X 3/16" X 14"LG
	23	AISI 304		U-BOLT, 6", 3/8-16, 6 5/8"ID, 8"LG, 3"LG THD, DALE CO. #US30 OR EQUIV
	52	AISI 304		WSHR, FLAT, 3/8", .438"ID, .812"OD, .064"THK, SAE
	52	AISI 304		NUT, HEX, NYLOCK, 3/8-16, ANSI
	3	AISI 304		U-BOLT, 3", 3/8-16, 3 9/16"ID, 4 3/4"LG, 2"LG THD, DALE CO. #US26 OR EQUIV

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MD BILL OF MATERIALS
REVISION TABLE

REV	CREATED	APPR	DATE	DESCRIPTION
0	CDP	.	01.21.15	RELEASED FOR SUBMITTAL
1	CDP		03.18.15	ADDED ITEM 7, ITEM 1 QTY WAS 75, ADDED 5% TO ITEM 4, 5, 100-103 QUANTITIES, ITEM 112 QTY WAS 390
2	CDP		03.31.15	REMOVED SPARES AND ADJUSTED QTY FOR ITEMS 4,5 100-103, 108,109
3	CDP		06.05.15	ITEM 30 QTY WAS 69, ITEM 114 QTY WERE 8 AND 7, DELETED ITEMS 27, 36-38,40, ADDED ITEMS 41-46, UPDATED HOLE QTY FOR ITEMS 8-19, ITEM 5 QTY WAS 468, UPDATED DESCRIPTION FOR ITEMS 20-23, ITEM 29 QTY WAS 81, ITEM 102 QTY WAS 468, ITEM 110 QTY WAS 648, ITEM 113 QTY WAS 648
4	CDP		08.31.15	QUANTITIES CHANGED FOR ITEMS 4,5, 8-16, 20, 102, 103,107 AND 114. ADDED ITEM 27, ITEM 114 DESCRIPTION WAS " 8" WALL PIPE SUPPORT ANCHORING FASTENERS", ADDED PIPE SUPPORT ANGLES AND HARDWARE TO ITEM 114. HOLE COUNTS CHANGED FOR ITEMS 8-19 AND 41-46. CHANGED LENGTH/CONFIGURATION TO DROP PIPES. ITEM 110 QTY WAS 612.

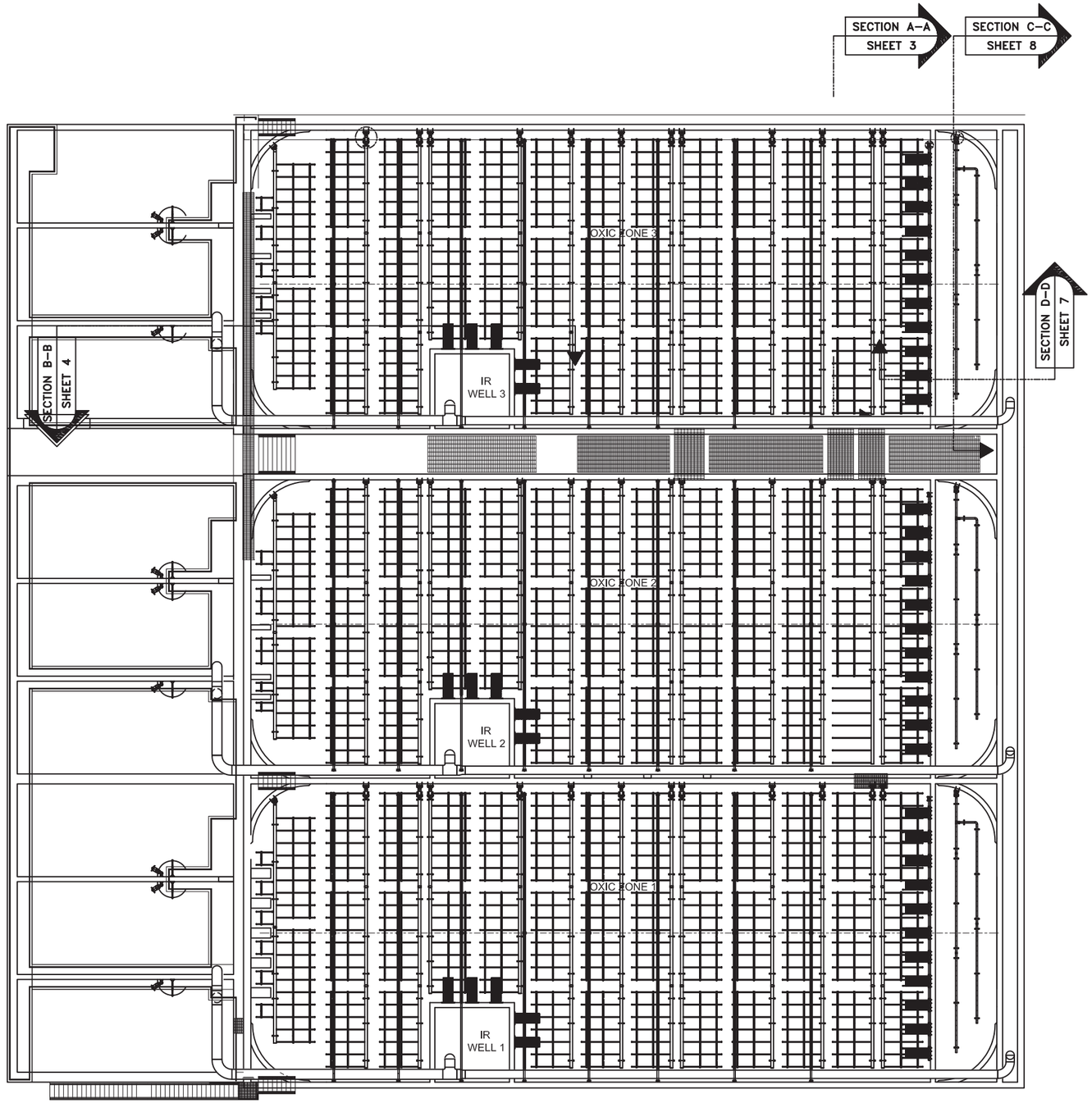
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SECTION 3.4.3

AERATION SYSTEM DRAWINGS

VEOLIA WATER
Solutions & Technologies



PLAN VIEW

NOTES:

1. ANY WALL THICKNESSES SHOWN ARE ESTIMATED AND ARE SHOWN FOR REFERENCE ONLY. ACTUAL WALL THICKNESSES AND FOOTINGS TO BE DETERMINED BY ENGINEER, NOT BY KRUGER.
2. ALL PIPE AND PIPE SUPPORTS NOT SHOWN ON THIS DRAWING ARE DESIGNED AND PROVIDED BY OTHERS. PIPE SUPPORTS SHALL BE PLACED SO THAT LOADS AND FORCES WILL NOT BE TRANSFERRED TO ANY KRUGER EQUIPMENT OR SUPPORTS.
3. ALL GASKETS AND HARDWARE FOR CONNECTING KRUGER PIPING/EQUIPMENT TO PIPING/EQUIPMENT PROVIDED BY OTHERS TO BE SUPPLIED BY INSTALLATION CONTRACTOR.
4. ANTI-SEIZE TO BE APPLIED TO ALL HARDWARE UNLESS OTHERWISE SPECIFIED.
5. ALL HARDWARE TO BE TIGHTENED TO APPROPRIATE TORQUE VALUES.
6. ALL ANCHOR BOLTS SHOWN SHALL UTILIZE HILTI HIT-RE 500 ADHESIVE ANCHORING SYSTEM.
7. ALL PENETRATIONS, WATER STOPS, INSERTS THRU WALLS AND FLOORS, ACCESS LADDERS, AND MAN WAYS TO BE DESIGNED BY ENGINEER, AND SUPPLIED AND INSTALLED BY INSTALLATION CONTRACTOR.
8. ALL SCREENS ARE DESIGNED TO PREVENT MEDIA MIGRATION. SCREENS TO BE INSTALLED FLUSH WITH ALL SURFACES TO ENSURE NO GAPS GREATER THAN 3/32" BETWEEN THE SCREEN AND THE WALL/FLOOR.
9. AIR GRID HEIGHT FROM FLOOR BASED ON HEIGHEST FLOOR ELEVATION FOR EACH CELL.
10. AIR GRIDS IN EACH REACTOR MUST BE LEVEL, ALONG THEIR LENGTH AND TO EACH OTHER, WITHIN ±1/8".
11. CYLINDRICAL SCREEN SPARGERS AND MANIFOLDS WITHIN A REACTOR MUST ALL BE LEVEL, ALONG THEIR LENGTH AND TO EACH OTHER, TO WITHIN ±1/8".
12. SECTION VIEWS REPRESENT TYPICAL BASIN LAYOUTS. ALL EQUIPMENT AND LOCATIONS ARE TYPICAL FOR EACH REACTOR, UNLESS OTHERWISE SPECIFIED.
13. ALL PLATFORMS NOT BY KRUGER.
14. MAINTAIN 3/8" GAP BETWEEN PIPE ENDS AT ALL COUPLING LOCATIONS.

REV	DESCRIPTION	DRAWN	APPR	DATE
3	AN/AX 18" LOWER, IMLR QTY WAS 12, ADDED SHT. 8	CDP	.	08.19.15
2	REVISED DROP PIPES & GRIDS, ADDED COUPLINGS	CDP	.	06.03.15
1	IMLR SCREENS QTY WAS 14, ADDED 2' DRAIN SCREENS	CDP	.	03.18.15
0	RELEASED FOR SUBMITTAL	CDP	.	01.14.15

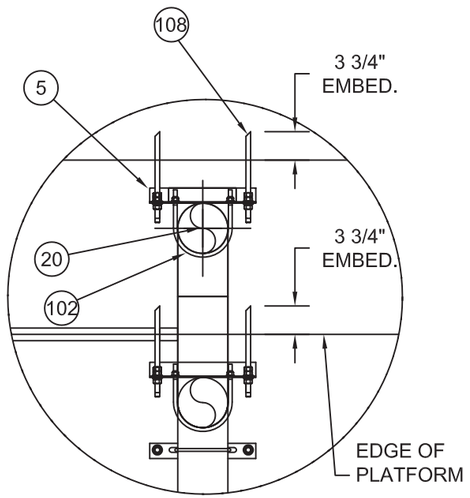
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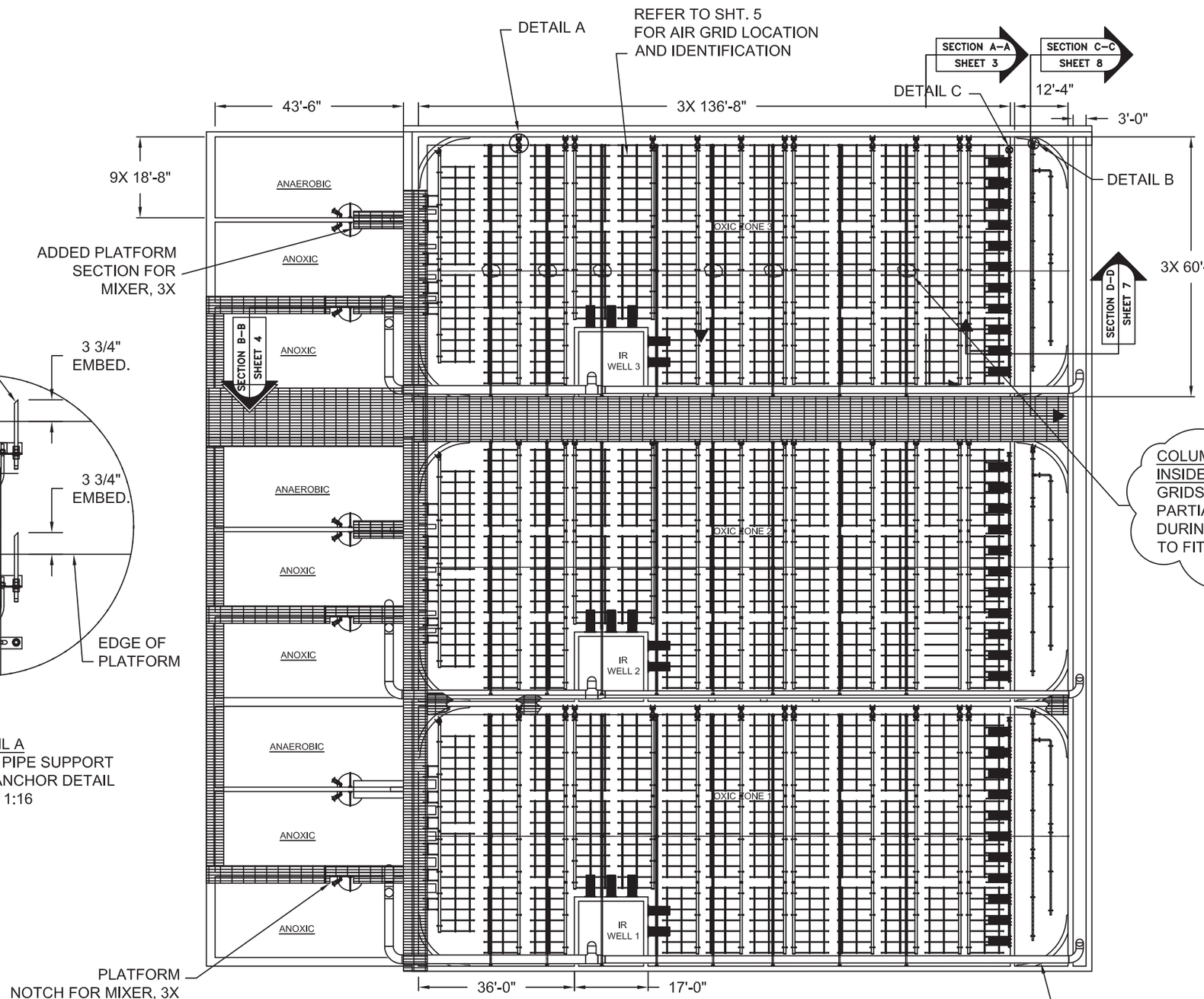
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MASSILLON, OH

ANOXKALDNES
DETAILS, MECHANICAL, PLAN & SECTIONS

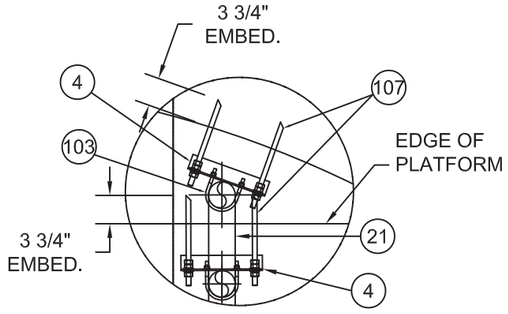
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SRW	.	1 : 320	930M-0001	1 of 8	3



DETAIL A
TYPICAL 6" DROP PIPE SUPPORT
CONNECTION & ANCHOR DETAIL
SCALE 1:16

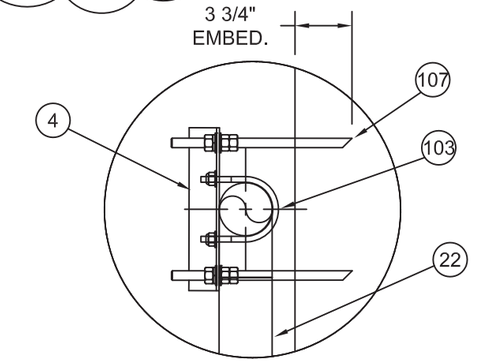


PLAN VIEW



DETAIL B
TYPICAL 3" DROP PIPE SUPPORT
CONNECTION & ANCHOR DETAIL
SCALE 1:16

COLUMN LOCATIONS
INSIDE AERATION GRIDS:
GRIDS WILL REQUIRE
PARTIAL DISASSEMBLY
DURING INSTALLATION
TO FIT AROUND COLUMNS.



DETAIL C
TYPICAL 3" SPARGER DROP PIPE SUPPORT
CONNECTION & ANCHOR DETAIL
SCALE 1:10

(#) B.O.M. ITEM NUMBER

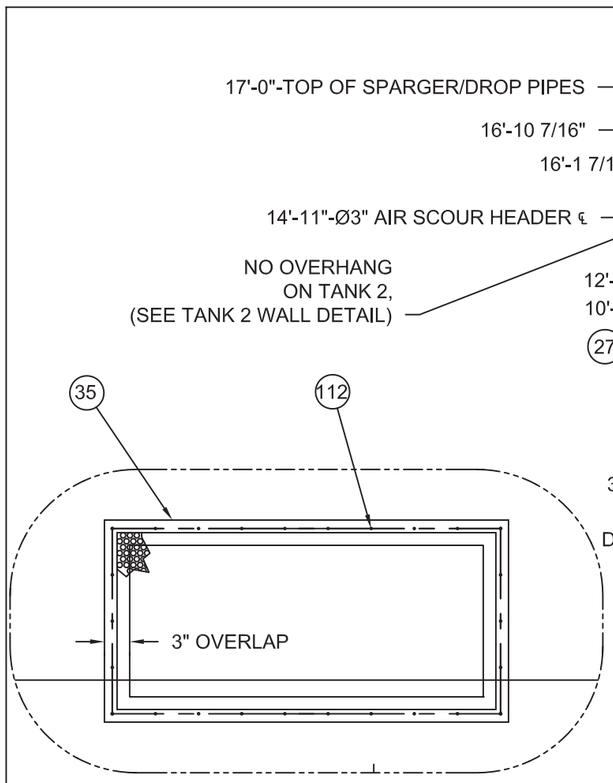
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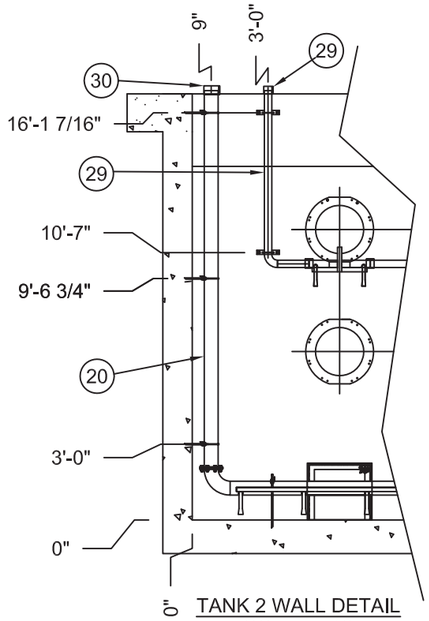
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DETAILS, MECHANICAL, PLAN
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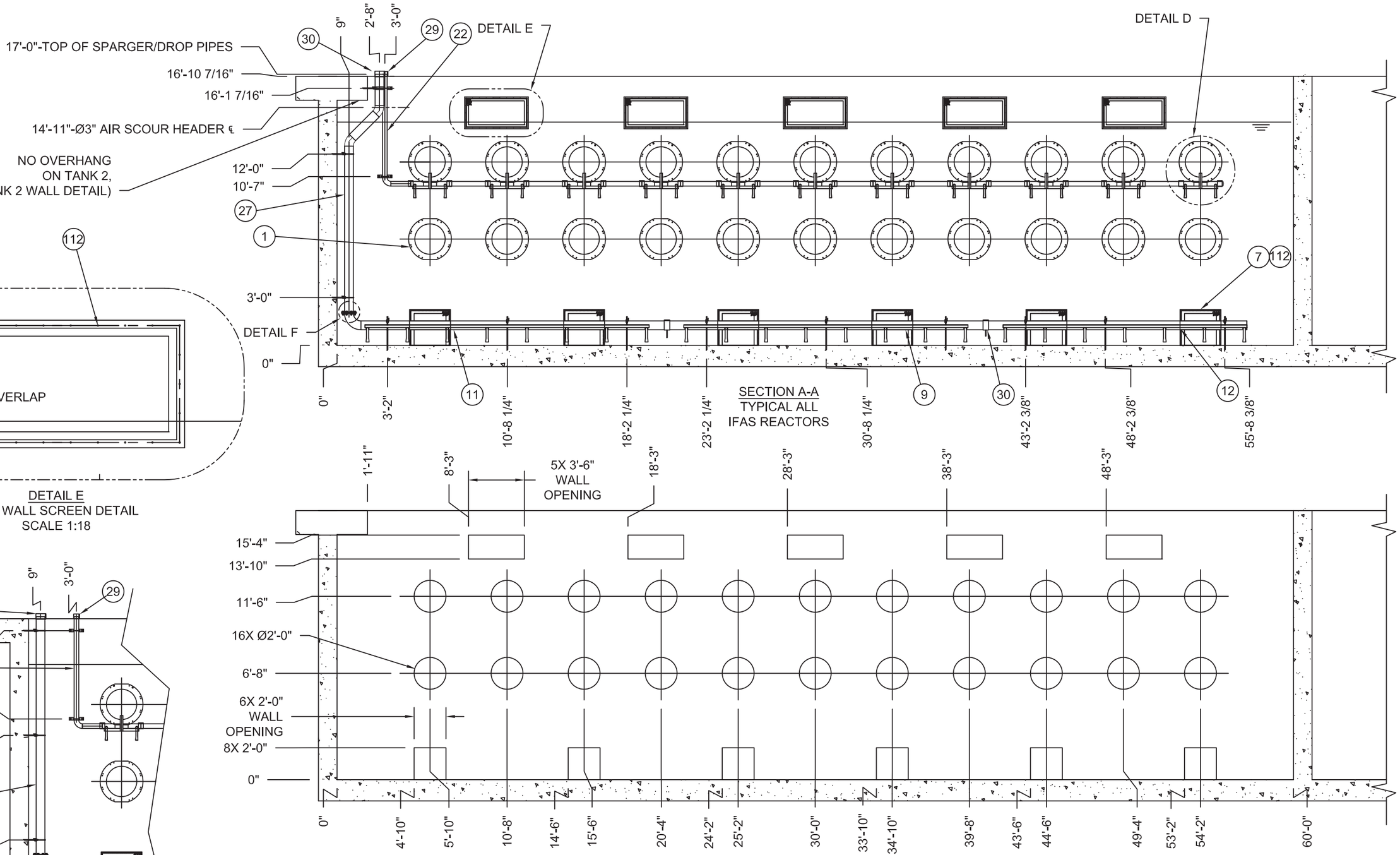
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DETAIL E
TYP WALL SCREEN DETAIL
SCALE 1:18



0" TANK 2 WALL DETAIL
SCALE 1:18



SECTION A-A
TYPICAL ALL
IFAS REACTORS

SECTION A-A
TYPICAL ALL IFAS REACTORS
(EQUIPMENT HIDDEN FOR CLARITY)

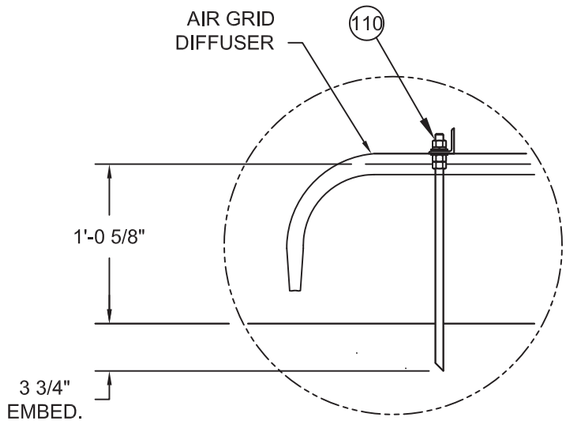
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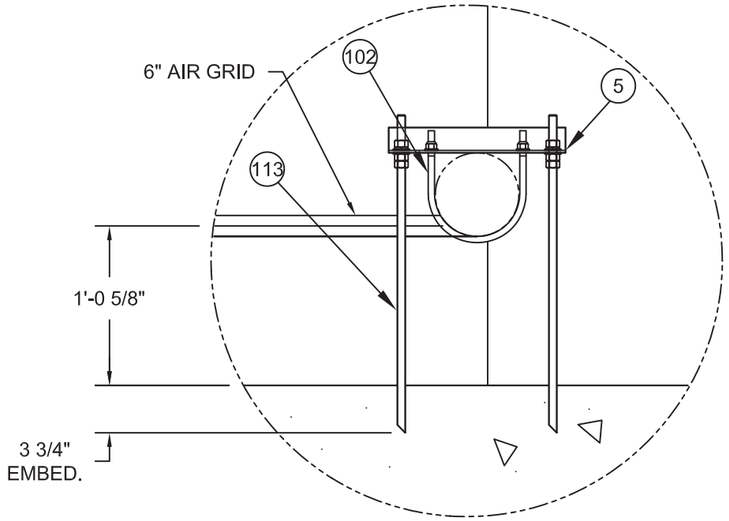
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ANOXKALDNES
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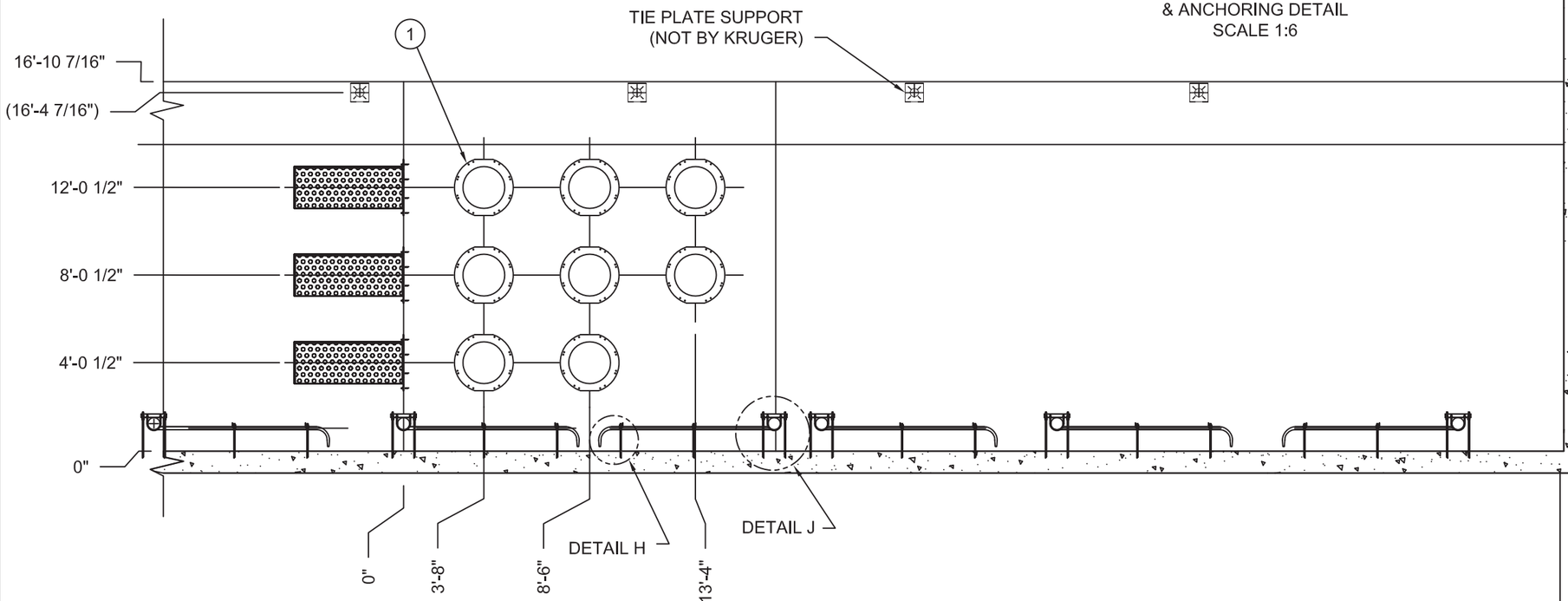
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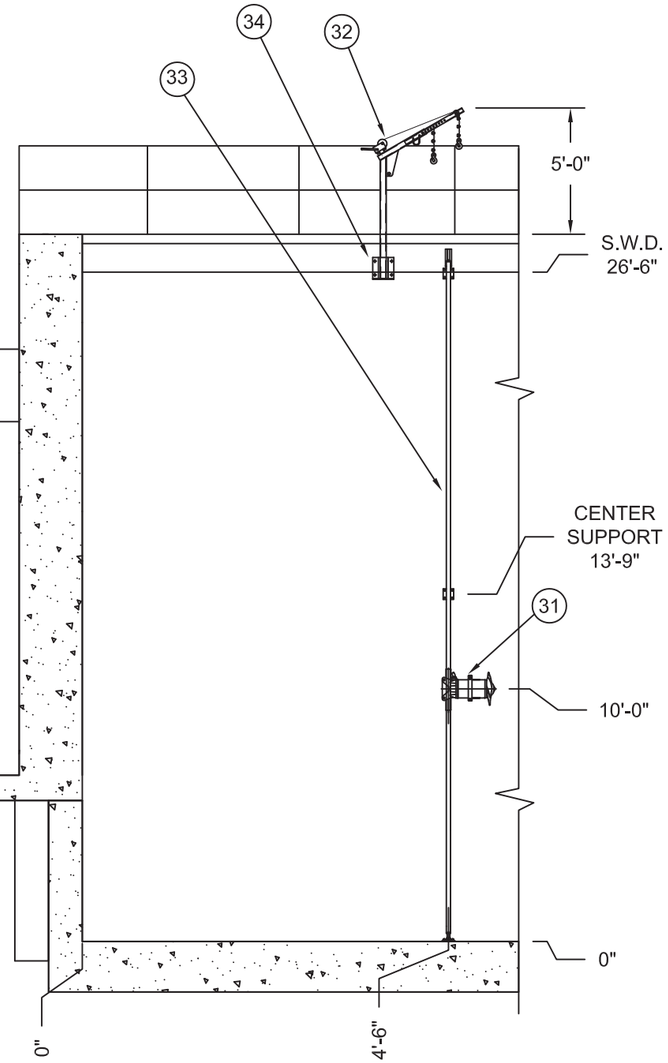
DETAIL H
AIR GRID DIFFUSER
& ANCHORING DETAIL
SCALE 1:6



DETAIL J
6" AIR GRID SUPPORT
& ANCHORING DETAIL
SCALE 1:6



SECTION B-B



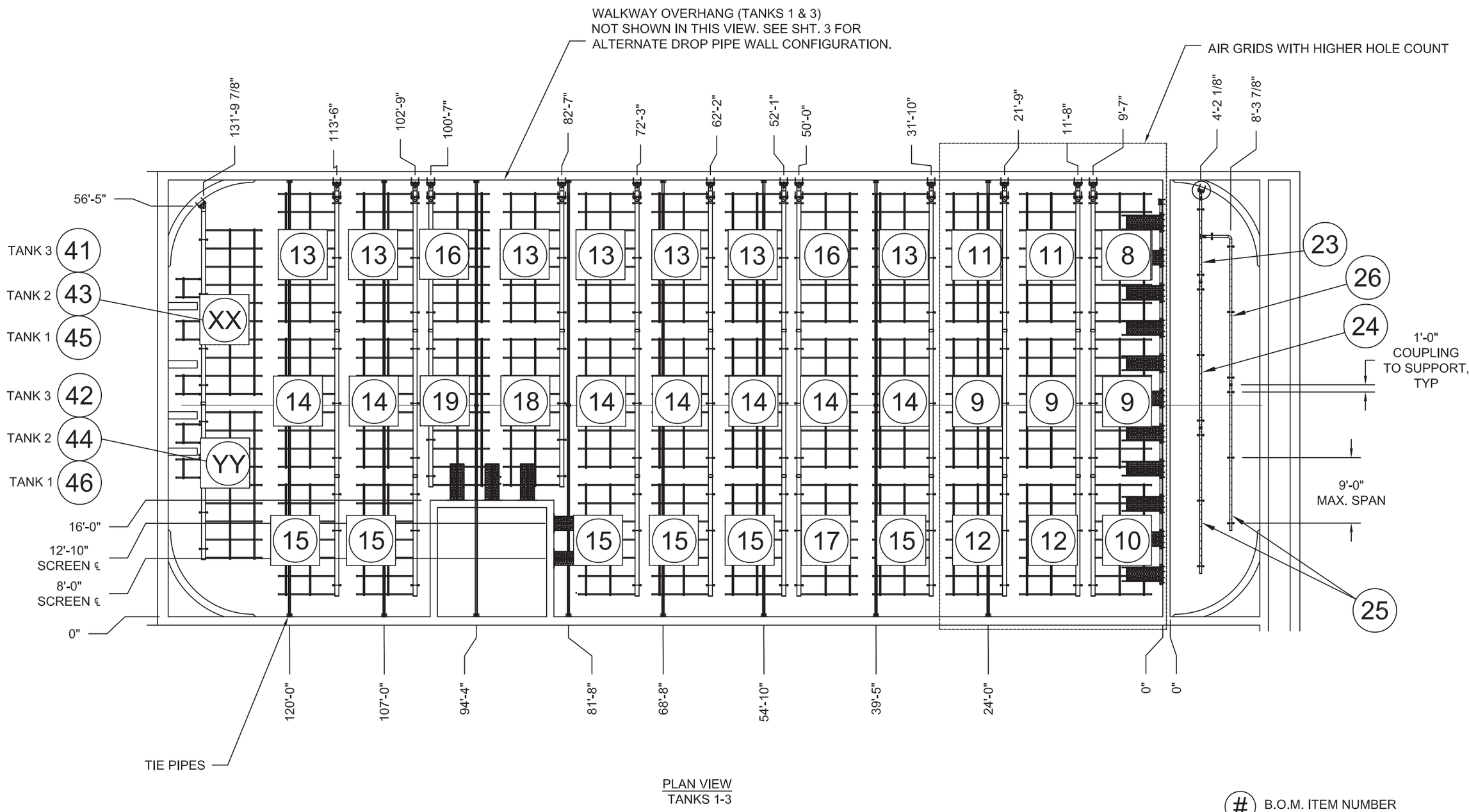
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PLAN VIEW
TANKS 1-3

(#) B.O.M. ITEM NUMBER

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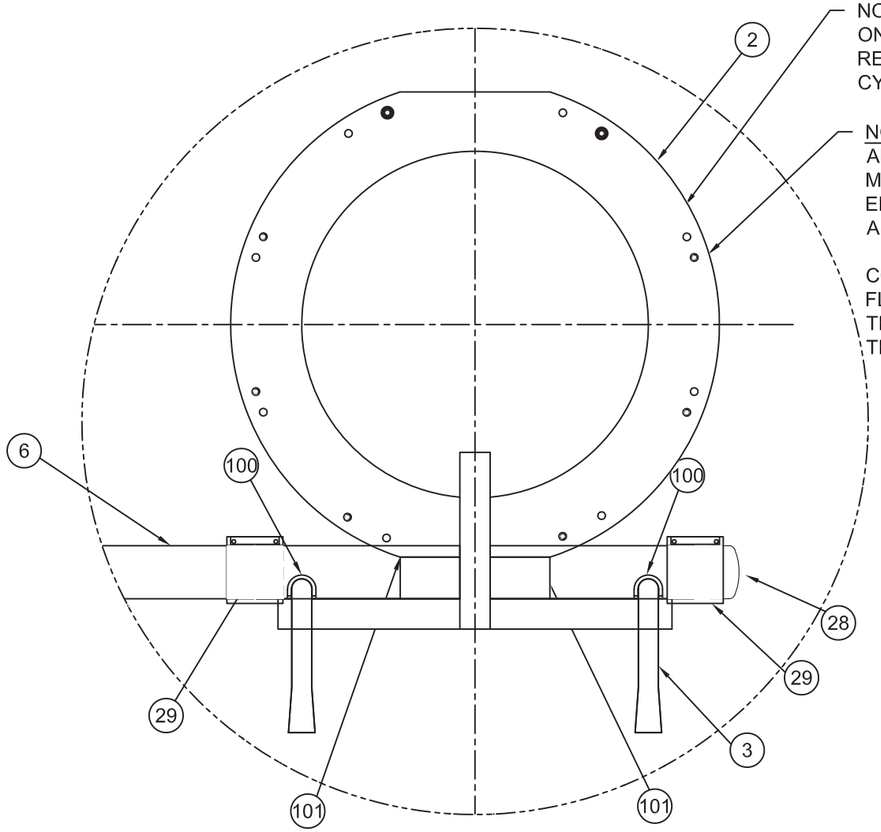
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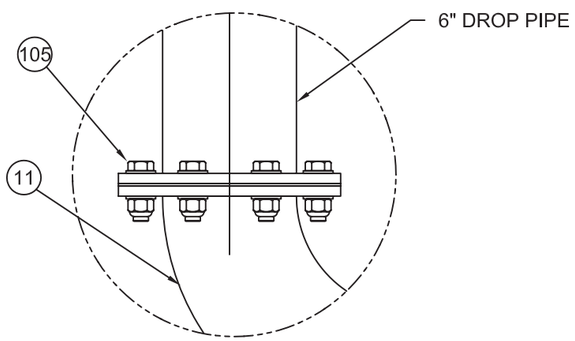
NOTE:
ONLY (8) ANCHORS ARE
REQUIRED TO SECURE EACH
CYLINDRICAL SCREEN.

NOTE:
ALL SCREENS ARE DESIGNED TO PREVENT
MEDIA MIGRATION. SCREENS TO BE INSTALLED FLUSH WITH ALL SURFACES TO
ENSURE NO GAPS GREATER THAN 3/32" BETWEEN THE SCREEN
AND THE WALL/FLOOR.

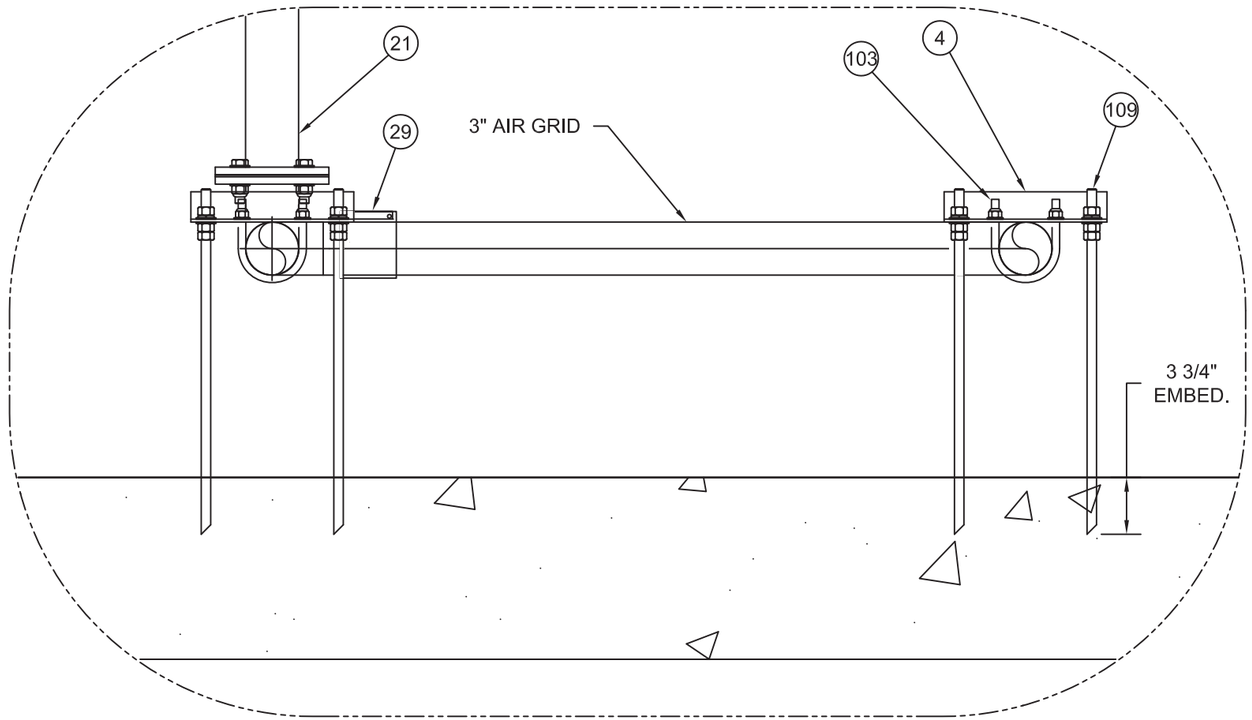
CONTRACTOR TO ENSURE CONCRETE SURFACE IS ADEQUATE FOR
FLUSH SCREEN MOUNTING. GAPS BEHIND CYLINDRICAL SCREENS SMALLER
THAN 1/4" MAY BE FILLED BY APPLYING A KRUGER APPROVED CAULK TO
THE FACE OF THE SCREEN FLANGE BEFORE MOUNTING.



DETAIL D
CYLINDRICAL SCREEN
& SPARGER DETAIL
SCALE 1:10



DETAIL F
6" FLANGE
CONNECTION DETAIL
SCALE 1:10



DETAIL G
3" AIR GRID SUPPORT
& ANCHORING DETAIL
SCALE 1:12

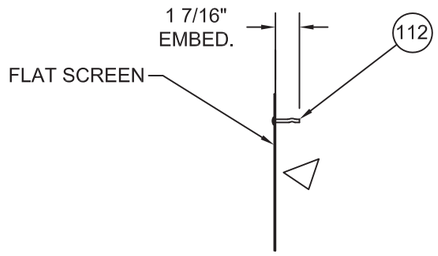
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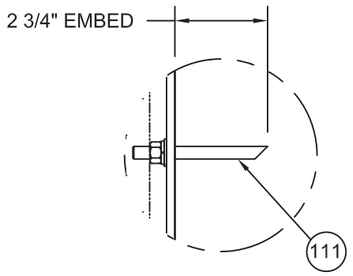
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ANOXKALDNES
DETAILS, MECHANICAL, PLAN
& SECTIONS

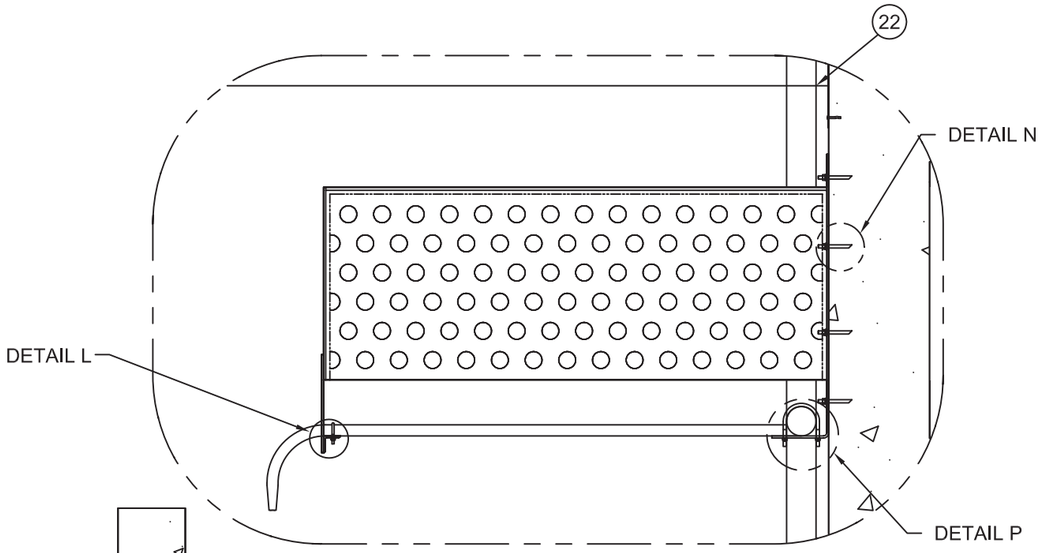
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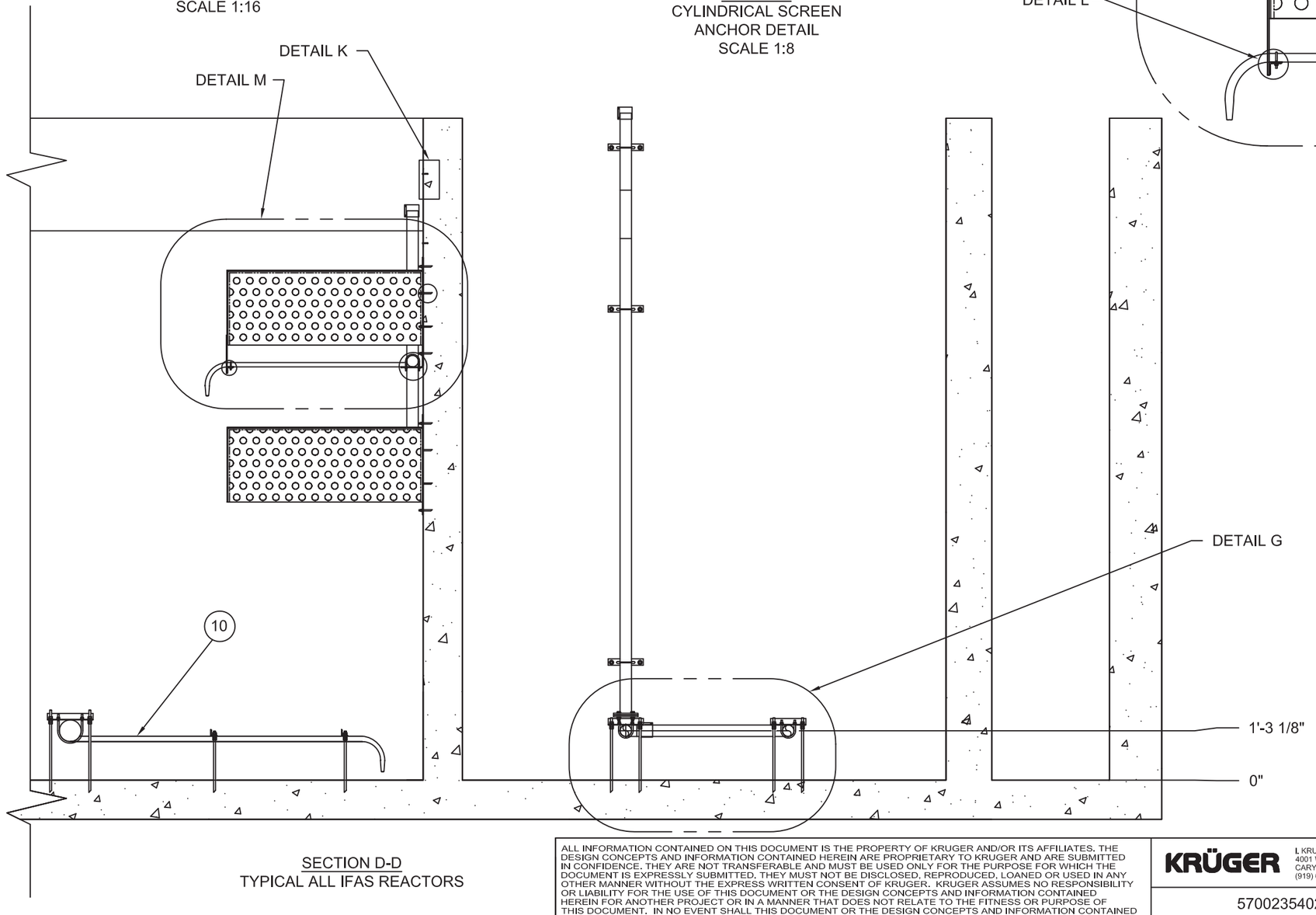
DETAIL K
FLAT SCREEN
CONNECTION DETAIL
SCALE 1:16



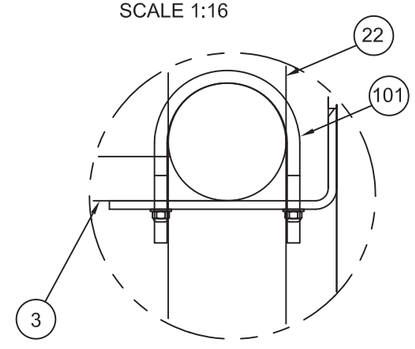
DETAIL N
CYLINDRICAL SCREEN
ANCHOR DETAIL
SCALE 1:8



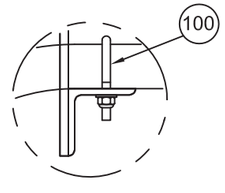
DETAIL M
CYLINDRICAL SCREEN
& SPARGER DETAIL
SCALE 1:16



SECTION D-D
TYPICAL ALL IFAS REACTORS



DETAIL P
SPARGER MANIFOLD
CONNECTION DETAIL
SCALE 1:8



DETAIL L
SPARGER DIFFUSER
CONNECTION DETAIL
SCALE 1:8

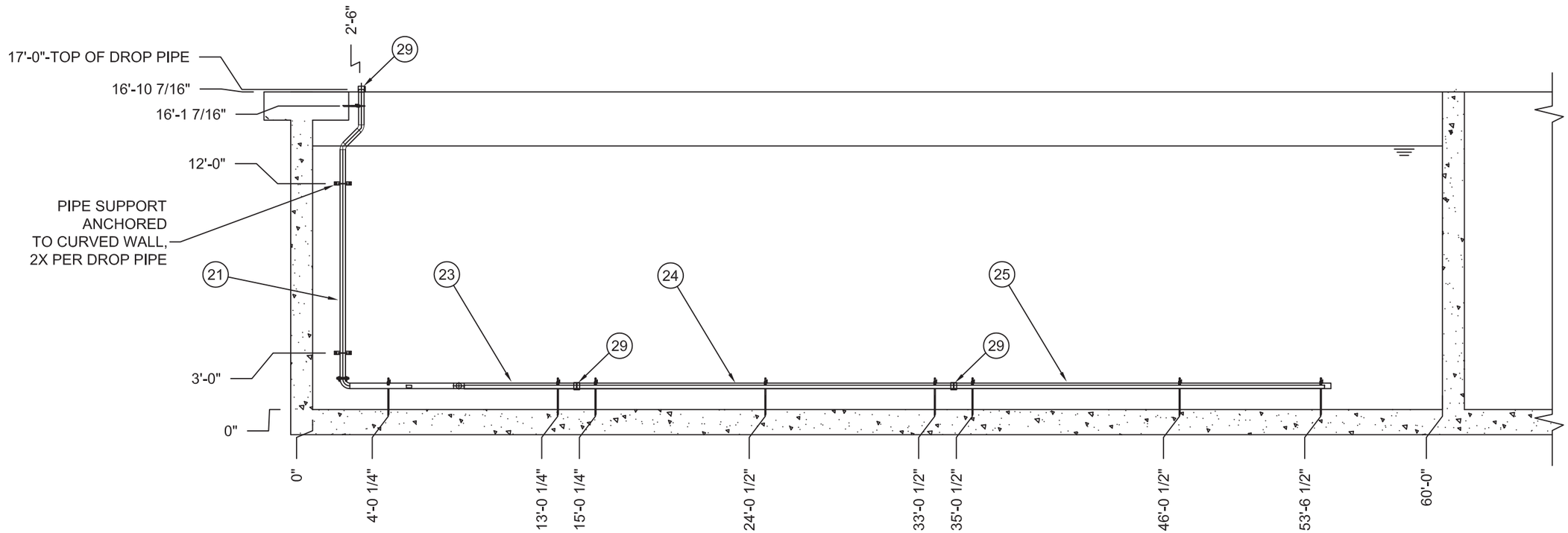
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SECTION C-C
TYPICAL ALL TANKS

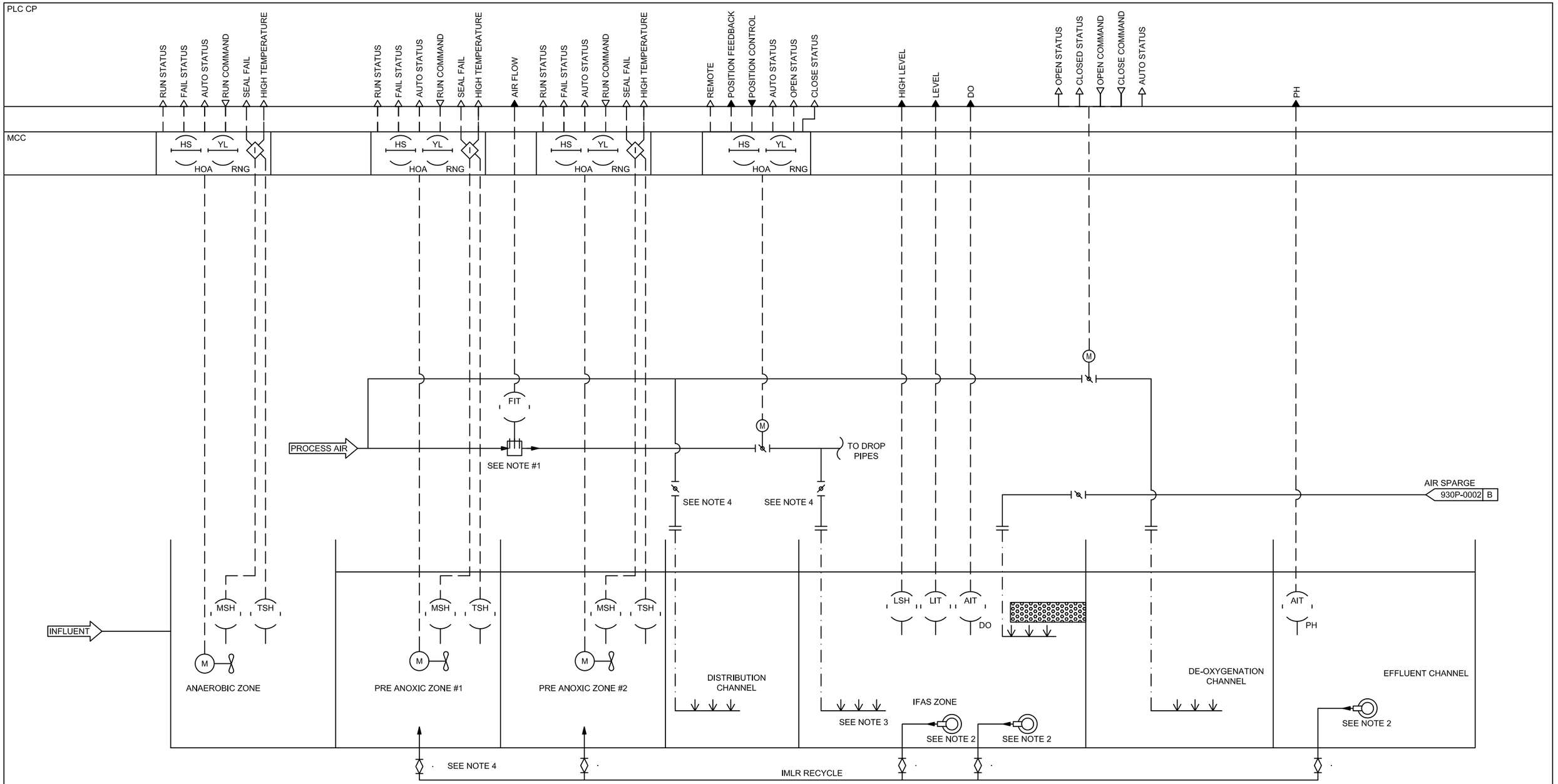
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4001 WESTON PARKWAY
CARY, NC 27513
(919) 677-8310

5700235402
MASSILLON, OH

ANOXKALDNES
DETAILS, MECHANICAL, PLAN
& SECTIONS

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
SRW	.	1 : 72	930M-0001	8 of 8	3



TYPICAL OF 3 TRAINS

NOTES:
1. RECOMMENDED STRAIGHT RUN OF AT LEAST 15 PIPE ID'S UPSTREAM OF AIR FLOW METERS AND 10 PIPE ID'S DOWNSTREAM.
2. IMLR PUMPS & VALVES BY OTHERS.
3. TYPICAL OF (13) DROP PIPES ALONG IFAS ZONE BASIN.
4. ALL MANUAL VALVES BY OTHERS.

REV	DESCRIPTION	DRAWN	APPR	DATE
2	REMOVED MOTOR FROM SPARGE VALVE	CDP	.	09.21.15
1	ADDED AUTO STATUS	CDP	.	06.09.15
0	PRELIMINARY RELEASE	CDP	.	03.18.15

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CARY, NC 27513
(919) 677-8310

5700235402
MASSILLON, OH

ANOXKALDNES
PIPING & INSTRUMENTATION DIAGRAM
TYPICAL REACTORS

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
JCC	.	1 : 2	930P-0001	1 of 1	2

PLC CP

BLOWER CONTROL PANELS

RUN STATUS
FAIL STATUS
AUTO STATUS
RUN COMMAND

HS
YL
XL
HOA
RNG

LCP

HS
YL
HOA
RNG

AIR SPARGE
930P-0001 B

M

SEE NOTE 1

BLOWER No. 1

BLOWER No. 2

NOTES:
1. VALVES BY OTHERS

REV	DESCRIPTION	DRAWN	APPR	DATE
0	PRELIMINARY RELEASE	CDP	.	03.18.15

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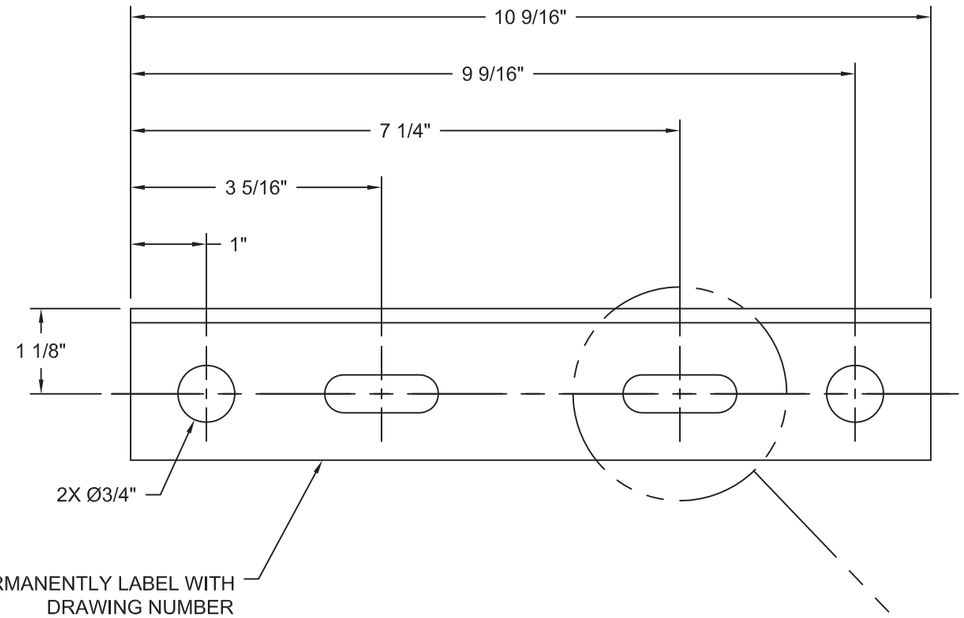
KRÜGER
I. KRUGER, INC.
4001 WESTON PARKWAY
CARY, NC 27513
(919) 677-8310

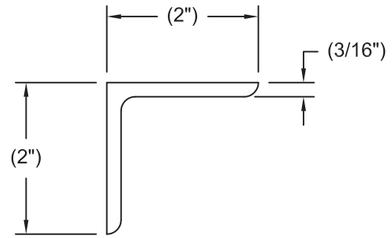
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MASSILLON, OH

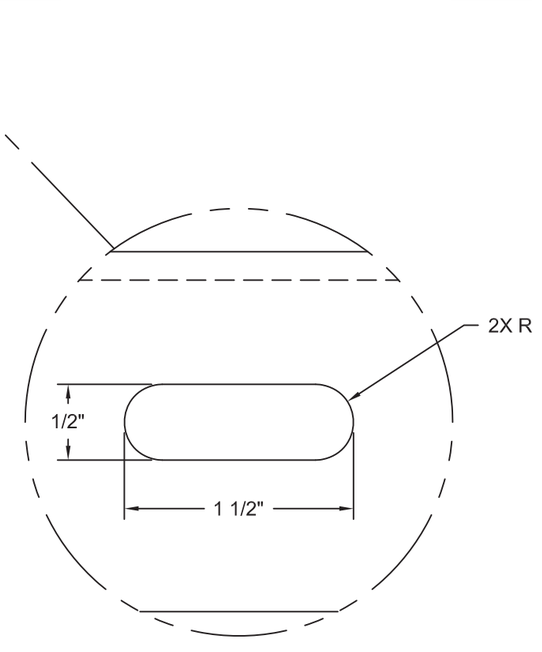
ANOXKALDNESS
PIPING & INSTRUMENTATION
AIR SPARGE BLOWER STATION

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
CDP		1 : 2	930P-0002	1 of 1	0

EST. WT.: 2 LBS
MAT'L: AISI 304







DETAIL A
SCALE 1:1
2X

REV	DESCRIPTION	DRAWN	APPR	DATE
1	REDUCED SLOT WIDTH FROM 1/2", LENGTH WAS 10 3/4"	SRW	.	08.22.13
0	RELEASED FOR FABRICATION	SRW	.	01.24.12

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401 HARRISON OAKS BLVD
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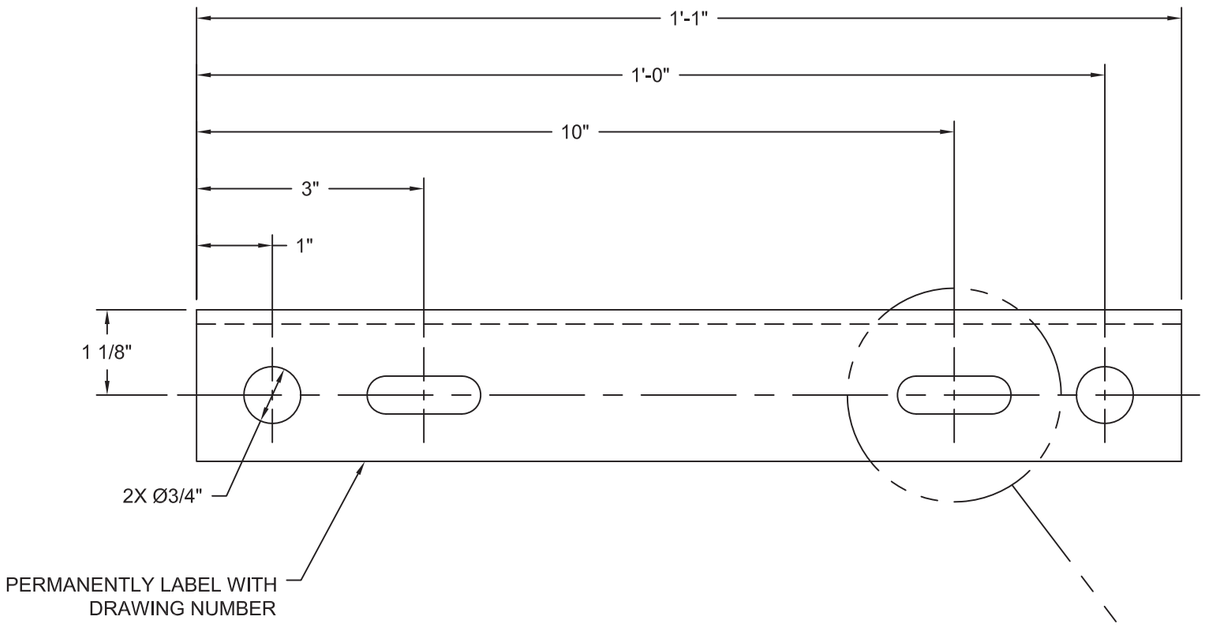
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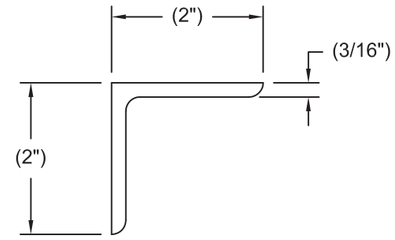
±1/8" ON LINEAR DIMENSIONS ,030 = ,X
±1/32" ON HOLE n AND LOCATIONS ,015 = ,XX
±1° ON ANGULAR DIMENSIONS ,005 = ,XXX
(X.XXX) = REFERENCE DIM
(X.XXX) = INSPECTION DIM
BREAK ALL SHARP EDGES

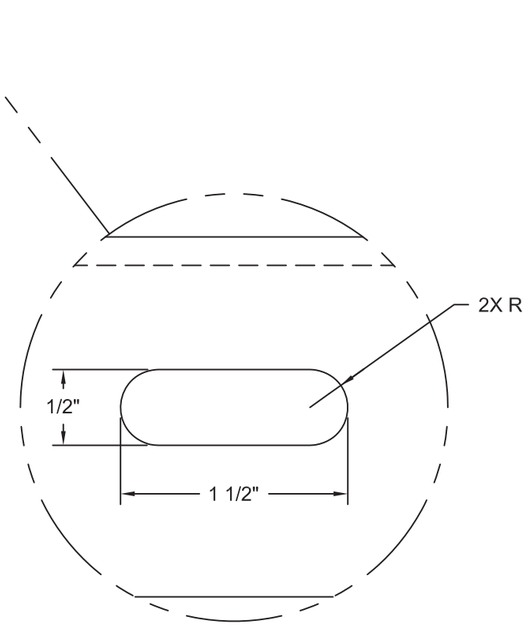
ANOXKALDNES
ANG, 3" PIPE SUPPORT,
2" X 2" X 3/16" X 10 9/16" LG.

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
SRW	.	1 : 2	930F-0701	1 of 1	1

EST. WT.: 3 LBS.
MAT'L: AISI 304







DETAIL A
SCALE 1:1
2X

REV	DESCRIPTION	DRAWN	APPR	DATE
2	DECREASED SLOT WIDTH TO 1/2"	SRW	.	07.22.13
1	UPDATED DESCRIPTION	SRW	.	10.30.12
0	RELEASED FOR FABRICATION	SRW	.	01.24.12

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CARY, NC 27513
(919) 677-8310

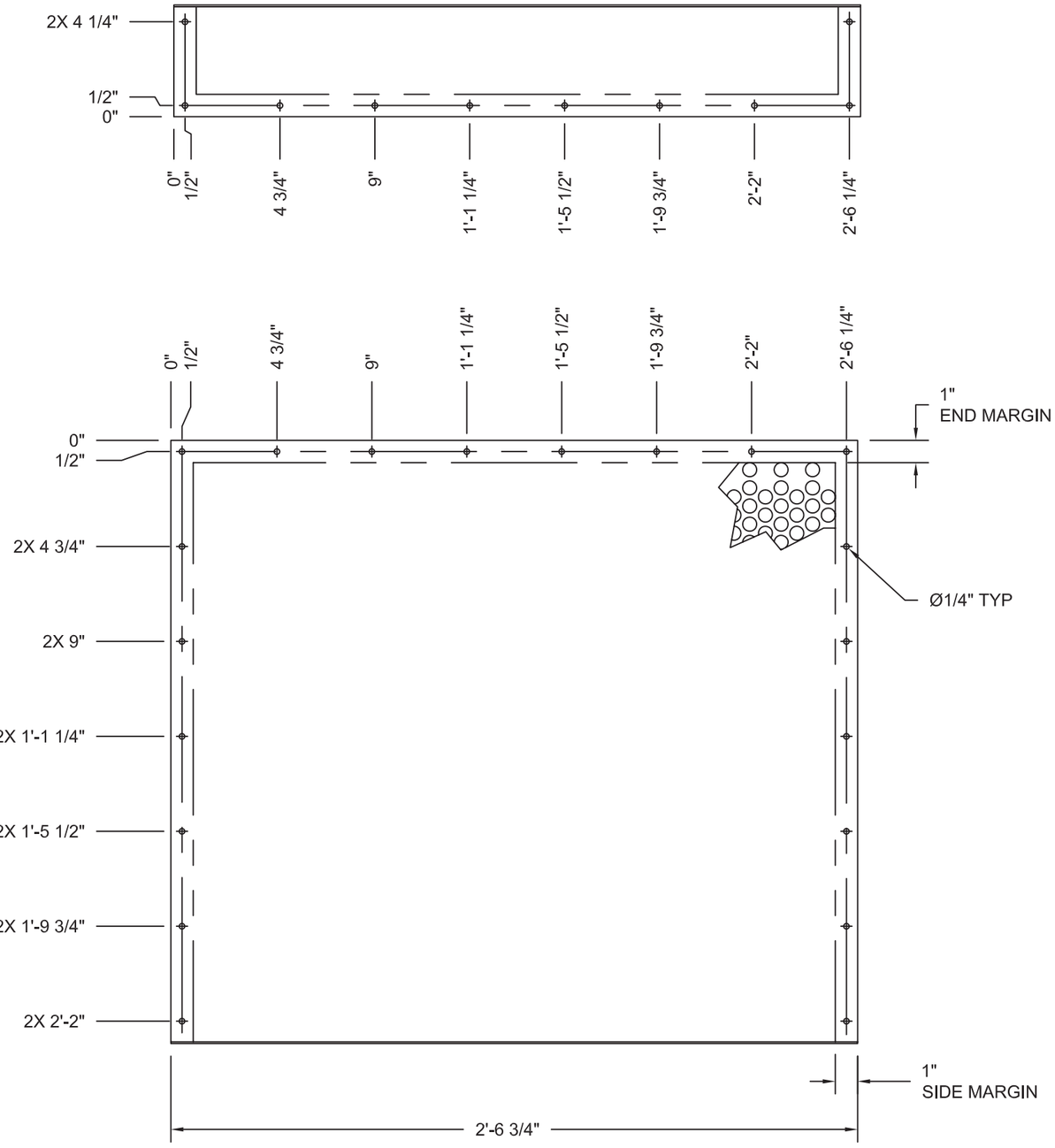
FABRICATION TOLERANCES AND NOTES

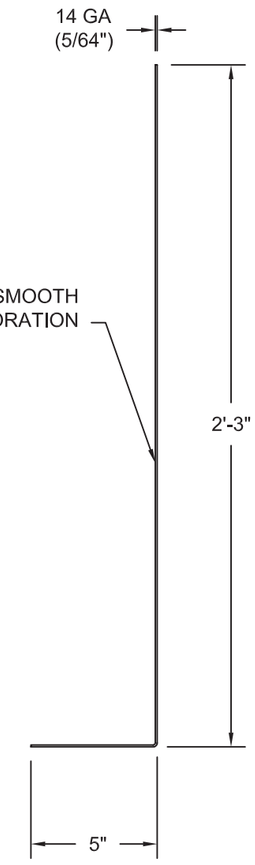
±1/8" ON LINEAR DIMENSIONS .030 = .X
±1/32" ON HOLE n AND LOCATIONS .015 = .XX
±1° ON ANGULAR DIMENSIONS .005 = .XXX
(X.XXX) = REFERENCE DIM
(X.XXX) = INSPECTION DIM
BREAK ALL SHARP EDGES

ANOXKALDNES
ANG, 6" PIPE SUPPORT, 2" X 2" X 3/16" X 13" LG.

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
SRW	.	1 : 2	930F-0703	1 of 1	2

EST. WT.: 10 LBS
MAT'L: AISI 304





REV	DESCRIPTION	DRAWN	APPR	DATE
1	LENGTHEN PART BY 2"	SRW	.	12.07.12
0	RELEASED FOR FABRICATION	LHB	SRW	11.13.12

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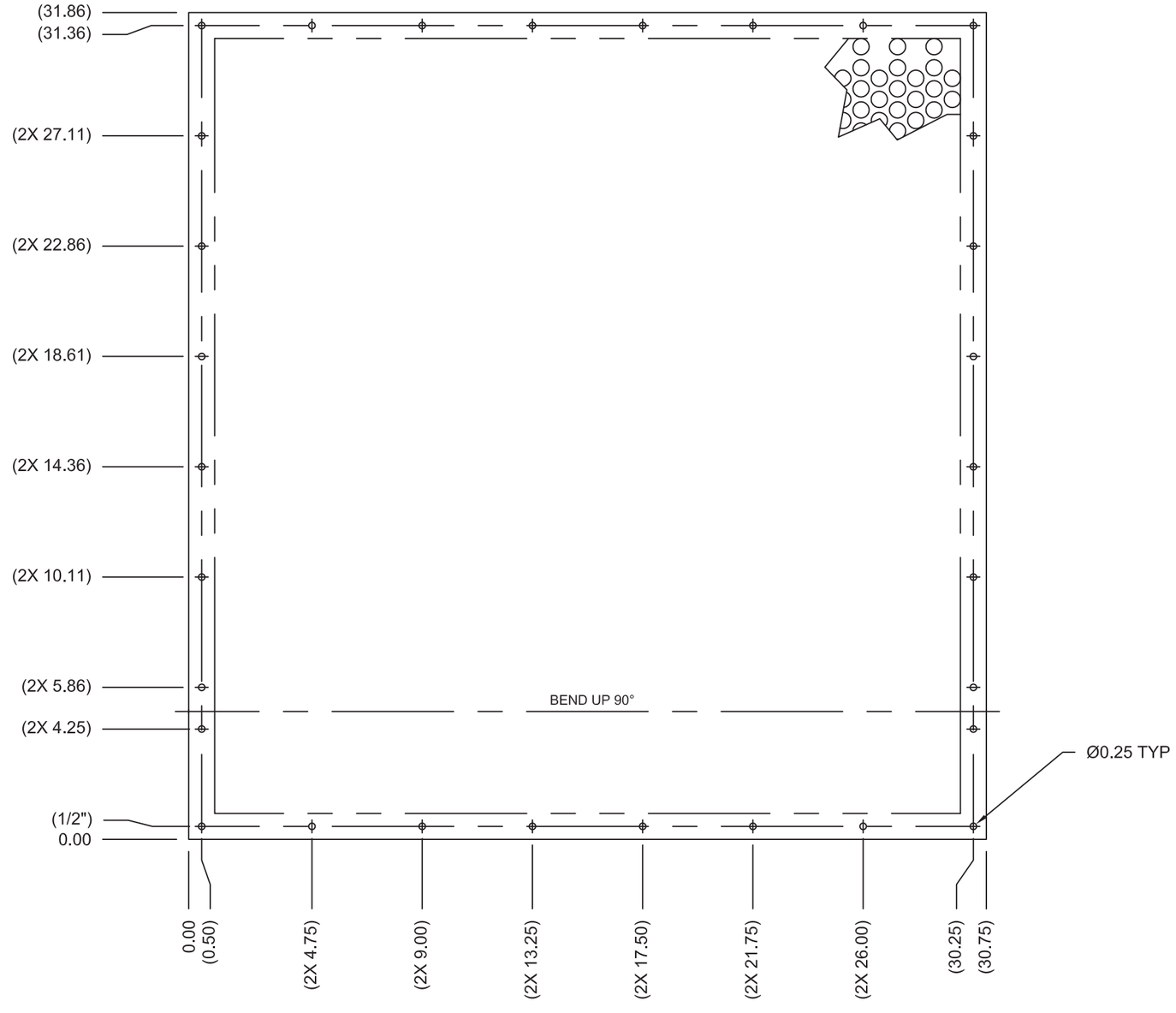
KRÜGER
I. KRUGER, INC.
401 HARRISON OAKS BLVD
CARY, NC 27513
(919) 677-8310

FABRICATION TOLERANCES AND NOTES

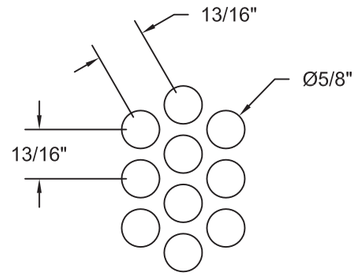
±1/8" ON LINEAR DIMENSIONS	.030 = .X
±1/32" ON HOLE Ø AND LOCATIONS	.015 = .XX
±1° ON ANGULAR DIMENSIONS	.005 = .XXX
(X.XXX) = REFERENCE DIM	
(X.XXX) = INSPECTION DIM	BREAK ALL SHARP EDGES

ANOXKALDNES
FLASHING, PERFORATED, 14 GA, 2'-6 3/4" X 2'-8" L-SHAPED, Ø5/8" HOLES, 13/16" CENTERS, STAGGERED

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
LHB	SRW	1 : 6	930F-0779	1 of 2	1



FLAT PATTERN



PERFORATION DETAIL
SCALE 1:2

NOTES:
1. CAD DRAWING OF FLAT PATTERNS AVAILABLE UPON REQUEST.
2. ALL FLAT PATTERN DIMENSIONS ARE FOR REFERENCE ONLY.
3. FLAT PATTERN BEND DEDUCTION (BD) - 0.078".

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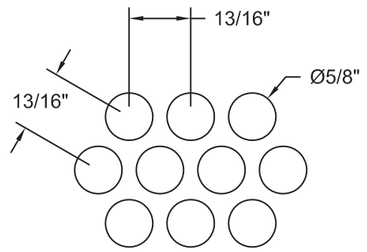
±1/8" ON LINEAR DIMENSIONS	.030 = .X
±1/32" ON HOLE Ø AND LOCATIONS	.015 = .XX
±1° ON ANGULAR DIMENSIONS	.005 = .XXX
(X.XXX) = REFERENCE DIM	
(X.XXX) = INSPECTION DIM	BREAK ALL SHARP EDGES

ANOXKALDNES
FLASHING, PERFORATED, 14 GA, 2'-6 3/4" X 2'-8" L-SHAPED, Ø5/8" HOLES, 13/16" CENTERS, STAGGERED

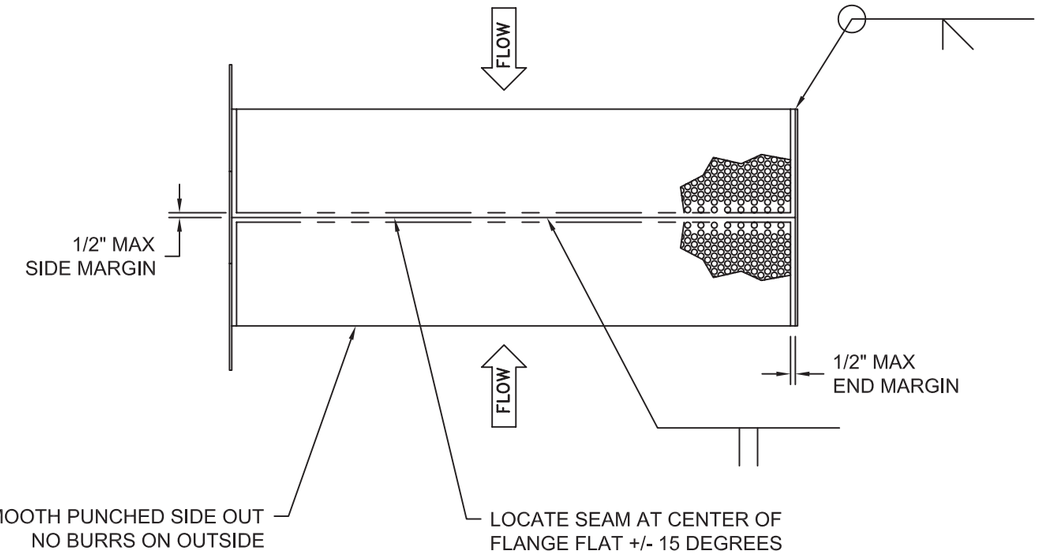
DRAWN	CHECKED		SCALE	DRAWING NO	SHEET	REV
LHB	SRW		1 : 5	930F-0779	2 of 2	1

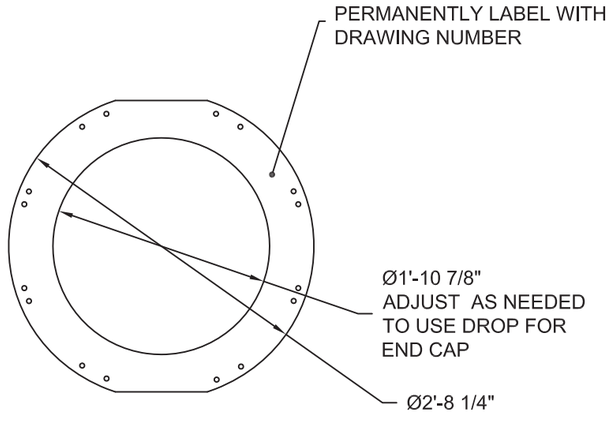
EST. WT.: 160 LBS.

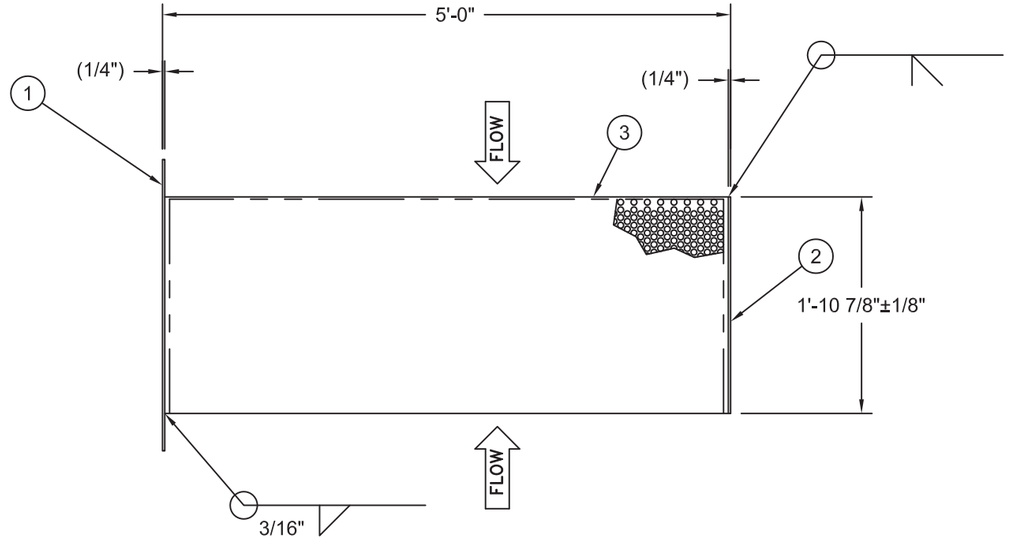
ITEM	QTY	MATERIAL	DRAWING NUMBER	DESCRIPTION
1	1	AISI 304L	-	PLATE, .25" X Ø32.25
2	1	AISI 304L	-	PLATE, .25" X Ø22.88"
3	1	AISI 304L	-	SHEET, 14 GA, 60.00" X 72.00"LG
4	1	18-8 SST	-	NUT, HEX, 1/2-13, AISI



PERFORATION DETAIL
IPA #130
SCALE 1:2







NOTES:
1. REFER TO KRUGER "WELDING FABRICATION PROCEDURE" FOR WELD SPECIFICATIONS.
2. REMOVE WELD SLAG, CLEAN AND DEGREASE BEFORE PASSIVATION OR PAINTING.
3. UNFINISHED END PATTERNS.

REV	DESCRIPTION	DRAWN	APPR	DATE
1	UPDATED DESIGN	DSD	SRW	04.29.14
0	RELEASE FOR FABRICATION	CHG	.	04.04.14

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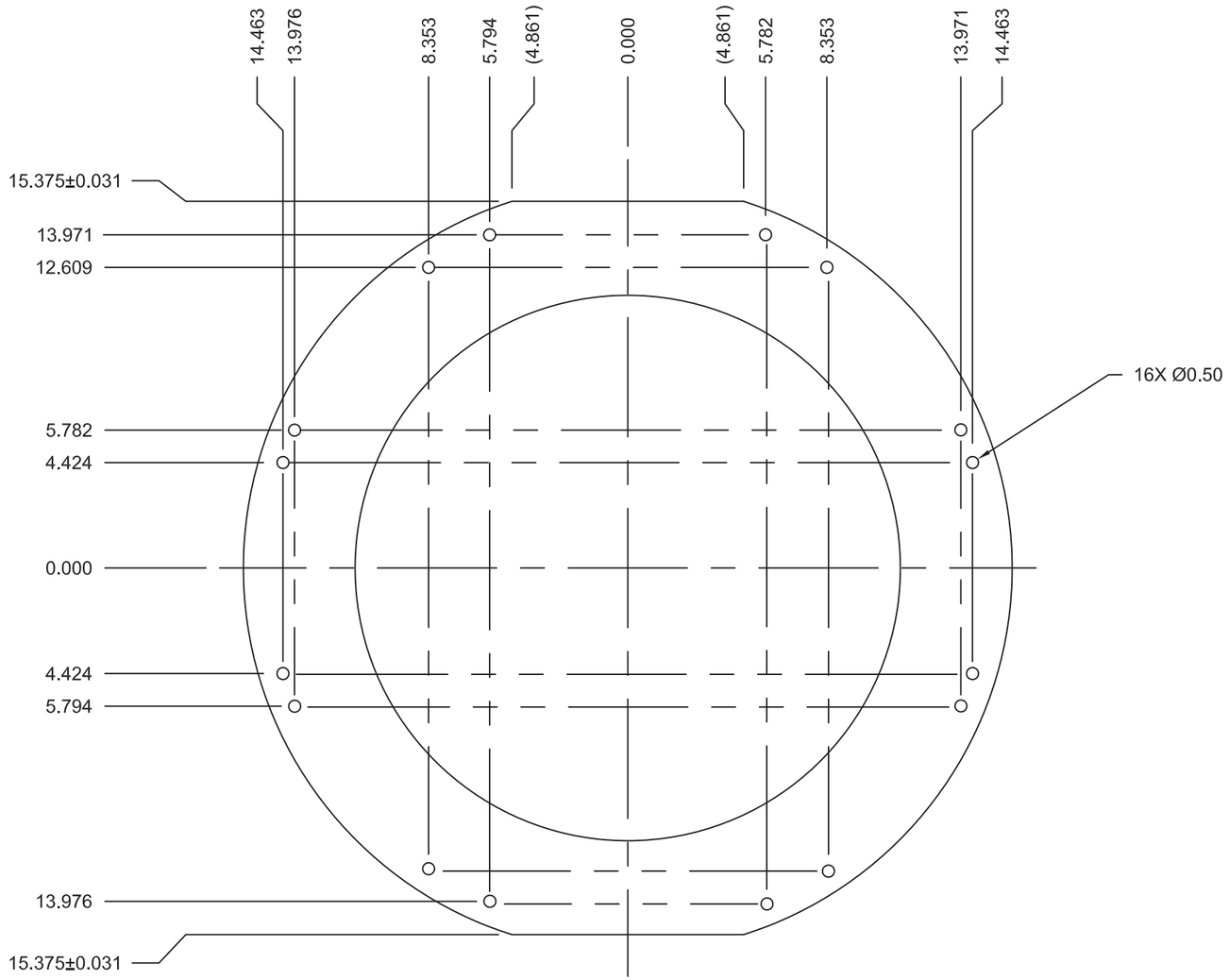
KRÜGER
I. KRUGER, INC.
401 HARRISON OAKS BLVD
CARY, NC 27513
(919) 677-8310

FABRICATION TOLERANCES AND NOTES

±1/8" ON LINEAR DIMENSIONS	.030 = .X
±1/32" ON HOLE n AND LOCATIONS	.015 = .XX
±1° ON ANGULAR DIMENSIONS	.005 = .XXX
(X.XXX) = REFERENCE DIM	
(X.XXX) = INSPECTION DIM	BREAK ALL SHARP EDGES

ANOXKALDNES
WLDMT, CYLINDRICAL SCREEN, PERF., Ø23", 5'-0"LG
Ø5/8" HOLE, 13/16" CTR, STAGGER, W/ FLG FLATS

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
CHG	.	1 : 16	930F-1050	1 of 2	1



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(919) 677-8310

FABRICATION TOLERANCES AND NOTES

±1/8" ON LINEAR DIMENSIONS	.030 = .X
±1/32" ON HOLE Ø AND LOCATIONS	.015 = .XX
±1° ON ANGULAR DIMENSIONS	.005 = .XXX
(X.XXX) = REFERENCE DIM	
(X.XXX) = INSPECTION DIM	BREAK ALL SHARP EDGES

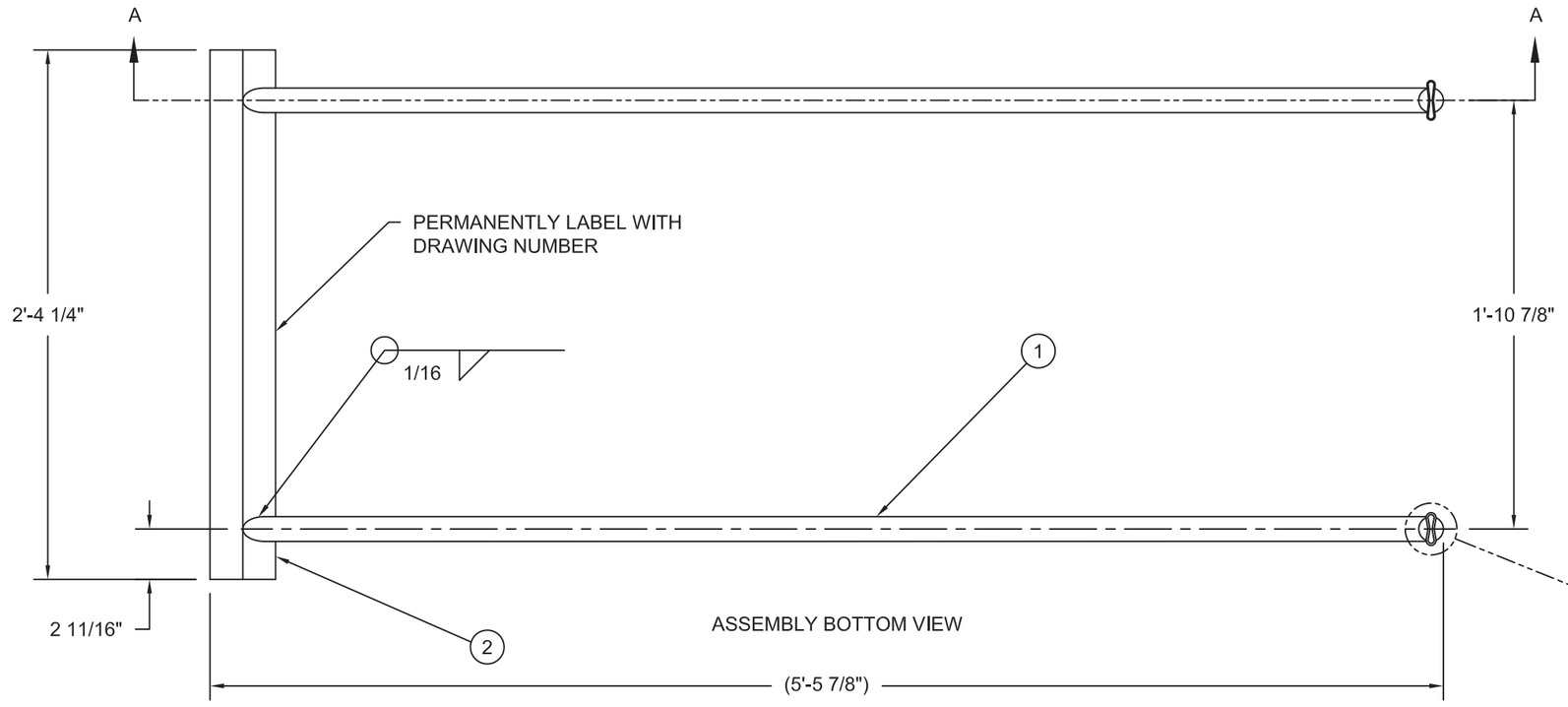
ANOXKALDNES
WLDMT, CYLINDRICAL SCREEN, PERF., Ø23", 5'-0"LG
Ø5/8" HOLE, 13/16" CTR, STAGGER, W/ FLG FLATS

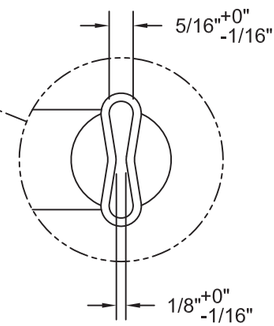
DRAWN	CHECKED		SCALE	DRAWING NO	SHEET	REV
CHG	SRW		1 : 6	930F-1050	2 of 2	1

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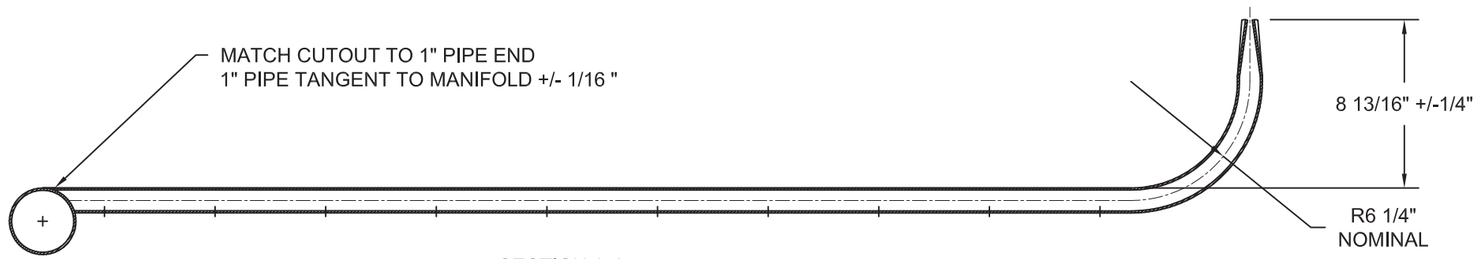
EST. WT.: 17 LBS

ITEM	QTY	MATERIAL	DRAWING NUMBER	DESCRIPTION
1	2	AISI 304L	-	PIPE, 1", SCH 10, 70.00"LG
2	1	AISI 304L	-	PIPE, 3", SCH 10, 28.25" LG

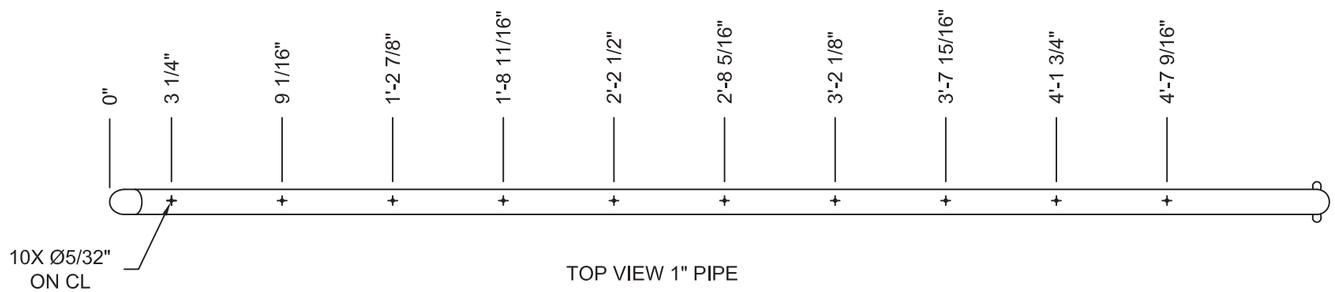




TYPICAL PIPE CRIMP
DETAIL
SCALE 1:2



SECTION A-A



TOP VIEW 1" PIPE

NOTES:
1. REFER TO KRUGER "WELDING FABRICATION PROCEDURE" FOR WELD SPECIFICATIONS.
2. REMOVE WELD SLAG, CLEAN AND DEGREASE BEFORE PASSIVATION OR PAINTING.

REV	DESCRIPTION	DRAWN	APPR	DATE
1	ADDED LABEL NOTE AND CHANGED DETAIL SCALE	LHB	SRW	05.12.15
0	RELEASE FOR FABRICATION	CDP	.	01.21.15

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CARY, NC 27513
(919) 677-8310

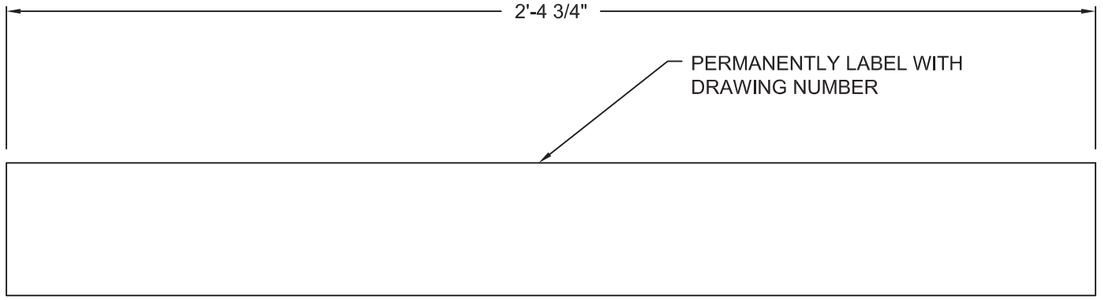
FABRICATION TOLERANCES AND NOTES

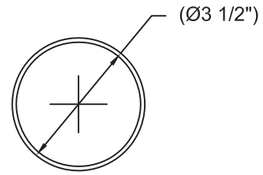
±1/8" ON LINEAR DIMENSIONS .030 = .X
±1/32" ON HOLE Ø AND LOCATIONS .015 = .XX
±1° ON ANGULAR DIMENSIONS .005 = .XXX
(X.XXX) = REFERENCE DIM
(X.XXX) = INSPECTION DIM
BREAK ALL SHARP EDGES

ANOXKALDNES
WLDMT, SPARGER, Ø23" X 5'-0"LG CYL SCREEN,
Ø3" MANIFOLD, WITH TURN DOWN

DRAWN	CHECKED		SCALE	DRAWING NO	SHEET	REV
CDP			1 : 8	930F-1207	1 of 1	1

EST. WT.: 10 LBS.
MAT'L: AISI 304





REV	DESCRIPTION	DRAWN	APPR	DATE
0	RELEASED FOR FABRICATION	CDP	.	01.21.15

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FABRICATION TOLERANCES AND NOTES

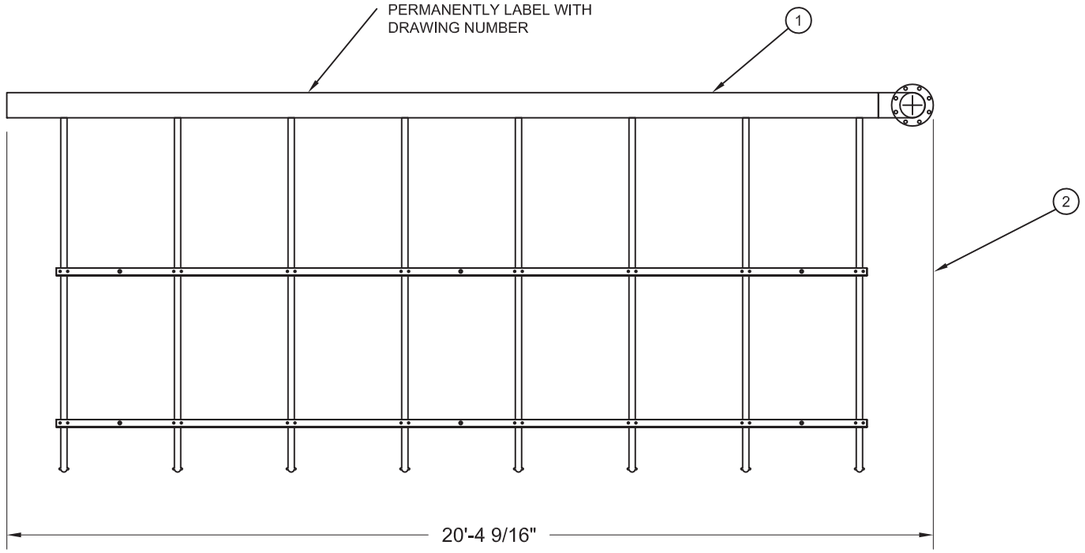
±1/8" ON LINEAR DIMENSIONS	.030 = .X
±1/32" ON HOLE Ø AND LOCATIONS	.015 = .XX
±1° ON ANGULAR DIMENSIONS	.005 = .XXX
(X.XXX) = REFERENCE DIM	
(X.XXX) = INSPECTION DIM	BREAK ALL SHARP EDGES

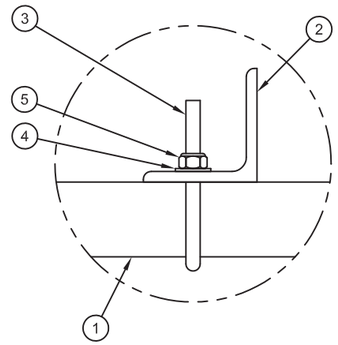
ANOXKALDNES
PIPE, 3", SCH10, 2'-4 3/4"LG
.

DRAWN	CHECKED		SCALE	DRAWING NO	SHEET	REV
CDP	.		1 : 4	930F-1208	1 of 1	0

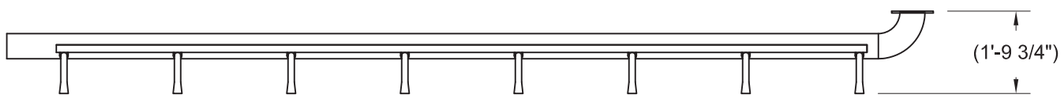
EST. WT.: 392 LBS.

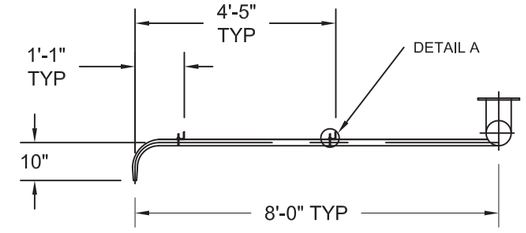
ITEM	QTY	SUPPLY	MATERIAL	DRAWING NUMBER	DESCRIPTION
1	1	-	SEE BOM	930F-1304	WLDMT, AERATION GRID, 6", (8) 1-1/4" HALF LATERALS @ 30 O.C., 8'-0" W, 248 HOLES, VERT FLG INLET, OPEN OUTLET, RH
2	2	-	AISI 304L	930F-1305	AERATION GRID SUPPORT ANGLE, 2" X 2" X 3/16" X 17'-10" LG, (8) 1-1/4" LATERALS @ 30" O.C.
3	16	-	AISI 304	-	U-BOLT, 1 1/4", 1/4-20, DALE Co. #U35 OR EQUIV, W/O NUTS
4	32	-	AISI 304	-	WSHR, FLAT, 1/4", .313" ID, .625" OD, .051" THK, SAE
5	32	-	AISI 304	-	NUT, HEX, NYLOCK, 1/4-20, ANSI





DETAIL A
AERATION GRID WELDMENT TO
SUPPORT ANGLE CONNECTION
SCALE 1:2





NOTES:
1. CLEAN AND DEGREASE PARTS BEFORE ASSEMBLY.
2. ANTI-SEIZE TO BE APPLIED TO ALL HDWR UNLESS OTHERWISE SPECIFIED.
3. ALL HDWR TO BE TIGHTENED TO APPROPRIATE TORQUE VALUES.

REV	DESCRIPTION	DRAWN	APPR	DATE
2	ADJUSTED FLANGE & HOLE COUNT WAS 288	CDP	.	08.25.15
1	DESCRIPTION WAS 320 HOLES, ADJUSTED DOWNTURN	CDP	.	06.01.15
0	RELEASED FOR FABRICATION	DSD	CDP	01.19.15

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FABRICATION TOLERANCES AND NOTES

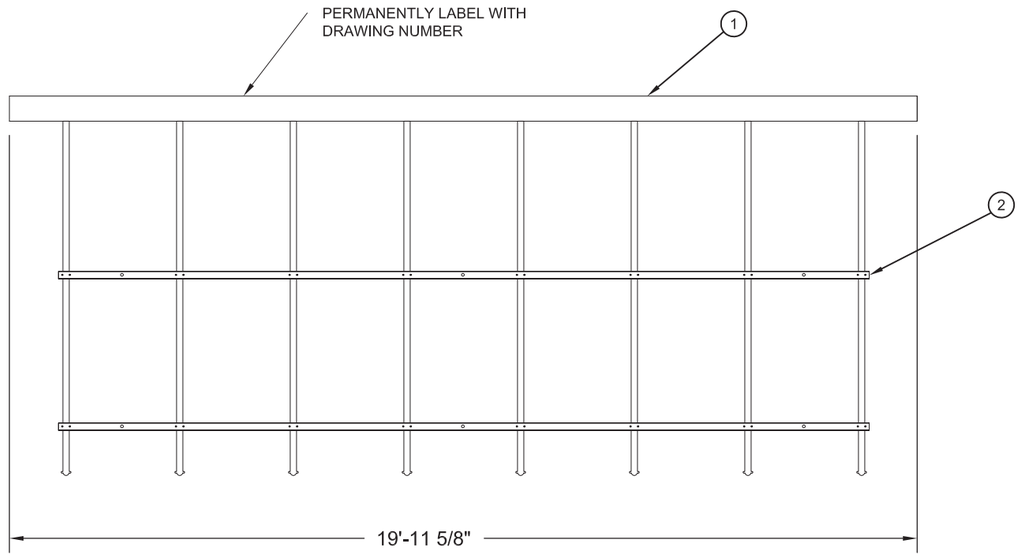
±1/8" ON LINEAR DIMENSIONS	.030 = .X
±1/32" ON HOLE Ø AND LOCATIONS	.015 = .XX
±1° ON ANGULAR DIMENSIONS	.005 = .XXX
(X.XXX) = REFERENCE DIM	
(X.XXX) = INSPECTION DIM	BREAK ALL SHARP EDGES

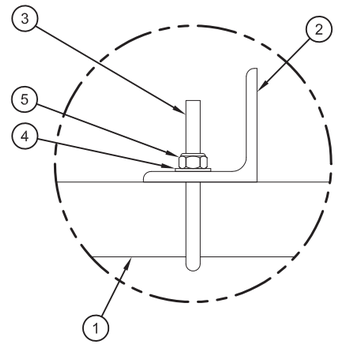
ANOXKALDNES
ASSY, AERATION GRID, 6", (8) 1-1/4" LATS @ 30" O.C.,
8'-0" W, 248 HOLES, VERT FLG INLET, OPEN OUTLET, RH

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
DSD	.	1 : 40	930F-1209	1 of 1	2

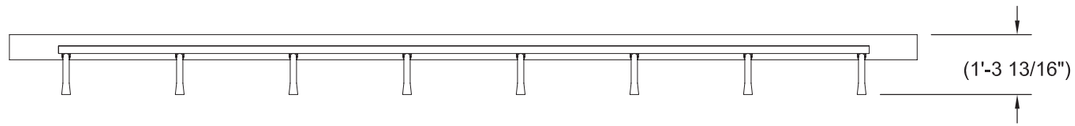
EST. WT.: 367 LBS.

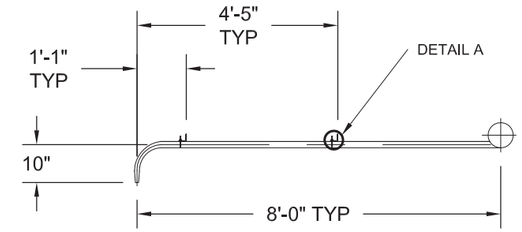
ITEM	QTY	SUPPLY	MATERIAL	DRAWING NUMBER	DESCRIPTION
1	1	-	SEE BOM	930F-1306	WLDMT, AERATION GRID, 6", (8) 1-1/4" HALF LATERALS @ 30 O.C., 8'-0" W, 248 HOLES, OPEN INLET, OPEN OUTLET, RH
2	2	-	AISI 304L	930F-1305	AERATION GRID SUPPORT ANGLE, 2" X 2" X 3/16" X 17'-10" LG, (8) 1-1/4" LATERALS @ 30" O.C.
3	16	-	AISI 304	-	U-BOLT, 1 1/4", 1/4-20, DALE Co. #U35 OR EQUIV, W/O NUTS
4	32	-	AISI 304	-	WSHR, FLAT, 1/4", .313" ID, .625" OD, .051" THK, SAE
5	32	-	AISI 304	-	NUT, HEX, NYLOCK, 1/4-20, ANSI





DETAIL A
AERATION GRID WELDMENT TO
SUPPORT ANGLE CONNECTION
SCALE 1:2





NOTES:
1. CLEAN AND DEGREASE PARTS BEFORE ASSEMBLY.
2. ANTI-SEIZE TO BE APPLIED TO ALL HDWR UNLESS OTHERWISE SPECIFIED.
3. ALL HDWR TO BE TIGHTENED TO APPROPRIATE TORQUE VALUES.

REV	DESCRIPTION	DRAWN	APPR	DATE
2	RE-DIMENSIONED, HOLE COUNT WAS 288	CDP	.	08.25.15
1	DESCRIPTION WAS 320 HOLES, ADJUSTED DOWNTURN	CDP	.	06.01.15
0	RELEASED FOR FABRICATION	DSD	CDP	01.19.15

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L KRUGER, INC.
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FABRICATION TOLERANCES AND NOTES

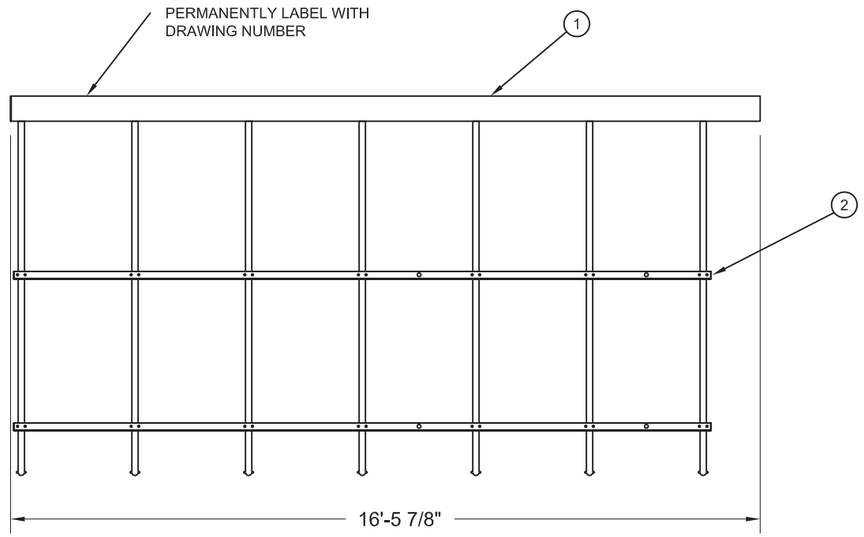
±1/8" ON LINEAR DIMENSIONS .030 = .X
±1/32" ON HOLE Ø AND LOCATIONS .015 = .XX
±1° ON ANGULAR DIMENSIONS .005 = .XXX
(X.XXX) = REFERENCE DIM
(X.XXX) = INSPECTION DIM
BREAK ALL SHARP EDGES

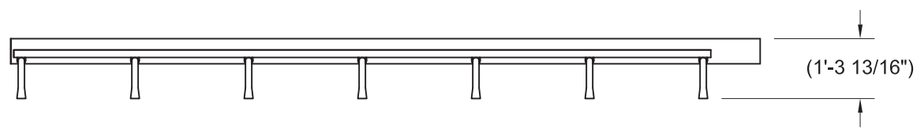
ANOXKALDNES
ASSY, AERATION GRID, 6", (8) 1-1/4" LATS @ 30" O.C., 8'-0" W, 248 HOLES, OPEN INLET, OPEN OUTLET, RH

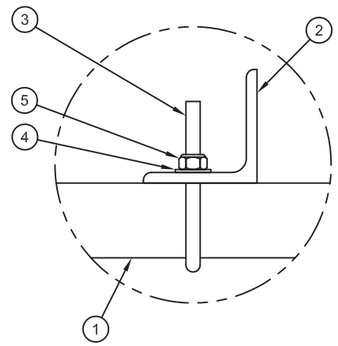
DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
DSD	.	1 : 40	930F-1210	1 of 1	2

EST. WT.: 313 LBS.

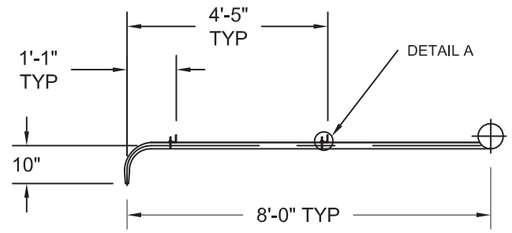
ITEM	QTY	SUPPLY	MATERIAL	DRAWING NUMBER	DESCRIPTION
1	1	-	SEE BOM	930F-1307	WLDMT, AERATION GRID, 6", (7) 1-1/4" HALF LATERALS @ 30 O.C., 8'-0" W, 217 HOLES, OPEN INLET, CAPPED OUTLET, RH
2	2	-	AISI 304L	930F-1308	AERATION GRID SUPPORT ANGLE, 2" X 2" X 3/16" X 15'-4" LG, (7) 1-1/4" LATERALS @ 30" O.C.
3	14	-	AISI 304	-	U-BOLT, 1 1/4", 1/4-20, DALE Co. #U35 OR EQUIV, W/O NUTS
4	28	-	AISI 304	-	WSHR, FLAT, 1/4", .313" ID, .625" OD, .051" THK, SAE
5	28	-	AISI 304	-	NUT, HEX, NYLOCK, 1/4-20, ANSI







DETAIL A
AERATION GRID WELDMENT TO
SUPPORT ANGLE CONNECTION
SCALE 1:2



NOTES:
1. CLEAN AND DEGREASE PARTS BEFORE ASSEMBLY.
2. ANTI-SEIZE TO BE APPLIED TO ALL HDWR UNLESS OTHERWISE SPECIFIED.
3. ALL HDWR TO BE TIGHTENED TO APPROPRIATE TORQUE VALUES.

REV	DESCRIPTION	DRAWN	APPR	DATE
2	RE-DIMENSIONED, HOLE COUNT WAS 252	CDP	.	08.25.15
1	DESCRIPTION WAS 320 HOLES, ADJUSTED DOWNTURN	CDP	.	06.01.15
0	RELEASED FOR FABRICATION	DSD	CDP	01.19.15

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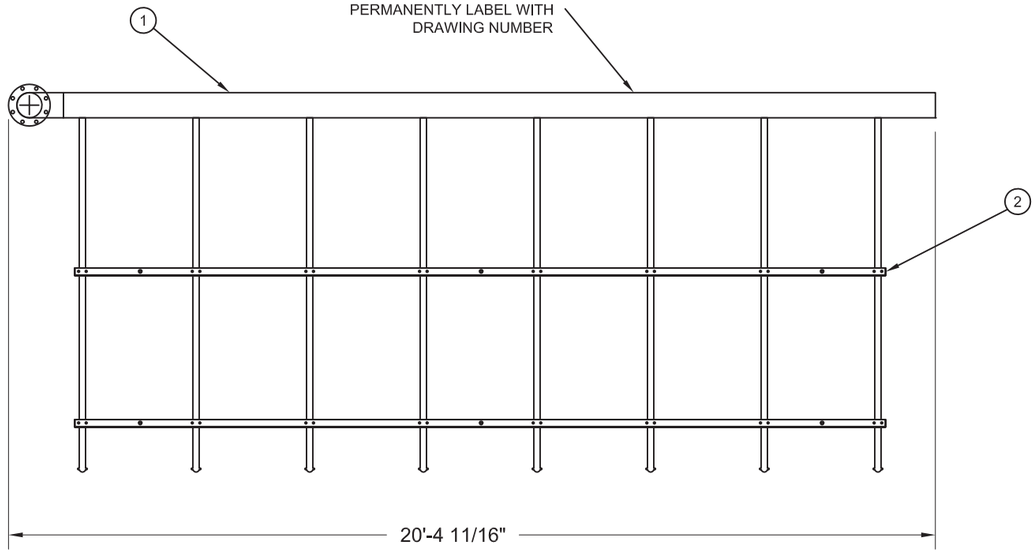
FABRICATION TOLERANCES AND NOTES
±1/8" ON LINEAR DIMENSIONS .030 = .X
±1/32" ON HOLE Ø AND LOCATIONS .015 = .XX
±1° ON ANGULAR DIMENSIONS .005 = .XXX
(X.XXX) = REFERENCE DIM
X.XXX = INSPECTION DIM
BREAK ALL SHARP EDGES

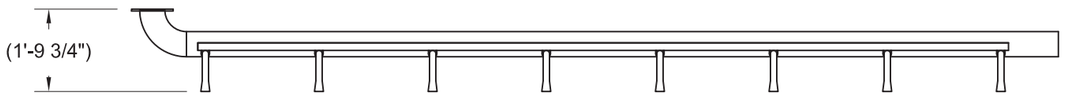
ANOXKALDNES
ASSY, AERATION GRID, 6", (7) 1-1/4" LATS @ 30" O.C., 8'-0" W, 217 HOLES, OPEN INLET, CAPPED OUTLET, RH

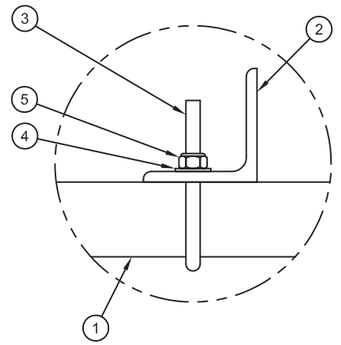
DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
DSD	.	1 : 40	930F-1211	1 of 1	2

EST. WT.: 392 LBS.

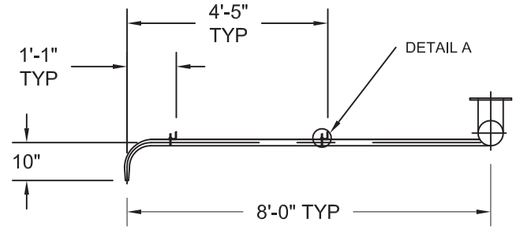
ITEM	QTY	SUPPLY	MATERIAL	DRAWING NUMBER	DESCRIPTION
1	1	-	SEE BOM	930F-1309	WLDMT, AERATION GRID, 6", (8) 1-1/4" HALF LATERALS @ 30 O.C., 8'-0" W, 248 HOLES, VERT FLG INLET, OPEN OUTLET
2	2	-	AISI 304L	930F-1305	AERATION GRID SUPPORT ANGLE, 2" X 2" X 3/16" X 17'-10" LG, (8) 1-1/4" LATERALS @ 30" O.C.
3	16	-	AISI 304	-	U-BOLT, 1 1/4", 1/4-20, DALE Co. #U35 OR EQUIV, W/O NUTS
4	32	-	AISI 304	-	WSHR, FLAT, 1/4", .313" ID, .625" OD, .051" THK, SAE
5	32	-	AISI 304	-	NUT, HEX, NYLOCK, 1/4-20, ANSI







DETAIL A
AERATION GRID WELDMENT TO
SUPPORT ANGLE CONNECTION
SCALE 1:2



NOTES:
1. CLEAN AND DEGREASE PARTS BEFORE ASSEMBLY.
2. ANTI-SEIZE TO BE APPLIED TO ALL HDWR UNLESS OTHERWISE SPECIFIED.
3. ALL HDWR TO BE TIGHTENED TO APPROPRIATE TORQUE VALUES.

REV	DESCRIPTION	DRAWN	APPR	DATE
2	ADJUSTED FLANGE, HOLE COUNT WAS 288	CDP	.	08.25.15
1	DESCRIPTION WAS 320 HOLES, ADJUSTED DOWNTURN	CDP	.	06.01.15
0	RELEASED FOR FABRICATION	DSD	.	01.19.15

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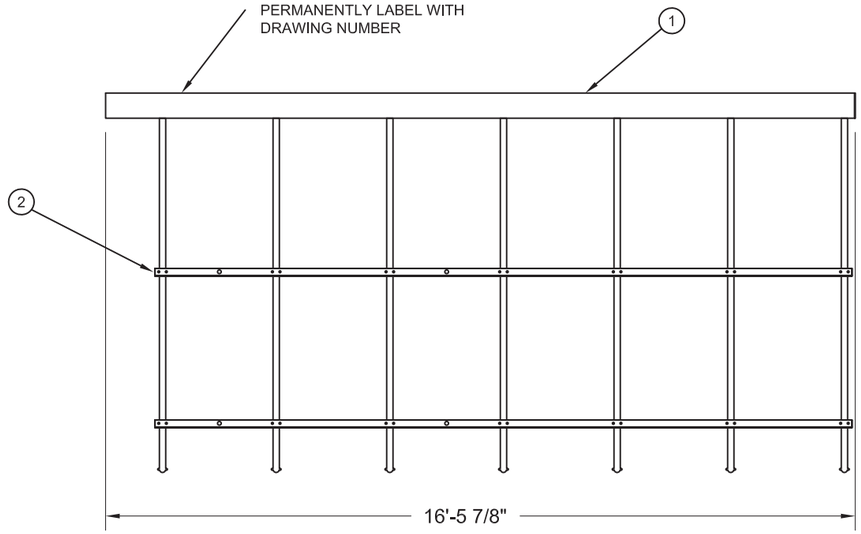
±1/8" ON LINEAR DIMENSIONS	.030 = .X
±1/32" ON HOLE Ø AND LOCATIONS	.015 = .XX
±1° ON ANGULAR DIMENSIONS	.005 = .XXX
(X.XXX) = REFERENCE DIM	
(X.XXX) = INSPECTION DIM	BREAK ALL SHARP EDGES

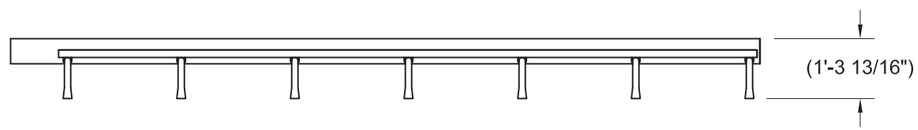
ANOXKALDNES
ASSY, AERATION GRID, 6", (8) 1-1/4" LATS @ 30" O.C.,
8'-0" W, 248 HOLES, VERT FLG INLET, OPEN OUTLET, LH

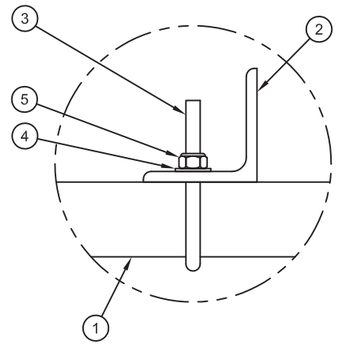
DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
DSD	.	1 : 40	930F-1212	1 of 1	2

EST. WT.: 314 LBS.

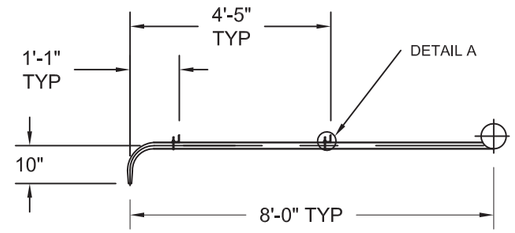
ITEM	QTY	SUPPLY	MATERIAL	DRAWING NUMBER	DESCRIPTION
1	1	-	SEE BOM	930F-1310	WLDMT, AERATION GRID, 6", (7) 1-1/4" HALF LATERALS @ 30 O.C., 8'-0" W, 217 HOLES, OPEN INLET, CAPPED OUTLET, LH
2	2	-	AISI 304L	930F-1308	AERATION GRID SUPPORT ANGLE, 2" X 2" X 3/16" X 15'-4" LG, (7) 1-1/4" LATERALS @ 30" O.C.
3	14	-	AISI 304	-	U-BOLT, 1 1/4", 1/4-20, DALE Co. #U35 OR EQUIV, W/O NUTS
4	28	-	AISI 304	-	WSHR, FLAT, 1/4", .313" ID, .625" OD, .051" THK, SAE
5	28	-	AISI 304	-	NUT, HEX, NYLOCK, 1/4-20, ANSI







DETAIL A
AERATION GRID WELDMENT TO
SUPPORT ANGLE CONNECTION
SCALE 1:2



NOTES:
1. CLEAN AND DEGREASE PARTS BEFORE ASSEMBLY.
2. ANTI-SEIZE TO BE APPLIED TO ALL HDWR UNLESS OTHERWISE SPECIFIED.
3. ALL HDWR TO BE TIGHTENED TO APPROPRIATE TORQUE VALUES.

REV	DESCRIPTION	DRAWN	APPR	DATE
2	RE-DIMENSIONED, HOLE COUNT WAS 255	CDP	.	08.25.15
1	DESCRIPTION WAS 280 HOLES, ADJUSTED DOWNTURN	CDP	.	06.01.15
0	RELEASED FOR FABRICATION	DSD	.	01.19.15

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KRÜGER
I. KRUGER, INC.
4001 WESTON PARKWAY
CARY, NC 27513
(919) 677-8310

FABRICATION TOLERANCES AND NOTES

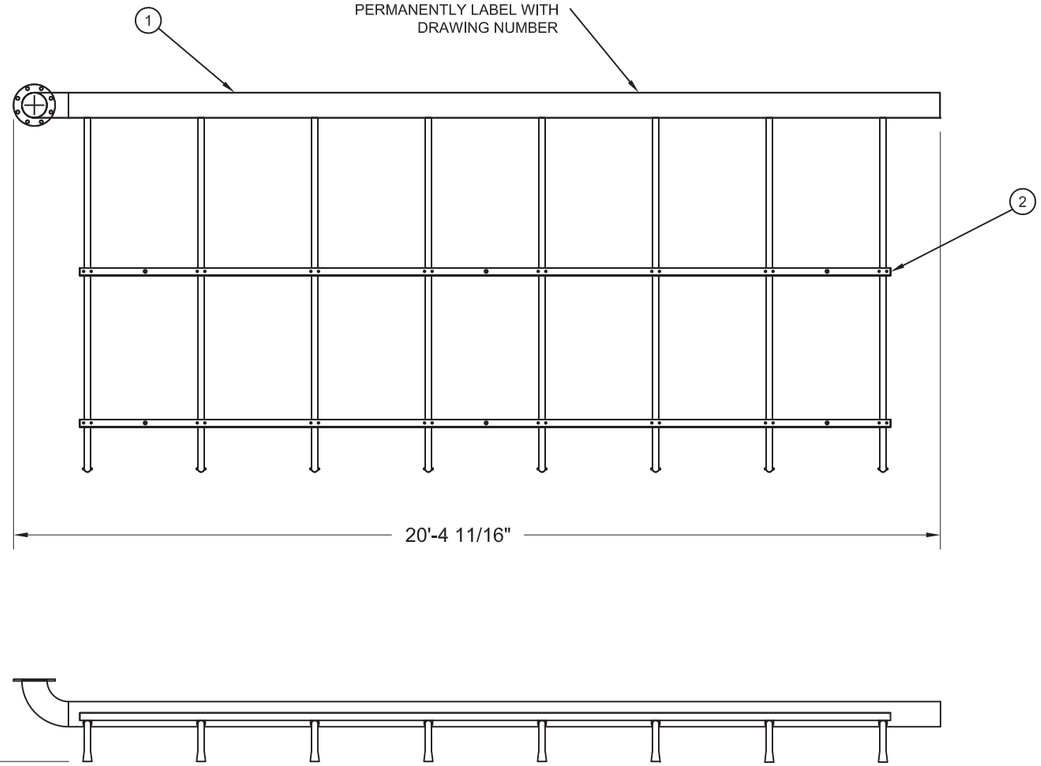
±1/8" ON LINEAR DIMENSIONS .030 = .X
±1/32" ON HOLE Ø AND LOCATIONS .015 = .XX
±1° ON ANGULAR DIMENSIONS .005 = .XXX
(X.XXX) = REFERENCE DIM
X.XXX = INSPECTION DIM
BREAK ALL SHARP EDGES

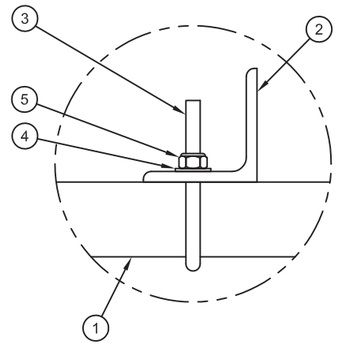
ANOXKALDNES
ASSY, AERATION GRID, 6", (7) 1-1/4" LATS @ 30" O.C., 8'-0" W, 217 HOLES, OPEN INLET, CAPPED OUTLET, LH

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
DSD	.	1 : 40	930F-1213	1 of 1	2

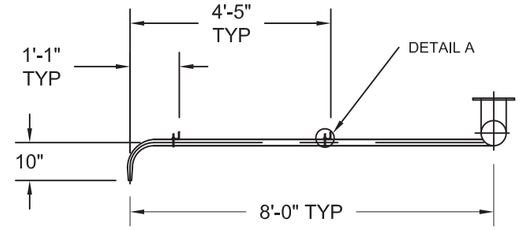
EST. WT.: 314 LBS.

ITEM	QTY	SUPPLY	MATERIAL	DRAWING NUMBER	DESCRIPTION
1	1	-	SEE BOM	930F-1311	WLDMT, AERATION GRID, 6", (8) 1-1/4" HALF LATERALS @ 30 O.C., 8'-0" W, 176 HOLES, VERT FLG INLET, OPEN OUTLET
2	2	-	AISI 304L	930F-1305	AERATION GRID SUPPORT ANGLE, 2" X 2" X 3/16" X 17'-10" LG, (8) 1-1/4" LATERALS @ 30" O.C.
3	16	-	AISI 304	-	U-BOLT, 1 1/4", 1/4-20, DALE Co. #U35 OR EQUIV, W/O NUTS
4	32	-	AISI 304	-	WSHR, FLAT, 1/4", .313" ID, .625" OD, .051" THK, SAE
5	32	-	AISI 304	-	NUT, HEX, NYLOCK, 1/4-20, ANSI





DETAIL A
AERATION GRID WELDMENT TO
SUPPORT ANGLE CONNECTION
SCALE 1:2



NOTES:
1. CLEAN AND DEGREASE PARTS BEFORE ASSEMBLY.
2. ANTI-SEIZE TO BE APPLIED TO ALL HDWR UNLESS OTHERWISE SPECIFIED.
3. ALL HDWR TO BE TIGHTENED TO APPROPRIATE TORQUE VALUES.

REV	DESCRIPTION	DRAWN	APPR	DATE
2	ADJUSTED FLANGE, HOLE COUNT WAS 232	CDP	.	08.25.15
1	DESCRIPTION WAS 256 HOLES, ADJUSTED DOWNTURN	CDP	.	06.01.15
0	RELEASED FOR FABRICATION	DSD	.	01.19.15

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I. KRUGER, INC.
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FABRICATION TOLERANCES AND NOTES

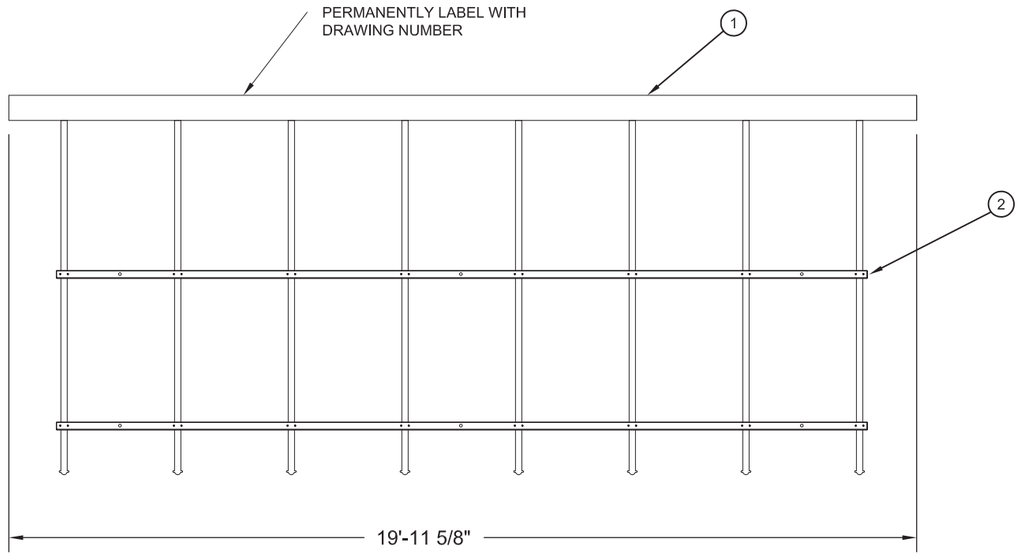
±1/8" ON LINEAR DIMENSIONS	.030 = .X
±1/32" ON HOLE Ø AND LOCATIONS	.015 = .XX
±1° ON ANGULAR DIMENSIONS	.005 = .XXX
(X.XXX) = REFERENCE DIM	
(X.XXX) = INSPECTION DIM	BREAK ALL SHARP EDGES

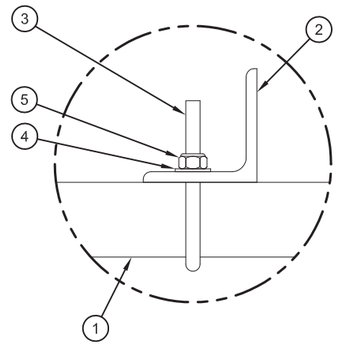
ANOXKALDNES
ASSY, AERATION GRID, 6", (8) 1-1/4" LATS @ 30" O.C.,
8'-0" W, 176 HOLES, VERT FLG INLET, OPEN OUTLET, LH

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
DSD	.	1 : 40	930F-1214	1 of 1	2

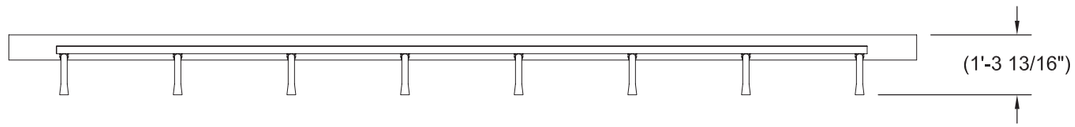
EST. WT.: 388 LBS.

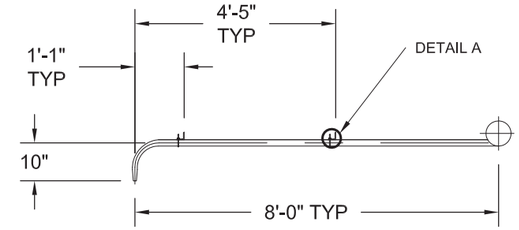
ITEM	QTY	SUPPLY	MATERIAL	DRAWING NUMBER	DESCRIPTION
1	1	-	SEE BOM	930F-1312	WLDMT, AERATION GRID, 6", (8) 1-1/4" HALF LATERALS @ 30 O.C., 8'-0" W, 176 HOLES, OPEN INLET, OPEN OUTLET, LH
2	2	-	AISI 304L	930F-1305	AERATION GRID SUPPORT ANGLE, 2" X 2" X 3/16" X 17'-10" LG, (8) 1-1/4" LATERALS @ 30" O.C.
3	16	-	AISI 304	-	U-BOLT, 1 1/4", 1/4-20, DALE Co. #U35 OR EQUIV, W/O NUTS
4	32	-	AISI 304	-	WSHR, FLAT, 1/4", .313" ID, .625" OD, .051" THK, SAE
5	32	-	AISI 304	-	NUT, HEX, NYLOCK, 1/4-20, ANSI





DETAIL A
AERATION GRID WELDMENT TO
SUPPORT ANGLE CONNECTION
SCALE 1:2





NOTES:
1. CLEAN AND DEGREASE PARTS BEFORE ASSEMBLY.
2. ANTI-SEIZE TO BE APPLIED TO ALL HDWR UNLESS OTHERWISE SPECIFIED.
3. ALL HDWR TO BE TIGHTENED TO APPROPRIATE TORQUE VALUES.

REV	DESCRIPTION	DRAWN	APPR	DATE
2	RE-DIMENSIONED, HOLE COUNT WAS 232	CDP	.	08.25.15
1	DESCRIPTION WAS 256 HOLES, ADJUSTED DOWNTURN	CDP	.	06.01.15
0	RELEASED FOR FABRICATION	DSD	CDP	01.19.15

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I. KRUGER, INC.
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CARY, NC 27513
(919) 677-8310

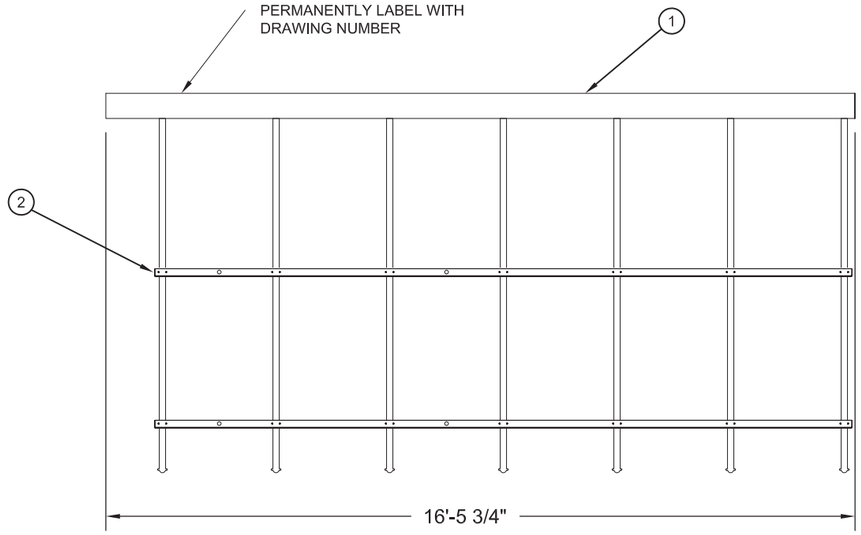
FABRICATION TOLERANCES AND NOTES
±1/8" ON LINEAR DIMENSIONS .030 = .X
±1/32" ON HOLE Ø AND LOCATIONS .015 = .XX
±1° ON ANGULAR DIMENSIONS .005 = .XXX
(X.XXX) = REFERENCE DIM
(X.XXX) = INSPECTION DIM BREAK ALL SHARP EDGES

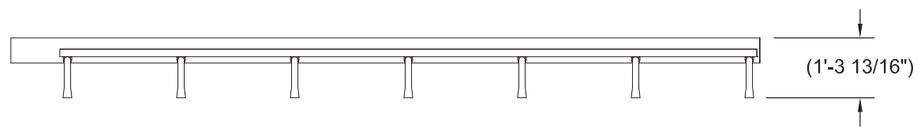
ANOXKALDNES
ASSY, AERATION GRID, 6", (8) 1-1/4" LATS @ 30" O.C.,
8'-0" W, 176 HOLES, OPEN INLET, OPEN OUTLET, LH

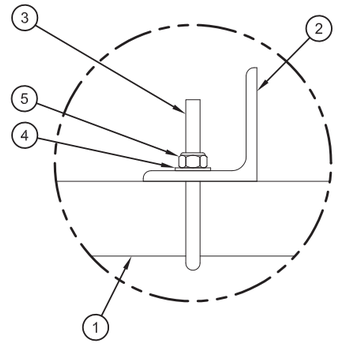
DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
DSD	.	1 : 40	930F-1215	1 of 1	2

EST. WT.: 302 LBS.

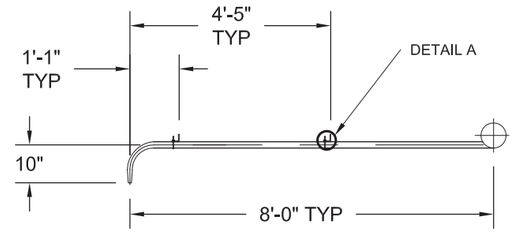
ITEM	QTY	SUPPLY	MATERIAL	DRAWING NUMBER	DESCRIPTION
1	1	-	SEE BOM	930F-1313	WLDMT, AERATION GRID, 6", (7) 1-1/4" HALF LATERALS @ 30 O.C., 8'-0" W, 154 HOLES, OPEN INLET, CAPPED OUTLET, LH
2	2	-	AISI 304L	930F-1308	AERATION GRID SUPPORT ANGLE, 2" X 2" X 3/16" X 15'-4" LG, (7) 1-1/4" LATERALS @ 30" O.C.
3	14	-	AISI 304	-	U-BOLT, 1 1/4", 1/4-20, DALE Co. #U35 OR EQUIV, W/O NUTS
4	28	-	AISI 304	-	WSHR, FLAT, 1/4", .313" ID, .625" OD, .051" THK, SAE
5	28	-	AISI 304	-	NUT, HEX, NYLOCK, 1/4-20, ANSI







DETAIL A
AERATION GRID WELDMENT TO
SUPPORT ANGLE CONNECTION
SCALE 1:2



NOTES:
1. CLEAN AND DEGREASE PARTS BEFORE ASSEMBLY.
2. ANTI-SEIZE TO BE APPLIED TO ALL HDWR UNLESS OTHERWISE SPECIFIED.
3. ALL HDWR TO BE TIGHTENED TO APPROPRIATE TORQUE VALUES.

REV	DESCRIPTION	DRAWN	APPR	DATE
2	RE-DIMENSIONED, HOLE COUNT WAS 203	CDP	.	08.25.15
1	DESCRIPTION WAS 224 HOLES, ADJUSTED DOWNTURN	CDP	.	06.01.15
0	RELEASED FOR FABRICATION	DSD	.	01.19.15

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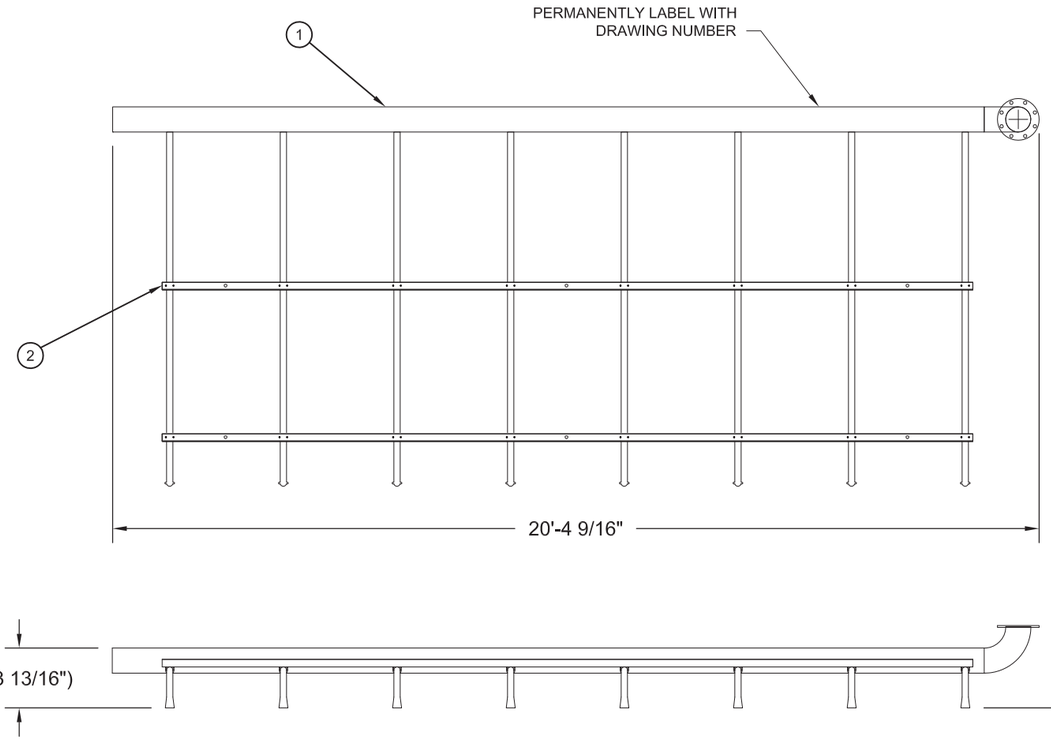
FABRICATION TOLERANCES AND NOTES
±1/8" ON LINEAR DIMENSIONS .030 = .X
±1/32" ON HOLE Ø AND LOCATIONS .015 = .XX
±1° ON ANGULAR DIMENSIONS .005 = .XXX
(X.XXX) = REFERENCE DIM
X.XXX = INSPECTION DIM
BREAK ALL SHARP EDGES

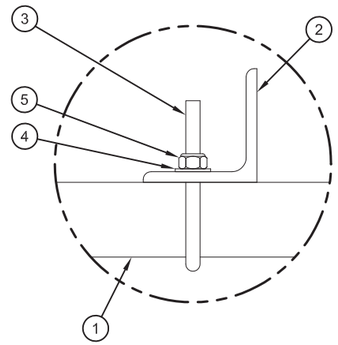
ANOXKALDNES
ASSY, AERATION GRID, 6", (7) 1-1/4" LATS @ 30" O.C., 8'-0" W, 154 HOLES, OPEN INLET, CAPPED OUTLET, LH

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
DSD	.	1 : 40	930F-1216	1 of 1	2

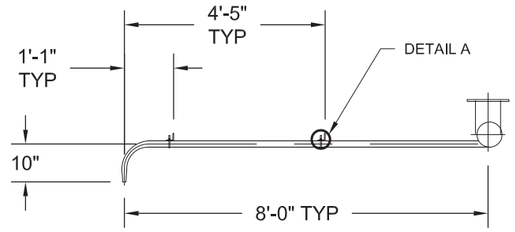
EST. WT.: 381 LBS.

ITEM	QTY	SUPPLY	MATERIAL	DRAWING NUMBER	DESCRIPTION
1	1	-	SEE BOM	930F-1314	WLDMT, AERATION GRID, 6", (8) 1-1/4" HALF LATERALS @ 30" O.C., 8'-0" W, 176 HOLES, VERT FLG INLET, OPEN OUTLET
2	2	-	AISI 304L	930F-1305	AERATION GRID SUPPORT ANGLE, 2" X 2" X 3/16" X 17'-10" LG, (12) 1-1/4" LATERALS @ 30" O.C.
3	16	-	AISI 304	-	U-BOLT, 1 1/4", 1/4-20, DALE Co. #U35 OR EQUIV, W/O NUTS
4	32	-	AISI 304	-	WSHR, FLAT, 1/4", .313" ID, .625" OD, .051" THK, SAE
5	32	-	AISI 304	-	NUT, HEX, NYLOCK, 1/4-20, ANSI





DETAIL A
AERATION GRID WELDMENT TO
SUPPORT ANGLE CONNECTION
SCALE 1:2



NOTES:
1. CLEAN AND DEGREASE PARTS BEFORE ASSEMBLY.
2. ANTI-SEIZE TO BE APPLIED TO ALL HDWR UNLESS OTHERWISE SPECIFIED.
3. ALL HDWR TO BE TIGHTENED TO APPROPRIATE TORQUE VALUES.

REV	DESCRIPTION	DRAWN	APPR	DATE
2	ADJUSTED FLANGE, HOLE COUNT WAS 232	CDP	.	08.25.15
1	DESCRIPTION WAS 256 HOLES, ADJUSTED DOWNTURN	CDP	.	06.01.15
0	RELEASED FOR FABRICATION	DSD	.	01.19.15

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(919) 677-8310

FABRICATION TOLERANCES AND NOTES

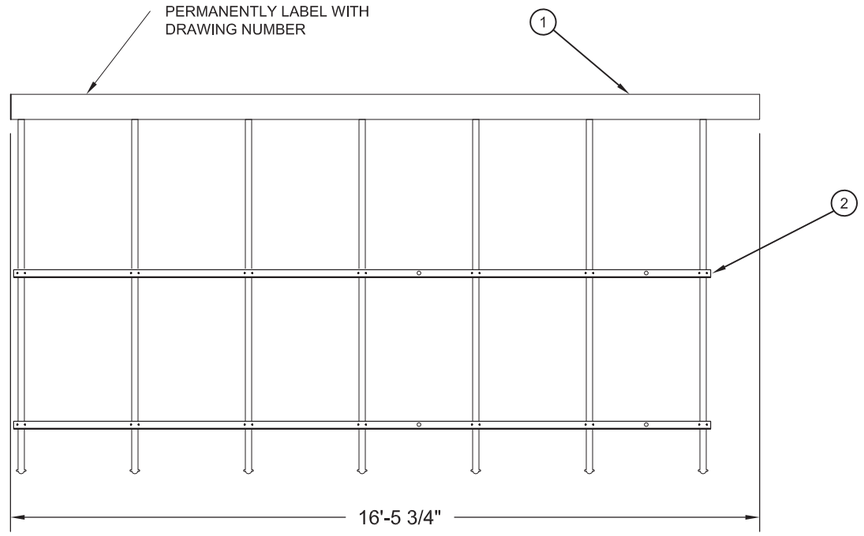
±1/8" ON LINEAR DIMENSIONS	.030 = .X
±1/32" ON HOLE Ø AND LOCATIONS	.015 = .XX
±1° ON ANGULAR DIMENSIONS	.005 = .XXX
(X.XXX) = REFERENCE DIM	
(X.XXX) = INSPECTION DIM	BREAK ALL SHARP EDGES

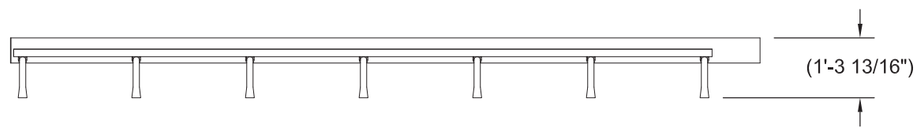
ANOXKALDNES
ASSY, AERATION GRID, 6", (8) 1-1/4" LATS @ 30" O.C.
8'-0" W, 176 HOLES, VERT FLG INLET, OPEN OUTLET, RH

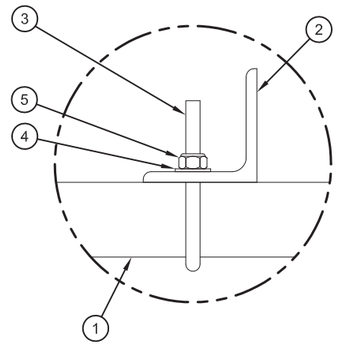
DRAWN	CHECKED		SCALE	DRAWING NO	SHEET	REV
DSD	.		1 : 40	930F-1217	1 of 1	2

EST. WT.: 302 LBS.

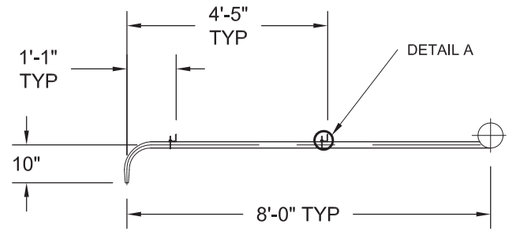
ITEM	QTY	SUPPLY	MATERIAL	DRAWING NUMBER	DESCRIPTION
1	1	-	SEE BOM	930F-1315	WLDMT, AERATION GRID, 6", (7) 1-1/4" HALF LATERALS @ 30 O.C., 8'-0" W, 154 HOLES, OPEN INLET, CAPPED OUTLET, RH
2	2	-	AISI 304L	930F-1308	AERATION GRID SUPPORT ANGLE, 2" X 2" X 3/16" X 15'-4" LG, (7) 1-1/4" LATERALS @ 30" O.C.
3	14	-	AISI 304	-	U-BOLT, 1 1/4", 1/4-20, DALE Co. #U35 OR EQUIV, W/O NUTS
4	28	-	AISI 304	-	WSHR, FLAT, 1/4", .313" ID, .625" OD, .051" THK, SAE
5	28	-	AISI 304	-	NUT, HEX, NYLOCK, 1/4-20, ANSI







DETAIL A
AERATION GRID WELDMENT TO
SUPPORT ANGLE CONNECTION
SCALE 1:2



NOTES:
1. CLEAN AND DEGREASE PARTS BEFORE ASSEMBLY.
2. ANTI-SEIZE TO BE APPLIED TO ALL HDWR UNLESS OTHERWISE SPECIFIED.
3. ALL HDWR TO BE TIGHTENED TO APPROPRIATE TORQUE VALUES.

REV	DESCRIPTION	DRAWN	APPR	DATE
2	RE-DIMENSIONED, HOLE COUNT WAS 203	CDP	.	08.25.15
1	DESCRIPTION WAS 224 HOLES, ADJUSTED DOWNTURN	CDP	.	06.01.15
0	RELEASED FOR FABRICATION	DSD	.	01.19.15

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4001 WESTON PARKWAY
CARY, NC 27513
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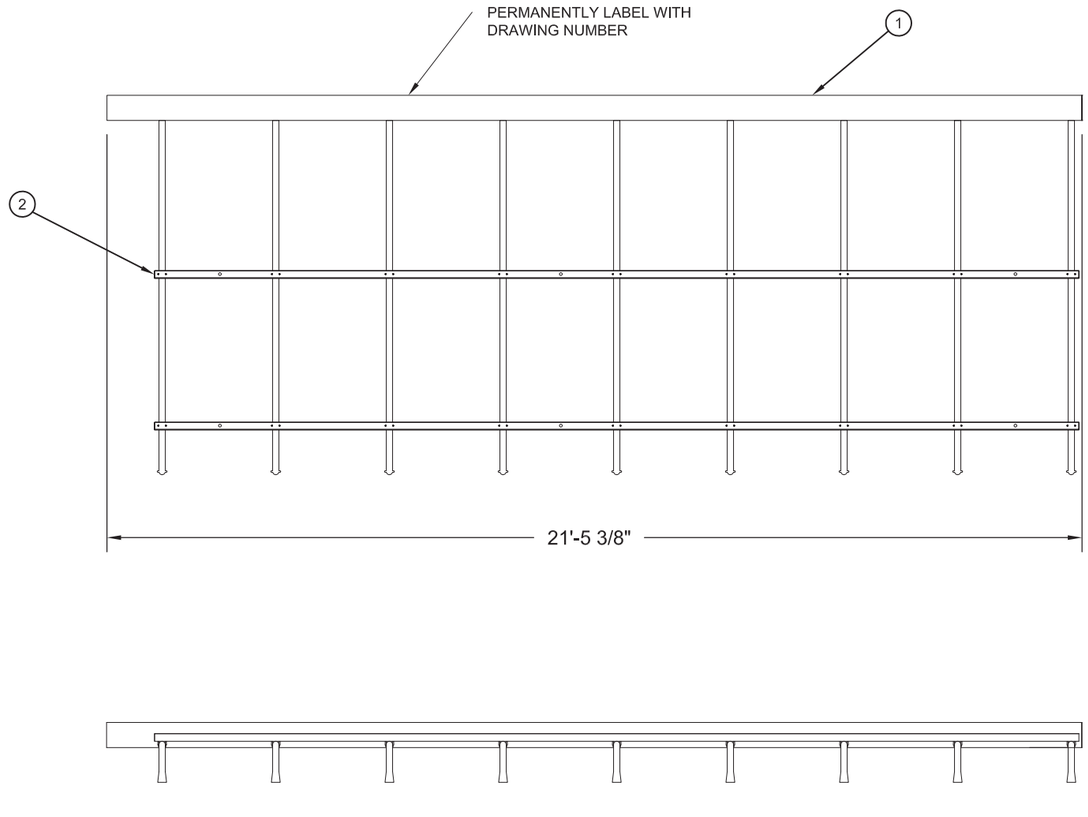
FABRICATION TOLERANCES AND NOTES
±1/8" ON LINEAR DIMENSIONS .030 = .X
±1/32" ON HOLE Ø AND LOCATIONS .015 = .XX
±1° ON ANGULAR DIMENSIONS .005 = .XXX
(X.XXX) = REFERENCE DIM
X.XXX = INSPECTION DIM
BREAK ALL SHARP EDGES

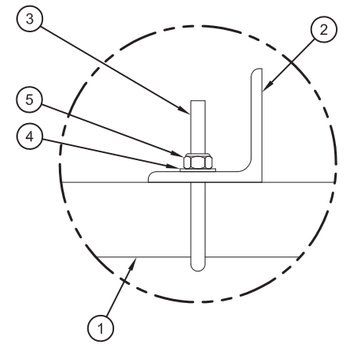
ANOXKALDNES
ASSY, AERATION GRID, 6", (7) 1-1/4" LATS @ 30" O.C., 8'-0" W, 154 HOLES, OPEN INLET, CAPPED OUTLET, RH

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
DSD	.	1 : 40	930F-1218	1 of 1	2

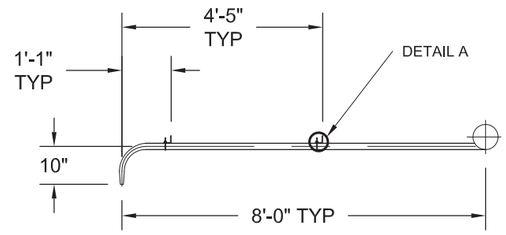
EST. WT.: 393 LBS.

ITEM	QTY	SUPPLY	MATERIAL	DRAWING NUMBER	DESCRIPTION
1	1	-	SEE BOM	930F-1316	WLDMT, AERATION GRID, 6", (9) 1-1/4" HALF LATERALS @ 30 O.C., 8'-0" W, 279 HOLES, OPEN INLET, CAPPED OUTLET, LH
2	2	-	AISI 304L	930F-1317	AERATION GRID SUPPORT ANGLE, 2" X 2" X 3/16" X 20'-4" LG, (9) 1-1/4" LATERALS @ 30" O.C.
3	16	-	AISI 304	-	U-BOLT, 1 1/4", 1/4-20, DALE Co. #U35 OR EQUIV, W/O NUTS
4	32	-	AISI 304	-	WSHR, FLAT, 1/4", .313" ID, .625" OD, .051" THK, SAE
5	32	-	AISI 304	-	NUT, HEX, NYLOCK, 1/4-20, ANSI





DETAIL A
AERATION GRID WELDMENT TO
SUPPORT ANGLE CONNECTION
SCALE 1:2



NOTES:
1. CLEAN AND DEGREASE PARTS BEFORE ASSEMBLY.
2. ANTI-SEIZE TO BE APPLIED TO ALL HDWR UNLESS OTHERWISE SPECIFIED.
3. ALL HDWR TO BE TIGHTENED TO APPROPRIATE TORQUE VALUES.

REV	DESCRIPTION	DRAWN	APPR	DATE
2	RE-DIMENSIONED, HOLE COUNT WAS 261	CDP	.	08.25.15
1	DESCRIPTION WAS 288 HOLES, ADJUSTED DOWNTURN	CDP	.	06.01.15
0	RELEASED FOR FABRICATION	DSD	.	01.19.15

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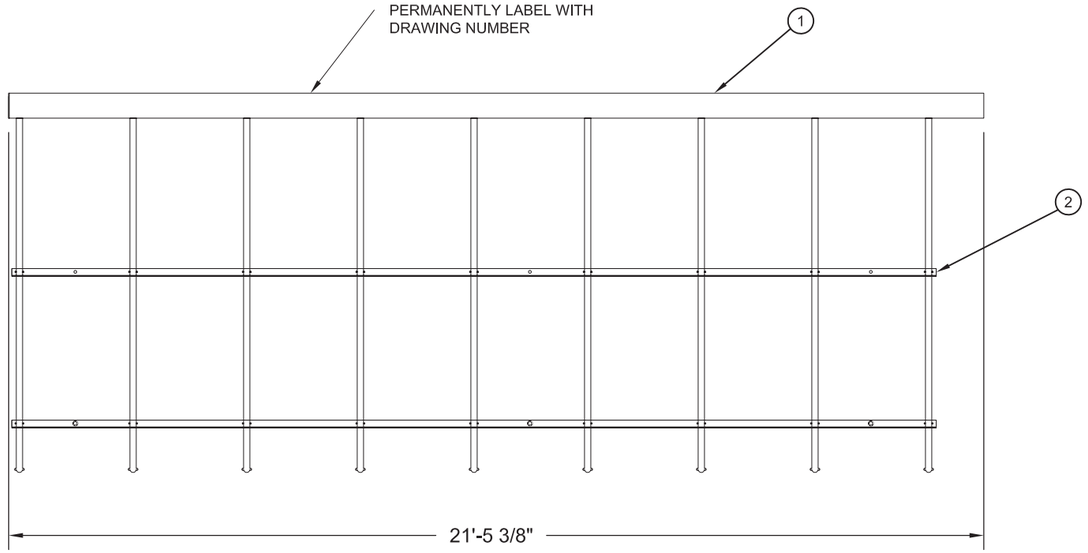
FABRICATION TOLERANCES AND NOTES
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(X.XXX) = INSPECTION DIM
BREAK ALL SHARP EDGES

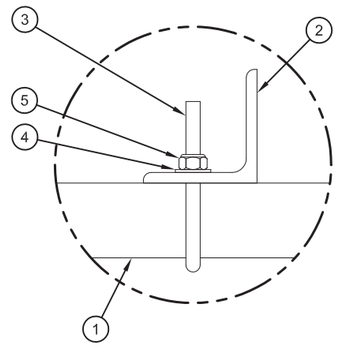
ANOXKALDNES
ASSY, AERATION GRID, 6", (9) 1-1/4" LATS @ 30" O.C.
8'-0" W, 279 HOLES, OPEN INLET, CAPPED OUTLET, LH

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
DSD	.	1 : 40	930F-1219	1 of 1	2

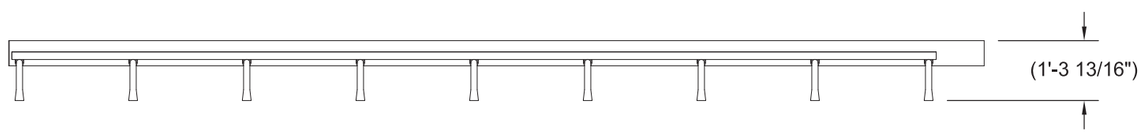
EST. WT.: 393 LBS.

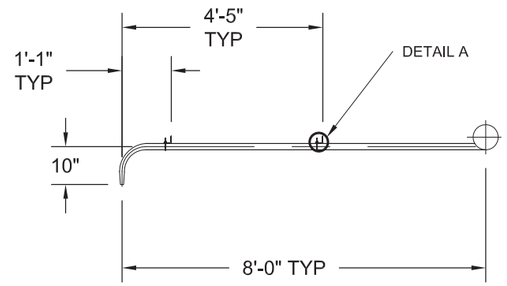
ITEM	QTY	SUPPLY	MATERIAL	DRAWING NUMBER	DESCRIPTION
1	1	-	SEE BOM	930F-1318	WLDMT, AERATION GRID, 6", (9) 1-1/4" HALF LAT. @ 30 O.C., 8'-0" W, 279 HOLES, OPEN INLET, OPEN OUTLET, RH
2	2	-	AISI 304L	930F-1317	AERATION GRID SUPPORT ANGLE, 2" X 2" X 3/16" X 20'-4" LG, (9) 1-1/4" LATERALS @ 30" O.C.
3	18	-	AISI 304	-	U-BOLT, 1 1/4", 1/4-20, DALE Co. #U35 OR EQUIV, W/O NUTS
4	36	-	AISI 304	-	WSHR, FLAT, 1/4", .313" ID, .625" OD, .051" THK, SAE
5	36	-	AISI 304	-	NUT, HEX, NYLOCK, 1/4-20, ANSI





DETAIL A
AERATION GRID WELDMENT TO
SUPPORT ANGLE CONNECTION
SCALE 1:2





NOTES:
1. CLEAN AND DEGREASE PARTS BEFORE ASSEMBLY.
2. ANTI-SEIZE TO BE APPLIED TO ALL HDWR UNLESS OTHERWISE SPECIFIED.
3. ALL HDWR TO BE TIGHTENED TO APPROPRIATE TORQUE VALUES.

REV	DESCRIPTION	DRAWN	APPR	DATE
2	CHANGED DESCRIPTION FOR ITEM 1, HOLE CNT WAS 261	CDP	.	08.25.15
1	DESCRIPTION WAS 288 HOLES, ADJUSTED DOWNTURN	CDP	.	06.01.15
0	RELEASED FOR FABRICATION	DSD	.	01.19.15

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FABRICATION TOLERANCES AND NOTES

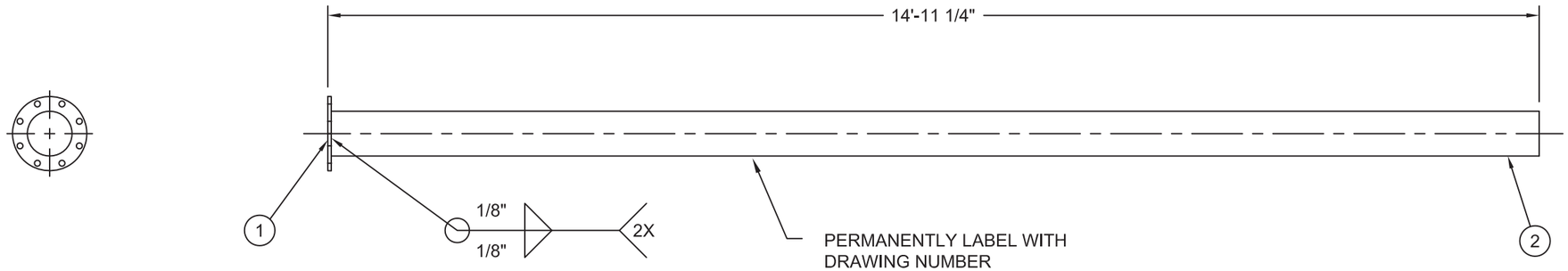
±1/8" ON LINEAR DIMENSIONS	.030 = .X
±1/32" ON HOLE Ø AND LOCATIONS	.015 = .XX
±1° ON ANGULAR DIMENSIONS	.005 = .XXX
(X.XXX) = REFERENCE DIM	
(X.XXX) = INSPECTION DIM	BREAK ALL SHARP EDGES

ANOXKALDNES
ASSY, AERATION GRID, 6", (9) 1-1/4" LATS @ 30" O.C., 8'-0" W, 279 HOLES, OPEN INLET, CAPPED OUTLET, RH

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
DSD	.	1 : 40	930F-1220	1 of 1	2

EST WT.: 155 LBS

ITEM	QTY	MATERIAL	DRAWING NUMBER	DESCRIPTION
1	1	AISI 304L	-	FLG, PIPE, PL, 6", 1/2" THK, 125LB
2	1	AISI 304L	-	PIPE, 6", SCH 10, 179.00" LG



NOTES:
1. REFER TO KRUGER "WELDING FABRICATION PROCEDURE" FOR WELD SPECIFICATIONS.
2. REMOVE WELD SLAG, CLEAN AND DEGREASE BEFORE PASSIVATION OR PAINTING.

REV	DESCRIPTION	DRAWN	APPR	DATE
3	LENGTH WAS 10-5 1/4"	CDP	.	08.14.15
2	SHORTENED LENGTH FROM 14'-9 3/4", REMOVED FLANGE	CDP	.	06.03.15
1	SHORTENED LENGTH FROM 15'-3 13/16"	CDP	.	03.19.15
0	RELEASED FOR FABRICATION	CDP	.	01.21.15

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401 HARRISON OAKS BLVD
CARY, NC 27513
(919) 677-8310

FABRICATION TOLERANCES AND NOTES

±1/8" ON LINEAR DIMENSIONS	.030 = .X
±1/32" ON HOLE n AND LOCATIONS	.015 = .XX
±1° ON ANGULAR DIMENSIONS	.005 = .XXX
(X.XXX) = REFERENCE DIM	
(X.XXX) = INSPECTION DIM	BREAK ALL SHARP EDGES

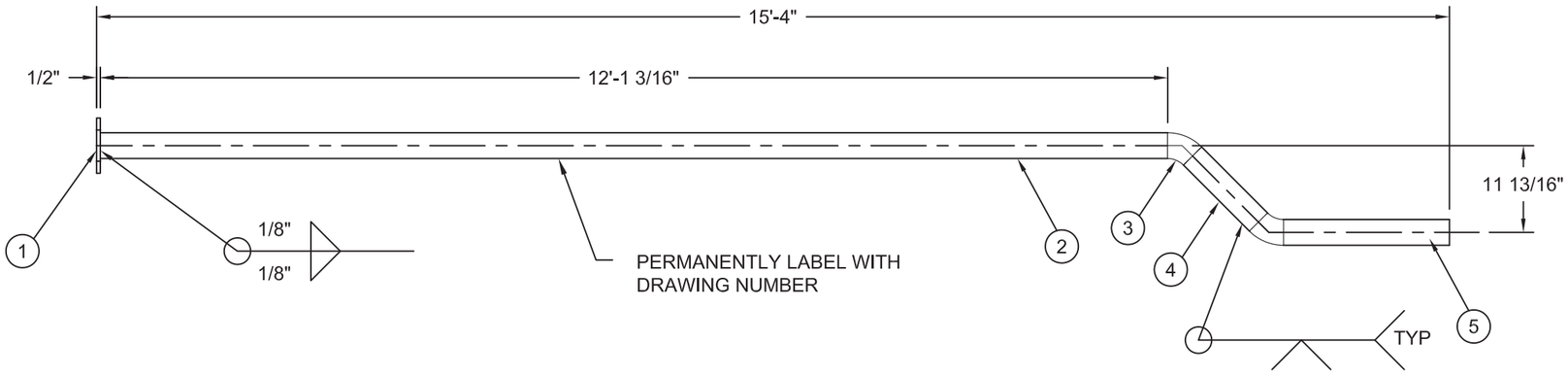
ANOXKALDNES
WLDMT, DROP PIPE, 6", SCH 10, FLG. ONE END,
14'-11 1/4" LG

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
SRW	.	1 : 20	930F-1221	1 of 1	3

EST WT.: 77 LBS

ITEM	QTY	MATERIAL	DRAWING NUMBER	DESCRIPTION
1	1	AISI 304L	-	FLG, PIPE, PL, 3", 1/2" THK, 125LB
2	1	AISI 304L	-	PIPE, 3", SCH 10, 145.41"LG
3	2	AISI 304L	-	ELB, 3", SCH 10, 45 DEG
4	1	AISI 304L	-	PIPE, 3", SCH 10, 11.69"LG
5	1	AISI 304L	-	PIPE, 3", SCH 10, 22.56"LG





NOTES:
1. REFER TO KRUGER "WELDING FABRICATION PROCEDURE" FOR WELD SPECIFICATIONS.
2. REMOVE WELD SLAG, CLEAN AND DEGREASE BEFORE PASSIVATION OR PAINTING.

REV	DESCRIPTION	DRAWN	APPR	DATE
2	LENGTH WAS 12'-10 1/8" LG, ADDED OFFSET	CDP	.	08.19.15
1	SHORTENED LENGTH FROM 15'-3 13/16"	CDP	.	06.03.15
0	RELEASED FOR FABRICATION	CDP	.	01.21.15

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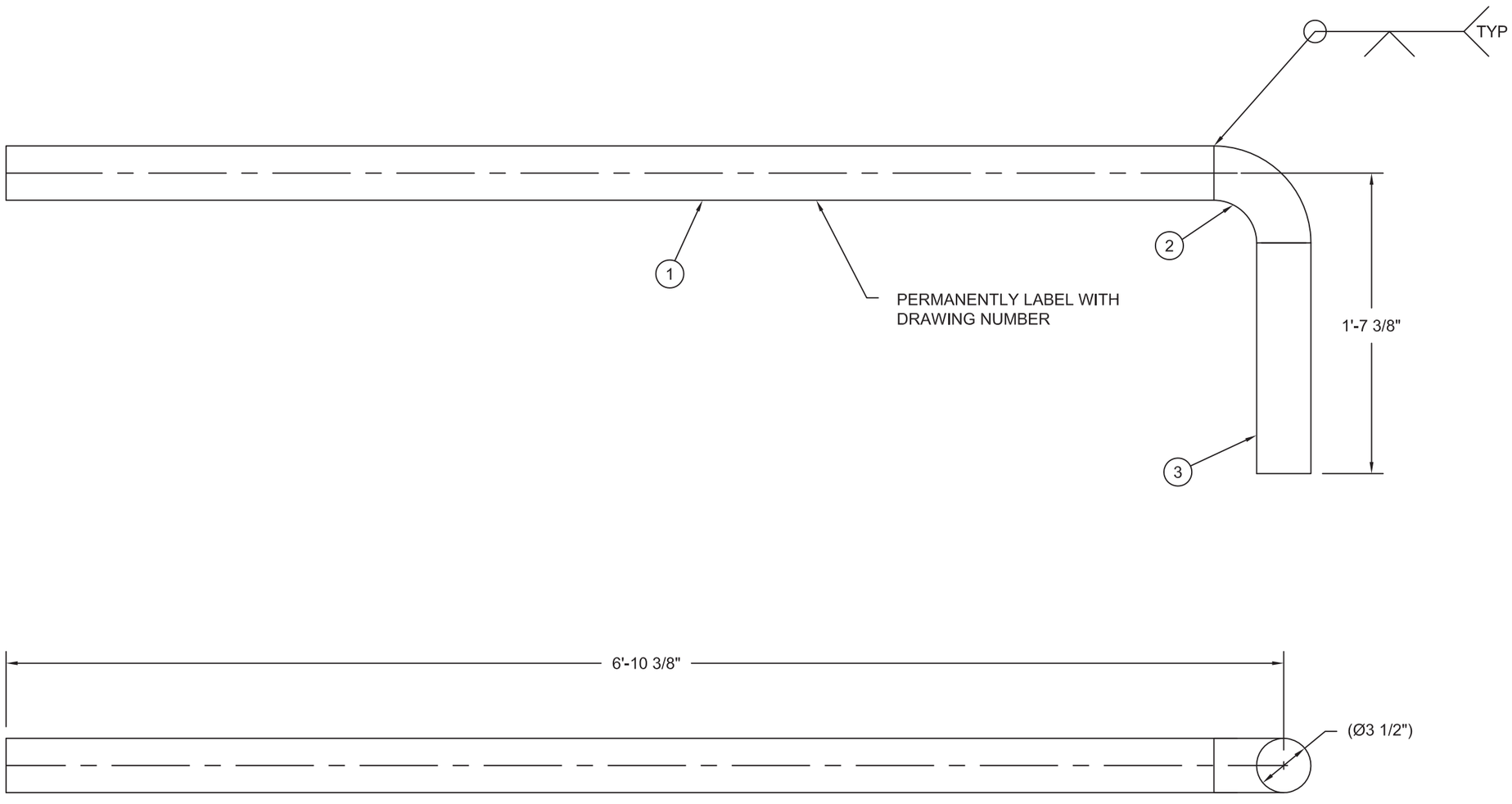
±1/8" ON LINEAR DIMENSIONS .030 = .X
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±1° ON ANGULAR DIMENSIONS .005 = .XXX
(X.XXX) = REFERENCE DIM
(X.XXX) = INSPECTION DIM BREAK ALL SHARP EDGES

ANOXKALDNES
WLDMT, DROP PIPE, 3", SCH 10, FLG. ONE END,
2X 45 DEG. OFFSET,15'-4" LG

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
SRW	.	1 : 20	930F-1222	1 of 1	2

EST. WT.: 31 LBS

ITEM	QTY	MATERIAL	DRAWING NUMBER	DESCRIPTION
1	1	AISI 304L	-	PIPE, 3", SCH 10, 77.88"LG
2	1	AISI 304L	-	ELB, 3", SCH 10, LR
3	1	AISI 304L	-	PIPE, 3", SCH 10, 14.88" LG



NOTES:
1. REFER TO KRUGER "WELDING FABRICATION PROCEDURE" FOR WELD SPECIFICATIONS.
2. REMOVE WELD SLAG, CLEAN AND DEGREASE BEFORE PASSIVATION OR PAINTING.

REV	DESCRIPTION	DRAWN	APPR	DATE
2	WAS 4-4 1/2" LG	CDP	.	08.14,15
1	SHORTENED FROM 6'-8 13/16"	CDP	.	06.03.15
0	RELEASE FOR FABRICATION	CDP	.	09.12.14

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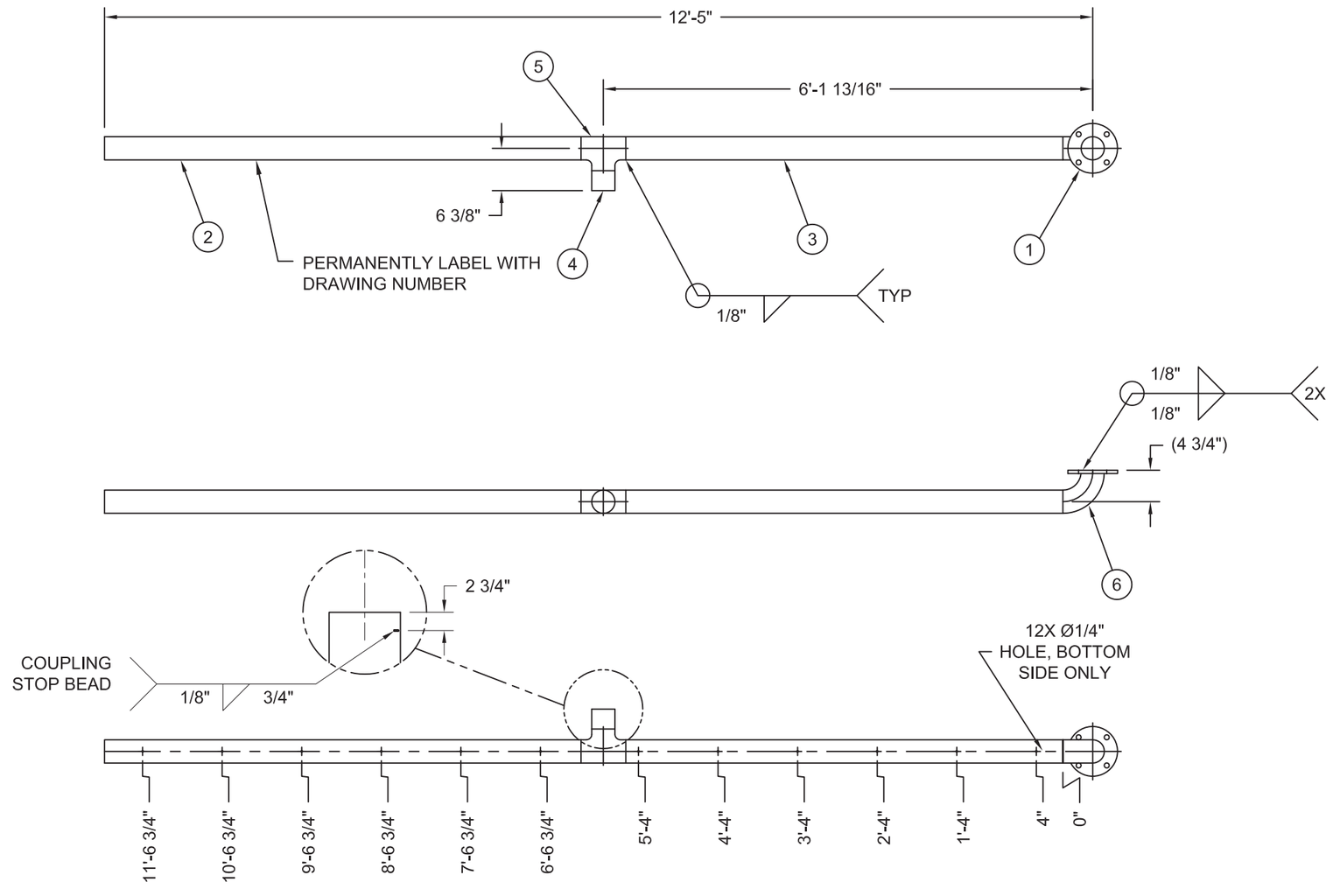
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(X.XXX) = REFERENCE DIM
(X.XXX) = INSPECTION DIM BREAK ALL SHARP EDGES

ANOXKALDNES
WLDMT, DROP PIPE, 3", SCH10
WITH ELBOW

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
CDP		1 : 8	930F-1223	1 of 1	2

EST WT.: 64 LBS

ITEM	QTY	MATERIAL	DRAWING NUMBER	DESCRIPTION
1	1	AISI 304L	-	FLG, PIPE, PL, 3", 1/2" THK, 125LB
2	1	AISI 304L	-	PIPE, 3", SCH 10, 71.84"LG
3	1	AISI 304L	-	PIPE, 3", SCH 10, 65.94"LG
4	1	AISI 304L	-	PIPE, 3", SCH 10, 3.00"LG
5	1	AISI 304L	-	TEE, PIPE, 3", SCH 10, BW
6	1	AISI 304L	-	ELBOW, PIPE, 3", SCH 10, BW



NOTES:
1. REFER TO KRUGER "WELDING FABRICATION PROCEDURE" FOR WELD SPECIFICATIONS.
2. REMOVE WELD SLAG, CLEAN AND DEGREASE BEFORE PASSIVATION OR PAINTING.

REV	DESCRIPTION	DRAWN	APPR	DATE
2	ITEM 3 WAS 48.50" L, ADDED COUPLING BEAD. WAS 23 HOLES	CDP	.	09.01.15
1	DESCRIPTION WAS 9'-11 1/8"	CDP	.	06.03.15
0	RELEASED FOR FABRICATION	CDP	.	01.21.15

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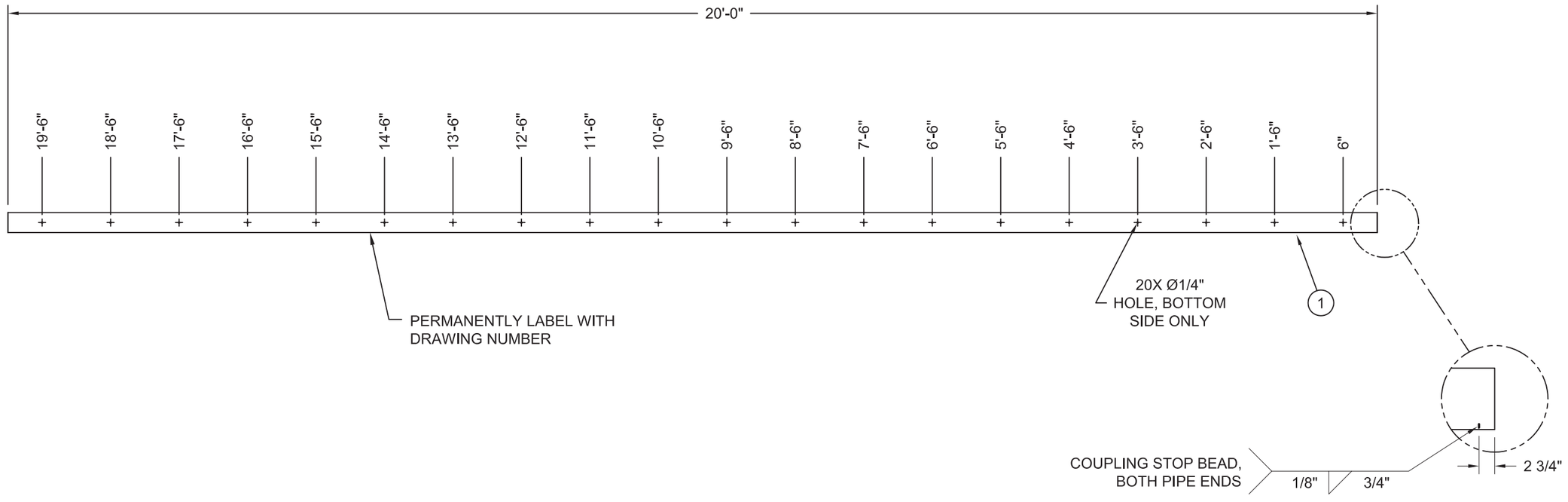
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±1° ON ANGULAR DIMENSIONS .005 = .XXX
(X.XXX) = REFERENCE DIM
(X.XXX) = INSPECTION DIM
BREAK ALL SHARP EDGES

ANOXKALDNES
WLDMT, AERATION GRID, 3", VERT FLG INLET, TEE W/OPEN OUTLET, 12'-5"LG

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
SRW	.	1 : 20	930F-1224	1 of 1	2

EST WT.: 87 LBS

ITEM	QTY	MATERIAL	DRAWING NUMBER	DESCRIPTION
1	1	AISI 304L	-	PIPE, 3", SCH 10, 20'-0"LG



NOTES:
1. REFER TO KRUGER "WELDING FABRICATION PROCEDURE" FOR WELD SPECIFICATIONS.
2. REMOVE WELD SLAG, CLEAN AND DEGREASE BEFORE PASSIVATION OR PAINTING.

REV	DESCRIPTION	DRAWN	APPR	DATE
1	ADDED COUPLING BEAD, HOLE NUMBER WAS 40	CDP	.	09.01.15
0	RELEASED FOR FABRICATION	CDP	.	01.21.15

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KRÜGER
I. KRUGER, INC.
401 HARRISON OAKS BLVD
CARY, NC 27513
(919) 677-8310

FABRICATION TOLERANCES AND NOTES

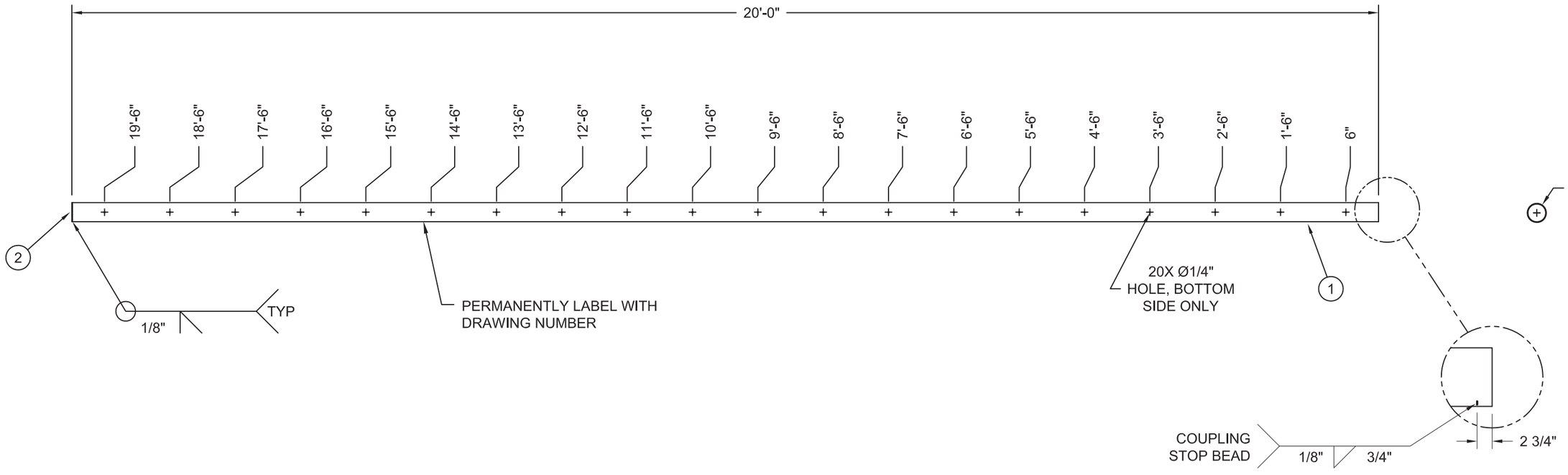
±1/8" ON LINEAR DIMENSIONS .030 = .X
±1/32" ON HOLE n AND LOCATIONS .015 = .XX
±1° ON ANGULAR DIMENSIONS .005 = .XXX
(X.XXX) = REFERENCE DIM
(X.XXX) = INSPECTION DIM BREAK ALL SHARP EDGES

ANOXKALDNES
WLDMT, AERATION GRID, 3", OPEN INLET, OPEN OUTLET, 20'-0"LG

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
SRW	.	1 : 20	930F-1225	1 of 1	1

EST WT.: 87 LBS

ITEM	QTY	MATERIAL	DRAWING NUMBER	DESCRIPTION
1	1	AISI 304L	-	PIPE, 3", SCH 10, 19'-11 7/8"LG
2	1	AISI 304L	-	PLATE, Ø3.50", 0.13" THK



NOTES:
1. REFER TO KRUGER "WELDING FABRICATION PROCEDURE" FOR WELD SPECIFICATIONS.
2. REMOVE WELD SLAG, CLEAN AND DEGREASE BEFORE PASSIVATION OR PAINTING.

REV	DESCRIPTION	DRAWN	APPR	DATE
2	ADDED COUPLING BEAD, HOLE COUNT WAS 40	CDP	.	09.01.15
1	LENGTH IN DESCRIPTION WAS 20'-0"	CDP	.	06.03.15
0	RELEASED FOR FABRICATION	CDP	.	01.21.15

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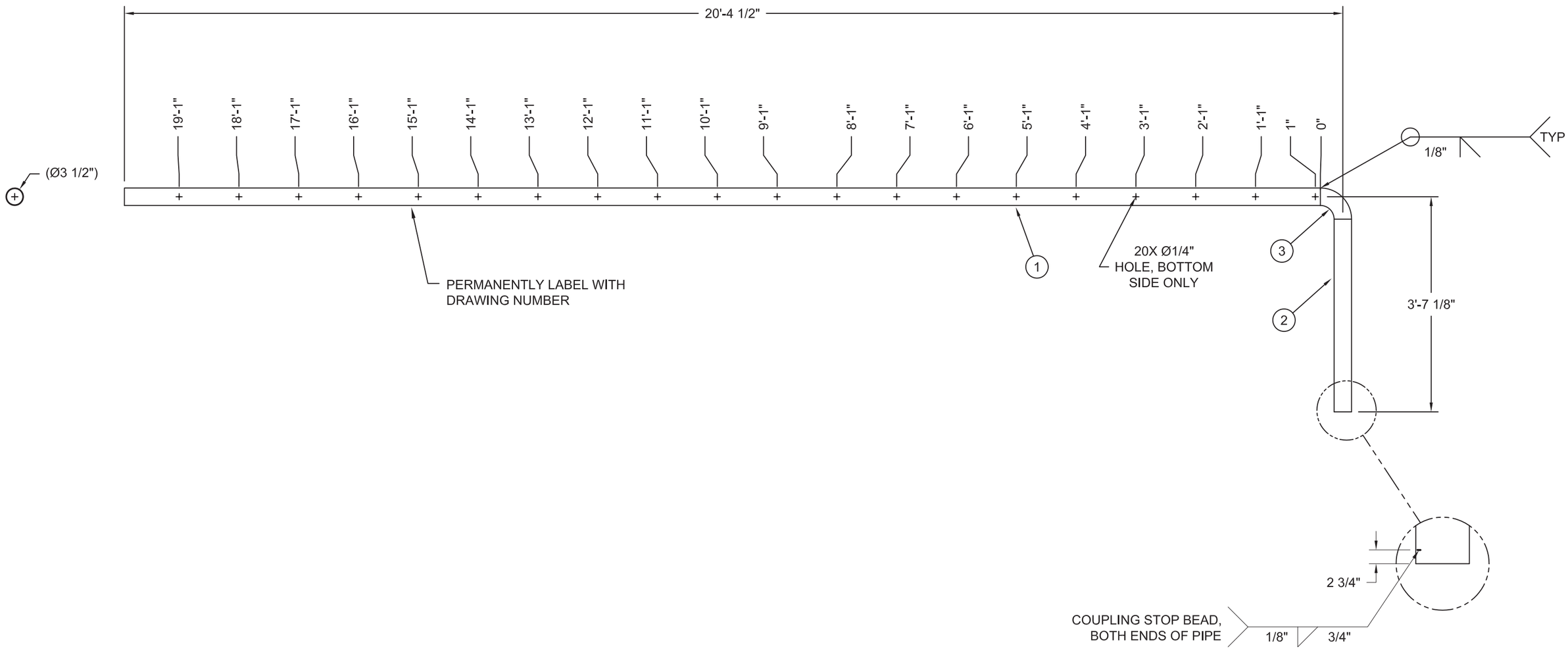
FABRICATION TOLERANCES AND NOTES
±1/8" ON LINEAR DIMENSIONS .030 = .X
±1/32" ON HOLE n AND LOCATIONS .015 = .XX
±1° ON ANGULAR DIMENSIONS .005 = .XXX
(X.XXX) = REFERENCE DIM
(X.XXX) = INSPECTION DIM BREAK ALL SHARP EDGES

ANOXKALDNES
WLDMT, AERATION GRID, 3", OPEN INLET, CAPPED OUTLET, 20'-0" LG

DRAWN	CHECKED		SCALE	DRAWING NO	SHEET	REV
SRW	.		1 : 20	930F-1226	1 of 1	2

EST WT.: 107 LBS

ITEM	QTY	MATERIAL	DRAWING NUMBER	DESCRIPTION
1	1	AISI 304L	-	PIPE, 3", SCH 10, 20'-0" LG
2	1	AISI 304L	-	PIPE, 3", SCH 10, 3'-2 5/8" LG
3	1	AISI 304L	-	ELB, 3", SCH 10, LR



NOTES:
1. REFER TO KRUGER "WELDING FABRICATION PROCEDURE" FOR WELD SPECIFICATIONS.
2. REMOVE WELD SLAG, CLEAN AND DEGREASE BEFORE PASSIVATION OR PAINTING.

REV	DESCRIPTION	DRAWN	APPR	DATE
2	ADDED COUPLING BEAD, HOLE COUNT WAS 40	CDP	.	09.01.15
1	REVISED ITEMS 2 & 3 IN BOM	CDP	.	06.04.15
0	RELEASED FOR FABRICATION	CDP	.	01.21.15

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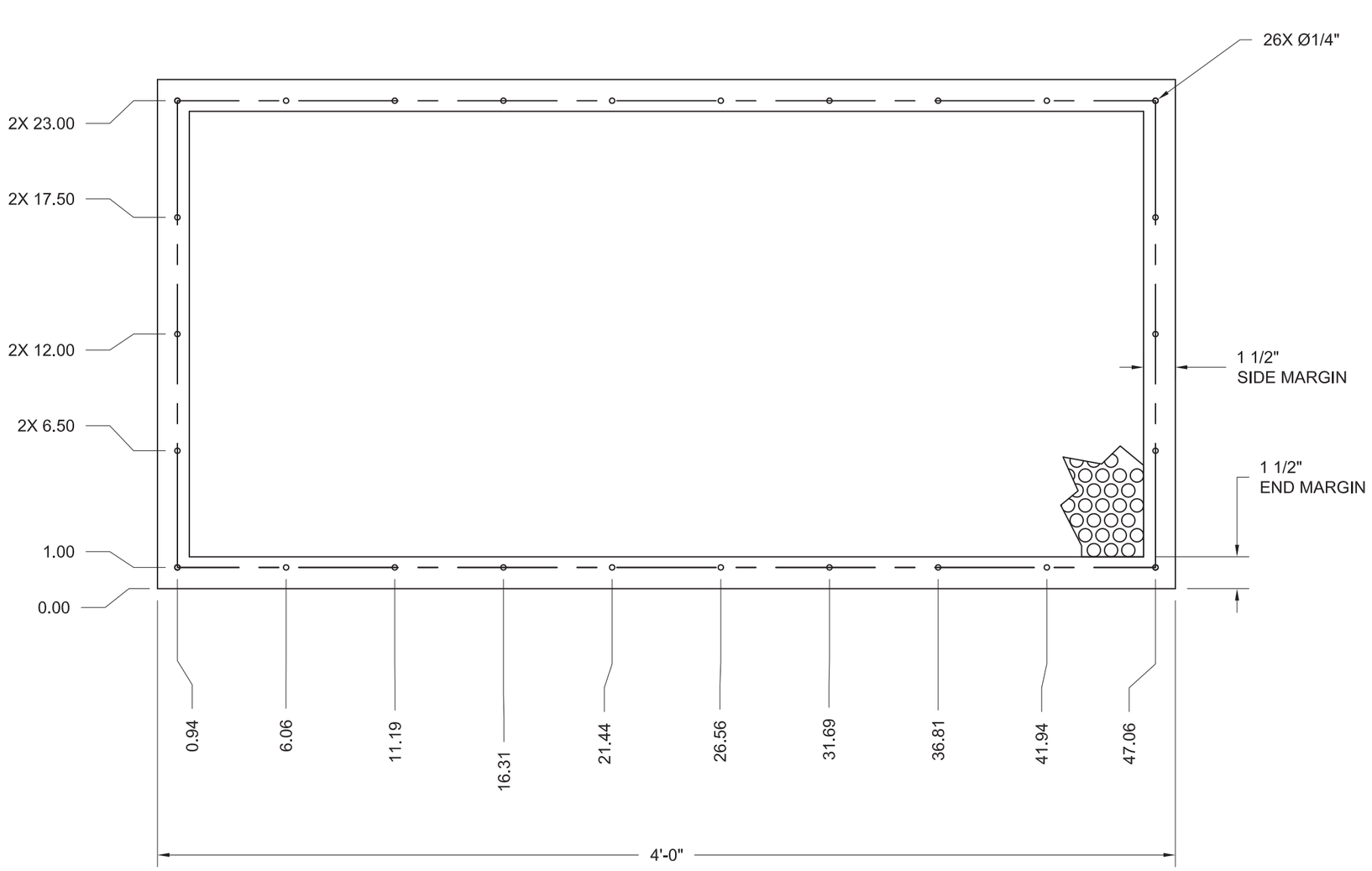
KRÜGER
I. KRUGER, INC.
401 HARRISON OAKS BLVD
CARY, NC 27513
(919) 677-8310

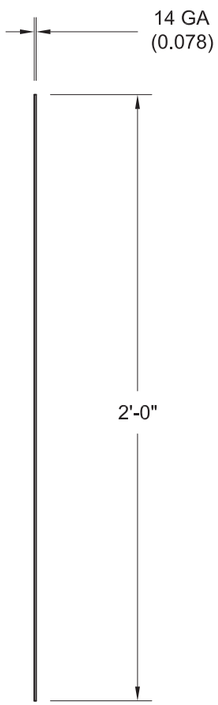
FABRICATION TOLERANCES AND NOTES
±1/8" ON LINEAR DIMENSIONS .030 = .X
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(X.XXX) = INSPECTION DIM
BREAK ALL SHARP EDGES

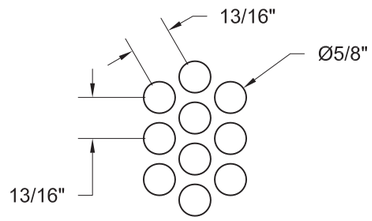
ANOXKALDNES
WLDMT, AERATION GRID, 3", OPEN INLET w/ELBOW, OPEN OUTLET, 20'-4 1/2"LG

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
SRW	.	1 : 20	930F-1227	1 of 1	2

EST. WT.: 10 LBS
MAT'L: AISI 304L







PERFORATION DETAIL
(IPA 130 PATTERN)
SCALE 1:2

REV	DESCRIPTION	DRAWN	APPR	DATE
1	UPDATED REVISION	CDP	.	06.04.15
0	RELEASED FOR FABRICATION	CDP	SRW	01.21.15

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4001 WESTON PARKWAY
CARY, NC 27513
(919) 677-8310

FABRICATION TOLERANCES AND NOTES

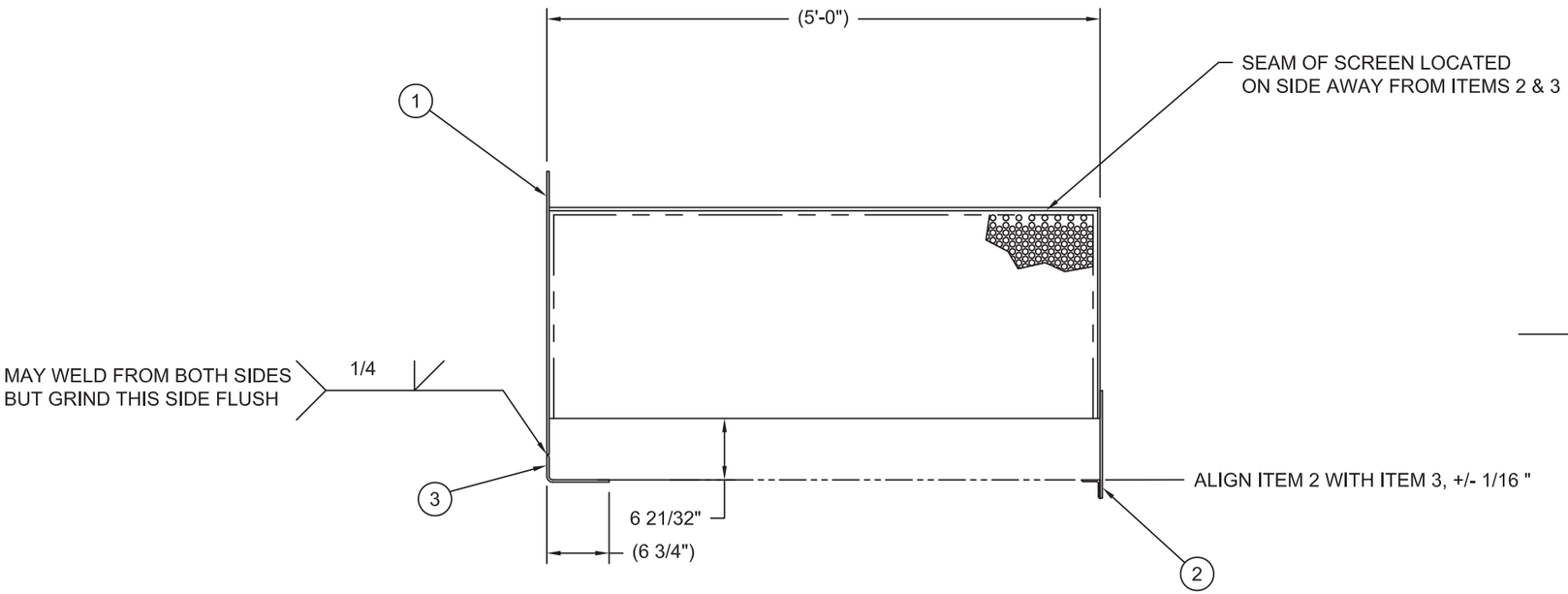
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±1/32" ON HOLE Ø AND LOCATIONS	.015 = .XX
±1° ON ANGULAR DIMENSIONS	.005 = .XXX
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[X.XXX] = INSPECTION DIM	BREAK ALL SHARP EDGES

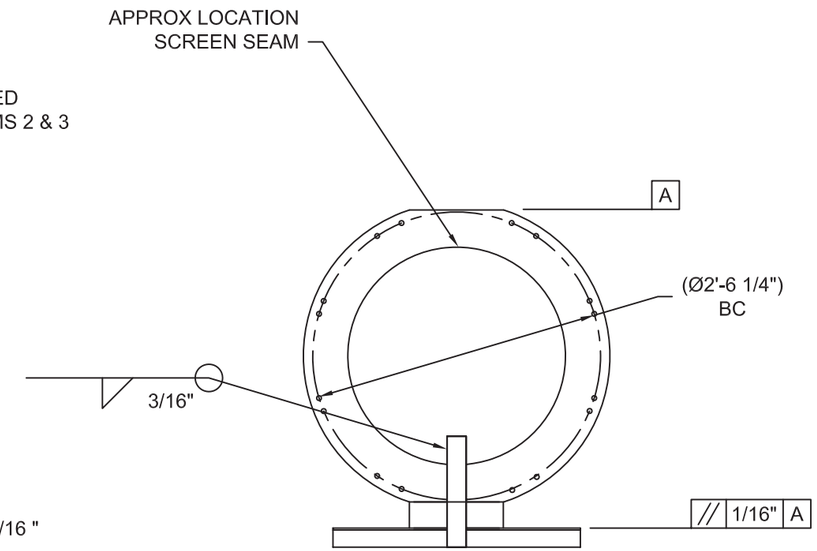
ANOXKALDNES
FLASHING, PERFORATED, 14 GA, 2'-0" X 4'-0", Ø5/8" HOLES, 13/16" CENTERS, STAGGERED

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
CDP	SRW	1 : 12	930F-1229	1 of 1	1

EST. WT.: 176 LBS.

ITEM	QTY	MATERIAL	DRAWING NUMBER	DESCRIPTION
1	1	SEE BOM	930F-1050	WELDMENT,CYLINDRICAL SCREEN
2	1	SEE BOM	930F-1049	WELDMENT, SPARGER SUPPORT, CYLINDRICAL SCREEN
3	1	SEE BOM	930F-1048	BRKT, PIPE SUPPORT, CYLINDRICAL SCREEN, FOR 2-1/2", 3", & 4" PIPE





NOTES:
1. REFER TO KRUGER "WELDING FABRICATION PROCEDURE" FOR WELD SPECIFICATIONS.
2. REMOVE WELD SLAG, CLEAN AND DEGREASE BEFORE PASSIVATION OR PAINTING.
3. UNFINISHED END PATTERNS.

REV	DESCRIPTION	DRAWN	APPR	DATE
1	REMOVED NOTE AND CHANGED ITEM #3 DESCRIPTION	LHB	SRW	05.12.15
0	RELEASE FOR FABRICATION	CDP	.	1.21.15

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I. KRUGER, INC.
401 HARRISON OAKS BLVD
CARY, NC 27513
(919) 677-8310

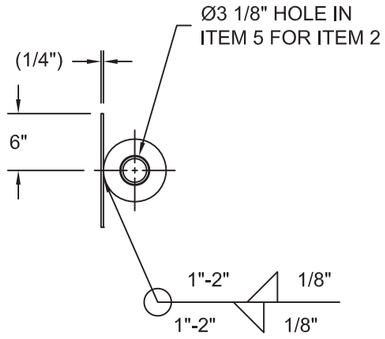
FABRICATION TOLERANCES AND NOTES
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(X.XXX) = INSPECTION DIM
BREAK ALL SHARP EDGES

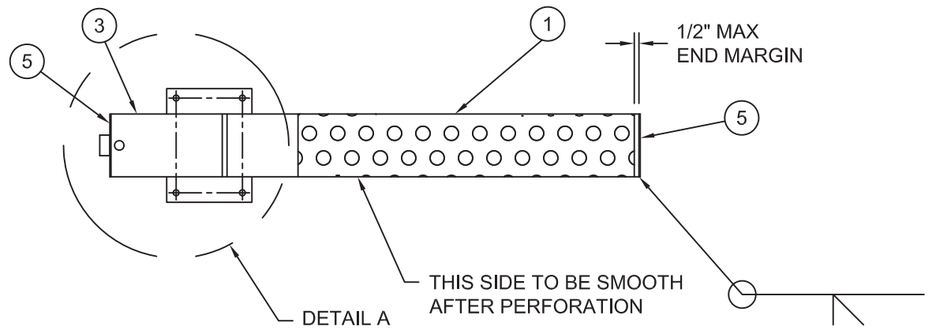
ANOXKALDNES
WLDMT, CYLINDRICAL SCREEN, PERF., Ø23", 5'-0"LG
Ø5/8" HOLES, 13/16" CTR, STAGGER, W/ PIPE HANGER

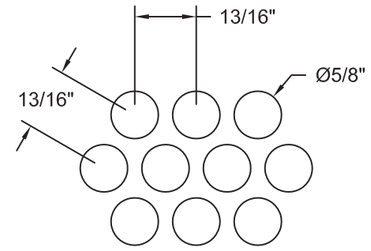
DRAWN	CHECKED		SCALE	DRAWING NO	SHEET	REV
CHG	.		1 : 16	930F-1230	1 of 1	1

EST. WT.: 35 LBS.

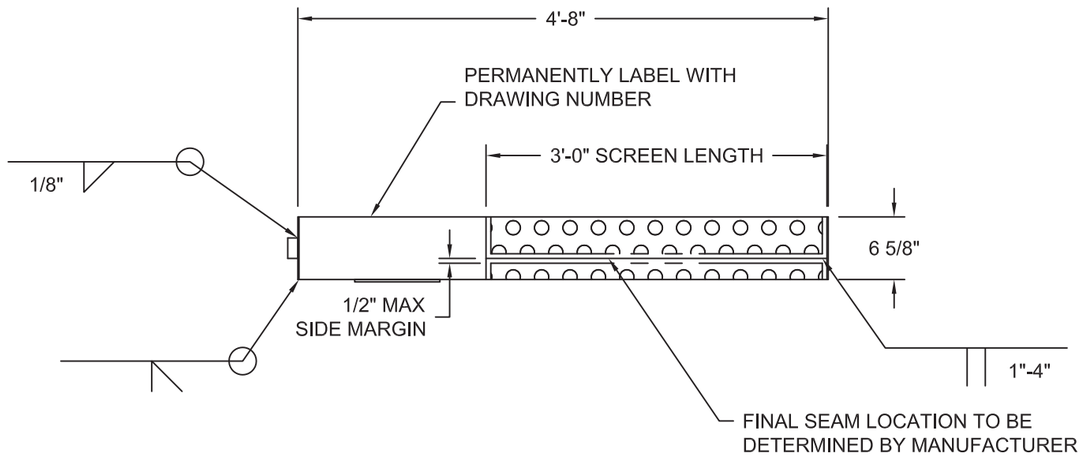
ITEM	QTY	MATERIAL	DRAWING NUMBER	DESCRIPTION
1	1	AISI 304L	-	SHEET, 14 GA, 20.88" X 36.00"LG
2	1	AISI 304L	-	CPLG, HALF, 2", 1000PSI, BUTT WELD
3	1	AISI 304L	-	PIPE, 6", SCH 10, 19.75"LG
4	1	AISI 304L	-	PLATE, .25" X 9.00" X 12.00"LG
5	2	AISI 304L	-	PLATE, .13" x 6.63" SQ

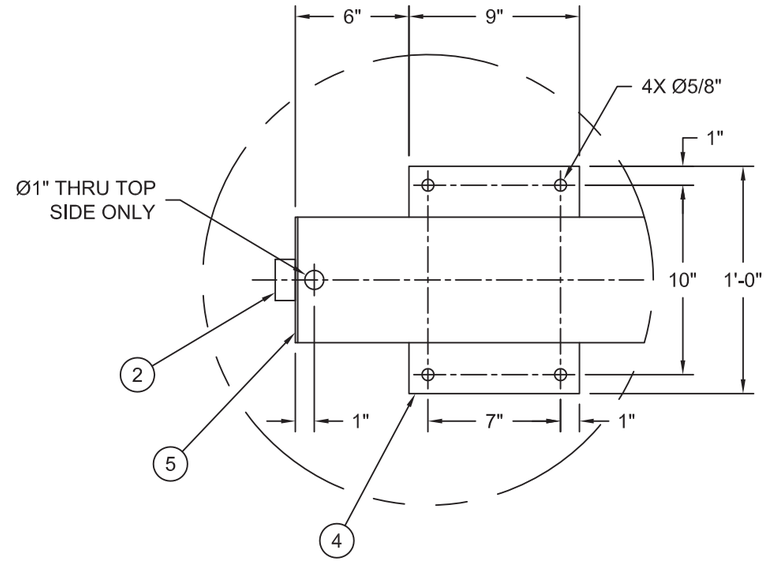






PERFORATION DETAIL
SCALE 1:2





DETAIL A
MOUNTING PLATE DETAIL
SCALE 1:8

NOTES:
1. REFER TO KRUGER "WELDING FABRICATION PROCEDURE" FOR WELD SPECIFICATIONS.
2. REMOVE WELD SLAG, CLEAN AND DEGREASE BEFORE PASSIVATION OR PAINTING.

REV	DESCRIPTION	DRAWN	APPR	DATE
0	RELEASED FOR FABRICATION	CDP	.	1.21.15

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(919) 677-8310

FABRICATION TOLERANCES AND NOTES

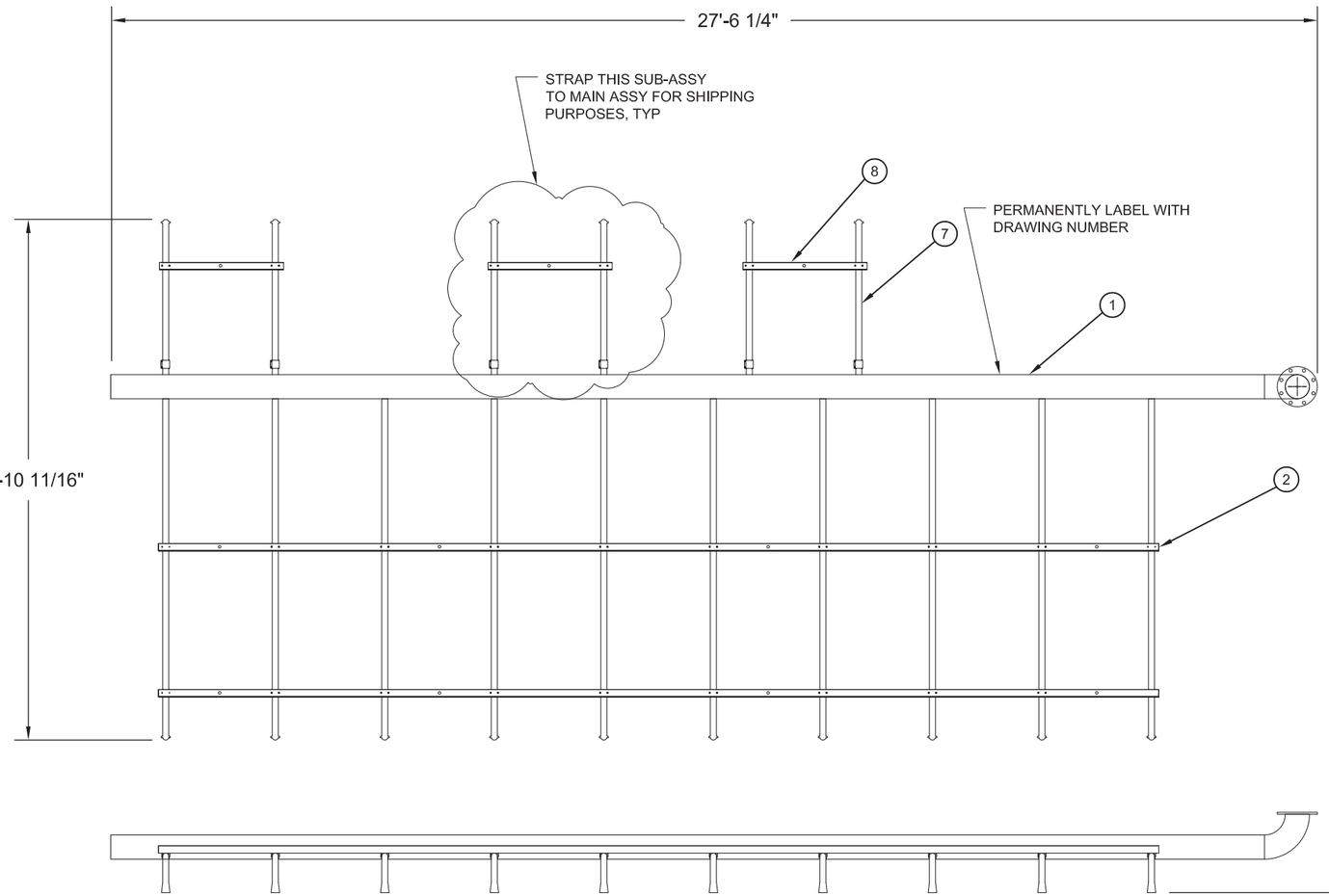
±1/8" ON LINEAR DIMENSIONS .030 = .X
±1/32" ON HOLE n AND LOCATIONS .015 = .XX
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(X.XXX) = REFERENCE DIM
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BREAK ALL SHARP EDGES

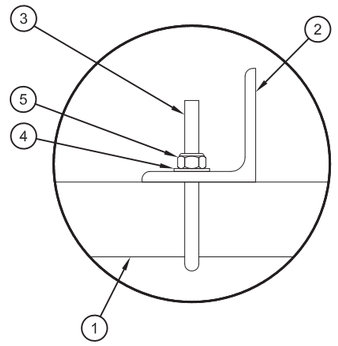
ANOXKALDNES
WLDMT, GUIDED RADAR SCREEN, 6", 4'-8" LG, PERF., Ø5/8" HOLES, 13/16" CENTERS

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
SRW	.	1 : 16	930F-1231	1 of 1	0

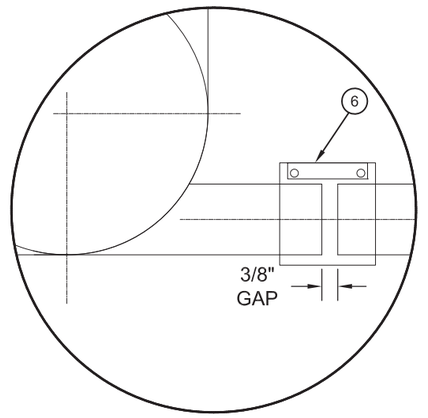
EST. WT.: 572 LBS.

ITEM	QTY	MATERIAL	DRAWING NUMBER	DESCRIPTION
1	1	SEE BOM	930F-1324	WLDMT, AERATION GRID, 6", (10+6) 1-1/4" LATS @ 30" O.C., 8'-6" W, 220 HOLES, FLANGED INLET, OPEN OUTLET, RH
2	2	AISI 304L	930F-1320	AERATION GRID SUPPORT ANGLE, 2" X 2" X 3/16" X 22'-10" LG, (10) 1-1/4" LATERALS @ 30" O.C.
3	26	AISI 304	-	U-BOLT, 1 1/4", 1/4-20, DALE Co. #U35 OR EQUIV, W/O NUTS
4	52	AISI 304	-	WSHR, FLAT, 1/4", .313" ID, .625" OD, .051" THK, SAE
5	52	AISI 304	-	NUT, HEX, NYLOCK, 1/4-20, ANSI
6	6	AISI 304		COUPLING, PIPE, FLEXIBLE, 1-1/4", STRAUB-GRIP-L-1.25-IPS-SS-E-SI
7	6	AISI 304L	930F-1323	LATERAL, 1-1/4" PIPE w/TURNDOWN, 3'-3" LG., 9 HOLES
8	3	AISI 304L	930F-1322	AERATION GRID SUPPORT ANGLE, 2" X 2" X 3/16" X 2'-10" LG, (2) 1-1/4" LATERALS @ 30" O.C.

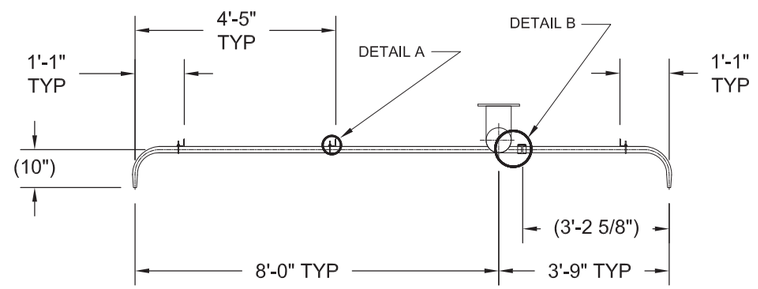




DETAIL A
AERATION GRID WELDMENT TO
SUPPORT ANGLE CONNECTION
SCALE 1:15



DETAIL B
AERATION GRID WELDMENT TO
LATERAL CONNECTION
SCALE 1:15



NOTES:
1. CLEAN AND DEGREASE PARTS BEFORE ASSEMBLY.
2. ANTI-SEIZE TO BE APPLIED TO ALL HDWR UNLESS OTHERWISE SPECIFIED.
3. ALL HDWR TO BE TIGHTENED TO APPROPRIATE TORQUE VALUES.

REV	DESCRIPTION	DRAWN	APPR	DATE
1	ITEM 1 WAS 25'-9 1/8", HOLE COUNT WAS 362	CDP	.	08.26.15
0	RELEASED FOR FABRICATION	CDP	.	06.02.15

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(919) 677-8310

FABRICATION TOLERANCES AND NOTES

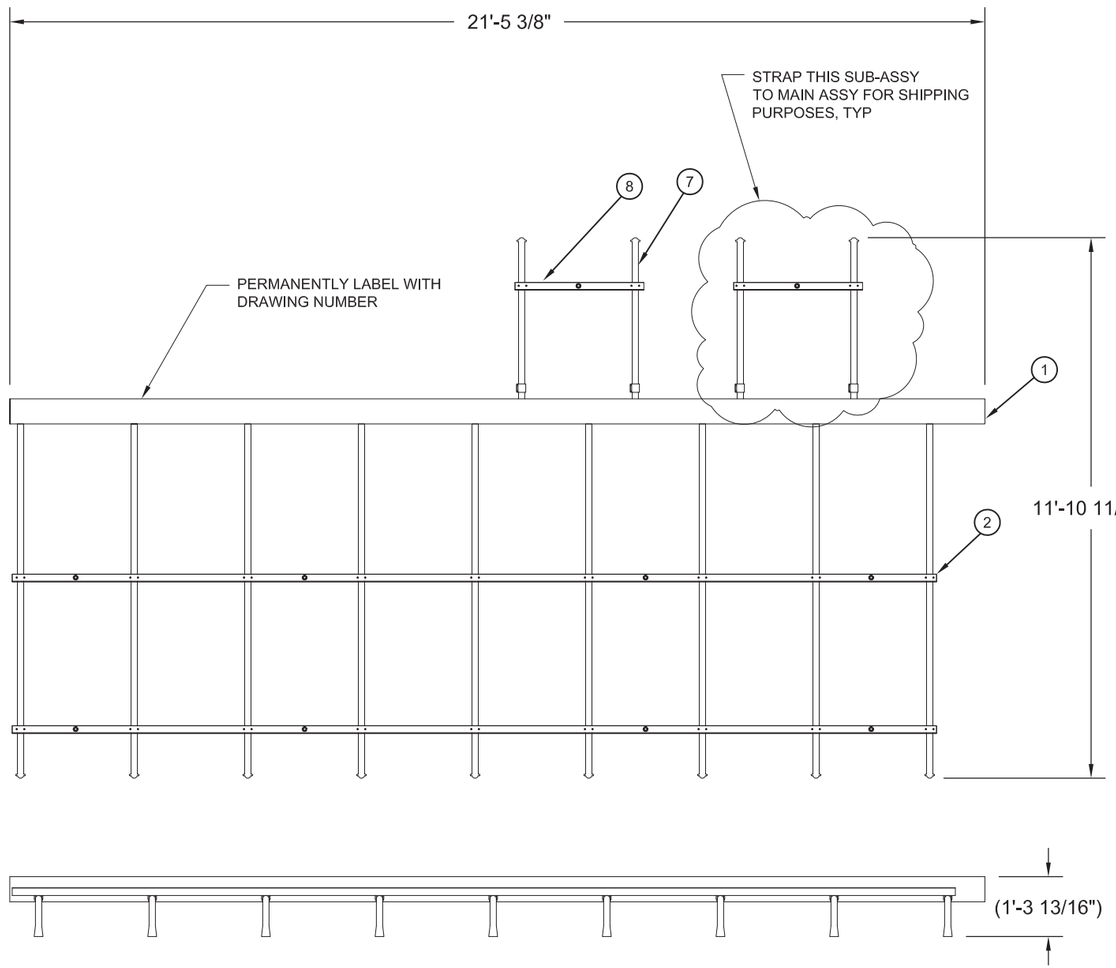
±1/8" ON LINEAR DIMENSIONS	.030 = .X
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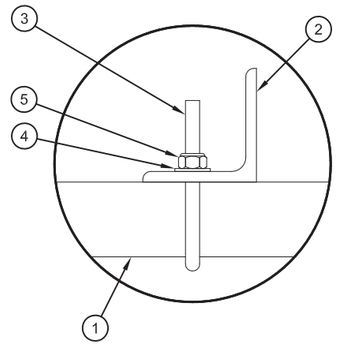
ANOXKALDNES
ASSY, AERATION GRID, 6", (10+6) 1-1/4" LATS @ 30" O.C.
274 HOLES, 11'-9" W, VERT FLG. INLET, OPEN OUTLET, RH

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
CDP	.	1 : 40	930F-1298	1 of 1	1

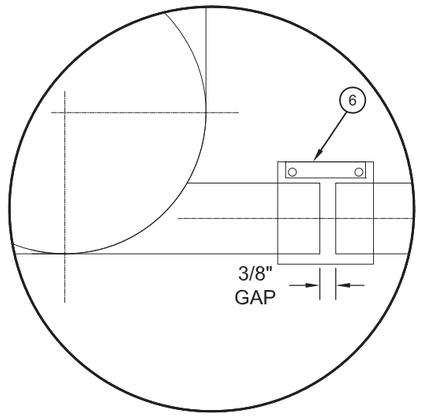
EST. WT.: 470 LBS.

ITEM	QTY	MATERIAL	DRAWING NUMBER	DESCRIPTION
1	1	SEE BOM	930F-1325	WLDMT, ASSY, AERATION GRID, 6", (9+4) 1-1/4" LATS @ 30" O.C., 198 HOLES, 8'-6" W, OPEN INLET, CAPPED OUTLET, RH
2	2	AISI 304L	930F-1317	AERATION GRID SUPPORT ANGLE, 2" X 2" X 3/16" X 20'-4" LG, (9) 1-1/4" LATERALS @ 30" O.C.
3	22	AISI 304	-	U-BOLT, 1 1/4", 1/4-20, DALE Co. #U35 OR EQUIV, W/O NUTS
4	44	AISI 304	-	WSHR, FLAT, 1/4", .313" ID, .625" OD, .051" THK, SAE
5	44	AISI 304	-	NUT, HEX, NYLOCK, 1/4-20, ANSI
6	4	AISI 304		COUPLING, PIPE, FLEXIBLE, 1-1/4", STRAUB-GRIP-L-1.25-IPS-SS-E-SI
7	4	AISI 304L	930F-1323	LATERAL, 1-1/4" PIPE w/TURNDOWN, 3'-3" LG., 9 HOLES
8	2	AISI 304L	930F-1322	AERATION GRID SUPPORT ANGLE, 2" X 2" X 3/16" X 2'-10" LG, (2) 1-1/4" LATERALS @ 30" O.C.

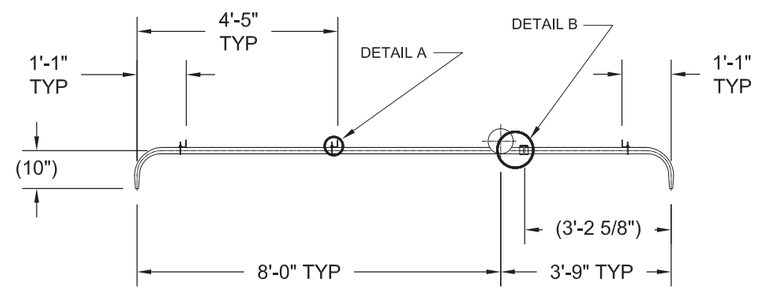




DETAIL A
AERATION GRID WELDMENT TO
SUPPORT ANGLE CONNECTION
SCALE 1:15



DETAIL B
AERATION GRID WELDMENT TO
LATERAL CONNECTION
SCALE 1:15



NOTES:
1. CLEAN AND DEGREASE PARTS BEFORE ASSEMBLY.
2. ANTI-SEIZE TO BE APPLIED TO ALL HDWR UNLESS OTHERWISE SPECIFIED.
3. ALL HDWR TO BE TIGHTENED TO APPROPRIATE TORQUE VALUES.

REV	DESCRIPTION	DRAWN	APPR	DATE
1	NUMBER OF HOLES WAS 336	CDP	.	08.24.15
0	RELEASED FOR FABRICATION	CDP	.	06.02.15

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FABRICATION TOLERANCES AND NOTES

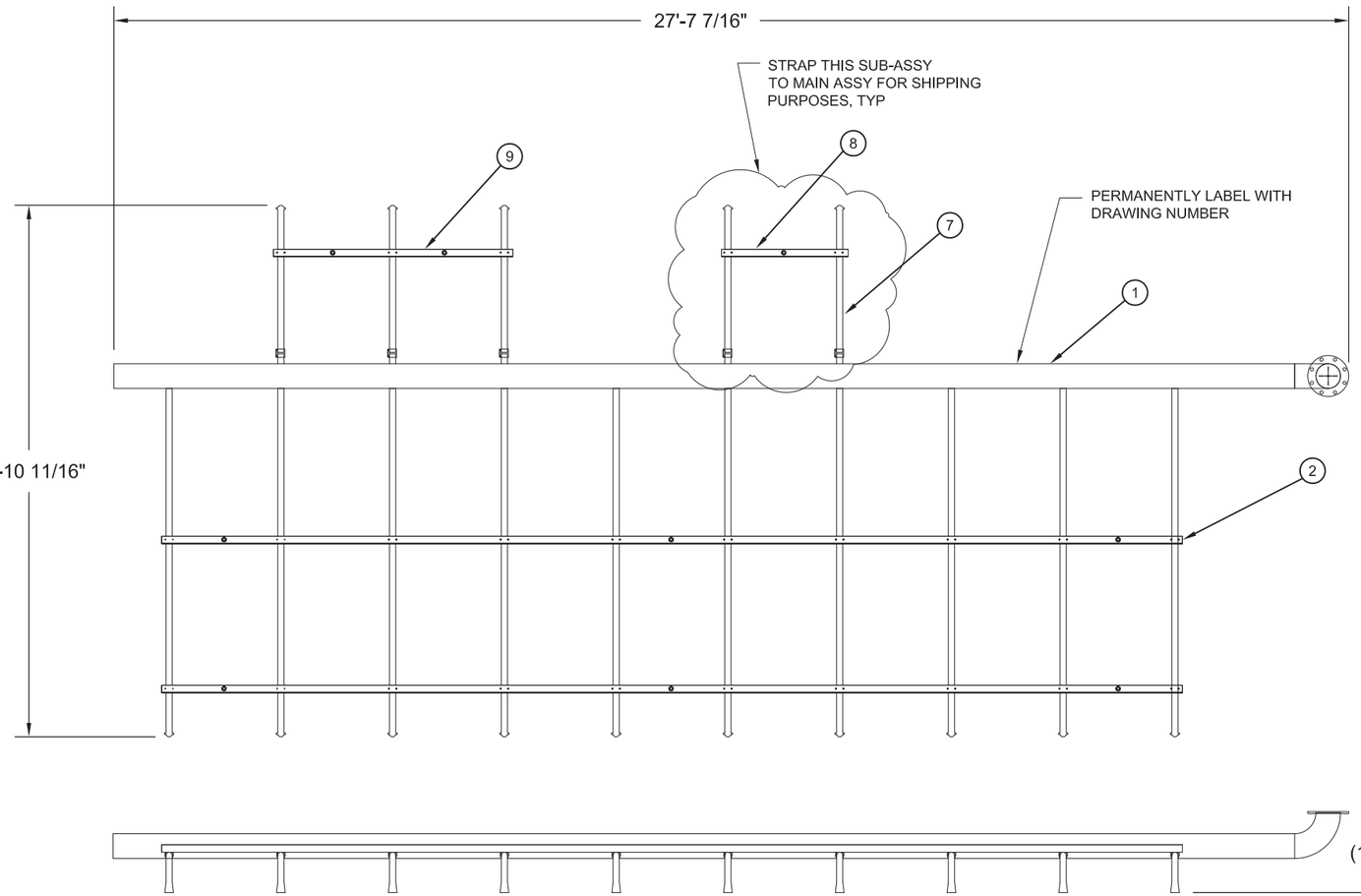
±1/8" ON LINEAR DIMENSIONS	.030 = .X
±1/32" ON HOLE Ø AND LOCATIONS	.015 = .XX
±1° ON ANGULAR DIMENSIONS	.005 = .XXX
(X.XXX) = REFERENCE DIM	
X.XXX = INSPECTION DIM	BREAK ALL SHARP EDGES

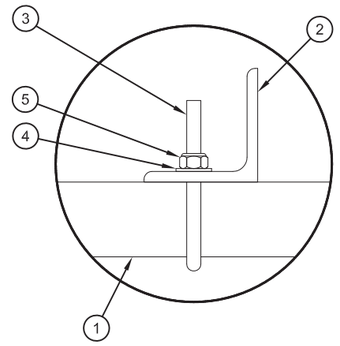
ANOXKALDNES
ASSY, AERATION GRID, 6", (9+4) 1-1/4" LATS @ 30" O.C.
11'-9" W, 234 HOLES, OPEN INLET, CAPPED OUTLET, RH

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
CDP	.	1 : 40	930F-1299	1 of 1	1

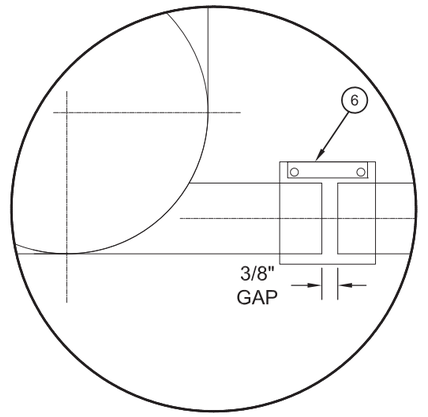
EST. WT.: 564 LBS.

ITEM	QTY	MATERIAL	DRAWING NUMBER	DESCRIPTION
1	1	SEE BOM	930F-1326	WLDMT, AERATION GRID, 6", (10+5) 1-1/4" LATS @ 30" O.C., 8'-6" W, 220 HOLES, FLANGED INLET, OPEN OUTLET, RH
2	2	AISI 304L	930F-1320	AERATION GRID SUPPORT ANGLE, 2" X 2" X 3/16" X 22'-10" LG, (10) 1-1/4" LATERALS @ 30" O.C.
3	26	AISI 304	-	U-BOLT, 1 1/4", 1/4-20, DALE Co. #U35 OR EQUIV, W/O NUTS
4	52	AISI 304	-	WSHR, FLAT, 1/4", .313" ID, .625" OD, .051" THK, SAE
5	52	AISI 304	-	NUT, HEX, NYLOCK, 1/4-20, ANSI
6	6	AISI 304		COUPLING, PIPE, FLEXIBLE, 1-1/4", STRAUB-GRIP-L-1.25-IPS-SS-E-SI
7	5	AISI 304L	930F-1323	LATERAL, 1-1/4" PIPE w/TURNDOWN, 3'-3" LG., 9 HOLES
8	1	AISI 304L	930F-1322	AERATION GRID SUPPORT ANGLE, 2" X 2" X 3/16" X 2'-10" LG, (2) 1-1/4" LATERALS @ 30" O.C.
9	1	AISI 304L	930F-1327	AERATION GRID SUPPORT ANGLE, 2" X 2" X 3/16" X 5'-4" LG, (3) 1-1/4" LATERALS @ 30" O.C.

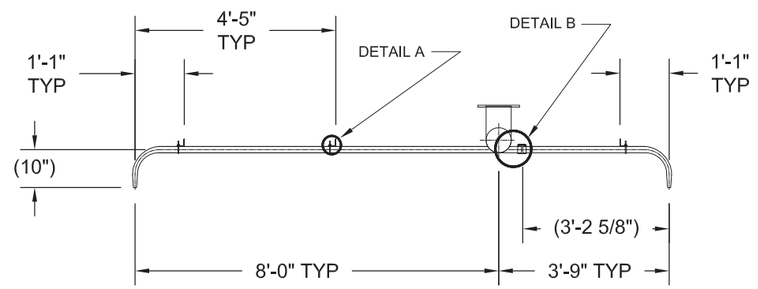




DETAIL A
AERATION GRID WELDMENT TO
SUPPORT ANGLE CONNECTION
SCALE 1:15



DETAIL B
AERATION GRID WELDMENT TO
LATERAL CONNECTION
SCALE 1:15



NOTES:
1. CLEAN AND DEGREASE PARTS BEFORE ASSEMBLY.
2. ANTI-SEIZE TO BE APPLIED TO ALL HDWR UNLESS OTHERWISE SPECIFIED.
3. ALL HDWR TO BE TIGHTENED TO APPROPRIATE TORQUE VALUES.

REV	DESCRIPTION	DRAWN	APPR	DATE
1	ITEM 1 WAS 25-9 1/8", HOLE COUNT WAS 350	CDP	.	08.26.15
0	RELEASED FOR FABRICATION	CDP	.	06.02.15

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FABRICATION TOLERANCES AND NOTES

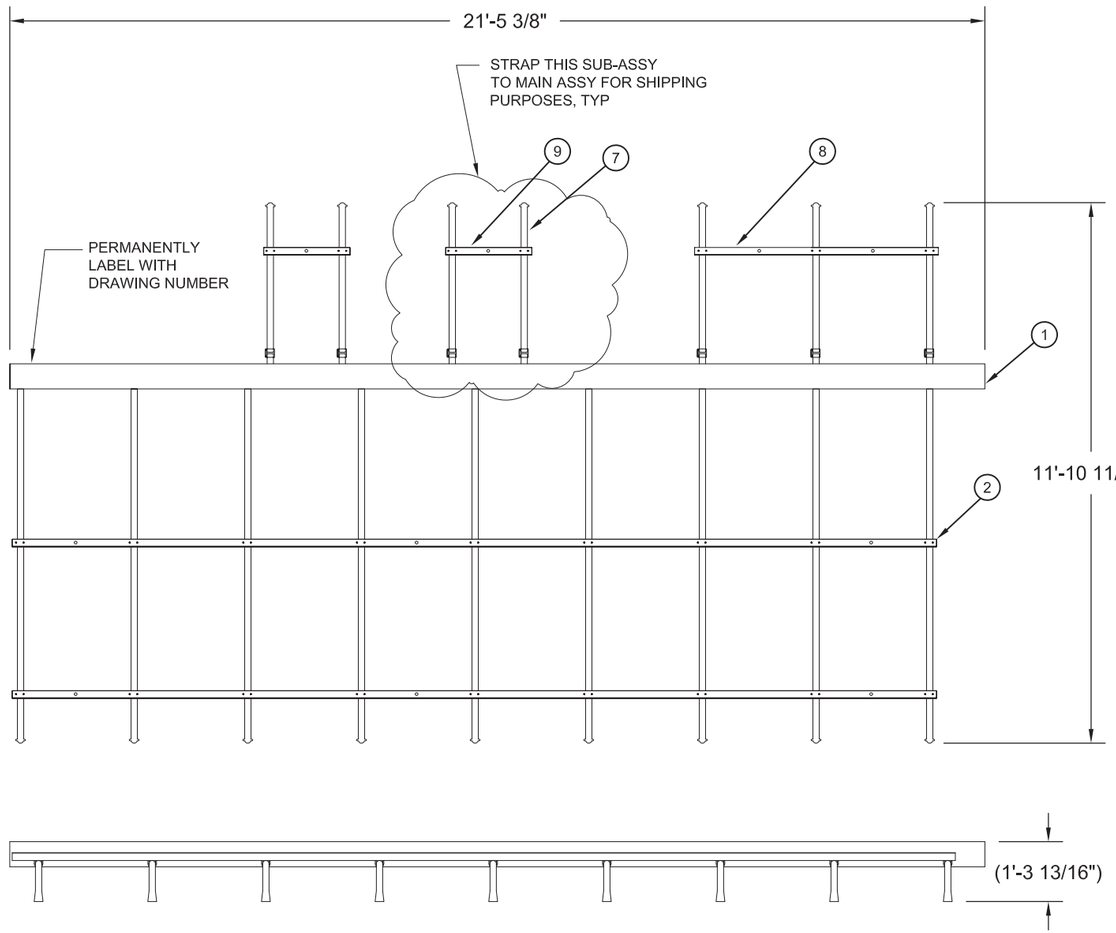
±1/8" ON LINEAR DIMENSIONS	.030 = .X
±1/32" ON HOLE Ø AND LOCATIONS	.015 = .XX
±1° ON ANGULAR DIMENSIONS	.005 = .XXX
(X.XXX) = REFERENCE DIM	
(X.XXX) = INSPECTION DIM	BREAK ALL SHARP EDGES

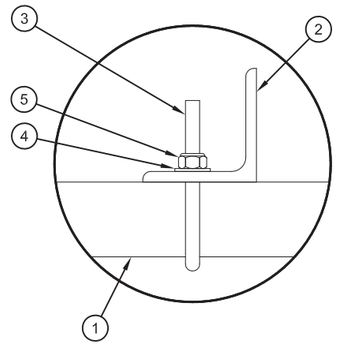
ANOXKALDNES
ASSY, AERATION GRID, 6", (10+5) 1-1/4" LATS @ 30" O.C.
265 HOLES, 11'-9" W, VERT. FLG. INLET, OPEN OUTLET, RH

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
DSD	.	1 : 40	930F-1300	1 of 1	1

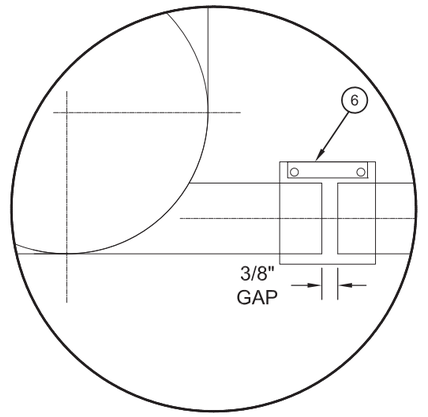
EST. WT.: 512 LBS.

ITEM	QTY	MATERIAL	DRAWING NUMBER	DESCRIPTION
1	1	SEE BOM	930F-1329	WLDMT, AERATION GRID, 6", (9+7) 1-1/4" LATS @ 30" O.C., 198 HOLES, 8'-6" W, OPEN INLET, CAPPED OUTLET, RH
2	2	AISI 304L	930F-1317	AERATION GRID SUPPORT ANGLE, 2" X 2" X 3/16" X 20'-4" LG, (9) 1-1/4" LATERALS @ 30" O.C.
3	25	AISI 304	-	U-BOLT, 1 1/4", 1/4-20, DALE Co. #U35 OR EQUIV, W/O NUTS
4	50	AISI 304	-	WSHR, FLAT, 1/4", .313" ID, .625" OD, .051" THK, SAE
5	50	AISI 304	-	NUT, HEX, NYLOCK, 1/4-20, ANSI
6	7	AISI 304		COUPLING, PIPE, FLEXIBLE, 1-1/4", STRAUB-GRIP-L-1.25-IPS-SS-E-SI
7	7	AISI 304L	930F-1323	LATERAL, 1-1/4" PIPE w/TURNDOWN, 3'-3" LG., 9 HOLES
8	1	AISI 304L	930F-1327	AERATION GRID SUPPORT ANGLE, 2" X 2" X 3/16" X 2'-10" LG, (3) 1-1/4" LATERALS @ 30" O.C.
9	2	AISI 304L	930F-1328	AERATION GRID SUPPORT ANGLE, 2" X 2" X 3/16" X 1'-7" LG, (2) 1-1/4" LATERALS @ 30" O.C.

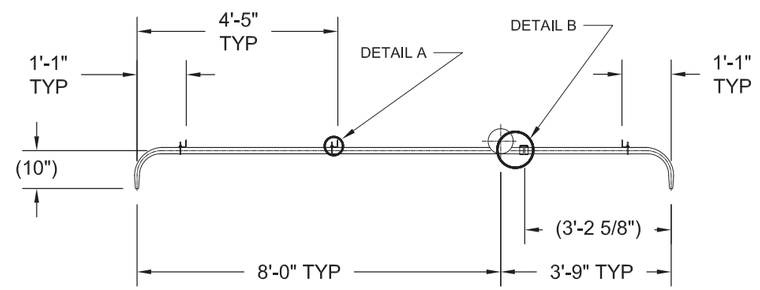




DETAIL A
AERATION GRID WELDMENT TO
SUPPORT ANGLE CONNECTION
SCALE 1:15



DETAIL B
AERATION GRID WELDMENT TO
LATERAL CONNECTION
SCALE 1:15



NOTES:
1. CLEAN AND DEGREASE PARTS BEFORE ASSEMBLY.
2. ANTI-SEIZE TO BE APPLIED TO ALL HDWR UNLESS OTHERWISE SPECIFIED.
3. ALL HDWR TO BE TIGHTENED TO APPROPRIATE TORQUE VALUES.

REV	DESCRIPTION	DRAWN	APPR	DATE
1	HOLE COUNT WAS 336	CDP	.	08.26.15
0	RELEASED FOR FABRICATION	CDP	.	06.02.15

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FABRICATION TOLERANCES AND NOTES

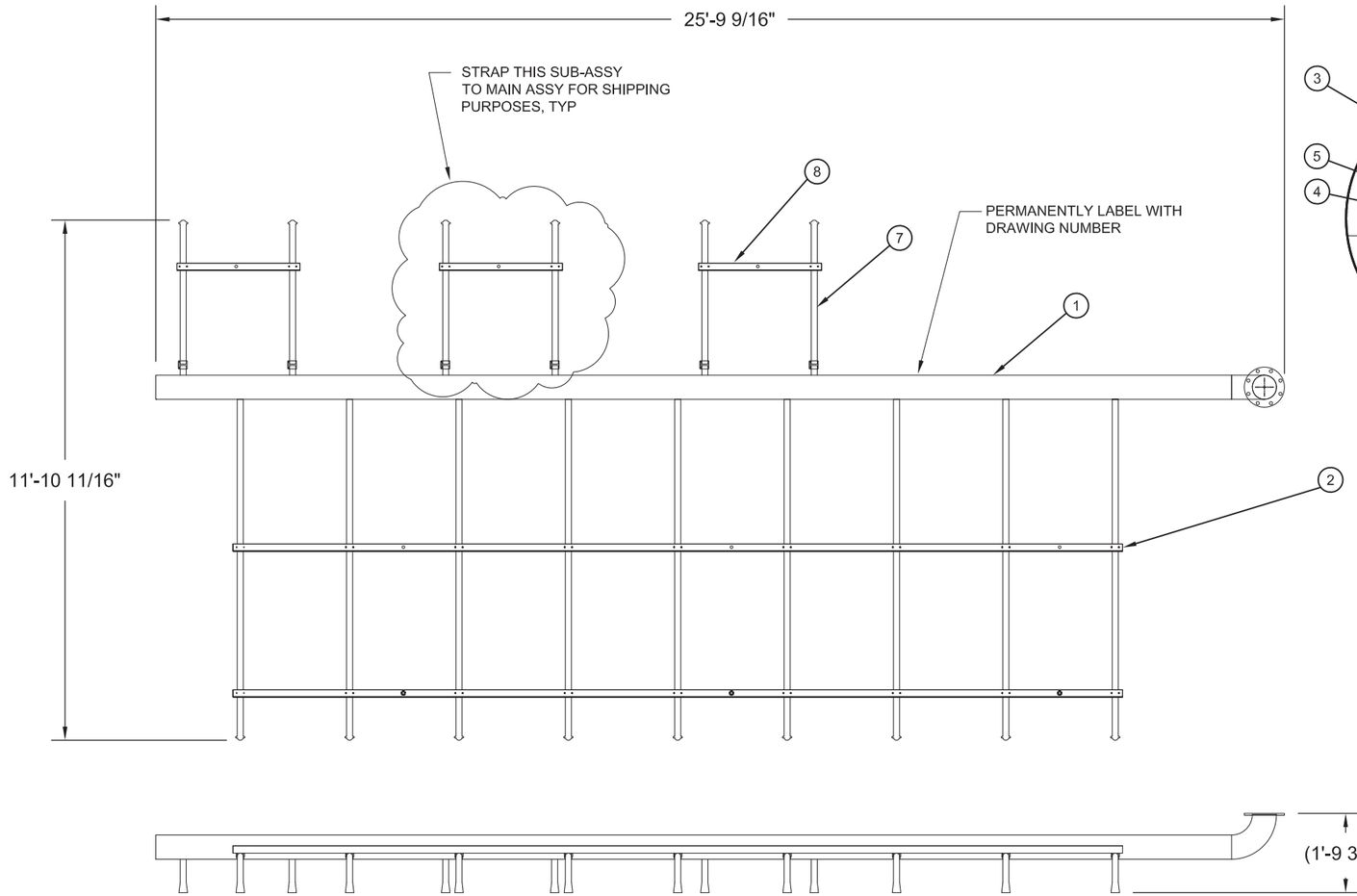
±1/8" ON LINEAR DIMENSIONS	.030 = .X
±1/32" ON HOLE Ø AND LOCATIONS	.015 = .XX
±1° ON ANGULAR DIMENSIONS	.005 = .XXX
(X.XXX) = REFERENCE DIM	
(X.XXX) = INSPECTION DIM	BREAK ALL SHARP EDGES

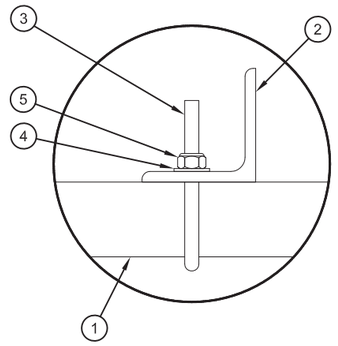
ANOXKALDNES
ASSY, AERATION GRID, 6", (9+7) 1-1/4" LATS @ 30" O.C
261 HOLES, 11'-9" W, OPEN INLET, CAPPED OUTLET, RH

DRAWN	CHECKED		SCALE	DRAWING NO	SHEET	REV
CDP	.		1 : 40	930F-1301	1 of 1	1

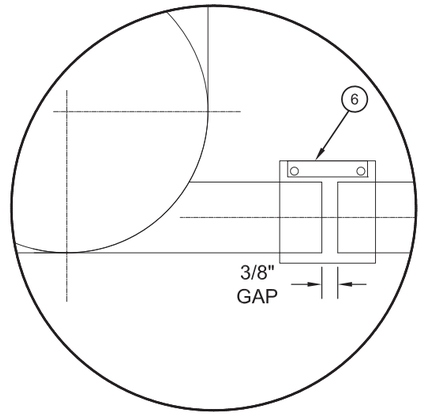
EST. WT.: 542 LBS.

ITEM	QTY	MATERIAL	DRAWING NUMBER	DESCRIPTION
1	1	SEE BOM	930F-1330	WLDMT, AERATION GRID, 6", (9+6) 1-1/4" LATS @ 30" O.C., 198 HOLES, 8'-6" W, VERT. FLG INLET, OPEN OUTLET, RH
2	2	AISI 304L	930F-1317	AERATION GRID SUPPORT ANGLE, 2" X 2" X 3/16" X 20'-4" LG, (9) 1-1/4" LATERALS @ 30" O.C.
3	26	AISI 304	-	U-BOLT, 1 1/4", 1/4-20, DALE Co. #U35 OR EQUIV, W/O NUTS
4	52	AISI 304	-	WSHR, FLAT, 1/4", .313" ID, .625" OD, .051" THK, SAE
5	52	AISI 304	-	NUT, HEX, NYLOCK, 1/4-20, ANSI
6	6	AISI 304	-	COUPLING, PIPE, FLEXIBLE, 1-1/4", STRAUB-GRIP-L-1.25-IPS-SS-E-SI
7	6	AISI 304L	930F-1323	LATERAL, 1-1/4" PIPE w/TURNDOWN, 3'-3" LG., 9 HOLES
8	3	AISI 304L	930F-1322	AERATION GRID SUPPORT ANGLE, 2" X 2" X 3/16" X 2'-10" LG, (2) 1-1/4" LATERALS @ 30" O.C.

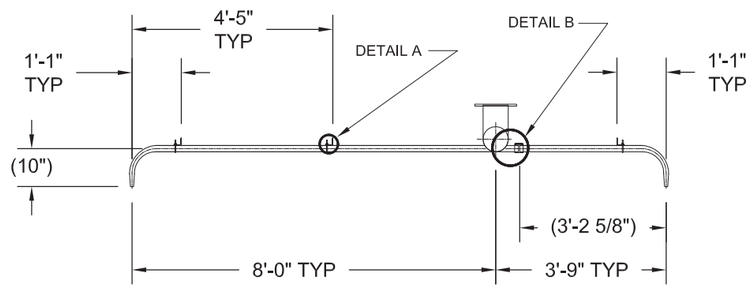




DETAIL A
AERATION GRID WELDMENT TO
SUPPORT ANGLE CONNECTION
SCALE 1:15



DETAIL B
AERATION GRID WELDMENT TO
LATERAL CONNECTION
SCALE 1:15



NOTES:
1. CLEAN AND DEGREASE PARTS BEFORE ASSEMBLY.
2. ANTI-SEIZE TO BE APPLIED TO ALL HDWR UNLESS OTHERWISE SPECIFIED.
3. ALL HDWR TO BE TIGHTENED TO APPROPRIATE TORQUE VALUES.

REV	DESCRIPTION	DRAWN	APPR	DATE
1	ITEM 1 WAS 23'-11 7/16", HOLE COUNT WAS 333	CDP	.	08.26.15
0	RELEASED FOR FABRICATION	CDP	.	06.02.15

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FABRICATION TOLERANCES AND NOTES

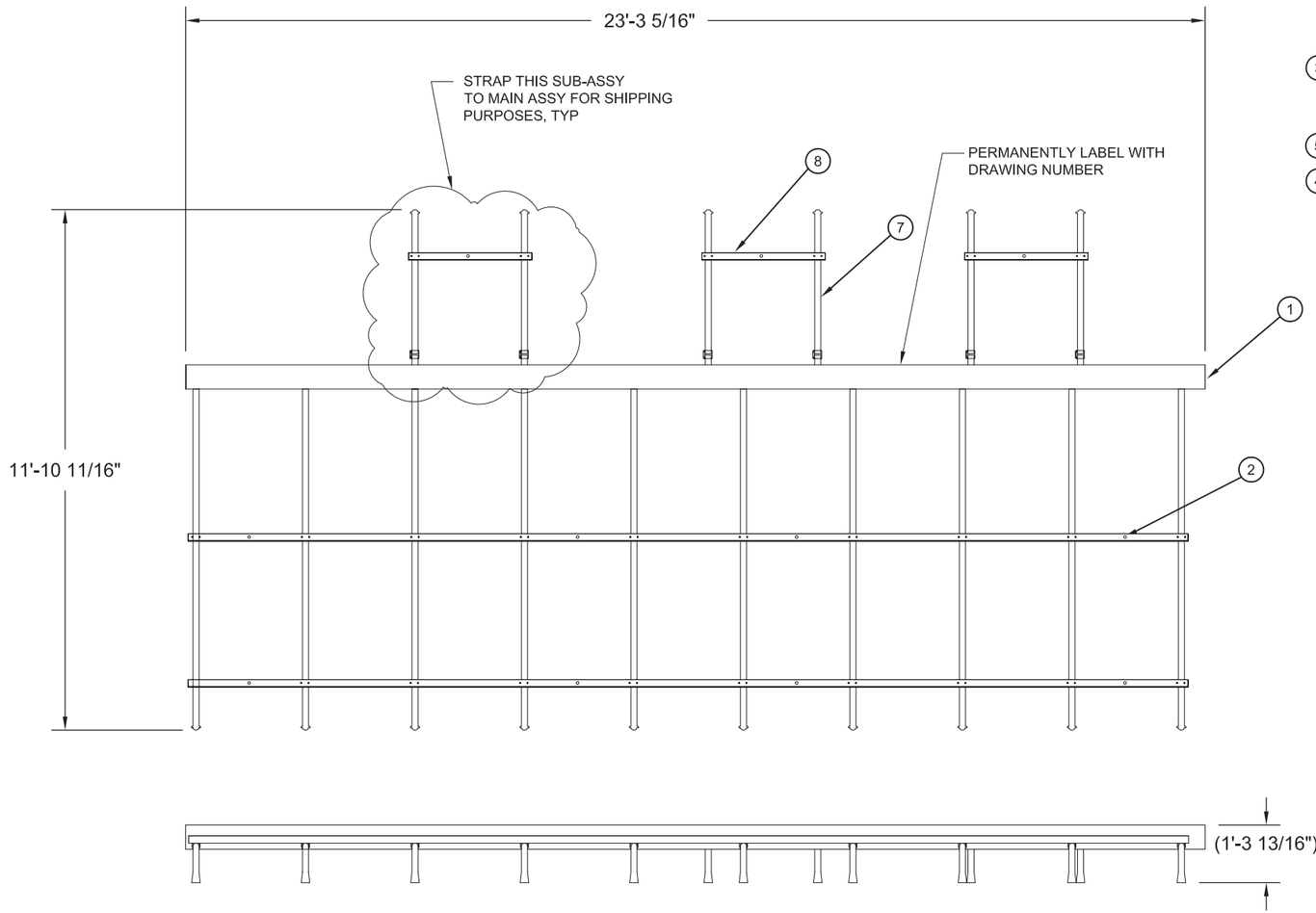
±1/8" ON LINEAR DIMENSIONS	.030 = .X
±1/32" ON HOLE Ø AND LOCATIONS	.015 = .XX
±1° ON ANGULAR DIMENSIONS	.005 = .XXX
(X.XXX) = REFERENCE DIM	
(X.XXX) = INSPECTION DIM	BREAK ALL SHARP EDGES

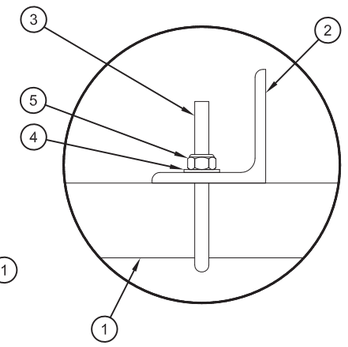
ANOXKALDNES
ASSY, AERATION GRID, 6", (9+6) 1-1/4" LATS @ 30" O.C.
11'-9" W, 252 HOLES, VERT. FLG. INLET, OPEN OUTLET, RH

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
CDP	.	1 : 40	930F-1302	1 of 1	1

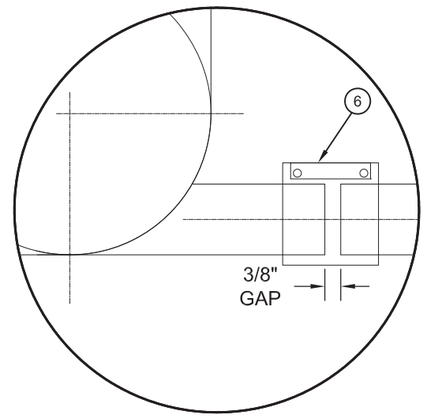
EST. WT.: 523 LBS.

ITEM	QTY	MATERIAL	DRAWING NUMBER	DESCRIPTION
1	1	SEE BOM	930F-1331	WLDMT, AERATION GRID, 6", (10+6) 1-1/4" LATS @ 30" O.C., 220 HOLES, 8'-6" W, OPEN INLET, OPEN OUTLET, RH
2	2	AISI 304L	930F-1320	AERATTION GRID SUPPORT ANGLE, 2" X 2" X 3/16" X 22'-10" LG, (10) 1-1/4" LATERALS @ 30" O.C.
3	26	AISI 304	-	U-BOLT, 1 1/4", 1/4-20, DALE Co. #U35 OR EQUIV, W/O NUTS
4	52	AISI 304	-	WSHR, FLAT, 1/4", .313" ID, .625" OD, .051" THK, SAE
5	52	AISI 304	-	NUT, HEX, NYLOCK, 1/4-20, ANSI
6	6	AISI 304	-	COUPLING, PIPE, FLEXIBLE, 1-1/4", STRAUB-GRIP-L-1.25-IPS-SS-E-SI
7	6	AISI 304L	930F-1323	LATERAL, 1-1/4" PIPE w/TURNDOWN, 3'-3" LG., 9 HOLES
8	3	AISI 304L	930F-1322	AERATION GRID SUPPORT ANGLE, 2" X 2" X 3/16" X 2'-10" LG, (2) 1-1/4" LATERALS @ 30" O.C.

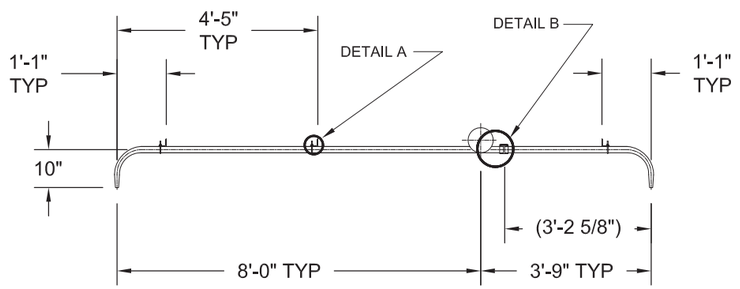




DETAIL A
AERATION GRID WELDMENT TO
SUPPORT ANGLE CONNECTION
SCALE 1:15



DETAIL B
AERATION GRID WELDMENT TO
LATERAL CONNECTION
SCALE 1:15



NOTES:
1. CLEAN AND DEGREASE PARTS BEFORE ASSEMBLY.
2. ANTI-SEIZE TO BE APPLIED TO ALL HDWR UNLESS OTHERWISE SPECIFIED.
3. ALL HDWR TO BE TIGHTENED TO APPROPRIATE TORQUE VALUES.

REV	DESCRIPTION	DRAWN	APPR	DATE
1	HOLE COUNT WAS 362	CDP	.	08.27.15
0	RELEASED FOR FABRICATION	CDP	.	06.02.15

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(919) 677-8310

FABRICATION TOLERANCES AND NOTES

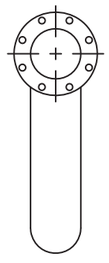
±1/8" ON LINEAR DIMENSIONS	.030 = .X
±1/32" ON HOLE Ø AND LOCATIONS	.015 = .XX
±1° ON ANGULAR DIMENSIONS	.005 = .XXX
(X.XXX) = REFERENCE DIM	
(X.XXX) = INSPECTION DIM	BREAK ALL SHARP EDGES

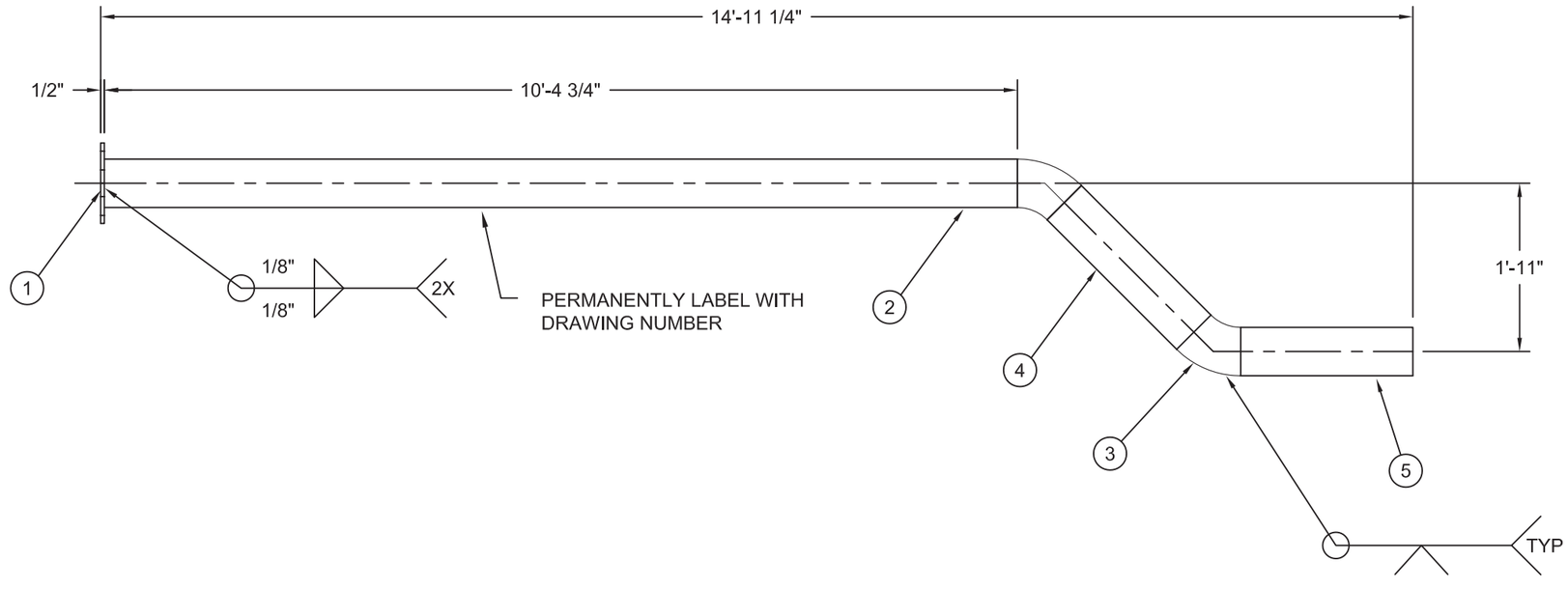
ANOXKALDNES
ASSY, AERATION GRID, 6", (10+6) 1-1/4" LATS @ 30" O.C.
274 HOLES, 11'-9" W, OPEN INLET, OPEN OUTLET, RH

DRAWN	CHECKED		SCALE	DRAWING NO	SHEET	REV
CDP	.		1 : 40	930F-1303	1 of 1	1

EST WT.: 155 LBS

ITEM	QTY	MATERIAL	DRAWING NUMBER	DESCRIPTION
1	1	AISI 304L	-	FLG, PIPE, PL, 6", 1/2" THK, 125LB
2	1	AISI 304L	-	PIPE, 6", SCH 10, 125.00" LG
3	2	AISI 304L	-	ELB, 6", SCH 10, 45 DEG
4	1	AISI 304L	-	PIPE, 6", SCH 10, 25.03" LG
5	1	AISI 304L	-	PIPE, 6", SCH 10, 23.50" LG





NOTES:
1. REFER TO KRUGER "WELDING FABRICATION PROCEDURE" FOR WELD SPECIFICATIONS.
2. REMOVE WELD SLAG, CLEAN AND DEGREASE BEFORE PASSIVATION OR PAINTING.

REV	DESCRIPTION	DRAWN	APPR	DATE
0	RELEASED	CDP	.	08.19.15

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±1° ON ANGULAR DIMENSIONS .005 = .XXX
(X.XXX) = REFERENCE DIM
(X.XXX) = INSPECTION DIM
BREAK ALL SHARP EDGES

ANOXKALDNES
WLDMT, DROP PIPE, 6", SCH10, FLG. ONE END, 2X 45 DEG. OFFSET, 14'-11 1/4"LG

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
CDP	.	1 : 20	930F-1334	1 of 1	0

KRÜGER

SECTION 3.4.4

EPOXY ADHESIVE ANCHORING SYSTEM

VEOLIA WATER
Solutions & Technologies

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HILTI

Submittal Package

SUBMITTED TO:

To:

Firm:

Project:

Date of Submittal:

PRODUCT SUBMITTAL:

Submitted Product:

Specified Product:

Section: Page: Paragraph: Detail/Sheet No.:

Description of Application:

SUBMITTED BY:

Name: Signature:

Company:

Address:

Phone:

Email:

FOR ARCHITECT/ENGINEER USE:

Approved: ☐ Approved As Noted ☐ Not Approved: ☐

If not approved, briefly explain:

By: Date:

Remarks:

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. Installation Instructions for RE 500 Epoxy Adhesive..... 17

. Material Safety Data Sheet (MSDS) for RE 500 Epoxy Adhesive..... 57

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Attached are page(s) from the 2014 Hilti North American Product Tech Guide. For complete details on this product, including data development, product specifications, general suitability, installation, corrosion, and spacing and edge distance guidelines, please refer to the Technical Guide, or contact Hilti.

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5400 South 122nd East Avenue
Tulsa, OK 74146

1-800-879-8000
www.hilti.com

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3.2.5 HIT-RE 500 Epoxy Adhesive Anchoring System

3.2.5.1 Product Description

3.2.5.2 Material Specifications

3.2.5.3 Technical Data

3.2.5.4 Installation Instructions

3.2.5.5 Ordering Information

Listings/Approvals

NSF/ANSI Std 61
certification for use in potable water
Europan Technical Approval
ETA-04/0027
ETA-08/0105

Independent Code Evaluation

LEED® Credit 4.1-Low Emitting Materials

The Leadership in Energy and Environmental Design (LEED®) Green Building Rating system™ is the nationally accepted benchmark for the design, construction and operation of high performance green buildings.

3.2.5.1 Product Description

The Hilti HIT-RE 500 System is a high strength, two part epoxy adhesive. The system consists of a side-by-side adhesive refill pack, a mixing nozzle, a HIT dispenser with refill pack holder, and either a threaded rod, rebar, HIS internally threaded insert or smooth epoxy coated bar. HIT-RE 500 is specifically designed for fastening into solid base materials such as concrete, grout, stone or solid masonry.
HIT-RE 500 is also suitable for use under exceptional conditions such as:

- Underwater Fastenings
- Oversized Holes
- Diamond Cored Holes

To meet specific handling requirements for those conditions, refer to instructions for use and/or contact Hilti for assistance.

Product Features

- Superior bond performance
- Use in diamond cored or pneumatic drilled holes.
- Underwater applications down to 165 ft (50 m)
- Meets DOT requirements for most states. Contact Hilti Technical Services for more information.
- Meets requirements of ASTM C881-90, Type IV, Grade 2 and 3, Class A, B, C except gel times
- Meets requirements of AASHTO specification M235, Type IV, Grade 3, Class A, B, C except gel times
- Mixing tube provides proper mixing, eliminates measuring errors and minimizes waste
- Contains no styrene and virtually odorless
- May be installed in concrete with temperatures ranging from 23°F to 104°F (-5°C to 40°C) with no degrading of bond strength.
- May be installed in concrete with temperatures ranging from 23°F to 104°F (-5°C to 40°C) with no degrading of bond strength.
- Good bond strength in elevated service temperatures
- Excellent resistance to weathering
- Suitable for oversized holes

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HIT-RE 500 Epoxy Adhesive Anchoring System 3.2.5

Guide Specifications

Master format section:

Previous	2004 Format	
03250	**03 16 00**	Concrete Anchors

Related Sections:

03200	**03 20 00**	Concrete Reinforcing
05050	**05 50 00**	Metal Fabrications
05120	**05 10 00**	Structural Metal Framing

Injectable adhesive shall be used for installation of all reinforcing steel dowels or threaded anchor rods and inserts into existing concrete. Adhesive shall be furnished in side-by-side refill packs which keep component A and component B separate. Side-by-side packs shall be designed to compress during use to minimize waste volume. Side-by-side packs shall also be designed to accept static mixing nozzle which thoroughly blends component A and component B and allows injection directly into drilled hole. Only injection tools and static mixing nozzles as supplied by manufacturer shall be used. Manufacturer's instructions shall be followed. Injection adhesive shall be formulated to include resin and hardener to provide optimal curing speed as well as high strength and stiffness. Typical curing time at 68°F (20°C) shall be approximately 12 hours.

Injection adhesive shall be HIT-RE 500 as furnished by Hilti.

Anchor rods shall be end stamped to show the grade of steel and overall rod length. Anchor rods shall be manufactured to meet the following requirements:

1. ISO 898 Class 5.8

2. ASTM A193, Grade B7 high strength carbon steel anchor;

3. AISI 304 or AISI 316 stainless steel, meeting the requirements of ASTM F593 condition CW.

Special order length HAS Rods may vary from standard product.

Nuts and washers Shall be furnished to meet the requirements of the above anchor rod specifications.

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3.2.5 HIT-RE 500 Epoxy Adhesive Anchoring System

3.2.5.2 Material Specifications

Table 1 - Material properties of fully cured HIT-RE 500 adhesive

Bond Strength ASTM C882-91[1] 2 day cure 7 day cure	 12.4 MPa 12.4 MPa	 1,800 psi 1,800 psi
Compressive Strength ASTM D695-96[1]	82.7 MPa	12,000 psi
Compressive Modulus ASTM D695-96[1]	1,493 MPa	0.22 x 10^6 psi
Tensile Strength 7 day ASTM D638-97	43.5 MPa	6,310 psi
Elongation at break ASTM D638-97	2.0%	
Heat Deflection Temperature ASTM D648-95	63°C	146°F
Absorption ASTM D570-95	0.06%	
Linear Coefficient of Shrinkage on Cure ASTM D2566-86	0.004	
Electrical resistance DIN IEC 93 (12.93)	6.6 x 10^{13} Ω/m	1.7 x 10^{12} Ω/in.

1 Minimum values obtained as the result of tests at 23°F, 40°F and 60°F.

HAS-E carbon steel specifications

Carbon steel rods conform to ISO 898 class 5.8 with a minimum tensile strength of 72.5 ksi (500 MPa) and a minimum yield strength of 58 ksi (400 MPa).

HAS-E nuts conform to SAE J995 Grade 5

HAS-E washers conform to ASTM F884, HV, and ANSI B18.22.1 Type A Plain.

HAS-E rod, nut and washer has an electroplated zinc coating conforming to ASTM B633, SC 1

HAS Super high strength specifications

Carbon steel rods manufactured from ASTM A193, Grade B7, with a minimum tensile strength of 125 ksi (862 MPa) and a minimum yield strength of 105 ksi (724 MPa).

HAS Super nuts conform to SAE J995 Grade 5

HAS Super washers conform to ASTM F884, HV, and ANSI B18.22.1 Type A Plain.

HAS Super rods, nuts and washers, except the 7/8-in. diameter, have an electroplated zinc coating conforming to ASTM B633, SC 1

7/8-in. HAS Super rods, nuts and washers are hot-dip galvanized in accordance with ASTM A153

HAS-R 304 stainless steel specifications

3/8-, 1/2- and 5/8-in. rods manufactured from AISI Type 304 stainless steel conforming to ASTM F593 Condition CW with a minimum tensile strength of 100 ksi (689 MPa) and a minimum yield strength of 65 ksi (448 MPa).

3/4-, 1- and 1 1/4-in. rods are manufactured from AISI Type 304 stainless steel conforming to ASTM F593 Condition CW with a minimum tensile strength of 85 ksi (586 MPa) and a minimum yield strength of 45 ksi (310 MPa).

AISI Type 304 stainless steel nuts conform to ASTM F594

AISI Type 304 stainless steel washers conform to ASTM A240 and ANSI B18.22.1 Type A Plain.

HAS-R 316 stainless steel specifications

3/8-, 1/2- and 5/8-in. rods manufactured from AISI Type 316 stainless steel with a minimum tensile strength of 100 ksi (689 MPa) and a minimum yield strength of 65 ksi (448 MPa).

3/4-, 1- and 1 1/4-in. rods are manufactured from AISI Type 316 stainless steel conforming to ASTM F593 Condition CW or cold worked.

AISI Type 316 stainless steel nuts conform to ASTM F594

AISI Type 316 stainless steel washers conform to ASTM A240 and ANSI B18.22.1 Type A Plain.

HIS-N and HIS-NR internally threaded insert specifications

3/8-in. HIS-N is manufactured from 11MnPb30+C carbon steel conforming to DIN 10277-3 with a minimum tensile strength of 71.1 ksi (490 MPa) and a minimum yield strength of 59.5 ksi (410 MPa).

1/2-, 5/8- and 3/4-in. HIS-N is manufactured from 11MnPb30+C carbon steel conforming to DIN 10277-3 with a minimum tensile strength of 66.7 ksi (460 MPa) and a minimum yield strength of 54.4 ksi (375 MPa).

HIS-NR is manufactured from X5CrNiMo 17122 K700 stainless steel conforming to DIN EN 10088-3 with a minimum tensile strength of 101.5 ksi (700 MPa) and a minimum yield strength of 50.8 ksi (350 MPa).

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3.2.5.3 Technical Data

Table 2 - HAS rod installation specifications installed with HIT-RE 500 adhesive anchor system

Setting information	Symbol	Units	Nominal anchor diameter						
			3/8	1/2	5/8	3/4	7/8	1	1-1/4
Drill bit diameter[1]	d_o	in.	7/16	9/16	11/16	13/16	15/16	1-1/16	1-1/2
Standard effective embedment	$h_{ef,std}$	in.	3-1/2	4-1/4	5	6-5/8	7-1/2	8-1/4	12
		(mm)	(90)	(110)	(125)	(170)	(190)	(210)	(305)
Installation torque embedment ≥ $h_{ef,std}$	T_{inst}	ft-lb	18	30	75	150	175	235	400
		(Nm)	(24)	(41)	(102)	(203)	(237)	(319)	(540)
Installation torque embedment < $h_{ef,std}$	T_{inst}	ft-lb	15	20	50	105	125	165	280
		(Nm)	(20)	(27)	(68)	(142)	(169)	(224)	(375)
Minimum concrete member thickness	h_{min}	in.	h_{ef}+2					h_{ef}+2-1/4	h_{ef}+3
		(mm)	h_{ef}+51					h_{ef}+57	h_{ef}+76

1 Hole may be drilled with rotary hammer drill or Hilti DD EC-1 Diamond Coring System.

Table 3 - HIS-N and HIS-RN installation specifications with HIT-RE 500 adhesive anchor system

Setting information		Symbol	Units	Thread size			
				3/8-16 UNC	1/2-13 UNC	5/8-11 UNC	3/4-10 UNC
Outside diameter of insert		d	in.	0.65	0.81	1.00	1.09
Nominal bit diameter[1]		d_o	in.	11/16	7/8	1-1/8	1-1/4
Standard effective embedment		$h_{ef,std}$	in.	4-3/8	5	6-5/8	8-1/4
			(mm)	(110)	(125)	(170)	(210)
Bolt engagement	minimum	h_s	in.	3/8	1/2	5/8	3/4
	maximum		in.	15/16	1-3/16	1-1/2	1-7/8
Installation torque		T_{inst}	ft-lb	18	30	75	150
			(Nm)	(24)	(41)	(102)	(203)
minimum concrete member thickness		h_{min}	in.	5.9	6.7	9.1	10.6
			(mm)	(150)	(170)	(230)	(270)

1 Hole may be drilled with rotary hammer drill or Hilti DD EC-1 Diamond Coring System.

Table 4 - Rebar installation specifications with HIT-RE 500 adhesive anchor system

Setting information	Symbol	Units	Rebar size								
			No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11
Drill bit diameter[1,2]	d_o	in.	1/2	5/8	3/4	7/8	1	1-1/8	1-3/8	1-1/2	1-3/4

1 Rebar diameters may vary. Use the smallest diameter drill bit which will accomodate the rebar.
2 Hole may be drilled with rotary hammer drill or Hilti DD EC-1 Diamond Coring System.

Figure 1— HAS rod specifications

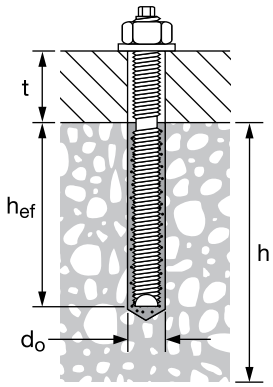
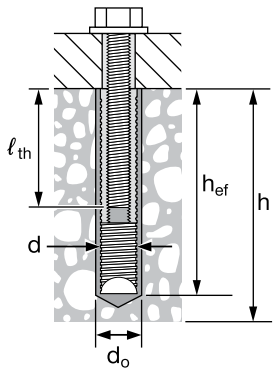


Figure 2— HIS-N and HIS-RN specifications



Combined shear and tension loading

$$\left(\frac{N_d}{N_{rec}}\right)^{5/3} + \left(\frac{V_d}{V_{rec}}\right)^{5/3} \leq 1.0$$

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3.2.5 HIT-RE 500 Epoxy Adhesive Anchoring System

Table 5 - HIT-RE 500 allowable and ultimate bond/concrete capacity for HAS rods in normal weight concrete[1,2,3,4]

Nominal anchor diameter in.	Effective embedment in. (mm)	HIT-RE 500 Allowable bond/concrete capacity				HIT-RE 500 Ultimate bond/concrete capacity			
		Tensile		Shear		Tensile		Shear	
		f'_c = 2000 psi (13.8 MPa) lb (kN)	f'_c = 4000 psi (27.6 MPa) lb (kN)	f'_c = 2000 psi (13.8 MPa) lb (kN)	f'_c = 4000 psi (27.6 MPa) lb (kN)	f'_c = 2000 psi (13.8 MPa) lb (kN)	f'_c = 4000 psi (27.6 MPa) lb (kN)	f'_c = 2000 psi (13.8 MPa) lb (kN)	f'_c = 4000 psi (27.6 MPa) lb (kN)
3/8	1-3/4 (44)	645 (2.9)	1,095 (4.9)	1,510 (6.7)	2,135 (9.5)	2,580 (11.5)	4,370 (19.4)	4,530 (20.2)	6,405 (28.4)
	3-3/8 (86)	2,190 (9.7)	2,585 (11.5)	3,155 (14.0)	4,460 (19.8)	8,760 (39.0)	10,345 (46.0)	9,460 (42.1)	13,380 (59.5)
	4-1/2 (114)	2,420 (10.8)	2,585 (11.5)	4,855 (21.6)	6,860 (30.5)	9,685 (43.1)	10,335 (46.0)	14,560 (64.8)	20,580 (91.5)
1/2	2-1/4 (57)	1,130 (5.0)	1,965 (8.7)	2,510 (11.2)	3,550 (15.8)	4,530 (20.2)	7,860 (35.0)	7,525 (33.5)	10,640 (47.3)
	4-1/2 (114)	4,045 (18.0)	5,275 (23.5)	5,610 (25.0)	7,935 (35.3)	16,185 (72.0)	21,095 (93.8)	16,820 (74.8)	23,800 (105.9)
	6 (152)	4,775 (21.2)	5,380 (23.9)	8,635 (38.4)	12,210 (54.3)	19,095 (84.9)	21,520 (95.7)	25,900 (115.2)	36,620 (162.9)
5/8	2-7/8 (73)	1,690 (7.5)	3,045 (13.5)	5,245 (23.3)	7,420 (33.0)	6,770 (30.1)	12,175 (54.2)	15,735 (70.0)	22,250 (99.0)
	5-5/8 (143)	6,560 (29.2)	7,355 (32.7)	8,760 (39.0)	12,395 (55.1)	26,240 (116.7)	29,420 (130.9)	26,280 (116.9)	37,180 (165.4)
	7-1/2 (190)	7,320 (32.6)	7,515 (33.4)	13,615 (60.6)	19,080 (84.9)	29,290 (130.3)	30,060 (133.7)	40,480 (180.1)	57,240 (254.6)
3/4	3-3/8 (86)	2,310 (10.3)	4,515 (20.1)	7,335 (32.6)	10,370 (46.1)	9,250 (41.1)	18,065 (80.4)	22,000 (97.9)	31,108 (138.4)
	6-3/4 (172)	8,670 (38.6)	10,755 (47.8)	12,615 (56.1)	17,840 (79.4)	34,685 (154.3)	43,020 (191.4)	37,840 (168.3)	53,520 (238.1)
	9 (229)	10,385 (46.2)	12,995 (57.8)	19,430 (86.4)	27,470 (122.2)	41,535 (184.8)	51,985 (231.2)	58,280 (259.2)	82,400 (366.5)
7/8	4 (101)	3,005 (13.4)	5,665 (25.2)	7,795 (34.7)	11,020 (49.0)	12,030 (53.5)	22,670 (100.8)	23,375 (104.0)	33,050 (147.0)
	7-7/8 (200)	12,495 (55.6)	15,875 (70.6)	17,175 (76.4)	24,290 (108.0)	49,975 (222.3)	63,495 (282.4)	51,520 (229.2)	72,860 (324.1)
	10-1/2 (267)	14,705 (65.4)	16,185 (72.0)	26,440 (117.6)	37,390 (166.3)	58,820 (261.6)	64,730 (287.9)	79,320 (352.8)	112,160 (498.9)
1	4-1/2 (114)	3,945 (17.5)	8,440 (37.5)	10,035 (44.6)	14,190 (63.1)	15,790 (70.2)	33,765 (150.2)	30,104 (133.9)	42,565 (189.3)
	9 (229)	13,845 (61.6)	17,365 (77.2)	22,435 (99.8)	31,720 (141.1)	55,380 (246.3)	69,465 (309.0)	67,300 (299.4)	95,160 (423.3)
	12 (305)	17,935 (79.8)	17,935 (79.8)	34,535 (153.6)	48,830 (217.2)	71,740 (319.1)	71,740 (319.1)	103,600 (460.8)	146,480 (651.6)
1-1/4	5-5/8 (143)	5,760 (25.6)	12,815 (57.0)	14,760 (65.7)	20,870 (92.8)	23,045 (102.5)	51,270 (228.1)	44,280 (197.0)	62,610 (278.5)
	11-1/4 (286)	24,610 (109.5)	31,620 (140.7)	35,050 (155.9)	49,570 (220.5)	9,8430 (437.8)	126,480 (562.6)	105,140 (467.7)	148,710 (661.5)
	15 (381)	34,130 (151.8)	35,270 (156.9)	53,960 (240.0)	76,300 (339.4)	136,525 (607.3)	141,090 (627.6)	161,880 (720.1)	228,900 (1018.2)

1 Influence factors for spacing and/or edge distance are applied to allowable concrete/bond values above, and then compared to the steel value. The lesser of the values is to be used for the design.

2 Average ultimate concrete shear capacity based on Strength Design Method for standard and deep embedment and based on testing for shallow embedment.

3 All values based on holes drilled with carbide bit and installed per manufacturer's instructions. Ultimate tensile concrete/bond loads represent the average values obtained in testing.

4 For underwater applications with a maximum depth of 165 ft (50 m), reduce the tabulated concrete/bond values 30% to account for reduced mechanical properties of saturated concrete.

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Table 6 - Allowable steel strength for carbon steel and stainless steel HAS rods[1]

Nominal anchor diameter in.	HAS-E ISO 898 Class 5.8		HAS Super ASTM A193 B7		HAS SS AISI 304/316 SS	
	Tensile	Shear	Tensile	Shear	Tensile	Shear
	lb (kN)	lb (kN)	lb (kN)	lb (kN)	lb (kN)	lb (kN)
3/8	2,640 (11.7)	1,360 (6.0)	4,555 (20.3)	2,345 (10.4)	3,645 (16.2)	1,875 (8.3)
1/2	4,700 (20.9)	2,420 (10.8)	8,100 (36.0)	4,170 (18.5)	6,480 (28.8)	3,335 (14.8)
5/8	7,340 (32.7)	3,780 (16.8)	12,655 (56.3)	6,520 (29.0)	10,125 (45.0)	5,215 (23.2)
3/4	10,570 (47.0)	5,445 (24.2)	18,225 (81.1)	9,390 (41.8)	12,390 (55.1)	6,385 (28.4)
7/8	14,385 (64.0)	7,410 (33.0)	24,805 (110.3)	12,780 (56.9)	16,865 (75.0)	8,690 (38.6)
1	18,790 (83.6)	9,680 (43.0)	32,400 (144.1)	16,690 (74.2)	22,030 (98.0)	11,350 (50.5)
1-1/4	29,360 (130.6)	15,125 (67.3)	50,620 (225.2)	26,080 (116.0)	34,425 (153.1)	17,735 (78.9)

1 Steel strength as defined in AISC Manual of Steel Construction (ASD):

Tensile = 0.33 x F_u x Nominal Area
Shear = 0.17 x F_u x Nominal Area

Table 7 - Ultimate steel strength for carbon steel and stainless steel HAS rods[1]

Nominal anchor diameter in.	HAS-E ISO 898 Class 5.8			HAS Super ASTM A193 B7			HAS SS AISI 304/316 SS		
	Yield	Tensile	Shear	Yield	Tensile	Shear	Yield	Tensile	Shear
	lb (kN)	lb (kN)	lb (kN)	lb (kN)	lb (kN)	lb (kN)	lb (kN)	lb (kN)	lb (kN)
3/8	4,495 (20.0)	6,005 (26.7)	3,605 (16.0)	8,135 (36.2)	10,350 (43.4)	6,210 (27.6)	5,035 (22.4)	8,280 (36.8)	4,970 (22.1)
1/2	8230 (36.6)	10,675 (47.5)	6,405 (28.5)	14,900 (66.3)	18,405 (79.0)	11,040 (49.1)	9,225 (41.0)	14,720 (65.5)	8,835 (39.3)
5/8	13110 (58.3)	16,680 (74.2)	10,010 (44.5)	23,730 (105.6)	28,760 (125.7)	17,260 (76.8)	14,690 (65.3)	23,010 (102.4)	13,805 (61.4)
3/4	19,400 (86.3)	24,020 (106.9)	14,415 (64.1)	35,120 (156.2)	41,420 (185.7)	24,850 (110.5)	15,050 (66.9)	28,165 (125.3)	16,800 (75.2)
7/8	26,780 (119.1)	32,695 (145.4)	19,620 (87.3)	48,480 (215.7)	56,370 (256.9)	33,825 (150.5)	20,775 (92.4)	38,335 (170.5)	23,000 (102.3)
1	35,130 (156.3)	42,705 (190.0)	25,625 (114.0)	63,600 (282.9)	73,630 (337.0)	44,180 (196.5)	27,255 (121.2)	50,070 (222.7)	30,040 (133.6)
1-1/4	56,210 (250.0)	66,730 (296.8)	40,035 (178.1)	101,755 (452.6)	115,050 (511.8)	69,030 (307.1)	43,610 (194.0)	78,235 (348.0)	46,940 (208.8)

1 Steel strength as defined in AISC Manual of Steel Construction 2nd Ed. (LRFD):

Yield = F_y x tensile stress area
Tensile = 0.75 x F_u x nominal area
Shear = 0.45 x F_u x nominal area

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3.2.5 HIT-RE 500 Epoxy Adhesive Anchoring System

Table 8 - HIT-RE 500 allowable bond or concrete capacity and steel strength for HIS-N and HIS-RN inserts[1]

Thread size in.	Effective embedment in. (mm)	HIT-RE 500 allowable bond/concrete capacity[2]		Steel bolt strength[2]			
				ASTM A325 carbon steel		ASTM F593 stainless steel	
		Tensile (13.8 MPa) lb (kN)	Shear (13.8 MPa) lb (kN)	Tensile lb (kN)	Shear lb (kN)	Tensile lb (kN)	Shear lb (kN)
3/8-16 UNC	4-3/8 (110)	2,870 (12.8)	1,565 (7.0)	4,370 (19.4)	2,250 (10.0)	3,645 (16.2)	1,875 (8.3)
1/2-13 UNC	5 (127)	4,530 (20.1)	2,890 (12.9)	7,775 (34.6)	4,005 (17.8)	6,480 (28.8)	3,335 (14.8)
5/8-11 UNC	6-5/8 (168)	8,255 (36.7)	4,635 (20.6)	12,150 (54.0)	6,260 (27.8)	10,125 (45.0)	5,215 (23.2)
3/4-10 UNC	8-1/4 (210)	9,030 (40.1)	6,695 (29.8)	17,945 (77.8)	9,010 (40.1)	12,395 (55.1)	6,385 (28.4)

Table 9 - HIT-RE 500 ultimate bond or concrete capacity and steel strength for HIS-N and HIS-RN inserts[1]

Thread size in.	Effective embedment in. (mm)	HIT-RE 500 ultimate bond/concrete capacity		Ultimate bolt strength[2]			
				ASTM A325 carbon steel		ASTM F593 stainless steel	
		Tensile (13.8 MPa) lb (kN)	Shear (13.8 MPa) lb (kN)	Tensile lb (kN)	Shear lb (kN)	Tensile lb (kN)	Shear lb (kN)
3/8-16 UNC	4-3/8 (110)	11,480 (51.0)	6,260 (27.8)	9,935 (44.2)	5,960 (26.5)	8,280 (36.8)	4,970 (22.1)
1/2-13 UNC	5 (127)	18,115 (80.5)	11,565 (51.4)	17,665 (78.6)	10,600 (47.2)	14,720 (65.5)	8,835 (39.3)
5/8-11 UNC	6-5/8 (168)	33,025 (146.9)	18,550 (82.5)	27,610 (122.8)	16,565 (73.7)	23,010 (102.4)	13,805 (61.4)
3/4-10 UNC	8-1/4 (210)	36,125 (160.6)	26,775 (119.1)	39,760 (176.9)	23,855 (106.1)	28,165 (125.3)	16,900 (75.1)

1 Use lower value of either allowable bond/concrete capacity or steel strength. Minimum concrete compressive strength f'_c is 2,000 psi.

2 Steel values in accordance with AISC

ASTM A325 bolts F_y = 92 ksi , F_u = 120 ksi

ASTM F593 (AISI 304/316) F_y = 65 ksi, F_u = 100 ksi for 3/8- through 5/8 in.

F_y = 45 ksi, F_u = 85 ksi for 3/4-in.

Allowable load values

Tension = 0.33 x F_u x A_{nom}

Shear = 0.17 x F_u x A_{nom}

Ultimate load values

Tension = 0.75 x F_u x A_{nom}

Shear = 0.45 x F_u x A_{nom}

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HIT-RE 500 Epoxy Adhesive Anchoring System 3.2.5

Table 10 - HIT-RE 500 ultimate bond capacity and steel strength for rebar in concrete

Rebar size	Effective embedment in. (mm)	Concrete compressive strength f'_c = 2000 psi (13.8 MPa)			Concrete compressive strength f'_c = 4000 psi (27.6 MPa)			Grade 60 rebar	
		Ultimate bond strength lb (kN)	Embed. to develop yield strength[1] in. (mm)	Embed. to develop tensile strength[1] in. (mm)	Ultimate bond strength lb (kN)	Embed. to develop yield strength[1] in. (mm)	Embed. to develop tensile strength[1] in. (mm)	Yield strength lb (kN)	Tensile strength lb (kN)
#3	3-3/8 (86)	10,105 (45.0)	2-1/4 (57)	3-3/8 (86)	10,810 (48.1)	2-1/8 (54)	3-1/4 (84)	6,600 (29.4)	9,900 (44.0)
	4-1/2 (114)	10,920 (48.6)			10,810 (48.1)				
#4	4-1/2 (114)	15,980 (71.1)	3-3/8 (86)	5-5/8 (143)	18,540 (82.5)	3 (76)	4-3/8 (111)	12,000 (53.4)	18,000 (80.1)
	6 (152)	18,830 (83.8)			18,655 (83.0)				
#5	5-5/8 (143)	20,630 (91.8)	5-1/8 (130)	8-7/8 (225)	27,790 (123.6)	3-7/8 (98)	5-3/4 (146)	18,600 (82.7)	27,900 (124.1)
	7-1/2 (191)	24,870 (110.6)			27,790 (128.6)				
#6	6-3/4 (171)	33,695 (149.9)	5-3/8 (136)	9-3/8 (238)	44,675 (198.7)	4 (102)	6 (152)	26,400 (117.4)	39,600 (176.2)
	9 (229)	38,960 (173.3)			44,870 (200.0)				
#7	7-7/8 (200)	40,525 (180.3)	7 (178)	12-3/8 (314)	59,340 (264.0)	4-7/8 (124)	7-1/4 (184)	36,000 (160.1)	54,000 (240.2)
	10-1/2 (267)	48,460 (215.6)			61,720 (274.6)				
#8	9 (229)	63,940 (284.4)	8-1/4 (210)	12-7/8 (327)	72,820 (323.9)	5-7/8 (149)	8-7/8 (225)	47,400 (210.9)	71,100 (316.3)
	12 (305)	69,610 (309.7)			72,950 (324.5)				
#9	10-1/8 (257)	72,245 (321.4)	8-1/2 (216)	13 (330)	81,235 (361.4)	7-1/2 (191)	12 (305)	60,000 (266.9)	90,000 (400.4)
	13-1/2 (343)	94,205 (419.1)			84,015 (373.7)				
#10	11-1/4 (286)	92,000 (409.3)	9-3/8 (238)	17-7/8 (454)	96,725 (430.3)	8-7/8 (225)	14 (356)	76,200 (339.0)	114,300 (508.5)
	15 (381)	95,850 (426.4)			97,070 (431.8)				
#11	12-3/8 (314)	118,615 (527.6)	9-7/8 (251)	18-3/4 (476)	123,120 (547.7)	9-1/2 (241)	16-1/2 (419)	93,600 (416.4)	140,400 (624.6)
	16-1/2 (419)	123,570 (549.7)			123,790 (550.7)				

1 Based on comparison of average ultimate adhesive bond test values versus minimum yield and ultimate tensile strength of rebar. For more information, contact Hilti.

Table 11 - HIT-RE 500 ultimate tensile bond strength for smooth epoxy coated dowel bars in concrete[1]

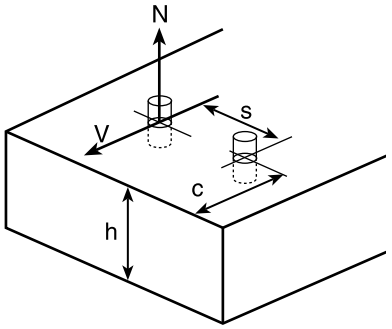
Dowel bar diameter in.	Nominal bit diameter in.	Embedment depth in. (mm)	Ultimate tensile load lb (kN)
1	1-1/8	9 (229)	40,385 (179.7)
1-1/4	1-3/8		
1-1/2	1-5/8		

1 Minimum concrete compressive strength is 2,400 psi.

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3.2.5 HIT-RE 500 Epoxy Adhesive Anchoring System

Figure 3 - Anchor spacing and edge distance in concrete

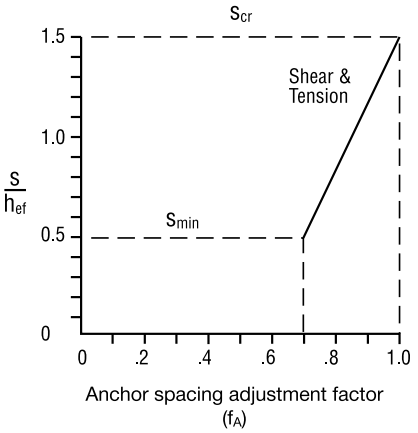


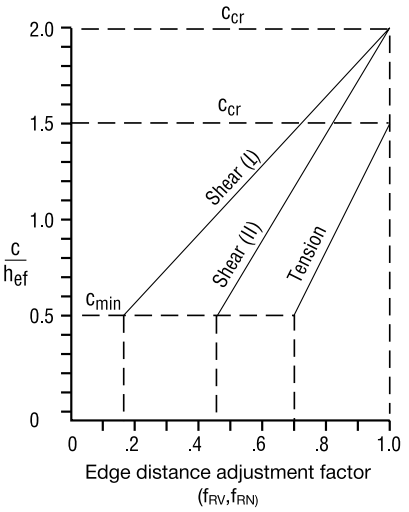
Anchor spacing adjustment factors

s = Actual spacing
h_{ef} = Actual embedment
s_{min} = 0.5 h_{ef}
s_{cr} = 1.5 h_{ef}

Edge distance adjustment factors

c = Actual edge distance
h_{ef} = Actual embedment
c_{min} = 0.5 h_{ef} Tension and shear
c_{cr} = 1.5 h_{ef} Tension
= 2.0 h_{ef} Shear
⊥ = Perpendicular to edge
II = Parallel to edge





Note: Tables apply for listed embedment depths. Reduction factors for other embedment depths must be calculated using equations below.

Spacing tension/shear
$s_{min} = 0.5\ h_{ef}$ $s_{cr} = 1.5\ h_{ef}$
$f_A = 0.3(s/h_{ef}) + 0.55$
for $s_{cr} > s > s_{min}$

Edge distance tension
$c_{min} = 0.5\ h_{ef}$ $c_{cr} = 1.5\ h_{ef}$
$f_{RN} = 0.3(c/h_{ef}) + 0.55$
for $c_{cr} > c > c_{min}$

Edge distance shear
⊥ toward edge
$c_{min} = 0.5\ h_{ef}$ $c_{cr} = 2.0\ h_{ef}$
$f_{RV1} = 0.54(c/h_{ef}) - 0.09$
for $c_{cr} > c > c_{min}$

Edge distance shear
II to or away from edge
$c_{min} = 0.5\ h_{ef}$ $c_{cr} = 2.0\ h_{ef}$
$f_{RV2} = 0.36(c/h_{ef}) + 0.28$
for $c_{cr} > c > c_{min}$

Table 12 - Load adjustment factors for 3/8-in. diameter anchors

Diameter		3/8-in.											
Adjustment factor		Spacing tension/shear f_A			Edge distance tension f_{RN}			Edge distance shear (⊥ toward edge) f_{RV1}			Edge distance shear (II to or away from edge) f_{RV2}		
Embedment depth, in.		1-3/4	3-3/8	4-1/2	1-3/4	3-3/8	4-1/2	1-3/4	3-3/8	4-1/2	1-3/4	3-3/8	4-1/2
Spacing (s)/edge distance (c), in.	7/8	0.70			0.70			0.18			0.46		
	1	0.72			0.72			0.22			0.49		
	1 11/16	0.84	0.70		0.84	0.70		0.43	0.18		0.63	0.46	
	2	0.89	0.73		0.89	0.73		0.53	0.22		0.69	0.49	
	2 1/4	0.94	0.75	0.70	0.94	0.75	0.70	0.60	0.27	0.18	0.74	0.52	0.46
	2 5/8	1.00	0.78	0.73	1.00	0.78	0.73	0.72	0.33	0.23	0.82	0.56	0.49
	3		0.82	0.75		0.82	0.75	0.84	0.39	0.27	0.90	0.60	0.52
	3 1/2		0.86	0.78		0.86	0.78	1.00	0.47	0.33	1.00	0.65	0.56
	4		0.91	0.82		0.91	0.82		0.55	0.39		0.71	0.60
	5 1/16		1.00	0.89		1.00	0.89		0.72	0.52		0.82	0.69
	5 1/2			0.92			0.92		0.79	0.57		0.87	0.72
	6			0.95			0.95		0.87	0.63		0.92	0.76
	6 3/4			1.00			1.00		1.00	0.72		1.00	0.82
	8									0.87			0.92
	9									1.00			1.00

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Anchor spacing and edge distance guidelines in concrete

Note: Tables apply for listed embedment depths. Reduction factors for other embedment depths must be calculated using equations below.

Spacing tension/shear
$s_{min} = 0.5\ h_{ef}$ $s_{cr} = 1.5\ h_{ef}$
$f_A = 0.3(s/h_{ef}) + 0.55$
for $s_{cr} > s > s_{min}$

Edge distance tension
$c_{min} = 0.5\ h_{ef}$ $c_{cr} = 1.5\ h_{ef}$
$f_{RN} = 0.3(c/h_{ef}) + 0.55$
for $c_{cr} > c > c_{min}$

Edge distance shear
⊥ toward edge
$c_{min} = 0.5\ h_{ef}$ $c_{cr} = 2.0\ h_{ef}$
$f_{RV1} = 0.54(c/h_{ef}) - 0.09$
for $c_{cr} > c > c_{min}$

Edge distance shear
II to or away from edge
$c_{min} = 0.5\ h_{ef}$ $c_{cr} = 2.0\ h_{ef}$
$f_{RV2} = 0.36(c/h_{ef}) + 0.28$
for $c_{cr} > c > c_{min}$

Table 13 - Load adjustment factors for 1/2-in. diameter anchors

Diameter		1/2-in.											
Adjustment factor		Spacing tension/shear f_A			Edge distance tension f_{RN}			Edge distance shear (⊥ toward edge) f_{RV1}			Edge distance shear (II to or away from edge) f_{RV2}		
Embedment depth, in.		2-1/4	4-1/2	6	2-1/4	4-1/2	6	2-1/4	4-1/2	6	2-1/4	4-1/2	6
Load adjustment factors for 5/8-in. and 3/4-in. diameter anchors	1-1/8	0.70			0.70			0.18			0.46		
	1-1/2	0.75			0.75			0.27			0.52		
	1-3/4	0.78			0.78			0.33			0.56		
	2	0.82			0.82			0.39			0.60		
	2-1/4	0.85	0.70		0.85	0.70		0.45	0.18		0.64	0.46	
	2-1/2	0.88	0.72		0.88	0.72		0.51	0.21		0.68	0.48	
	3	0.95	0.75	0.70	0.95	0.75	0.70	0.63	0.27	0.18	0.76	0.52	0.46
	3-3/8	1.00	0.78	0.72	1.00	0.78	0.72	0.72	0.32	0.21	0.82	0.55	0.48
	4		0.82	0.75		0.82	0.75	0.87	0.39	0.27	0.92	0.60	0.52
	4-1/2		0.85	0.78		0.85	0.78	1.00	0.45	0.32	1.00	0.64	0.55
	5		0.88	0.80		0.88	0.80		0.51	0.36		0.68	0.58
	6		0.95	0.85		0.95	0.85		0.63	0.45		0.76	0.64
	6-3/4		1.00	0.89		1.00	0.89		0.72	0.52		0.82	0.69
	7			0.90			0.90		0.75	0.54		0.84	0.70
	8			0.95			0.95		0.87	0.63		0.92	0.76
	9			1.00			1.00		1.00	0.72		1.00	0.82
	10									0.81			0.88
	11									0.90			0.94
	12									1.00			1.00

Table 14 - Load adjustment factors for 5/8-in. and 3/4-in. diameter anchors

Diameter		5/8-in.												3/4-in.											
Adjustment factor		Spacing tension/shear f_A			Edge distance tension f_{RN}			Edge distance shear (⊥ toward edge) f_{RV1}			Edge distance shear (II to or away from edge) f_{RV2}			Spacing tension/shear f_A			Edge distance tension f_{RN}			Edge distance shear (⊥ toward edge) f_{RV1}			Edge distance shear (II to or away from edge) f_{RV2}		
Embedment depth, in.		2-7/8	5-5/8	7-1/2	2-7/8	5-5/8	7-1/2	2-7/8	5-5/8	7-1/2	2-7/8	5-5/8	7-1/2	3-3/8	6-3/4	9	3-3/8	6-3/4	9	3-3/8	6-3/4	9	3-3/8	6-3/4	9
Spacing (s)/edge distance (c), in.	1-7/16	0.70			0.70			0.18			0.46													
	1-11/16	0.73			0.73			0.23			0.49			0.70			0.70			0.18			0.46		
	2	0.76			0.76			0.29			0.53			0.73			0.73			0.23			0.49		
	2-13/16	0.84	0.70		0.84	0.70		0.44	0.18		0.63	0.46		0.80			0.80			0.36			0.58		
	3-3/8	0.90	0.73		0.90	0.73		0.54	0.23		0.70	0.50		0.85	0.70		0.85	0.70		0.45	0.18		0.64	0.46	
	3-3/4	0.94	0.75	0.70	0.94	0.75	0.70	0.61	0.27	0.18	0.75	0.52	0.46	0.88	0.72		0.88	0.72		0.51	0.21		0.68	0.48	
	4-5/16	1.00	0.78	0.72	1.00	0.78	0.72	0.72	0.32	0.22	0.82	0.56	0.49	0.93	0.74		0.93	0.74		0.60	0.26		0.74	0.51	
	4-1/2		0.79	0.73		0.79	0.73	0.76	0.34	0.23	0.84	0.57	0.50	0.95	0.75	0.70	0.95	0.75	0.70	0.63	0.27	0.18	0.76	0.52	0.46
	5-1/16		0.82	0.75		0.82	0.75	0.86	0.40	0.27	0.91	0.60	0.52	1.00	0.78	0.72	1.00	0.78	0.72	0.72	0.32	0.21	0.82	0.55	0.48
	5-5/8		0.85	0.78		0.85	0.78	0.97	0.45	0.32	0.98	0.64	0.55		0.80	0.74		0.80	0.74	0.81	0.36	0.25	0.88	0.58	0.51
	5-3/4		0.86	0.78		0.86	0.78	1.00	0.46	0.32	1.00	0.65	0.56		0.81	0.74		0.81	0.74	0.83	0.37	0.26	0.89	0.59	0.51
	6-3/4		0.91	0.82		0.91	0.82		0.56	0.40		0.71	0.60		0.85	0.78		0.85	0.78	1.00	0.45	0.32	1.00	0.64	0.55
	8-7/16		1.00	0.89		1.00	0.89		0.72	0.52		0.82	0.69		0.93	0.83		0.93	0.83		0.59	0.42		0.73	0.62
	10-1/8			0.96			0.96		0.88	0.64		0.93	0.77		1.00	0.89		1.00	0.89		0.72	0.52		0.82	0.69
	11-1/4			1.00			1.00		1.00	0.72		1.00	0.82			0.93			0.93		0.81	0.59		0.88	0.73
	12									0.77			0.86			0.95			0.95		0.87	0.63		0.92	0.76
	13-1/2									0.88			0.93			1.00			1.00		1.00	0.72		1.00	0.82
	15									1.00			1.00									0.81			0.88
	16																					0.87			0.92
	18																					1.00			1.00

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3.2.5 HIT-RE 500 Epoxy Adhesive Anchoring System

Anchor spacing and edge distance guidelines in concrete

Note: Tables apply for listed embedment depths. Reduction factors for other embedment depths must be calculated using equations below.

Spacing tension/shear
$s_{min} = 0.5\ h_{ef}$ $s_{cr} = 1.5\ h_{ef}$
$f_A = 0.3(s/h_{ef}) + 0.55$
for $s_{cr} > s > s_{min}$

Edge distance tension
$c_{min} = 0.5\ h_{ef}$ $c_{cr} = 1.5\ h_{ef}$
$f_{RN} = 0.3(c/h_{ef}) + 0.55$
for $c_{cr} > c > c_{min}$

Edge distance shear
⊥ toward edge
$c_{min} = 0.5\ h_{ef}$ $c_{cr} = 2.0\ h_{ef}$
$f_{RV1} = 0.54(c/h_{ef}) - 0.09$
for $c_{cr} > c > c_{min}$

Edge distance shear
II to or away from edge
$c_{min} = 0.5\ h_{ef}$ $c_{cr} = 2.0\ h_{ef}$
$f_{RV2} = 0.36(c/h_{ef}) + 0.28$
for $c_{cr} > c > c_{min}$

Table 15 - Load adjustment factors for 7/8-in. diameter anchors

Diameter		7/8-in.											
Adjustment factor		Spacing tension/shear f_A			Edge distance tension f_{RN}			Edge distance shear (⊥ toward edge) f_{RV1}			Edge distance shear (II to or away from edge) f_{RV2}		
Embedment depth, in.		4	7-7/8	10-1/2	4	7-7/8	10-1/2	4	7-7/8	10-1/2	4	7-7/8	10-1/2
Spacing (s)/Edge distance (c), in.	2	0.70			0.70			0.18			0.46		
	2-1/2	0.74			0.74			0.25			0.51		
	3	0.78			0.78			0.32			0.55		
	3-1/2	0.81			0.81			0.38			0.60		
	3-15/16	0.85	0.70		0.85	0.70		0.44	0.18		0.63	0.46	
	4-1/2	0.89	0.72		0.89	0.72		0.52	0.22		0.69	0.49	
	5	0.93	0.74		0.93	0.74		0.59	0.25		0.73	0.51	
	5-1/4	0.94	0.75	0.70	0.94	0.75	0.70	0.62	0.27	0.18	0.75	0.52	0.46
	6	1.00	0.78	0.72	1.00	0.78	0.72	0.72	0.32	0.22	0.82	0.55	0.49
	6-1/2		0.80	0.74		0.80	0.74	0.79	0.36	0.24	0.87	0.58	0.50
	7		0.82	0.75		0.82	0.75	0.86	0.39	0.27	0.91	0.60	0.52
	8		0.85	0.78		0.85	0.78	1.00	0.46	0.32	1.00	0.65	0.55
	10		0.93	0.84		0.93	0.84		0.60	0.42		0.74	0.62
	11-13/16		1.00	0.89		1.00	0.89		0.72	0.52		0.82	0.69
	12			0.89			0.89		0.73	0.53		0.83	0.69
	14			0.95			0.95		0.87	0.63		0.92	0.76
	15-3/4			1.00			1.00		1.00	0.72		1.00	0.82
	18									0.84			0.90
	20									0.94			0.97
	21									1.00			1.00

Table 16 - Load adjustment factors for 1-in. and 1-1/4-in. diameter anchors

Diameter		1-in.												1-1/4-in.											
Adjustment factor		Spacing tension/shear f_A			Edge distance tension f_{RN}			Edge distance shear (⊥ toward edge) f_{RV1}			Edge distance shear (II to or away from edge) f_{RV2}			Spacing tension/shear f_A			Edge distance tension f_{RN}			Edge distance shear (⊥ toward edge) f_{RV1}			Edge distance shear (II to or away from edge) f_{RV2}		
Embedment depth, in.		4-1/2	9	12	4-1/2	9	12	4-1/2	9	12	4-1/2	9	12	5-5/8	11-1/4	15	5-5/8	11-1/4	15	5-5/8	11-1/4	15	5-5/8	11-1/4	15
Spacing (s)/Edge distance (c), in.	2-1/4	0.70			0.70			0.18			0.46														
	2-3/4	0.73			0.73			0.24			0.50			0.70			0.70			0.18			0.46		
	3	0.75			0.75			0.27			0.52			0.71			0.71			0.20			0.47		
	4	0.82			0.82			0.39			0.60			0.76			0.76			0.29			0.54		
	4-1/2	0.85	0.70		0.85	0.70		0.45	0.18		0.64	0.46		0.79			0.79			0.34			0.57		
	5	0.88	0.72		0.88	0.72		0.51	0.21		0.68	0.48		0.82			0.82			0.39			0.60		
	5-5/8	0.93	0.74		0.93	0.74		0.59	0.25		0.73	0.51		0.85	0.70		0.85	0.70		0.45	0.18		0.64	0.46	
	6	0.95	0.75	0.70	0.95	0.75	0.70	0.63	0.27	0.18	0.76	0.52	0.46	0.87	0.71		0.87	0.71		0.49	0.20		0.66	0.47	
	6-3/4	1.00	0.78	0.72	1.00	0.78	0.72	0.72	0.32	0.21	0.82	0.55	0.48	0.91	0.73		0.91	0.73		0.56	0.23		0.71	0.50	
	7-1/2		0.80	0.74		0.80	0.74	0.81	0.36	0.25	0.88	0.58	0.51	0.95	0.75	0.70	0.95	0.75	0.70	0.63	0.27	0.18	0.76	0.52	0.46
	8-1/4		0.83	0.76		0.83	0.76	0.90	0.41	0.28	0.94	0.61	0.53	0.99	0.77	0.72	0.99	0.77	0.72	0.70	0.31	0.21	0.81	0.54	0.48
	9		0.85	0.78		0.85	0.78	1.00	0.45	0.32	1.00	0.64	0.55	1.00	0.79	0.73	1.00	0.79	0.73	0.77	0.34	0.23	0.86	0.57	0.50
	10		0.88	0.80		0.88	0.80		0.51	0.36		0.68	0.58		0.82	0.75		0.82	0.75	0.87	0.39	0.27	0.92	0.60	0.52
	11		0.92	0.83		0.92	0.83		0.57	0.41		0.72	0.61		0.84	0.77		0.84	0.77	1.00	0.44	0.31	0.98	0.63	0.54
	12		0.95	0.85		0.95	0.85		0.63	0.45		0.76	0.64		0.87	0.79		0.87	0.79		0.49	0.34	1.00	0.66	0.57
	13-1/2		1.00	0.89		1.00	0.89		0.72	0.52		0.82	0.69		0.91	0.82		0.91	0.82		0.56	0.40		0.71	0.60
	14			0.90			0.90		0.75	0.54		0.84	0.70		0.92	0.83		0.92	0.83		0.58	0.41		0.73	0.62
	16-7/8			0.97			0.97		0.92	0.67		0.96	0.79		1.00	0.89		1.00	0.89		0.72	0.52		0.82	0.69
	18			1.00			1.00		1.00	0.72		1.00	0.82			0.91			0.91		0.77	0.56		0.86	0.71
	20									0.81			0.88			0.95			0.95		0.87	0.63		0.92	0.76
	22-1/2									0.92			0.96			1.00			1.00		1.00	0.72		1.00	0.82
	24									1.00			1.00									0.77			0.86
	27																					0.88			0.93
	30																					1.00			1.00

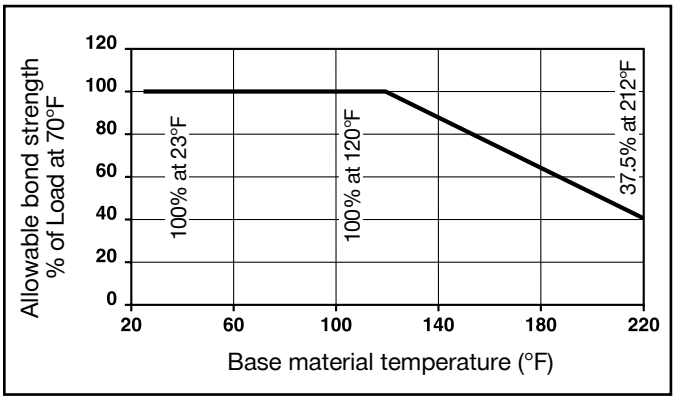
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Figure 4 - Resistance of HIT-RE 500 to chemicals

Chemical	Chemicals Tested	Resistant	Not Resistant
Alkaline	Concrete drilling mud (10%) pH=12.6	+	
	Concrete drilling mud (10%) pH=13.2	+	
	Concrete potash solution (10%) pH=14.0	+	
Acids	Acetic acid (10%)[1]		–
	Nitric acid (10%)[1]		–
	Hydrochloric acid (10%) 3 month -		–
	Sulfuric acid (10%)		–
Solvents	Benzyl alcohol		–
	Ethanol		–
	Ethyl acetate		–
	Methyl ethyl ketone (MEK)		–
	Trichlorethylene		–
	Xylene (mixture)	+	
Chemicals used on job sites	Concrete plasticizer	+	
	Diesel oil	+	
	Oil	+	
	Petrol	+	
	Oil for form work (forming oil)	+	
Environmental chemicals	Salt water	+	
	de-mineralized water	+	
	salt spraying test	+	
	SO_2	+	
	Environment/weather	+	

1 Concrete was dissolved by acid.

Figure 5 - Influence of temperature on bond strength[1,2]



1 Test procedure involves the concrete being held at the elevated temperature for 24 hours then removing it from the controlled environment and testing to failure.

2 Long term creep test in accordance with ICC-ES Acceptance Criteria AC58 is available; please contact Hilti Technical Services.

Samples of the HIT-RE 500 resin were immersed in the various chemical compounds for up to one year. At the end of the test period, the samples were analyzed. Any samples showing no visible damage and having less than a 25% reduction in bending (flexural) strength were classified as Resistant. Samples that were heavily damaged or destroyed were classified as Not Resistant.

Note: In actual use, the majority of the resin is encased in the base material, leaving very little surface area exposed.

Table 17 - Full cure time

Base material temperature		Approximate full curing time
°F	°C	
23	–5	72 h
32	0	50 h
50	10	24 h
68	20	12 h
86	30	8 h
104	40	4 h

Table 18 - Initial cure time to develop 25% of bond strength

Base material temperature		Approximate initial cure time
°F	°C	
23	–5	36 h
32	0	25 h
50	10	12 h
68	20	6 h
86	30	4 h
104	40	2 h

Table 19 - Gel time

Base material temperature		Approximate gel time
°F	°C	
23	–5	4 h
32	0	3 h
50	10	2 h
68	20	30 min
86	30	20 min
104	40	12 min

1 Minimum product temperature must be maintained above 41°F (5°C) prior/during installation.

2 Gel times and full cure times are approximate.

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3.2.5 HIT-RE 500 Epoxy Adhesive Anchoring System

3.2.5.4 Installation instructions

Installation Instructions For Use (IFU) are included with each product package. They can also be viewed or downloaded online at www.us.hilti.com (US) and www.hilti.ca (Canada). Because of the possibility of changes, always verify that downloaded IFU are current when used. Proper installation is critical to achieve full performance. Training is available on request. Contact Hilti Technical Services for applications and conditions not addressed in the IFU.

HIT-RE 500 Volume

Table 20 - Threaded rod installation

Nominal anchor diameter in.	Nominal bit diameter in.	Adhesive volume required per Inch of embedment in^3
1/4	5/16	0.055
3/8	7/16	0.095
1/2	9/16	0.133
5/8	3/4	0.261
3/4	7/8	0.326
7/8	1	0.391
1	1-1/8	0.478
1-1/4	1-3/8	0.626

The useable volume of HIT-RE 500 refill cartridge is 16.5 in^3 (270 ml)

The useable volume of HIT-RE 500 medium refill is 26.9 in^3 (440 ml)

The useable volume of HIT-RE 500 medium refill is 81.8 in^3 (1340 ml)

Example:

5/8-in. diameter rod with an embedment of 10 inches:

10 in. x 0.26 in^3 /in. = 2.6 in^3/fastening

16.5 in^3/cartridge ÷ 2.6 in^3/fastening ≈ 6 fastenings/cartridge

81.8 in^3/cartridge ÷ 2.6 in^3/fastening ≈ 31 fastenings/cartridge

Table 21 - Rebar installation[1]

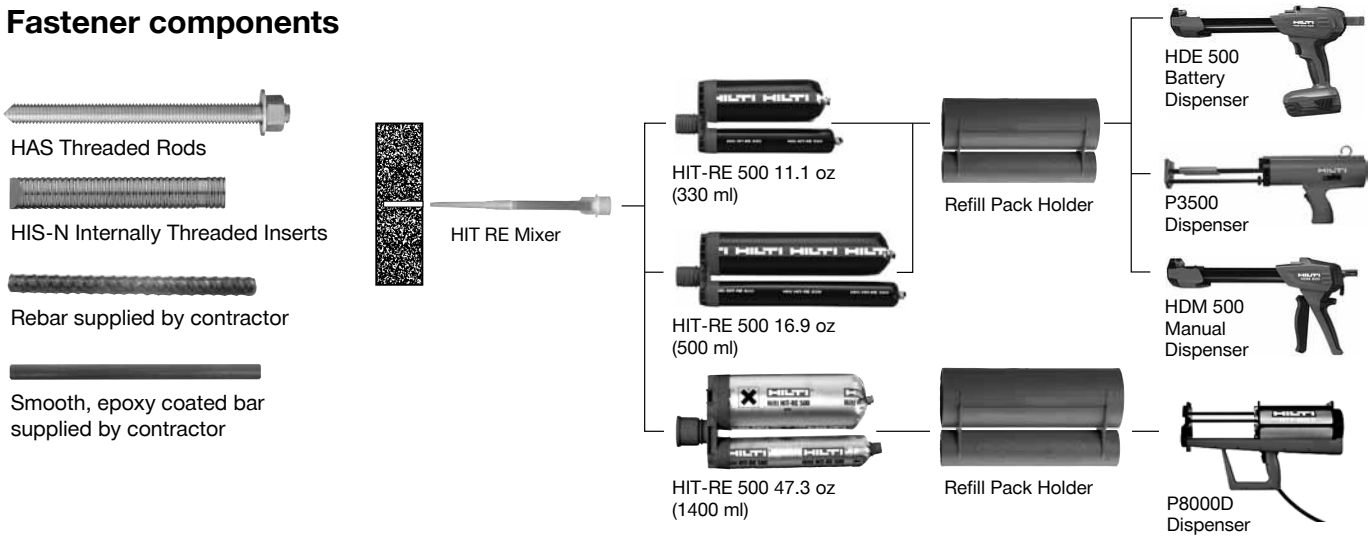
Rebar Size	Nominal bit[1] diameter in.	Adhesive volume required per Inch of embedment in^3
#3	1/2	0.110
#4	5/8	0.146
#5	3/4	0.176
#6	7/8	0.218
#7	1	0.252
#8	1-1/8	0.299
#9	1-3/8	0.601
#10	1-1/2	0.659
#11	1-3/4	1.037

1 Rebar diameter may vary. Use smallest drill bit which will accommodate rebar.

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3.2.5.5 Ordering information[1]

Fastener components



HIT-RE 500 Epoxy Adhesive

Order information

Description	Package contents	Qty of foil packs
HIT-RE 500 (11.1 fl oz/330 ml)	Includes (1) refill pack and (1) mixer with filler tube	1
HIT-RE 500 MC Master Carton (11.1 fl oz/330 ml)	Includes (25) refill packs and (25) mixer with filler tube	25
HIT-RE 500 (16.9 fl oz/500 ml)	Includes (20) refil packs and (20) mixer with filler tube	20
HIT-RE 500 (47.3 fl oz/1400 ml)	Includes (4) jumbo refil packs and (4) mixder	4

1 For complete information about Hilti anchors, adhesive anchoring dispensers, drilled hole preparation and other adhesive anchoring accessories, see HIT-HY 200 Anchoring System, Section 3.2.3.5 Ordering Information.

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Notes

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HILTI

Hilti HIT-RE 500
See the Material Safety Data Sheet for this product before handling.
For Industrial Use Only. Keep out of the reach of children!
Danger: Corrosive. Harmful if inhaled or swallowed. Can cause eye and skin burns. Risk of serious damage to eyes. Can cause sensitization with some individuals.
Contains: quartz sand.
Precautions: Wear suitable protection clothing, eye protection and gloves. Do not get in eyes. Avoid contact with the skin. Avoid inhalation of vapors. Avoid inhalation of dusts during demolition/removal.
First Aid: For eye contact, flush with water for 15 minutes while holding the eyelids apart. Seek medical attention immediately. For skin contact, wash immediately with soap and water. If ingested, drink two glasses of water and seek medical attention immediately.

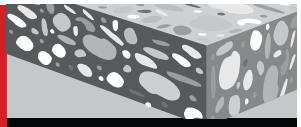
Hilti HIT-RE 500
Se reporter á la Fiche de données de sécurité du produit déjà l'usage.
Pour usage industriel seulement. Tenir hors de la portée des enfants!
Danger: Corrosif. Nocif si respiré ou avalé. Peut brûler les yeux et la peau. Risque de lésions oculaires graves. Peut entraîner la sensibilisation chez certains individus.
Contient du: sable quartzeux.
Précautions: Pour travailler, porter des vêtements, des gants et une protection pour les yeux. Eviter tout contact avec les yeux. Eviter tout contact avec la peau. Eviter d'inhaler les vapeurs. Eviter d'inhaler les poussières lors de la démolition ou du retrait.
Premiers soins: En cas de contact avec les yeux, rincer à grande eau pendant 15 minutes en tenant les paupières ouvertes. Faire immédiatement appel à un médecin. En cas de contact avec la peau, se laver immédiatement avec de l'eau et du savon. En cas d'ingestion, boire deux verres d'eau et faire immédiatement appel à un médecin.

Hilti HIT-RE 500
Consulte con las Hoja de datos de seguridad para este producto antes de usarlo.
Sólo Para Uso Industrial. Mantener alejado del alcance de los niños.
Peligro: Corrosivo. Nocivo en caso de ser inhalado o ingerido. Puede causar quemadura de la piel y de los ojos. Riesgo de lesiones oculares graves. Puede causar sensibilización en algunas personas.
Contiene: arena de Cuarzo.
Precaución: Utilice indumentaria y guantes adecuados y protección para los ojos/la cara. Evite contacto con los ojos y la piel. Evite inhalación de los vapores. Evite inhalación polvo durante la remoción o la demolición. Primeros auxilios: Para contacto con los ojos, enjuague con agua por 15 minutos mientras aguante los párpados abiertos. Acudir atención medica. Para contacto con la pie5l, enjuague inmediatemente con agua y jabón. De ser ingerido, tome dos vasos de agua y acudir inmediatamente a un medico.



Hilti, Inc. Tulsa, OK 74146 / Hilti Canada Corp.

In Case of Emergency, call Chem-Trec: 1-800-424-9300 (USA, P.R., Virgin Islands, Canada)
En cas d'urgence, téléphoner Chem-Trec: 1-800-424-9300 (USA, P.R., Virgin Islands, Canada)
En Caso de Emergencia, llame Chem-Trec: 001-703-527-3887 (other countries/ autres pays/ otros países)



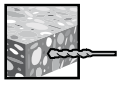
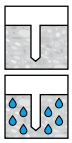
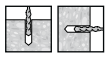
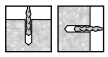
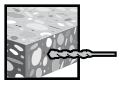
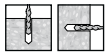
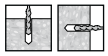
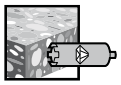
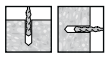
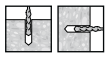
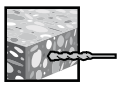
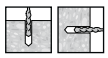
Hilti HIT-RE 500

Instructions for use en
Instrucciones de uso es
Mode d'emploi fr
Instruções de utilização pt

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en	Adhesive anchoring system for rebar and anchor fastenings in concrete. Read the safety instructions, general informations and warnings before using the product.	→ 30 31
es	Mortier de scellement pour ancrage de chevilles et d'armatures dans le béton. Avant utilisation, bien lire les prescriptions de sécurité, les informations générales et les indications d'avertissement.	→ 32 33
fr	Mortier de scellement pour ancrage de chevilles et d'armatures dans le béton. Avant utilisation, bien lire les prescriptions de sécurité, les informations générales et les indications d'avertissement.	→ 34 35
pt	Buchas químicas para fixações de ferros e de ancoragens em betão. Antes da aplicação, ler a ficha de segurança, as informações gerais e as advertências.	→ 36 37

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			d_0	h_{ef}		
1			3/8"... 1/2" 10...20 mm	 d 4...20 d 2 3/8"...10" 40...250 mm		 14 15
2						 16 17
3			3/8"...1 3/4" 10...55 mm	4...100 d 2 3/8"...120" 40...3200 mm		 18 19
4						 20 21
5			3/8"...1/2" 10...20 mm	4...20 d 2 3/8"...10" 40...250 mm		 22 23
6			3/8"...1 3/4" 10...55 mm	4...100 d 2 3/8"...120" 40...3200 mm		 24 25
7			3/8"...1/2" 10...20 mm	4...20 d 2 3/8"...10" 40...250 mm		 22 23
8			3/8"...1 3/4" 10...55 mm	4...100 d 2 3/8"...120" 40...3200 mm		 24 25
9						 26 27
10			3/8"...1 3/4" 10...55 mm	4...20 d 2 3/8"...10" 40...250 mm		 28 29

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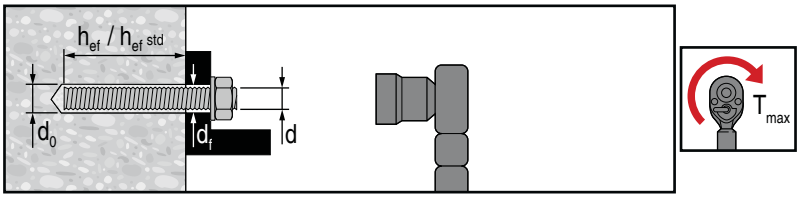

en	Dry concrete	Water saturated concrete	Waterfilled borehole in concrete	Submerged borehole in concrete
es	Hormigón seco	Hormigón saturado de agua	Taladro lleno de agua en hormigón	Taladro sumergido en hormigón
fr	Béton sec	Béton saturé d'eau	Trou dans le béton rempli d'eau	Trou dans le béton immergé
pt	Betão seco	Betão saturado de água	Furo em betão cheio de água	Furo debaixo de água em betão

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			 t_{work}	 $t_{cure,\ ini}$	 $t_{cure,\ full}$
en	Hammer drilling	Diamond coring	Working time	Initial curing time	Curing time
es	Taladrado con martillo	Taladrado con diamante	Tiempo de tratamiento	Resistencia de montaje	Tiempo de fraguado
fr	Perçage avec percussion	Forage au diamant	Temps de manipulation	Stabilité du montage	Temps de durcissement
pt	Perfurar de martelo	Perfurar com equipamento diamantado	Tempo de trabalho	Resistência de montagem	Tempo de cura total

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HIT-V (-R, -F, -HCR) / HAS (-R, -F, -HCR) / HAS-E (-R, -F, -HCR)



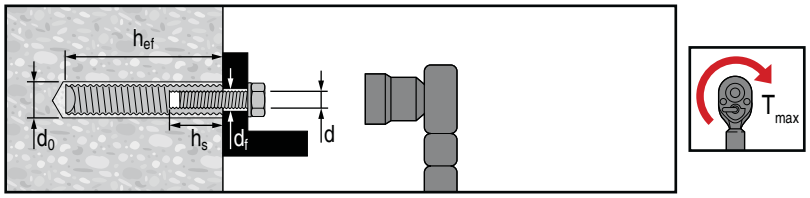
Ø d [inch]	Ø d_0 [inch]	$h_{ef\ std}$ [inch]	h_{ef} [inch]	Ø d_f [inch]	T_{max} [ft-lb]	T_{max} [Nm]
3/8	7/16	3 3/8	2 3/8 ... 7 1/2	7/16	≤ 15	≤ 20
1/2	9/16	4 1/2	2 3/4 ... 10	9/16	≤ 30	≤ 41
5/8	3/4	5 5/8	3 1/8 ... 12 1/2	11/16	≤ 60	≤ 81
3/4	7/8	6 3/4	3 1/2 ... 15	13/16	≤ 100	≤ 136
7/8	1	7 7/8	3 1/2 ... 17 1/2	15/16	≤ 125	≤ 169
1	1 1/8	9	4 ... 20	1 1/8	≤ 150	≤ 203
1 1/4	1 3/8	11 1/4	5 ... 25	1 3/8	≤ 200	≤ 271

Ø d [mm]	Ø d_0 [mm]	$h_{ef\ std}$ [mm]	h_{ef} [mm]	Ø d_f [mm]	T_{max} [Nm]
M8	10	80	40...160	9	≤10
M10	12	90	40...200	12	≤20
M12	14	110	48...240	14	≤40
M16	18	125	64...320	18	≤80
M20	24	170	80...400	22	≤150
M24	28	210	96...480	26	≤200
M27	30	240	108...540	30	≤270
M30	35	270	120...600	33	≤300

1 inch = 25,4 mm

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HIS (-N, -RN)

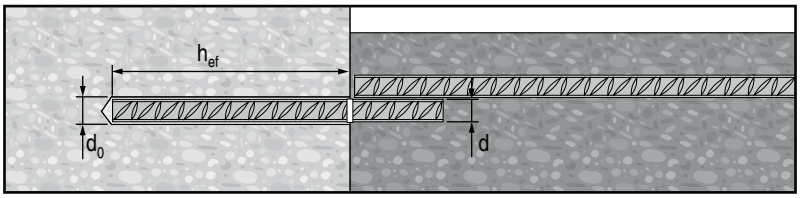


Ø d [inch]	Ø d_0 [inch]	h_{ef} [inch]	h_{ef} [mm]	Ø d_f [inch]	T_{max} [ft-lb]	T_{max} [Nm]
3/8	11/16	4 3/8	110	7/16	≤ 15	≤ 20
1/2	7/8	5	125	9/16	≤ 30	≤ 41
5/8	1 1/8	6 3/4	170	11/16	≤ 60	≤ 81
3/4	1 1/4	8 1/8	205	13/16	≤ 100	≤ 136

Ø d [mm]	Ø d_0 [mm]	h_{ef} [mm]	Ø d_f [mm]	T_{max} [Nm]
M8	14	90	9	≤ 10
M10	18	110	12	≤ 20
M12	22	125	14	≤ 40
M16	28	170	18	≤ 80
M20	32	205	22	≤ 150

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Rebar



US Rebar

d	Ø d_0 [inch]	$h_{ef\ std}$ [inch]	h_{ef} [inch]
#3	1/2	3 3/8	2 3/8...37 1/2
#4	5/8	4 1/2	2 3/4...50
#5	3/4	5 5/8	3 1/8...62 1/2
#6	7/8	6 3/4	3 1/2...75
#7	1	7 7/8	3 1/2...87 1/2
#8	1 1/8	9	4...100
#9	1 3/8	10 1/8	4 1/2...112 1/2
#10	1 1/2	11 1/4	5...120
#11	1 3/4	12 3/8	5 1/2...120

CA Rebar

d	Ø d_0 [inch]	$h_{ef\ std}$ [mm]	h_{ef} [mm]
10 M	9/16	115	70...226
15 M	3/4	145	80...320
20 M	1	200	90...390
25 M	1 1/4	230	101...504
30 M	1 1/2	260	120...598
35 M	1 3/4	315	143...714

1 inch = 25,4 mm

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EU Rebar

Ø d [mm]	Ø d_0 [mm]	h_{ef} [mm]
8	12	60...1000
10	14	60...1000
12	16	70...1000
14	18	75...1400
16	20	80...1500
18	22	85...1800
20	25	90...2000
22	28	95...2200
24	32	96...2400
25	32	101...2500
26	35	104...2600
28	35	112...2800
30	37	120...3000
32	40	128...3200
34	45	136...3200
36	45	143...3200
40	55	160...3200

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Ø	HIT-V HAS-	HIS-N	Rebar	HIT-RB		HIT-IP		HIT-DL	
d_0 [inch]	d [inch]			[inch]	Art. No.	[inch]	Art. No.	[inch]	Art. No.
7/16	3/8	–	–	7/16	273203	–	–	–	–
1/2	–	–	#3	1/2	273204	1/2	274019	1/2	38237
9/16	1/2	–	–	9/16	273205	9/16	274020	9/16	38238
5/8	–	–	#4	5/8	273207	5/8	274021	9/16	38238
11/16	–	3/8	–	11/16	273209	11/16	274022	11/16	38239
3/4	5/8	–	#5	3/4	273210	3/4	274023	3/4	38240
7/8	3/4	1/2	#6	7/8	273211	7/8	274024	7/8	38241
1	7/8	–	#7	1	273212	1	274025	1	38242
1 1/8	1	5/8	#8	1 1/8	273214	1 1/8	274026	1	38242
1 1/4	–	3/4	–	1 1/4	273216	1 1/4	274027	1	38242
1 3/8	1 1/4	–	#9	1 3/8	273217	1 3/8	274028	1 3/8	38243
1 1/2	–	–	#10	1 1/2	273218	1 1/2	274029	1 3/8	38243
1 3/4	1 1/2	–	#11	1 3/4	273219	1 3/4	274030	1 3/8	38243

	HIT-OHC		HIT-OHW
Ø d_0	HIT-...	Art. No.	Art. No.
7/16 ... 3/4 inch	OHC 1	387551	387550
7/8 ... 1 3/4 inch	OHC 2	387552	

Ø d_0	h_{ef}	Art. No.	
≤1 1/4 inch	≤31 inch	381215	6 bar/90 psi
>1 1/4 inch	>31 inch	–	183 cyd/hour

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Ø	HIT-V HAS-	HIS-N	Rebar	HIT-RB		HIT-SZ		HIT-DL	
d_0 [mm]	d [mm]			[mm]	Art. No.	[mm]	Art. No.	[mm]	Art. No.
10	8	–	8	10	380917	–	–	–	–
12	10	–	8/10	12	336548	12	335022	12	371715
14	12	8	10/12	14	336549	14	335023	14	371716
16	–	–	12	16	336550	16	335024	16	371717
18	16	10	14	18	336551	18	335025	18	371718
20	–	–	16	20	336552	20	335026	20	371719
22	–	12	18	22	370774	22	380922	20	371719
24	20	–	–	24	380918	24	380923	20	371719
25	–	–	20	25	336553	25	335027	25	371720
28	24	16	22	28	380919	28	380924	25	371720
30	27	–	–	30	380920	30	380925	25	371720
32	–	20	24/25	32	336554	32	335028	32	371721
35	30	–	26/28	35	380921	35	380926	32	371721
40	–	–	32	40	382260	40	380927	32	371721

HIT-DL: h_{ef} >250 mm, h_{ef} >20 × d

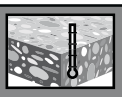
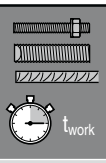
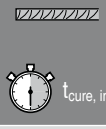
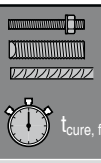
	HIT-OHC		HIT-OHW
Ø d_0	HIT-...	Art. No.	Art. No.
10 ... 20 mm	OHC 1	387551	387550
22 ... 32 mm	OHC 2	387552	

Ø d_0	h_{ef}	Art. No.	
≤32 mm	≤800 mm	381215	6 bar/90 psi
>32 mm	>800 mm	–	140 m³/h

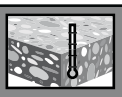
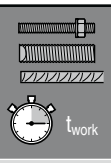
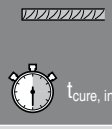
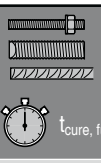
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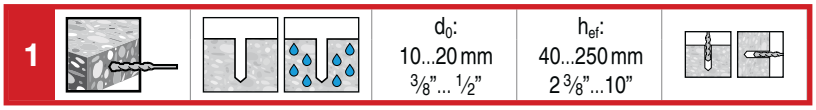
ETA

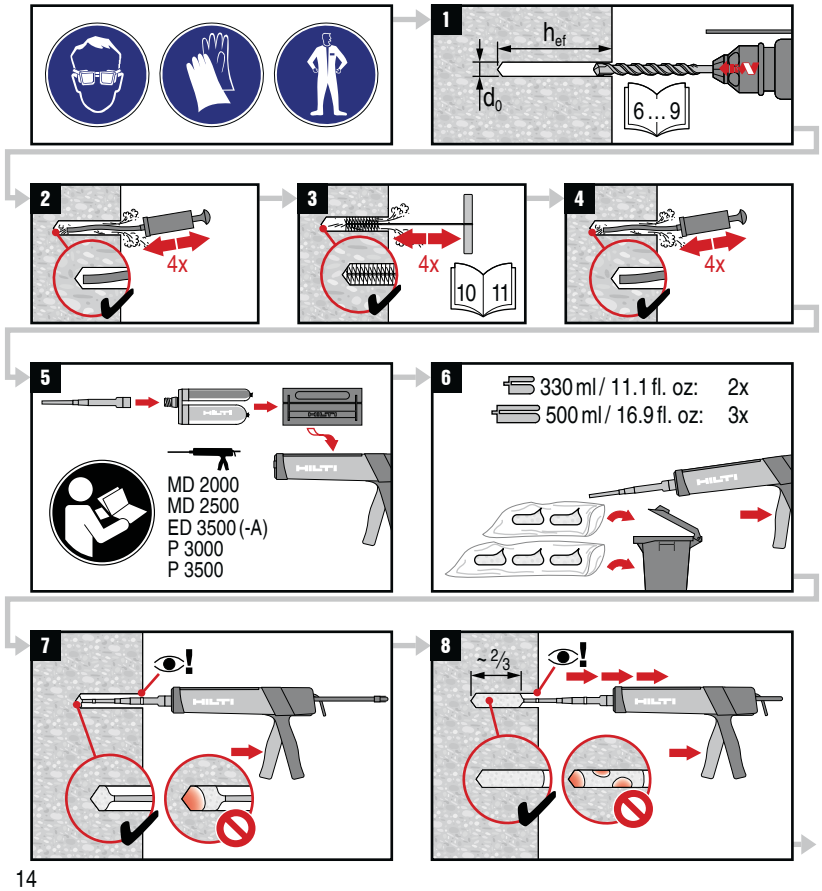
 [°C]	[°F]	 t_{work}	 $t_{cure,\ ini}$	 $t_{cure,\ full}$
5…9	41 – 49	0…2 h	≥ 18 h	≥ 72 h
10…14	50 – 58	0…1½ h	≥ 12 h	≥ 48 h
15…19	59 – 67	0…30 min	≥ 9 h	≥ 24 h
20…29	68 – 85	0…20 min	≥ 6 h	≥ 12 h
30…39	86 – 103	0…12 min	≥ 4 h	≥ 8 h
40	104	0…12 min	≥ 4 h	≥ 4 h

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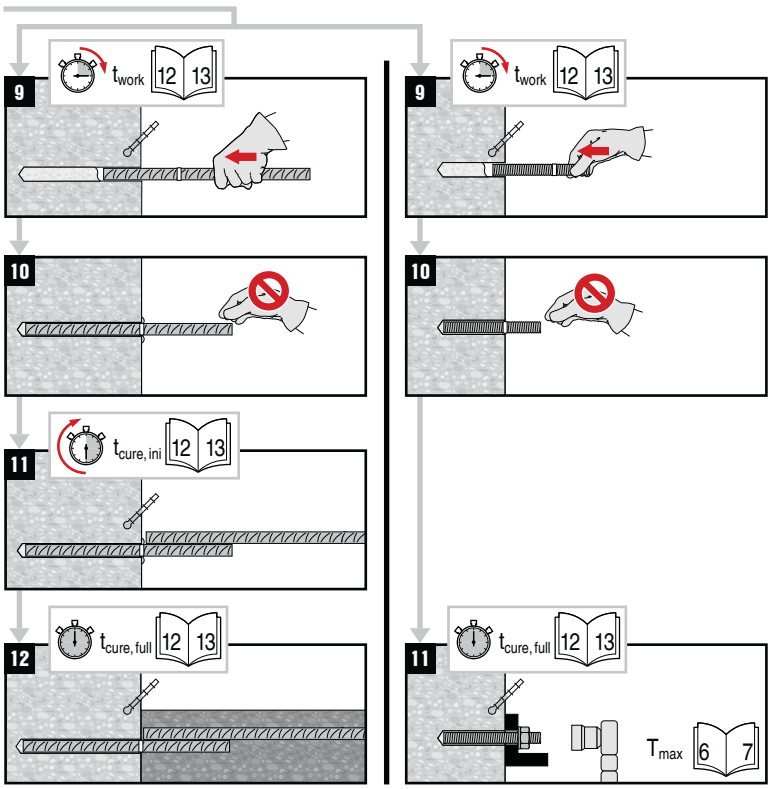
 [°C]	[°F]	 t_{work}	 $t_{cure,\ ini}$	 $t_{cure,\ full}$
–5...–1	23 – 31	0...4 h	≥ 36 h	≥ 72 h
0...9	32 – 49	0...3 h	≥ 25 h	≥ 50 h
10...19	50 – 67	0...2 h	≥ 12 h	≥ 24 h
20...29	68 – 85	0...20 min	≥ 6 h	≥ 12 h
30...39	86 – 103	0...12 min	≥ 4 h	≥ 8 h
40	104	0...12 min	≥ 2 h	≥ 4 h

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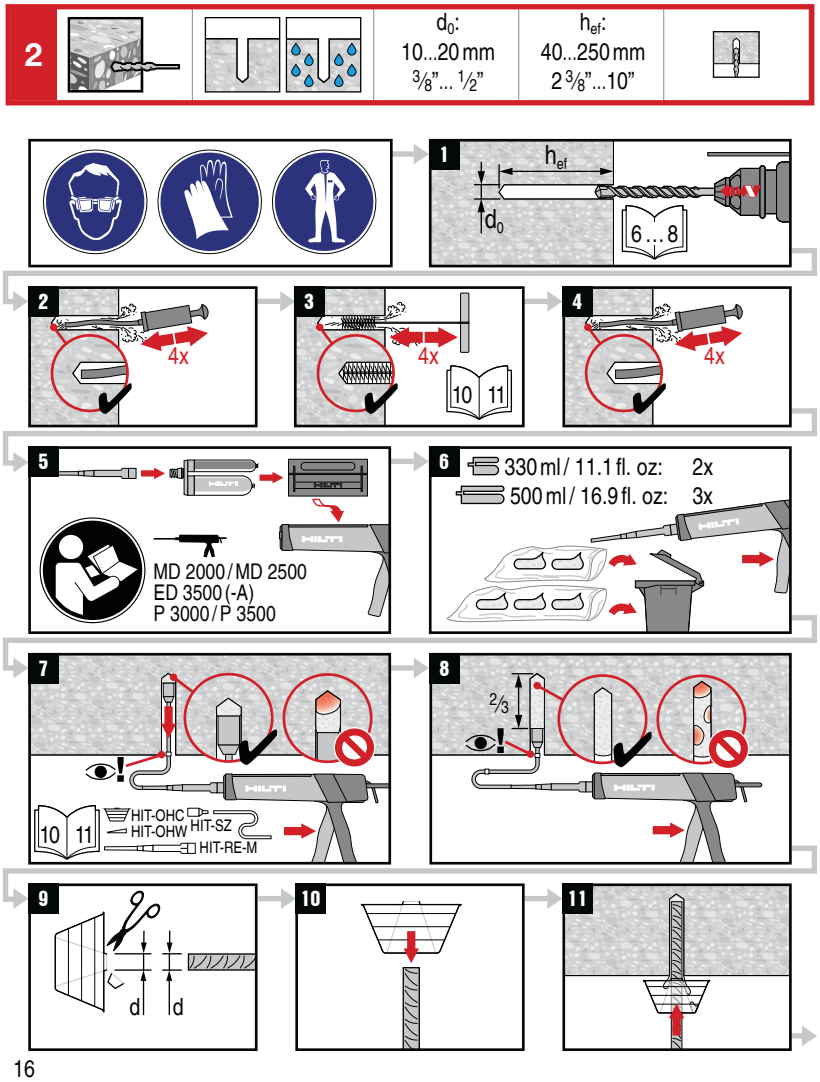




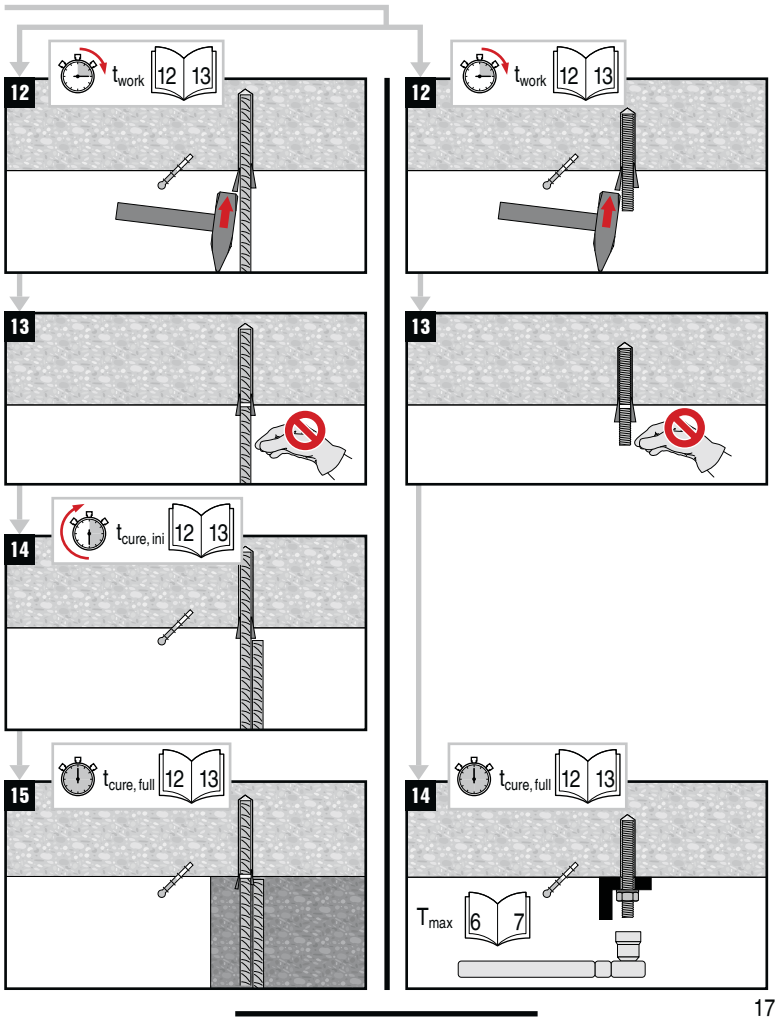
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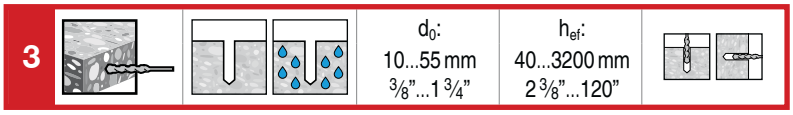
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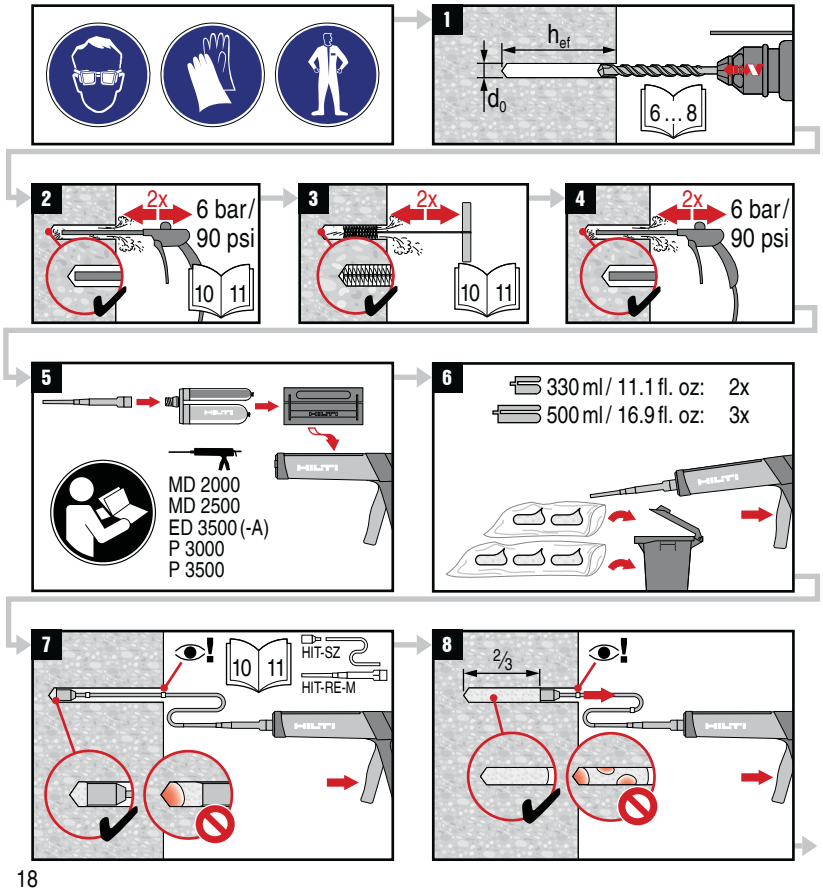


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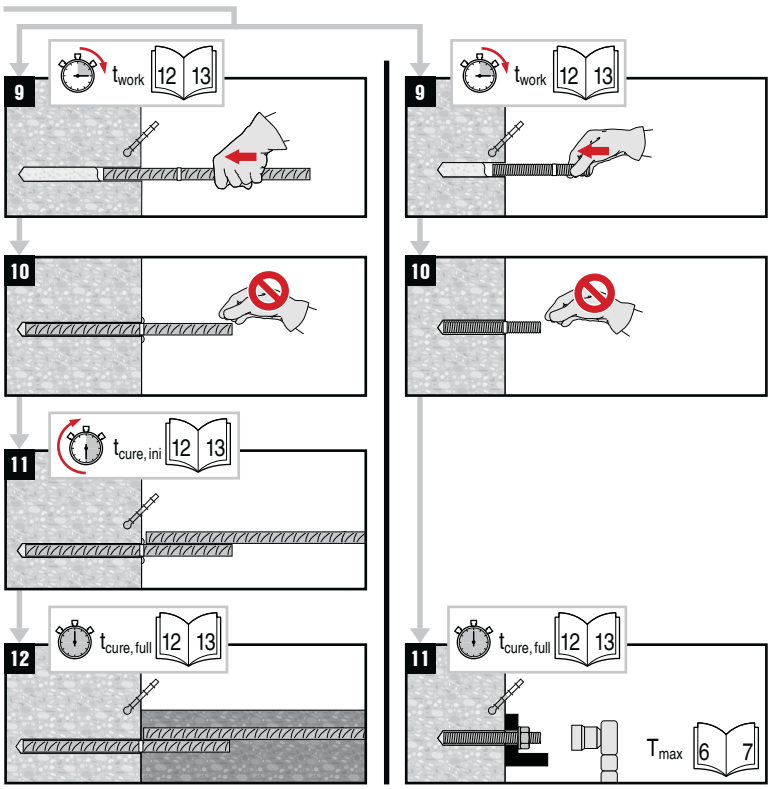


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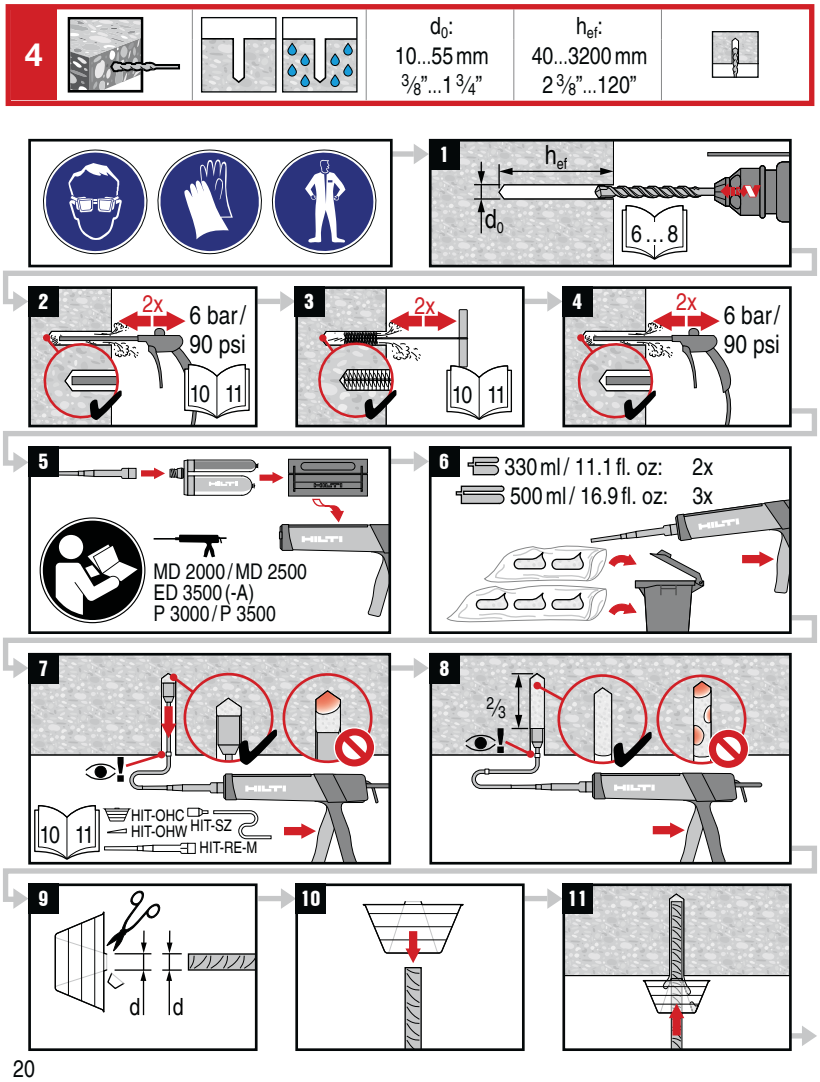




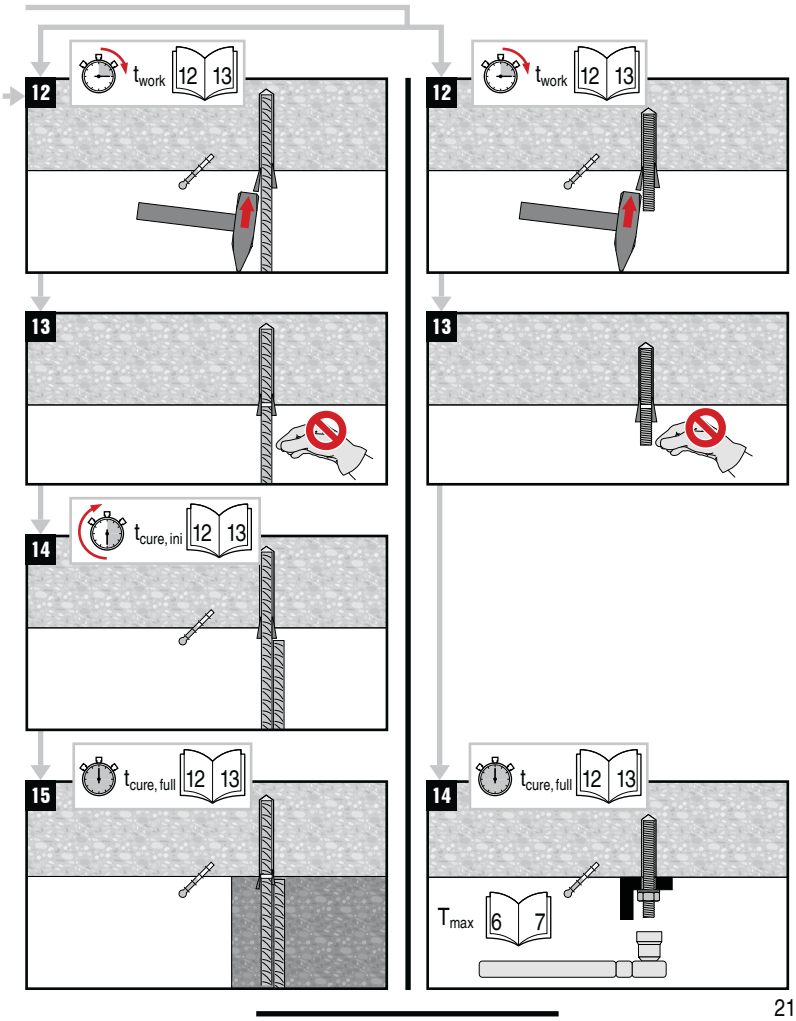
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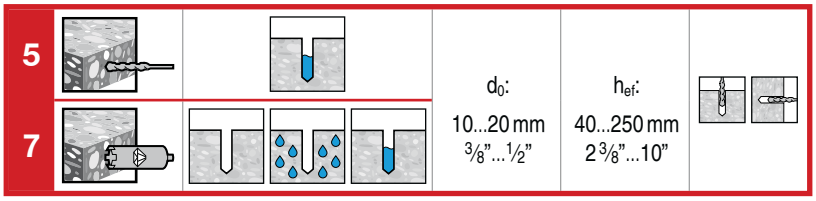
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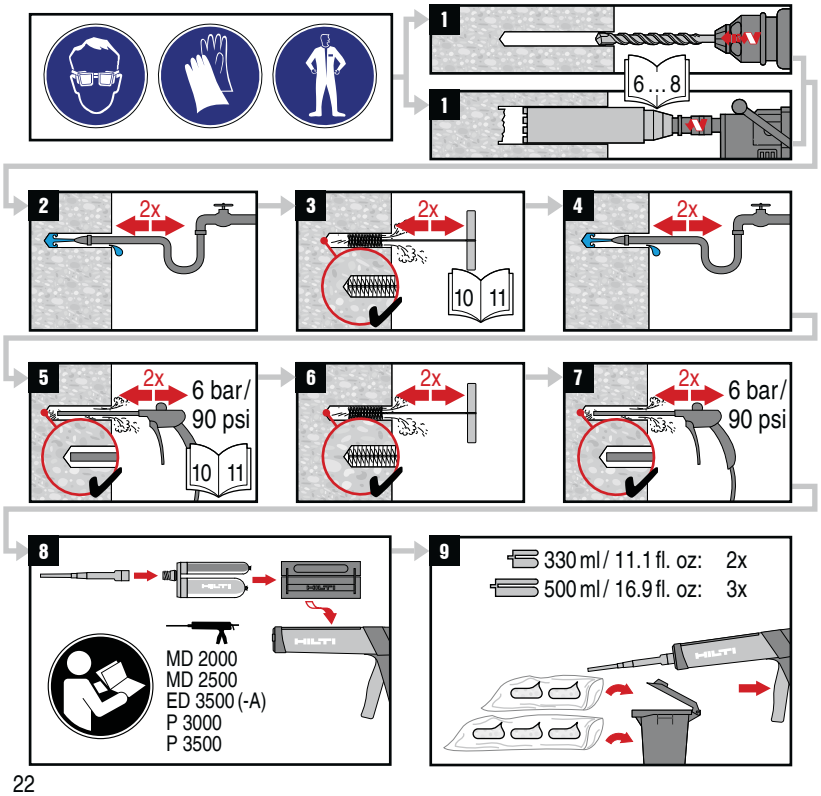


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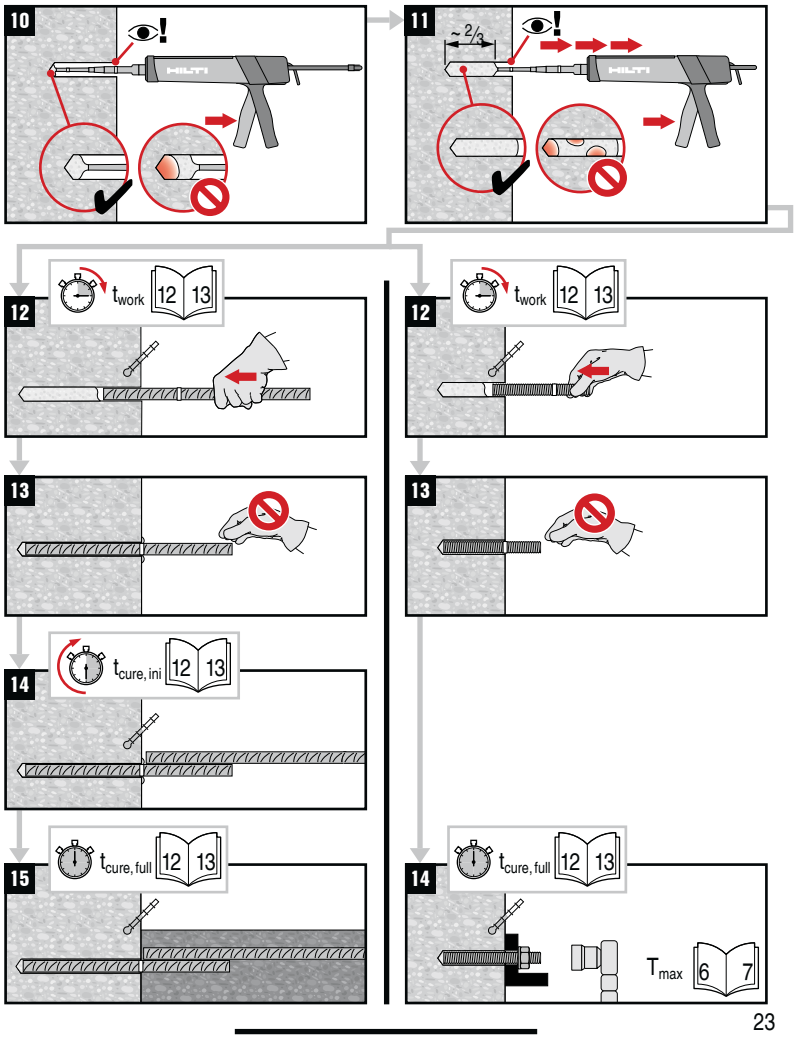


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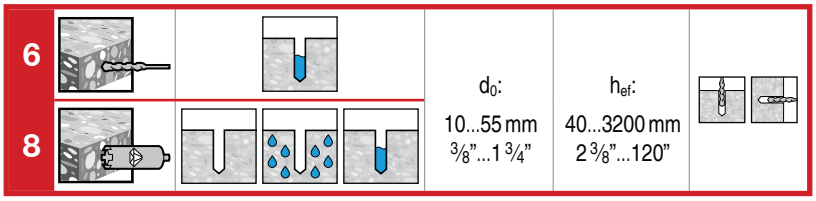


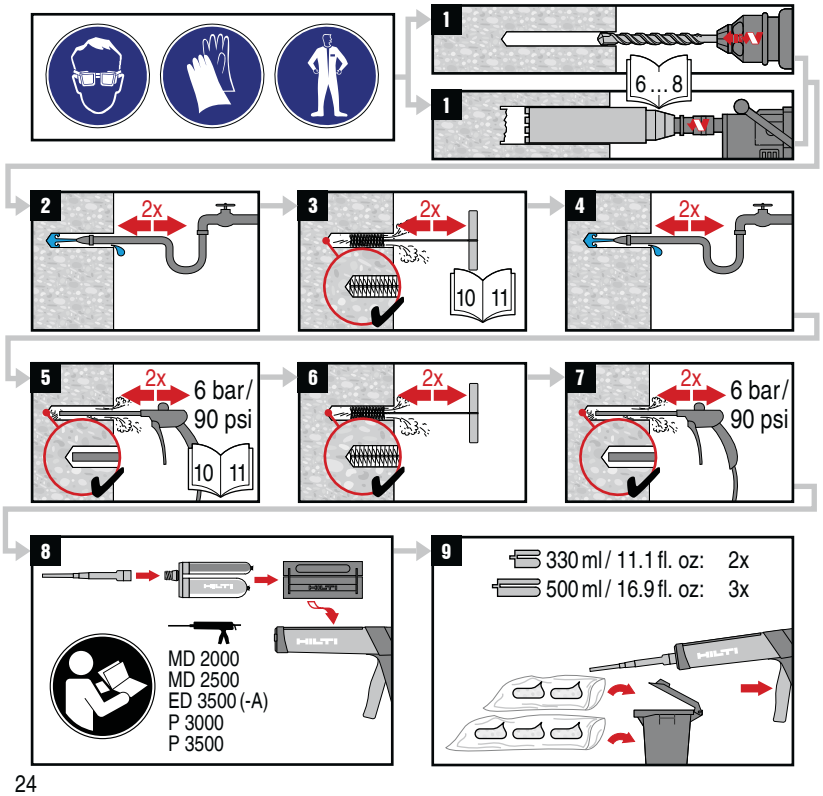


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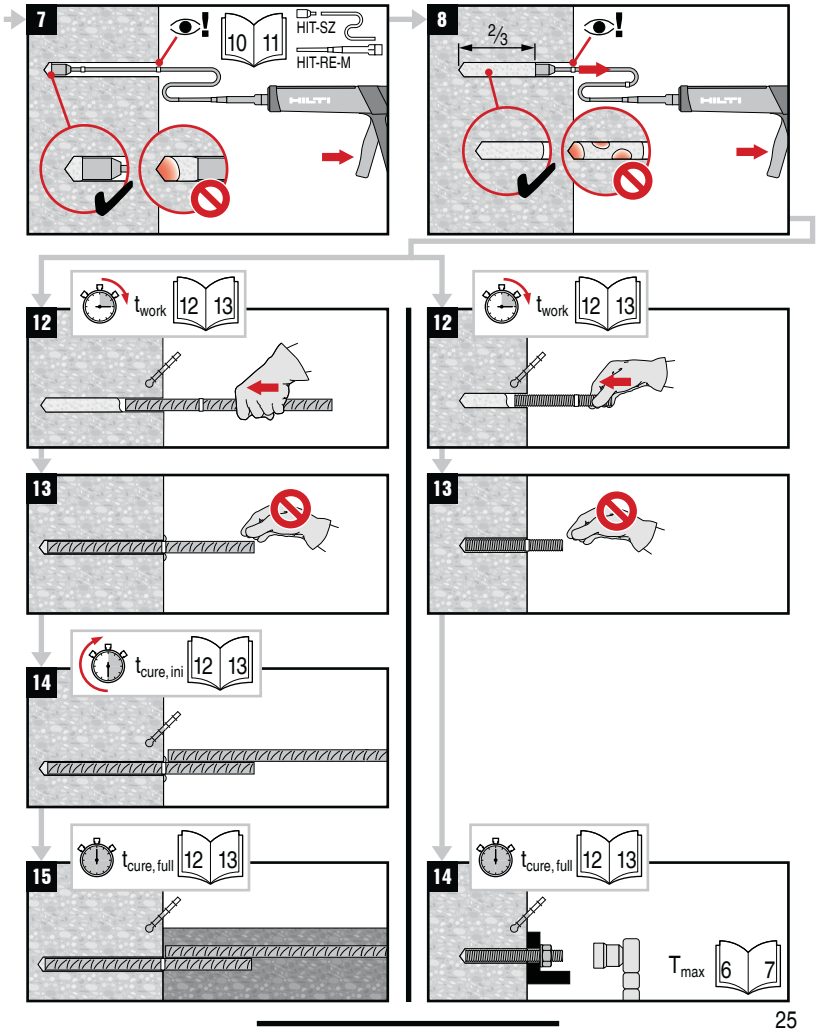


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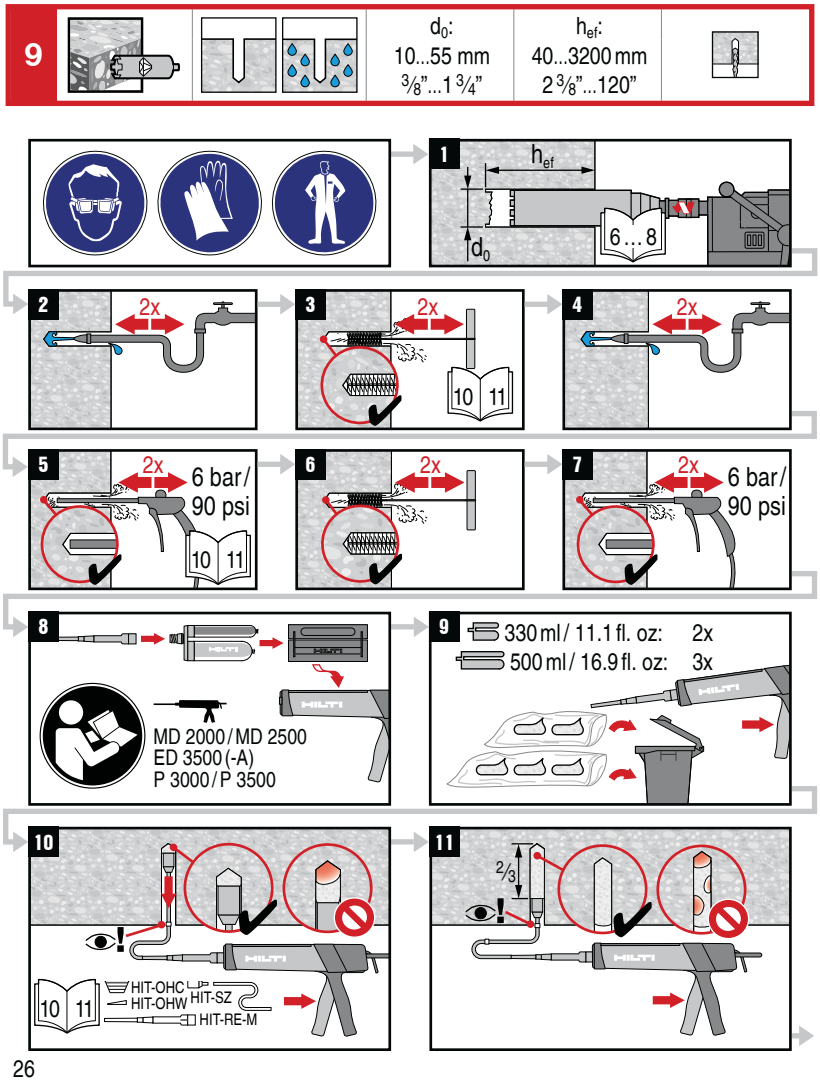




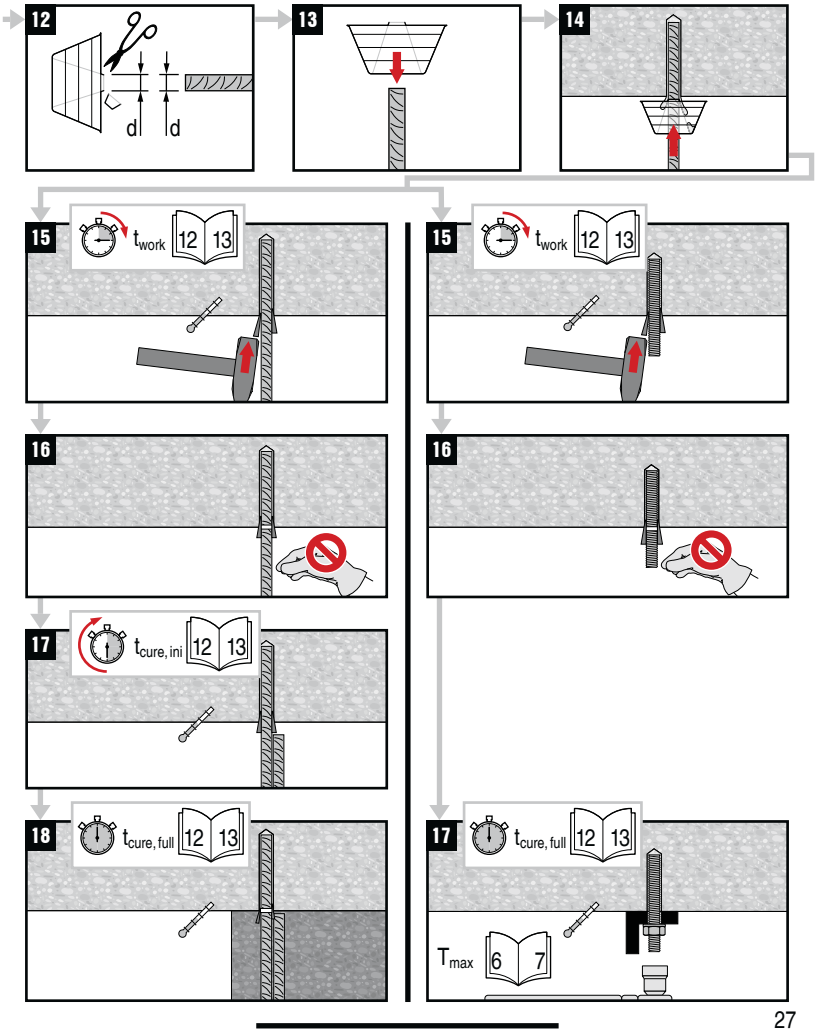
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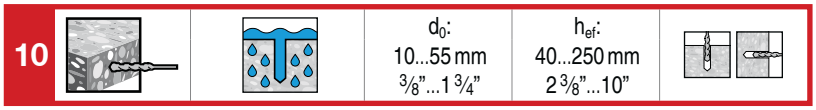
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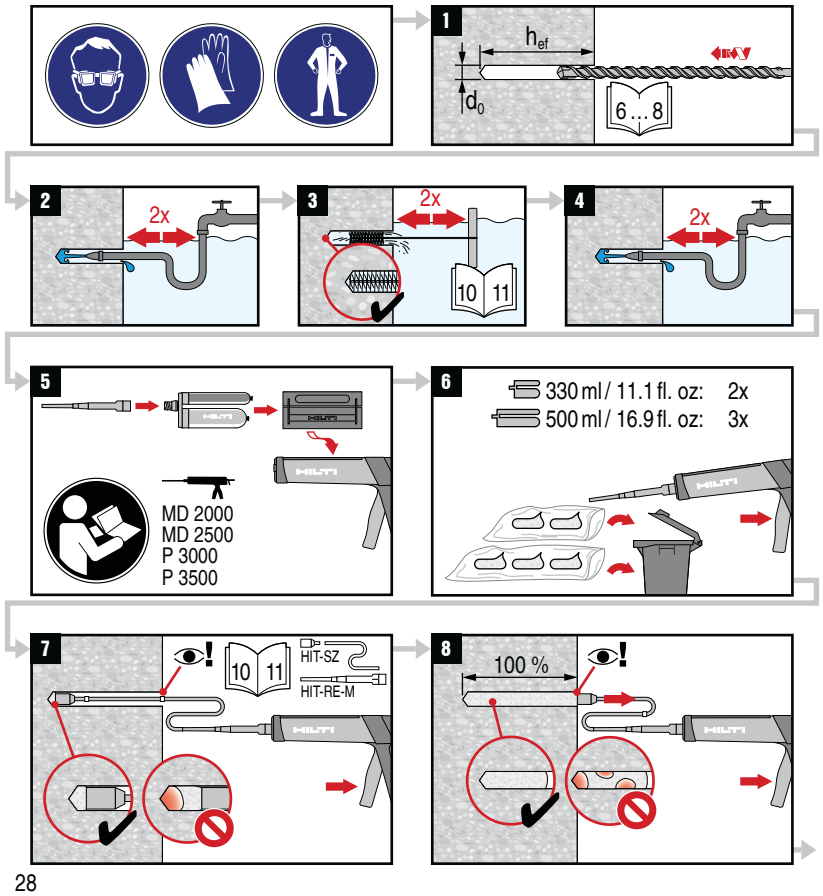


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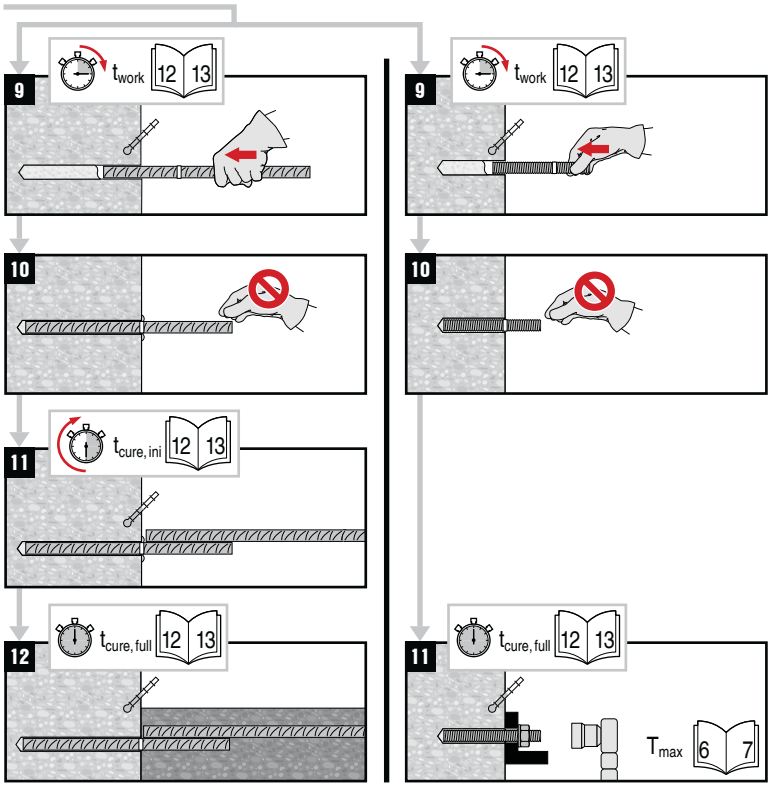


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Hilti HIT-RE 500

Adhesive anchoring system for rebar and anchor fastenings in concrete

► Prior to use of product, follow the instructions for use and the legally obligated safety precautions.
► See the Material Safety Data Sheet for this product.

Safety precautions

For Industrial Use Only. Keep out of reach of children.



Danger: Corrosive
Harmful if inhaled or swallowed.
Can cause eye and skin burns.
Can cause sensitization with some individuals.
Contains quartz sand.

Precautions:
Wear eye protection and gloves. Do not get in eyes.
Avoid contact with the skin. Avoid inhalation of vapors. Avoid inhalation of dusts during demolition/removal.

First Aid:
For **eye contact**, flush with water for 15 minutes while holding the eyelids apart. Seek medical attention. For **skin contact**, wash immediately with soap and water. If **ingested**, drink two glasses of water and seek medical attention immediately.

Hilti, Inc. Tulsa, OK 74146 / Hilti (Canada) Corp., Mississauga, Ontario L5N 2V8.

Ingredient	CAS Number
Part A: (Large side)	
Quartz sand	14808-60-7
Bisphenol A epoxy resin	25068-38-6
Bisphenol F epoxy resin	28064-14-4
Diglycidyl ether (NJ TSRN)	19136100-5013*
Alkylglycidyl ether (NJ TSRN)	19136100-5012*
Amorphous silica	67762-90-7
Part B: (Small side)	
m-xylene diamine	01477-55-0
Aliphatic polyamine (NJ TSRN)	19136100-5014*
Quartz sand	14808-60-7
Bonding agent	65997-16-2
Aluminum oxide	01344-28-1
Amorphous silica	67762-90-7

* NJ TSNR = New Jersey Trade Secret Registry Number

Warranty: Refer to standard Hilti terms and conditions of sale for warranty information.

Made in Germany

Content:	330 ml / 11.1 fl.oz	500 ml / 16.9 fl.oz
Weight:	470 g / 16.6 oz	710 g / 25.0 oz

Failure to observe these installation instructions, use of non-Hilti anchors, poor or questionable concrete conditions, or unique applications may affect the reliability or performance of the fastenings.

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Product Information

- Always keep this instruction for use together with the product.
- Ensure that the instruction for use is with the product when it is given to other persons.
- **Material Safety Data Sheet**: Review the MSDS before use.
- **Check expiration date**: See expiration date imprint on foilpack manifold (month/year). Do not use expired product.
- **Foil pack temperature during usage**: +5 °C to 40 °C / 41 °F to 104 °F.
- **Conditions for transport and storage**: Keep in a cool, dry and dark place between +5 °C to 25 °C / 41 °F to 77 °F.
- For any application not covered by this document / beyond values specified, please contact Hilti.
- Partly used foil packs must be used up within 4 weeks. Leave the mixer attached on the foil pack manifold and store under the recommended storage conditions. If reused, attach a new mixer and discard the initial quantity of anchor adhesive.

⚠ WARNING

! Improper handling may cause mortar splashes. Eye contact with mortar may cause irreversible eye damage!
- Always wear tightly sealed safety glasses, gloves and protective clothes before handling the mortar!
- Never start dispensing without a mixer properly screwed on.
- Use only the type of mixer supplied with the adhesive. Do not modify the mixer in any way.
- Never use damaged foil packs and/or damaged or unclean foil pack holders.

! Poor load values / potential failure of fastening points due to inadequate borehole cleaning. The boreholes must be free of debris, dust, water, ice, oil, grease and other contaminants prior to adhesive injection.
- For blowing out the borehole - blow out with oil free air until return air stream is free of noticeable dust.
- For flushing the borehole - flush with water line pressure until water runs clear.

! Ensure that boreholes are filled from the back of the boreholes without forming air voids.
- If necessary, use the accessories / extensions to reach the back of the borehole.
- For overhead applications use the overhead accessories HIT-SZ / IP and take special care when inserting the fastening element. Excess adhesive may be forced out of the borehole. Make sure that no mortar drips onto the installer.
- If a new mixer is installed onto a previously-opened foil pack, the first trigger pulls must be discarded.
- A new mixer must be used for each new foil pack.

Hilti accepts no liability for damage or failure caused by:
– Storage and transport not in accordance with the specified conditions.
– Failure to observe the instructions for use and setting data.
– Inadequate design of the anchor points
– Inadequate load bearing capacity of the base material
– Incorrect use
– Other influences of which Hilti is not aware or on which Hilti has no influence, e.g. use with products from a third party.

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Resina de inyección para la fijación de anclajes y tacos en hormigón

► Lea estas instrucciones de uso y observe las indicaciones de seguridad antes de utilizar el producto.
► Consulte con las Hojas de Seguridad para este producto.

Indicaciones de seguridad

Sólo Para Uso Industrial. Mantener alejado del alcance de los niños.



Peligro: Corrosivo
Nocivo en caso de ser inhalado o ingerido. Puede causar quemadura de la piel y de los ojos. Puede causar sensibilización en algunas personas. Contiene arena de cuarzo.

Precauciones:
Utilice gafas de seguridad y guantes.
Evitecontacto con los ojos y la piel.
Evite inhalación de los vapores.
Evite inhalación polvo durante la remoción o la demolición.

Primeros Auxilios:
Para contacto **con los ojos**, enjuague con agua por 15 minutos mientras aguante los párpados abiertos. Acudir atención medica. Para contacto **con la piel**, enjuague inmediatemente con agua y jabón. De **ser ingerido**, tome dos vasos de agua y acudir inmediatamente a un medico.

Hilti, Inc., Tulsa, OK 74146 / Hilti (Canada) Corp., Mississauga, Ontario L5N 2V8.

Ingrediente	**CAS Número**
Parte A: (cara grande)	
Arena de cuarzo	14808-60-7
Resina epoxi bifenol	A 25068-38-6
Resina epoxi bifenol	F 28064-14-4
Diglycidyl ether (NJ TSRN)	19136100-5013*
Alkylglycidyl ether (NJ TSRN)	19136100-5012*
Silicio amorfo	67762-90-7
Parte B: (cara pequeña)	
diamina xyleno -m	01477-55-0
Aliphatic polyamine (NJ TSRN)	19136100-5014*
Arena de cuarzo	14808-60-7
Agente ligante	65997-16-2
Aluminum oxide	01344-28-1
Silicio amorfo	67762-90-7

Garantia Para información sobre la garantia, consultar las condiciones de venta estándard de Hilti.

* NJ TSNR = New Jersey registro de secreto comercial núm.

Hecho en Alemania

Contenido:	330 ml/11.1 fl.oz	500 ml/16.9 fl.oz
Peso:	470 g/16.6 oz	710 g/25.0 oz

La inobservancia de las instrucciones de instalación, el uso de anclajes que no sean Hilti, malas o dudosas condiciones del hormigón y/o aplicaciones inadecuadas pueden afectar la fiabilidad y respuesta de las fijaciones.

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Información de producto

- Guarde siempre estas instrucciones de uso junto con el producto.
- En caso de entregar el producto a terceros, deben incluirse siempre las instrucciones de uso.
- **Hoja de datos de seguridad:** consulte la hoja de datos de seguridad antes de utilizar el producto.
- **Fecha de caducidad:** compruebe la fecha de caducidad (mes/año) de la pieza de conexión del cartucho. El producto no debe utilizarse después de la fecha de caducidad.
- **Temperatura del cartucho durante la utilización:** de +5 °C a 40 °C / de 41 °F a 104 °F.
- **Condiciones de transporte y almacenamiento:** lugar fresco, seco y oscuro con una temperatura de +5 °C a 25 °C / de 41 °F a 77 °F.
- Para aplicaciones que no se describen en las presentes instrucciones de uso o no se enmarcan en la especificación, póngase en contacto con Hilti.
- Los cartuchos que no estén completamente vacíos deberán utilizarse antes de cuatro semanas. Para ello deberán guardarse con el mezclador enroscado en las condiciones de almacenamiento recomendadas. Antes de utilizarlo de nuevo, enroscar un nuevo mezclador y desechar la resina inicial.

⚠ ADVERTENCIA

! La resina puede salpicar si se utiliza incorrectamente. El contacto de la resina con los ojos puede causar lesiones oculares permanentes.
- Utilice gafas protectoras herméticas, guantes de protección y ropa adecuada durante el trabajo.
- No comience a exprimir si no se ha enroscado el mezclador.
- Enrosque un mezclador nuevo antes de exprimir un cartucho nuevo. Asegúrese de que el asiento sea firme.
- Utilice exclusivamente el modelo de mezclador suministrado con la resina. No modifique el mezclador en ningún caso.
- Nunca utilice cartuchos en mal estado y/o portacartuchos dañados o sucios.

! Valores de sujeción deficientes/Fallo de la fijación debido a limpieza insuficiente del taladro. Antes de inyectar la resina, los taladros deben estar libres de restos de perforación, polvo, agua, hielo, aceite, grasa o cualquier otro agente contaminante.
- Soplado a presión del taladro: – limpie el taladro con aire a presión sin aceite hasta que el aire de retorno esté libre de polvo.
- Lavado del taladro: – lave con una manguera con la presión normal de la red hasta que salga agua limpia.

! Verificar que el relleno del taladro se produce desde el fondo del taladro para que no se formen burbujas de aire.
- Si es necesario, utilice las prolongaciones para alcanzar el fondo del taladro.
- En aplicaciones por encima de la cabeza, utilice el accesorio HIT-SZ/IP y preste especial atención al introducir el elemento de fijación. Puede salir resina sobrante del taladro. Asegúrese de que la resina no gotee sobre el usuario.
- Si se enrosca un nuevo mezclador en un cartucho ya abierto, las primeras aplicaciones también deben desecharse.
- Utilice un nuevo mezclador para cada cartucho nuevo.

Hilti no se responsabiliza de daños causados por:
– condiciones de almacenamiento y transporte diferentes a las especificadas
– incumplimiento de las instrucciones de uso y los datos de fijación
– anclajes mal dimensionados
– capacidad de carga insuficiente de la superficie
– aplicación incorrecta
– otros factores desconocidos o no atribuibles a Hilti como, por ejemplo, el uso de productos de otros fabricantes.

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Hilti HIT-RE 500

Mortier de scellement pour ancrage de chevilles et d'armatures dans le béton

► Avant toute utilisation, bien lire le présent mode d'emploi ainsi que les directives de sécurité qui y sont mentionnées.
► Se reporter à la fiche signalétique du produit.

Directives de sécurité

Pour usage industriel seulement. Tenir hors de la portée des enfants!



Danger: Corrosif
Nocif si respiré ou avalé.
Peut brûler les yeux et la peau. Peut entraîner la sensibilisation chez certains individus.
Contient du sable quartzeux.

Précautions:
Porter des gants et une protection pour les yeux. Eviter tout contact avec les yeux. Eviter tout contact avec la peau. Eviter d'inhaler les vapeurs. Eviter d'inhaler les poussières lors de la démolition ou du retrait.

Premiers secours:
En cas de contact **avec les yeux**, rincer à grande eau pendant 15 minutes en tenant les paupières ouvertes. Faire immédiatement appel à un médecin. En cas de contact **avec la peau**, se laver immédiatement avec de l'eau et du savon. **En cas d'ingestion**, boire deux verres d'eau et faire immédiatement appel à un médecin.

Hilti, Inc. Tulsa, OK 74146 / Hilti (Canada) Corp., Mississauga, Ontario L5N 2V8.

Ingrédient Numéro	**CAS**
Partie A: (Grande)	
Quartz sand	14808-60-7
Bisphenol A epoxy resin	25068-38-6
Bisphenol F epoxy resin	28064-14-4
Diglycidyl ether (NJ TSRN)	19136100-5013*
Alkylglycidyl ether (NJ TSRN)	19136100-5012*
Amorphous silica	67762-90-7
Partie B: (Petite)	
m-xylene diamine	01477-55-0
Aliphatic polyamine (NJ TSRN)	19136100-5014*
Quartz sand	14808-60-7
Bonding agent	65997-16-2
Aluminum oxide	01344-28-1
Amorphous silica	67762-90-7

Garantie: pour tous détails concernant la garantie, consulter les conditions de vente Hilti.

* NJ TSNR = New Jersey Trade Secret Registry Number.

Fabriqué en Allemagne

Contenu :	330 ml/11.1 fl.oz	500 ml/16.9 fl.oz
Poids :	470 g/16.6 oz	710 g/25.0 oz

Le non respect de ces instructions de pose, l'utilisation de chevilles autres qu'Hilti, la pose dans un béton faible ou matériau ou des applications particulières peuvent avoir un impact sur la sécurité et la performance de la fixation.

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Information produit

- Le présent mode d'emploi doit toujours être conservé avec le produit.
- Ne pas donner le produit à un autre utilisateur sans lui fournir le mode d'emploi.
- **Données de sécurité :** Avant toute utilisation, prendre connaissance des informations de sécurité sur les matériaux.
- **Date de péremption :** Contrôler la date de péremption (mois/année) imprimée sur le raccord de la cartouche. Ne plus utiliser un produit dont la date de péremption est dépassée.
- **Température des recharges en cours d'utilisation :** de +5 °C à 40 °C / 41 °F à 104 °F.
- **Conditions de transport et de stockage :** dans un endroit frais, sec et à l'abri de la lumière à une température de +5 °C à 25 °C / 41 °F à 77 °F.
- En cas d'applications qui ne sont pas décrites dans le présent mode d'emploi ou hors plage de valeurs spécifiées, s'adresser à Hilti.
- Les cartouches souples entamées doivent être réutilisées dans les quatre semaines. Laisser la buse mélangeuse vissée sur la recharge entamée et stocker la recharge conformément à la réglementation. Avant réutilisation, visser une nouvelle buse mélangeuse et jeter le mortier extrudé lors des premières pressions.

⚠ AVERTISSEMENT

! En cas de maniement non conforme, il y a risque de projection du mortier. Tout contact des yeux avec le mortier peut entraîner des lésions irréversibles !
- Lors du travail, porter une protection des yeux étanche, des gants et des vêtements de protection !
- Ne jamais commencer à travailler si la buse mélangeuse n'est pas vissée !
- Avant de commencer l'extrusion d'une nouvelle cartouche souple, visser une nouvelle buse mélangeuse. Vérifier qu'elle est bien en place.
- Utiliser exclusivement le type de buse fourni avec le mortier. Ne modifier la buse mélangeuse en aucun cas.
- Ne jamais utiliser de cartouches souples endommagées ni de porte-cartouches endommagés/très encrassés.

! Mauvaise fixation/défaillance du chevillage à cause d'un nettoyage insuffisant du trou. Avant de procéder à l'injection, s'assurer que le trou de perçage est exempt de déblais de perçage, poussières, eau, glace, huile, graisse ou autres contaminants.
- Soufflage du trou foré – souffler avec de l'air comprimé exempt d'huile, jusqu'à ce que l'air sortant soit exempt de toute poussière.
- Rinçage du trou foré – rincer le trou à l'eau à pression de conduite normale jusqu'à ce que de l'eau propre ressorte.

! Veiller à ce que le remplissage se fasse à partir du fond du trou pour éviter la formation de bulles d'air.
- Si nécessaire, utiliser des prolongateurs pour atteindre le fond du trou.
- En cas d'applications au plafond, utiliser l'accessoire HIT-SZ/IP et faire particulièrement attention lors de l'introduction de l'élément de fixation. L'excédent de mortier peut ressortir du trou foré. Veiller alors à ce que celui-ci ne goutte pas sur l'opérateur.
- Si une nouvelle buse mélangeuse est utilisée avec une cartouche déjà entamée, jeter également le premier mortier extrudé.
- Utiliser une nouvelle buse mélangeuse pour chaque cartouche souple neuve.

Hilti rejette toute responsabilité en cas de dommages dus :
– à des conditions de stockage et de transport non conformes aux consignes
– au non-respect du mode d'emploi et des données de pose
– à un dimensionnement insuffisant de l'ancrage
– à une capacité de charge insuffisante du matériau support
– à une erreur d'utilisation
– ou à tous autres facteurs non connus de Hilti ou indépendants de sa volonté, par exemple en cas d'utilisation de produits d'autres marques.

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Hilti HIT-RE 500

Sistema de ancoragem química para a fixação de ferros de armadura e ancoragens em betão

► Antes de utilizar este produto, siga as instruções de utilização e as precauções de segurança obrigatórias por lei.
► Consulte a Ficha de Segurança do Material para este produto.

Precauções de segurança

Apenas para utilização industrial. Manter fora do alcance das crianças.



Perigo: Corrosivo
Nocivo por inalação ou ingestão.
Pode provocar queimaduras dos olhos e da pele.
Pode causar sensibilização em determinados indivíduos.
Contém areia quartzosa.

Precauções:
Usar um equipamento protector para os olhos e luvas. Evitar o contacto com os olhos.
Evitar o contacto com a pele. Evitar a inalação de vapores. Evitar a inalação de poeiras durante a demolição/remoção.

Primeiros Socorros:
Em caso de **contacto com os olhos**, lavar com água durante 15 minutos mantendo as pálpebras separadas. Procurar cuidados médicos. Em caso de contacto com a **pele**, lavar imediata e abundantemente com água e sabão. Em caso de **ingestão**, beber dois copos de água e procurar imediatamente cuidados médicos.

Hilti, Inc. Tulsa, OK 74146/Hilti (Canada) Corp., Mississauga, Ontario L5N 2V8.

Ingrediente	**Número CAS**
Parte A: (Parte grande)	
Areia quartzosa	14808-60-7
Resina epoxídica à base de bisfenol A	25068-38-6
Resina epoxídica à base de bisfenol F	28064-14-4
Diglicidiléter (NJ TSRN)	19136100-5013*
Alquilglicidiléter (NJ TSRN)	19136100-5012*
Sílica amorfa	67762-90-7
Parte B: (Parte pequena)	
m-xileno diamina	01477-55-0
Poliamina alifática (NJ TSRN)	19136100-5014*
Areia quartzosa	14808-60-7
Aglutinante	65997-16-2
Alumina	01344-28-1
Sílica amorfa	67762-90-7

Garantia: Para informações sobre a garantia, consulte os termos e condições de venda padrão da Hilti.

* NJ TSRN = New Jersey Trade Secret Registry Number

Made in Germany

Conteúdo:	330 ml/11,1 fl.oz	500 ml/16,9 fl.oz
Peso:	470 g/16,6 oz	710 g/25,0 oz

O não cumprimento destas instruções de colocação, a utilização de ancoragens que não sejam da Hilti, as condições fracas ou duvidosas do betão, ou aplicações fora do comum podem afectar a segurança ou a eficácia das fixações.

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Dados informativos sobre o produto

- Guarde estas instruções de utilização sempre em conjunto com o produto.
- Entregue o produto a outras pessoas apenas juntamente com as instruções de utilização.
- **Ficha de segurança:** antes de iniciar os trabalhos, tenha em consideração a ficha de segurança.
- **Prazo de validade:** veja o prazo de validade (mês/ano) na peça de junção do cartucho. Não utilize produtos cujo prazo de validade se encontre ultrapassado.
- **Temperatura do cartucho durante a utilização:** entre +5 °C e 40 °C / 41 °F e 104 °F.
- **Condições de transporte e armazenamento:** em lugar fresco, seco e ao abrigo da luz, entre +5 °C e 25 °C / 41 °F e 77 °F.
- Em caso de aplicações que não se encontrem descritas nas presentes instruções de utilização ou estejam fora das especificações, é favor dirigir-se à Hilti.
- As sobras de cartuchos parcialmente usados devem ser utilizadas num prazo de quatro semanas. Deixe o misturador enroscado e armazene-o juntamente com o cartucho, de acordo com as condições de armazenagem preconizadas. Quando/se reutilizados, utilize um misturador novo e não utilize novamente a resina inicial.

⚠ AVISO

! No caso de manuseamento incorrecto, é possível que seja injectada resina. O contacto da resina com os olhos pode provocar lesões oculares permanentes!
- Durante a realização de trabalhos, use óculos de protecção que fiquem bem justos, luvas de protecção e roupa de trabalho!
- Nunca comece a aplicação sem que o misturador esteja enroscado!
- Antes da aplicação de um novo cartucho, enrosque um misturador novo. Certifique-se de que está bem apertado.
- Utilize apenas o tipo de misturador fornecido com a resina. Não modifique o misturador de forma alguma.
- Nunca utilize cartuchos danificados e/ou suportes danificados ou sujos.

! Valores de retenção deficientes/falha da fixação devido a limpeza insuficiente do furo. Antes da injecção, os furos têm de estar isentos de material de perfuração, pó, água, gelo, óleo, gordura ou outras impurezas.
- Limpar o furo por sopro – limpe o furo por sopro com ar isento de óleo, até que o ar saia sem pó.
- Lavar o furo – lave com uma mangueira com pressão normal, até sair água limpa.

! Assegure que o enchimento do furo é efectuado a partir do fundo, para que não se formem bolhas de ar.
- Se necessário, utilize os prolongadores para alcançar o fundo do furo.
- No caso de aplicações em suspensão, utilize o acessório HIT-SZ/IP e preste especial atenção ao inserir o elemento de fixação. Pode sair resina em excesso do furo. Certifique-se de que não pinga resina sobre o utilizador.
- Se for enroscado um misturador novo num cartucho já aberto, também não utilizar o produto das primeiras bombadas.
- Para cada cartucho novo deverá utilizar-se um misturador novo.

A Hilti não assume responsabilidade por danos provocados por:
– condições de armazenagem/transporte contrárias às especificadas;
– falha na observância das condições de utilização/colocação;
– uso de buchas com dimensão inadequada;
– insuficiente capacidade de resistência à carga do material base;
– aplicação incorrecta;
– como resultado de influências desconhecidas ou inaceitáveis para a Hilti, por exemplo, a utilização de produtos de outros fabricantes.

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(AR) Hilti Argentina S.R.L.
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AR-Buenos Aires
Tel +54 11 4721 4400 Fax +54 11 4721 4410

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06460-120 Barueri, SP
Tel +55 11 4134 9000 Fax +55 11 4134 9072

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Mississauga, Ontario L5N 6S2
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(CL) Hilti Chile Ltda.
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Col. Los Morales Polanco
Del. Miguel Hidalgo
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Tel +511 211 4423 Fax +51 1 211 4050

(PR) Hilti Caribe, LLC
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Carr. 869 KM 2, Palmas Industrial Park
Cataño, PR 00962
Tel +1-787 936-7060 Fax +1 787 936-7065

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CE
0756
Hilti AG
FL-9494 Schaan
Herstellwerk Hilti Werke
04
0756-CPD-0045
ETA-04/0027
ETAG 001-1, -5
Option 7

CE
0756
Hilti AG
FL-9494 Schaan
Herstellwerk Hilti Werke
08
0756-CPD-0217
ETA-08/0105
ETAG 001 - TR 023

Hilti
Z-21.8-1790
Institut für Massivbau Technische Universität Darmstadt

NSF
Certified to ANSI-NSF 61

www.hilti.com **Made in Germany**

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MATERIAL SAFETY DATA SHEET

Product name:	**HIT–RE 500**
Description:	High strength adhesive for anchoring in concrete. (Part A is the large tube)
Supplier:	Hilti, Inc. P.O. Box 21148, Tulsa, OK 74121
Emergency # (Chem-Trec.):	1 800 424 9300 (USA, PR, Virgin Islands, Canada); 001 703 527 3887 (other countries)

INGREDIENTS AND EXPOSURE LIMITS

Ingredients:		**CAS Number:**	**TLV:**	**PEL:**	**STEL:**
Part A:	Bisphenol A epoxy resin	25068-38-6	NE	NE	NE
	Bisphenol F epoxy resin	28064-14-4	NE	NE	NE
	Quartz sand	14808-60-7	0.025 mg/m^3 (R)	$\frac{10\ mg/m^3}{\%\ SiO_2 + 2}$	NE
	Alkylglycidyl ether	19136100-5012 *	NE	NE	NE
	Diglycidyl ether	19136100-5013 *	NE	NE	NE
	Siloxanes & silicones	67762-90-7	NE	NE	NE
Part B:	m-xylene diamine	01477-55-0	NE	NE	C: 0.1 / S
	Aliphatic polyamine	19136100-5014 *	NE	NE	NE
	Quartz sand	14808-60-7	0.025 mg/m^3 (R)	$\frac{10\ mg/m^3}{\%\ SiO_2 + 2}$	NE
	Aluminum oxide	01344-28-1	1 mg/m^3 (R)	15 mg/m^3 (T)	NE
	Cement	65997-16-2	NE	NE	NE
	Siloxanes & silicones	67762-90-7	NE	NE	NE

Abbreviations: * = indicates New Jersey Trade Secret Registry Number. **C** = Ceiling. **NE** = None Established. **R** =dust "respirable" fraction. **S** = Skin exposure, including the mucous membranes, eyes, and skin. **T** = "total" dust. **TLV** = ACGIH Threshold Limit Values. **PEL** = OSHA Permissible Exposure Limits. **STEL** = ACGIH/OSHA Short Term Exposure Limit

PHYSICAL DATA

Appearance and Odor:	A: Gray; B: red / paste. Amine-like odor.	**VOC Content:**	4.0 g/l
Boiling Point:	Approx. 212° F	**Vapor Pressure:**	Not determined.
Vapor Density: (air = 1)	Not determined.	**Odor Threshold:**	Not determined
Evaporation Rate:	Not applicable.	**Solubility in Water:**	Insoluble .
Specific Gravity:	1.5	**pH:**	11 (Part B with 1:1 water)

FIRE AND EXPLOSION HAZARD DATA

Flash Point:	> 200° F	**Flammable Limits:**	Not applicable.
Extinguishing Media:	CO_2, Dry Chemical, Foam, Water Spray.		
Special Fire Fighting Procedures:	A self-contained breathing apparatus should be worn when fighting fires involving chemicals.		
Unusual Fire and Explosion Hazards:	None known. Thermal decomposition products can be formed including CO_X, NO_X, water and carbon.		

REACTIVITY DATA

Stability:	Stable.	**Hazardous Polymerization:**	Will not occur.
Incompatibility:	Strong acids and oxidizing agents.		
Decomposition Products:	Thermal decomposition can yield CO_X, NO_X, water and carbon.		
Conditions to Avoid:	Avoid temperature extremes that could shorten the shelf-life of this product. (See handling and storage requirements for recommended storage temperatures).		

HEALTH HAZARD DATA

Known Hazards:	**Part A:** Eye and skin irritation. Possible skin sensitizer. **Part B:** Corrosive
Signs and Symptoms of Exposure:	**Part A:** Can be irritating to the eyes and skin, Can cause skin sensitization with some individuals (itching, redness, swelling). **Part B:** Can cause eye and skin burns. Vapors can be irritating. If swallowed, can cause burns.

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Routes of Exposure:	Contact. Inhalation.
Carcinogenicity:	IARC classifies crystalline silica (quartz sand) as a Group I carcinogen based upon evidence among workers in industries where there has been long-term and chronic exposure (via inhalation) to silica dust; e.g. mining, quarry, stone crushing, refractory brick and pottery workers. This product does not pose a dust hazard; therefore, this classification is not relevant.
Medical Conditions Aggravated by Exposure:	Eye, skin, and respiratory conditions.

EMERGENCY AND FIRST AID PROCEDURES

Eyes:	Flush **immediately** with water for at least 15 minutes. Contact a Physician if symptoms occur.
Skin:	Wash **immediately** with soap and water. Contact a Physician if symptoms occur.
Inhalation:	If symptoms occur, move to fresh air. Contact a Physician if symptoms occur.
Ingestion:	Do not induce vomiting unless directed by a physician. Contact a Physician immediately.
Other:	Referral to a physician is recommended if there is any question about the seriousness of the injury/exposure

CONTROL MEASURES AND PERSONAL PROTECTIVE EQUIPMENT

Ventilation:	General (natural or mechanically induced fresh air movements).
Eye Protection:	Chemical goggles recommended.
Skin Protection:	Impermeable gloves recommended.
Respiratory Protection:	None normally required. Where ventilation is inadequate to control vapors, use a NIOSH-approved respirator with organic vapor cartridges.

PRECAUTIONS FOR SAFE HANDLING AND USE

Handling and Storing Precautions:	For industrial use only. Keep away from children. Use with adequate ventilation. Avoid contact with the eyes or skin. Practice good hygiene; i.e. wash after using and before eating or smoking. Store in a cool dry area between 41° and 77° F (5 - 25° C). Keep from freezing.
Spill Procedures:	Take up with an absorbent material and place in a container for proper disposal.

REGULATORY INFORMATION

Hazard Communication:	This MSDS has been prepared in accordance with the federal OSHA Hazard Communication Standard 29 CFR 1910.1200.
HMIS Codes:	Health 3, Flammability 1, Reactivity 0, PPE B
DOT Shipping Name:	Limited Quantity - LQ
IATA / ICAO Shipping Name:	Amines, solid, corrosive, n.o.s. (M-xylenediamine), Class 8, UN3259, PG II
TSCA Inventory Status:	Chemical components listed on TSCA inventory.
SARA Title III, Section 313:	This product does not contain any toxic chemicals which are subject to reporting under Section 313 of SARA Title III (40 CFR Part 372).
EPA Waste Code(s):	Not regulated by EPA as a hazardous waste
Waste Disposal Methods:	Consult with regulatory agencies or your corporate personnel for disposal methods that comply with local, state, and federal safety, health and environmental regulations.

CONTACTS

Customer Service:	1 800 879 8000	**Technical Service:**	1 800 879 8000
Health / Safety:	1 800 879 6000 Jerry Metcalf (x1003704)		
Emergency # (Chem-Trec):	1 800 424 9300 (USA, PR, Virgin Islands, Canada); 001 703 527 3887 (other countries)		

The information and recommendations contained herein are based upon data believed to be correct; however, no guarantee or warranty of any kind expressed or implied is made with respect to the information provided.

KRÜGER

SECTION 3.4.5

ADHESIVE/SEALANT

VEOLIA WATER
Solutions & Technologies

Product Data Sheet
Edition 9.13.2012
Sikaflex-1a

Sikaflex®-1a

One part polyurethane, elastomeric sealant/adhesive

SEALANT • WATERPROOFING & RESTORATION INSTITUTE

Issued to: Sika Corporation
Product: Sikaflex®-1A

C719: Pass ✔ Ext:+35% Comp:-35%

Substrate: Mortar, Aluminum, Glass
[mortar substrate primed with Sika Primer 429]

C661: Rating 40

Validation Date: 8/3/12 – 8/2/17

No. 0812-S11211 *Copyright © 2012*

SEALANT VALIDATION
www.swrionline.org

Construction

Description

Sikaflex-1a is a premium-grade, high-performance, moisture-cured, 1-component, polyurethane-based, non-sag elastomeric sealant. Meets Federal specification TT-S-00230C, Type II, Class A. Meets ASTM C-920, Type S, Grade NS, Class 35, use T, NT, O, M, G, I; Canadian standard CAN/CGSB 19.13-M87.

Where to Use

- Designed for all types of joints where maximum depth of sealant will not exceed 1/2 in.
- Excellent for small joints and fillets, windows, door frames, reglets, flashing, common roofing detail applications, and many construction adhesive applications.
- Suitable for vertical and horizontal joints; readily placeable at 40°F.
- Has many applications as an elastic adhesive between materials with dissimilar coefficients of expansion.
- Submerged conditions, such as canal and reservoir joints.

Advantages

- Eliminates time, effort, and equipment for mixing, filling cartridges, pre-heating or thawing, and cleaning of equipment.
- Fast tack-free and final cure times.
- High elasticity - cures to a tough, durable, flexible consistency with exceptional cut and tear-resistance.
- Stress relaxation.
- Excellent adhesion - bonds to most construction materials without a primer.
- Excellent resistance to aging, weathering.
- Proven in tough climates around the world.
- Odorless, non-staining.
- Jet fuel resistant.
- Certified to the NSF/ANSI Standard 61 for potable water.
- Urethane-based; suggested by EPA for radon reduction.
- Paintable with water-, oil- and rubber-based paints.
- Capable of ±35% joint movement.

Coverage

10.1 fl. oz. cartridge seals 12.4 lineal ft. of 1/2 x 1/4 in. joint. 20 fl. oz. uni-pac sausage seals 24 lineal ft. of 1/2 x 1/4 in. joint.

Packaging

Disposable 10.1 fl. oz., moisture-proof composite cartridges, 24/case; and uni-pac sausages, 20 fl. oz., 20/carton.

Typical Data *(Material and curing conditions @ 73°F (23°C) and 50% R.H.)*

RESULTS MAY DIFFER BASED UPON STATISTICAL VARIATIONS DEPENDING UPON MIXING METHODS AND EQUIPMENT, TEMPERATURE, APPLICATION METHODS, TEST METHODS, ACTUAL SITE CONDITIONS AND CURING CONDITIONS.

Shelf Life

10.1 fl. oz. cartridges	12 months
20 fl. oz. uni-pac sausages	12 months
5 gallon pail	6 months
55 gallon drum	6 months

Storage Conditions Store at 40°-95°F (4°-35°C). Condition material to 65°-75°F before using.

Colors White, colonial white, aluminum gray, limestone, black, dark bronze, capitol tan, stone and medium bronze. Special architectural colors on request.

Application Temperature 40° to 100°F. Sealant should be installed when joint is at mid-range of its anticipated movement.

Service Range -40° to 170°F

Curing Rate

Tack-free time	3 to 6 hours
Tack-free to touch	3 hours
Final cure	4 to 7 days

Tear Strength (ASTM D-624) 55 lb./in.

Shore A Hardness (ASTM C-661) 21 day 40±5

Movement Capability (ASTM C-719) +/- 35%

Tensile Properties (ASTM D-412)

21 day	Tensile Stress		175 psi (1.21 MPa)
	Elongation at Break		550%
	Modulus of Elasticity	25%	35 psi (0.24 MPa)
		50%	60 psi (0.41 MPa)
		100%	85 psi (0.59 MPa)

Adhesion in Peel (TT-S-00230C, ASTM C 794)

Substrate	Peel Strength	Adhesion Loss
Concrete	20 lb.	0%
Aluminum	20 lb.	0%
Glass	20 lb.	0%

Weathering Resistance Excellent

Chemical Resistance Good resistance to water, diluted acids, and diluted alkalines. Consult Technical Service for specific data.

Construction

How to Use

Surface Preparation

Clean all surfaces. Joint walls must be sound, clean, dry, frost-free, and free of oil and grease. Curing compound residues and any other foreign matter must be thoroughly removed. A roughened surface will also enhance bond. Install bond breaker tape or backer rod to prevent bond at base of joint.

Priming

Priming is not usually necessary. Most substrates only require priming if testing indicates a need or where sealant will be subjected to water immersion after cure.

Consult Sikaflex Primer Technical Data Sheet or Technical Service for additional information on priming.

Application

Recommended application temperatures: 40°-100°F. For cold weather application, condition units at approximately 70°F; remove prior to using.

For best performance, Sikaflex-1a should be gunned into joint when joint slot is at mid-point of its designed expansion and contraction.

Place nozzle of gun into bottom of the joint and fill entire joint. Keep the nozzle in the sealant, continue on with a steady flow of sealant preceding the nozzle to avoid air entrapment.

Avoid overlapping of sealant to eliminate entrapment of air. Tool sealant to ensure full contact with joint walls and remove air entrapment. Joint dimension should allow for 1/4 inch minimum and 1/2 inch maximum thickness for sealant. Proper design is 2:1 width to depth ratio,

For use in horizontal joints in traffic areas, the absolute minimum depth of the sealant is 1/2 in. and closed cell backer rod is recommended.

Linear Feet of Sealant per Gallon

Width \ Depth	Inches	¼	½
	¼	308.0	
	½	154.0	77.0
	¾	102.7	51.3
	1	77.0	38.5
	1 ½	61.6	30.8
	1 ¾	51.3	25.7

Limitations

- Allow 1-week cure at standard conditions when using Sikaflex-1a in total water immersion situations and prior to painting.
- When overcoating with water, oil and rubber based paints, compatibility and adhesion testing is essential.
- Avoid exposure to high levels of chlorine. (Maximum continuous level is 5 ppm of chlorine.)
- Maximum depth of sealant must not exceed 1/2 in.; minimum depth is 1/4 in.
- Maximum expansion and contraction should not exceed 25% of average joint width.
- Do not cure in the presence of curing silicone sealants.
- Avoid contact with alcohol and other solvent cleaners during cure.
- Do not apply when moisture-vapor-transmission condition exists from the substrate as this can cause bubbling within the sealant.
- Use opened cartridges and uni-pac sausages the same day.
- When applying sealant, avoid air-entrapment.
- Since system is moisture-cured, permit sufficient exposure to air.
- White color tends to yellow slightly when exposed to ultraviolet rays.
- Light colors can yellow if exposed to direct gas fired heating element.
- The ultimate performance of Sikaflex-1a depends on good joint design and proper application with joint surfaces properly prepared.
- The depth of sealant in horizontal joints subject to traffic is 1/2 in.
- Do not tool with detergent or soap solutions.
- Do not use in contact with bituminous/asphaltic materials.

Caution

WARNING: IRRITANT, SENSITIZER. Contains Polyisocyanate Prepolymer (Mixture), Xylene (CAS 1330-20-7). Causes eye irritation. May cause skin/respiratory irritation. May cause skin and/or respiratory sensitization after prolonged contact. May be harmful if swallowed. Reports have associated repeated and prolonged exposure to some of the chemicals in this product with permanent brain, liver, kidney and nervous system damage. Headaches and dizziness may result. **Deliberate misuse by inhalation of vapors may be harmful or fatal. Strictly follow all usage, handling and storage instructions.**

Handling & Storage

Avoid direct contact. Wear personal protective equipment (chemical resistant goggles/gloves/clothing) to prevent direct contact with skin and eyes. Use only in well ventilated areas. Open doors and windows during use. Use a properly fitted NIOSH respirator if ventilation is poor. Wash thoroughly with soap and water after use. Remove contaminated clothing and launder before reuse. Store in cool dry well ventilated area.

Cleanup

Use personal protective equipment (chemical resistant gloves/goggles/clothing). Without direct contact, remove spilled or excess product and placed in suitable sealed container. Dispose of excess product and container in accordance with applicable environmental regulations.

First Aid Measures

Eyes: Hold eyelids apart and flush thoroughly with water for 15 minutes. **Skin**: Remove contaminated clothing. Wash skin thoroughly for 15 minutes with soap and water. **Inhalation:** Remove to fresh air. **Ingestion:** Do not induce vomiting. Dilute with water. Contact physician. **In all cases contact a physician immediately if symptoms persist.**

KEEP CONTAINER TIGHTLY CLOSED • KEEP OUT OF REACH OF CHILDREN • NOT FOR INTERNAL CONSUMPTION • FOR INDUSTRIAL USE ONLY

All information provided by Sika Corporation ("Sika") concerning Sika products, including but not limited to, any recommendations and advice relating to the application and use of Sika products, is given in good faith based on Sika's current experience and knowledge of its products when properly stored, handled and applied under normal conditions in accordance with Sika's instructions. In practice, the differences in materials, substrates, storage and handling conditions, actual site conditions and other factors outside of Sika's control are such that Sika assumes no liability for the provision of such information, advice, recommendations or instructions related to its products, nor shall any legal relationship be created by or arise from the provision of such information, advice, recommendations or instructions related to its products. The user of the Sika product(s) must test the product(s) for suitability for the intended application and purpose before proceeding with the full application of the product(s). Sika reserves the right to change the properties of its products without notice. All sales of Sika product(s) are subject to its current terms and conditions of sale which are available at **www.sikausa.com** or by calling 800-933-7452.

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LIMITED WARRANTY: Sika warrants this product for one year from date of installation to be free from manufacturing defects and to meet the technical properties on the current Technical Data Sheet if used as directed within shelf life. User determines suitability of product for intended use and assumes all risks. Buyer's sole remedy shall be limited to the purchase price or replacement of product exclusive of labor or cost of labor. **NO OTHER WARRANTIES EXPRESS OR IMPLIED SHALL APPLY INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. SIKA SHALL NOT BE LIABLE UNDER ANY LEGAL THEORY FOR SPECIAL OR CONSEQUENTIAL DAMAGES. SIKA SHALL NOT BE RESPONSIBLE FOR THE USE OF THIS PRODUCT IN A MANNER TO INFRINGE ON ANY PATENT OR ANY OTHER INTELLECTUAL PROPERTY RIGHTS HELD BY OTHERS.**

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Regional Information and Sales Centers. For the location of your nearest Sika sales office, contact your regional center.

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Carretera Libre Celaya Km. 8.5
Fracc. Industrial Balvanera
Corregidora, Queretaro
C.P. 76920
Phone: 52 442 2385800
Fax: 52 442 2250537

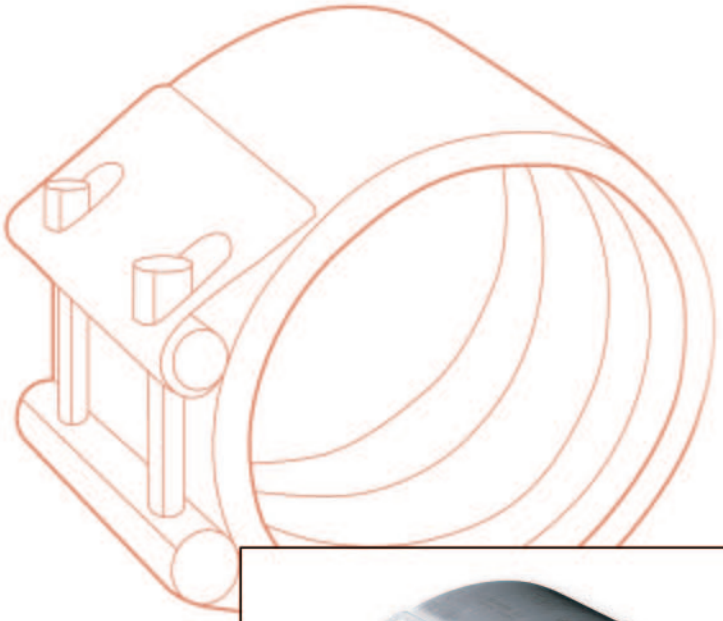
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KRÜGER

SECTION 3.4.6

FLEXIBLE COUPLINGS

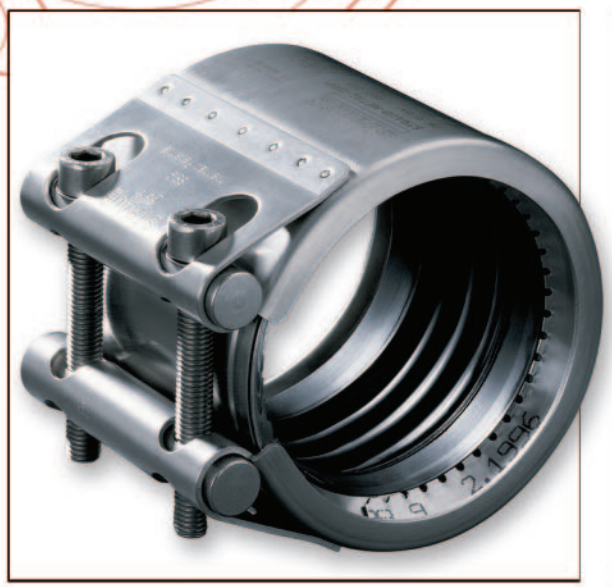
VEOLIA WATER
Solutions & Technologies



straub®

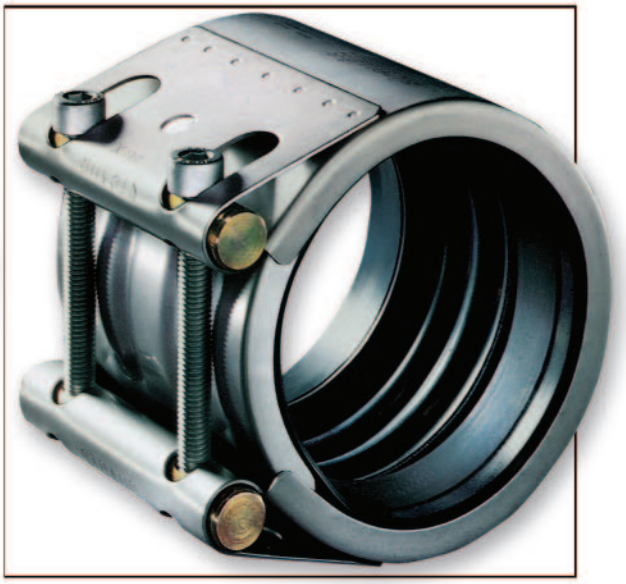
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the right connection









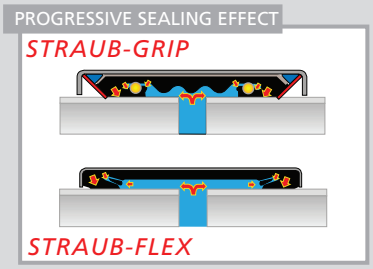
straub couplings

Trusted Pipe-Joining Solutions For Over Forty Years

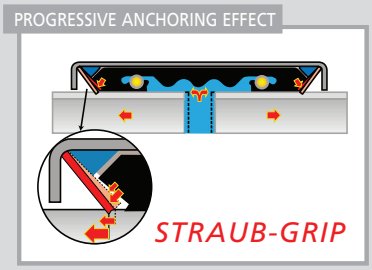


STRAUB Pipe Couplings

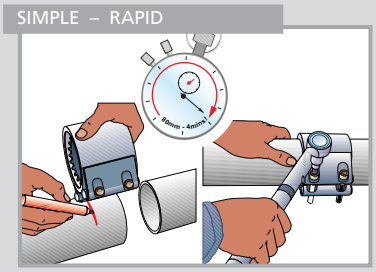
PROGRESSIVE SEALING EFFECT



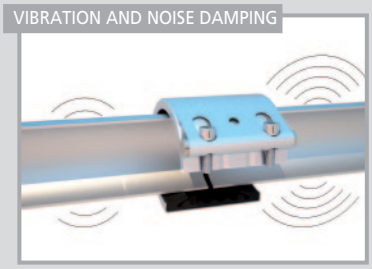
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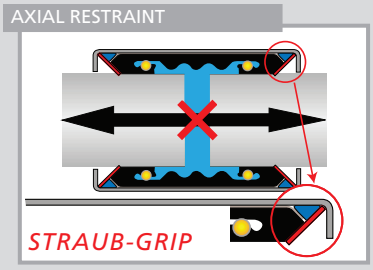
SIMPLE – RAPID



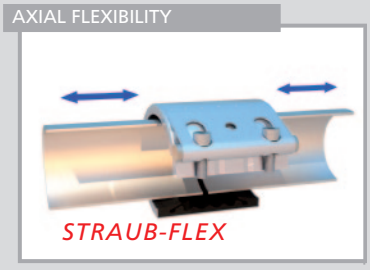
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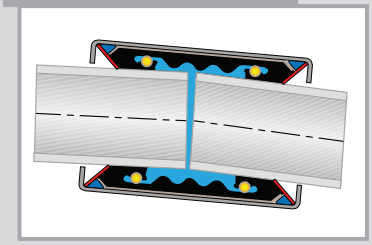
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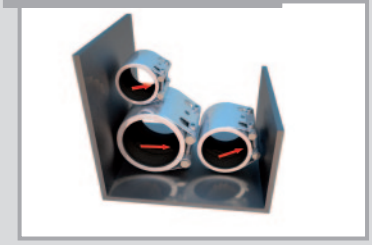
AXIAL FLEXIBILITY



FLEXIBILITY



SPACE SAVING

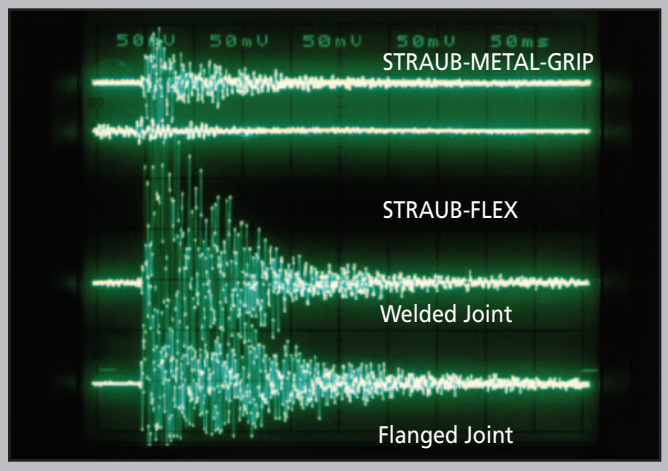


- Joins different pipe materials
- Progressive lip seal technology
- Eliminates Welding. No Special tools Required.
- Detachable and reusable
- Fastest and easiest way to join pipes.
- Saves: Time - Labor - Money
- Over 180 approvals worldwide

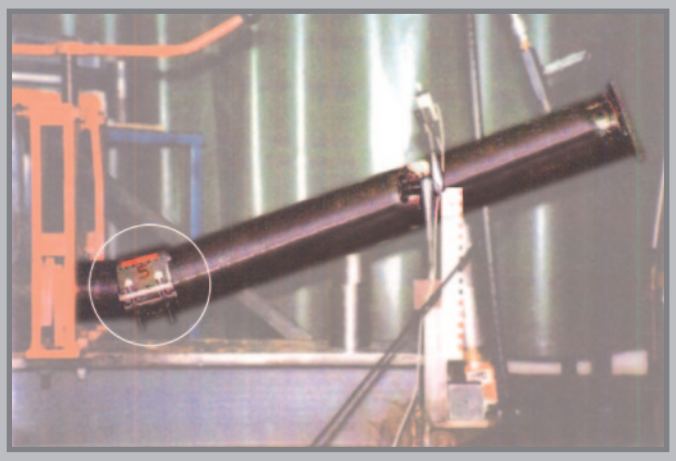
an Aliaxis company

HI-PERFORMANCE PIPE COUPLINGS

The dependable plain end coupling system that **SAVES TIME**, **SAVES MONEY** and **SAVES SPACE**.
The STRAUB coupling is a patented mechanical coupling system for joining plain end pipe in sizes ¾" through 144".



Noise & Vibration Damping



Angular Deflection: 20 degrees
Pressure: 300 PSI

FAST AND ECONOMICAL

- Stab fit design - ready to install
- No Special Tools Required
- Fits Plain-End Pipes
- Reusable

The STRAUB system eliminates the need for any pipe end preparation, saving time and money. Assembly requires only a torque wrench to secure the pipe joint. The unique low profile design closes around the circumference of the pipe or tube, creating a leak tight seal without the need for lubricant. STRAUB couplings are used to join virtually any plain end pipe or tube including steel, stainless steel, ductile iron, FRP, PVC, CPVC, C900, CPP, concrete pipe, copper, and CuNi.

FEATURES & BENEFITS

UNIVERSAL USE
- Suitable for almost any pipe material
- Joins pipes of the same or dissimilar materials
- Suitable for pressure, vacuum or suction lines
- Leakproof joint, due to the pressure responsive gasket
- Quick and simple repairs to existing pipe lines

ECONOMICAL
- Pre-assembled, stab-fit design ensures simple, rapid installation
- For use on plain-end pipes without the need for costly pipe end preparation
- Simply cut pipes to length, center coupling and tighten bolts
- Suitable for thick or thin wall pipes
- Needs only a torque wrench - no other special tools required

RELIABLE
- Stress-free, flexible pipe joint
- Compensates for axial movement and angular deflection
- Pressure-resistant and leak-proof even with inaccurate pipe assembly
- Dampens water-hammer, vibration and structure-borne noise

EASY HANDLING
- Detachable and re-usable, maintenance free
- Eases pipe alignment problems
- Simple and quick to install, reduces installation costs
- No heat or fire hazard, can be fitted in fire risk or confined spaces without special equipment or permits

DURABLE
- Progressive sealing effect, higher pressures reinforce the seal
- Axial restraint versions available, prevents pipe pull-out
- Corrosion resistant; all stainless steel construction
- Good resistance to temperature and chemicals
- Reusable

SPACE-SAVING
- Compact design, saves space and allows pipes to be compactly installed
- Allows the use of low profile pipe insulation
- Can be accessed in confined areas, coupling can be rotated to provide ease of access to bolts
- Light weight

THE STRAUB CONCEPT

PRESSURE RESPONSIVE SEAL

- Seal is reinforced by increasing line pressure, ensuring long life performance.
- Seals on rough pipe surfaces
- No lubrication of gasket is required
- Pressure or vacuum service
- Absorbs noise and vibration
- Low torque/compression ensures long service life

COMPACT DESIGN

- Saves Space
- Allows pipes to be closely grouped
- Allows low profile installation
- Corrosion resistant construction

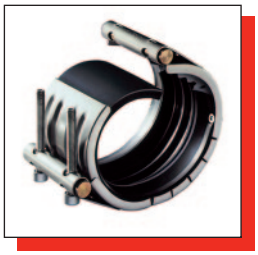
EASE OF HANDLING & ASSEMBLY

- Light weight
- Simple and quick to install
- Stab fit, no need to disassemble
- Low torque required
- No pipe end preparation
- Reusable
- Never needs retightening
- No welding

All STRAUB couplings require the correct use of a torque wrench for a safe and proper installation. STRAUB couplings must be torqued to the specified value as printed on each individual coupling. Failure to do so can result in injury or death.







STRAUB-METAL-GRIP & STRAUB-GRIP-L

The STRAUB-GRIP-L and STRAUB-METAL-GRIP couplings join plain end pipes with axial restraint. STRAUB-GRIP-L and STRAUB-METAL-GRIP provide pull out resistance in excess of the coupling's rated working pressure. Whether for pressure or suction lines, thick or thin wall pipe, the STRAUB-GRIP-L and STRAUB-METAL-GRIP couplings are installed quickly, safely and economically. Due to the unique design of the teeth, as internal pressure increases, the anchoring effect is progressively increased. The engagement of the teeth into the pipe's outside surfaces provides for electrical conductivity across the pipe joint.

STRAUB-FLEX

The STRAUB-FLEX coupling will join virtually any plain end pipe. Whether pressure or suction lines, thick or thin wall pipe, the STRAUB-FLEX coupling is installed quickly, safely and economically. STRAUB-FLEX couplings can accommodate pipe system expansion and contraction movement as well as angular deflection. STRAUB-FLEX couplings require the pipes to be axially restrained and are an economical alternative to rubber and metal expansion joints.

STRAUB-OPEN-FLEX

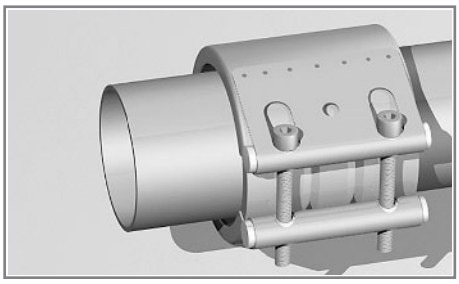
The STRAUB-OPEN-FLEX is a split coupling version of STRAUB-FLEX, offering all the STRAUB-FLEX benefits, plus being able to make repairs to in service pipe lines. With the STRAUB-OPEN-FLEX coupling, leaks due to faulty weld joints, pitting holes and short cracks can be temporarily or permanently repaired with minimal down time. The split gasket design can be wrapped around the pipe and installed without pipe disassembly. Assembly tools are available to ease the installation of the STRAUB-OPEN-FLEX coupling. When used to join pipe ends the STRAUB-OPEN-FLEX coupling provides the same flexibility features as the STRAUB-FLEX design. STRAUB-OPEN-FLEX couplings require the pipes to be axially restrained.

THE BASIC CONCEPT

Two types of Straub Couplings

• STRAUB-GRIP

PULL OUT RESISTANT



• STRAUB-FLEX/ OPEN-FLEX

NOT PULL OUT RESISTANT

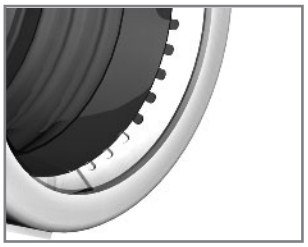
STRAUB-GRIP

STRAUB-GRIP type couplings utilize a patented grip ring and are pull-out resistant to a minimum of four times the agency approval working pressure.*

STRAUB-GRIP

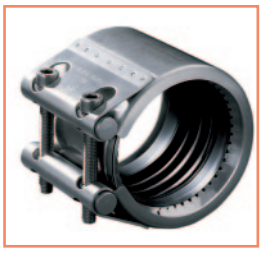


PULL OUT RESISTANT





STRAUB-GRIP-L
PAGE 8, 15



STRAUB-METAL-GRIP
PAGE 9

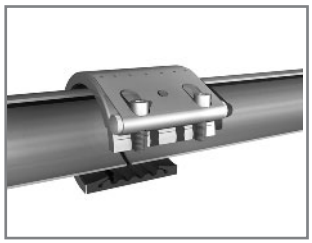
STRAUB-PLAST-PRO on pages: 15.

STRAUB-FLEX/-OPEN-FLEX

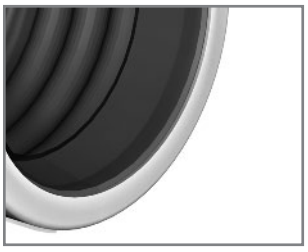
STRAUB-FLEX type couplings do not have a grip ring and are therefore suitable for applications requiring axial movement due to thermal growth or other factors. STRAUB-FLEX couplings are a suitable replacement for expansion joints.

STRAUB-OPEN-FLEX couplings are a split case version of the standard STRAUB-FLEX coupling.

STRAUB-FLEX/-OPEN-FLEX



NOT PULL OUT RESISTANT





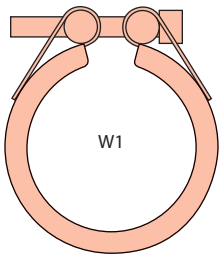
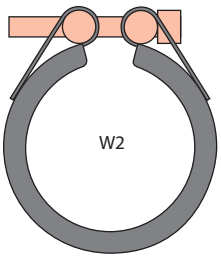
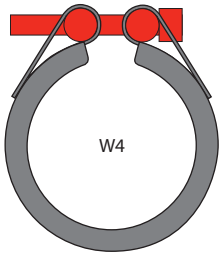
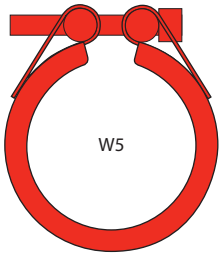
STRAUB-FLEX
PAGE 10-14



STRAUB-OPEN-FLEX
PAGE 10-14

*** Marine Approval Societies**

MATERIAL SPECIFICATIONS

Components	COUPLING TYPES							
								
	W1		**W2**		**W4**		**W5**	
	DIN	AISI	DIN	AISI	DIN	AISI	DIN	AISI
Casing	1.0570, galvanized	1024	1.4301/1.4404	304/316L	1.4301	304	1.4571	316 Ti/316L
Bolts	1.7220	4135	1.7220	4135	1.4404/1.4435	316L	1.4404/1.4435	316L
Bars	1.0737 galvanized	12L14	1.0737, galvanized	12L14	1.4404/1.4435	316L	1.4404/1.4435	316L
Anchoring ring	1.43110	301	1.4310/1.4301	301	1.4310/1.4301	301	1.4310	301
Strip insert (option)	1.44350	316L	1.4435	316L	1.4435	316L	1.4435	316L

Optional strip insert - AISI Type 316L Stainless Steel, HDPE or PVDF.
For casing designations refer to the size and pressure indicated in the STRAUB-FLEX and STRAUB-OPEN-FLEX selection chart.
All materials meets ANSI / AISI standards.
Duplex available for some couplings upon request.

GASKET SPECIFICATIONS

GASKET MATERIAL:	GENERAL SERVICE APPLICATION:
EPDM -4° to +212°F*	Water, dilute acids, alkalies, salts, and many chemical services not involving hydrocarbons, oils or gases. Excellent oxidation resistance. NOT FOR USE WITH HYDROCARBONS.
Nitrile -4° to +180°F	Petroleum products, vegetable oils, mineral oils and air contaminated with petroleum oils. H-NBR available for higher temperature applications.
HNBR -4° to +257°F (on request)	Water, Gas, Oil, Fuel and other Hydrocarbons
FPM/FKM -4° to +356°F Fluoroelastomer	High temperature resistance to oxidizing acids, petroleum oils, hydraulic fluids, halogenated hydrocarbons and lubricants. (Not available in all sizes/types).

* Maximum temperature limit is 212°F (100°C) with EPDM gasket material.
Higher temperature limits may be allowed subject to specific factory approval.
For specific chemical recommendations, please consult your Straub Professional.

HOW TO ORDER (Example)

PRODUCT DESIGNATION	NOMINAL PIPE SIZE OR PIPE O.D.	PIPE DESIGNATION	LOCK PARTS	GASKET MATERIAL	OPTIONAL STRIP INSERT
STRAUB-GRIP-L	10"	IPS	Stainless Steel "SS"	E - EPDM	SI
STRAUB-METAL-GRIP		CTS	Galvanized "G"	N - Nitrile	PVDF
STRAUB-FLEX + (casing type)		AWWA		V - Viton®	T
STRAUB-OPEN-FLEX + (casing type)		Other (Supply actual Pipe OD)			

Example: STRAUB-GRIP-L -10 - IPS - SS- E - SI

Represents STRAUB-GRIP-L style coupling for 10" IPS pipe with stainless steel lock parts, an EPDM gasket and the optional stainless strip insert.

INTERNATIONAL CERTIFICATION

ISO 9001
ISO 14001
BUREAU VERITAS
Certification

Some of the approvals for STRAUB couplings are shown above. STRAUB couplings are approved and listed by a large number of national and international agencies in various industries, including water engineering, fire protection, mining, shipbuilding & offshore, gas, petrochemical and general industry. Contact STRAUB for details. STRAUB is an ISO 9001 certified manufacturing facility and 14001 certified . US Patent Numbers: 5 280 969, 5 137 305, 3 877 733, 5 273 322, 4 119 333, 4 629 217, 5 280 970, 4 664 422, 5 310 223, 5 203 594.

STRAUB Couplings meet or exceed the requirements of ASTM 1476 & ISO/NP-15837/ 15838 & ANSI / AWWA C227-07

INDUSTRIES SERVED

- Shipbuilding & Offshore
- Water & Wastewater
- Gas Turbines
- Engine Manufacturing
- Locomotives
- Ultra - Filtration
- Compressors
- Landfills

COUPLING CHART NOTES

1	2		3	4		5		6		7	8
	PIPE OUTSIDE DIAMETER			COUPLING DIMENSIONS		ASSEMBLED DIMENSIONS		MAXIMUM DISTANCE BETWEEN PIPE ENDS (Rmax.)			
Nominal IPS	Actual	OD Range +/-	Working Pressure	B	C	DV	KV	Without Strip insert	With	Torque Rate	Approx. Weight Each
Inches	*In./mm*	*In./mm*	*psi/bar*	*In./mm*	*In./mm*	*In./mm*	*In./mm*	*In./mm*	*In./mm*	*Ft.lbs./Nm*	*Lbs./kg*

1. STRAUB Couplings are identified by either the nominal IPS pipe size, CTS tube size, or AWWA ductile iron pipe size in inches, or the pipe/tube OD in inches and millimeters.
2. Nominal outside diameter of pipe or tube that coupling will fit.
3. Maximum line pressure, including surge, to which the pipe joint should be subjected. Note: For a one-time field test the maximum joint working pressure may be increased to $1^1/_2$ times the figure shown.

   (For STRAUB-GRIP-L and STRAUB-METAL-GRIP couplings, an additional pressure rating column is shown. This is for applications that require authorization by Marine Approval Agencies such as Lloyds, ABS, DNV, etc.)
4. Coupling dimensions for reference purposes only.
5. The DV and KV assembled dimensions provided for reference.
6. Maximum allowable distance between pipe ends when assembled (with or without strip inserts).
7. Required Torque Rate. This is also printed on all couplings. Torque rate is suitable for all recommended pipe materials
8. Weight of complete coupling.

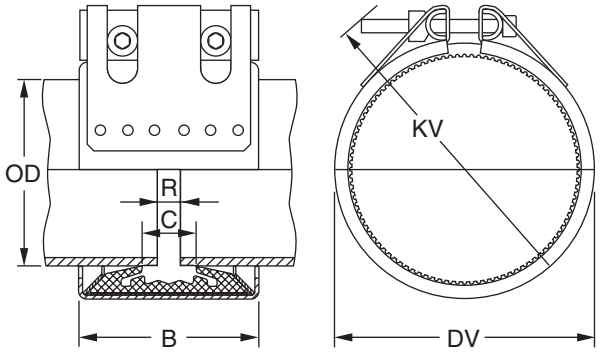


Axial-Restraint Pipe Coupling

STRAUB-GRIP-L COUPLING



For IPS Outside Diameter Pipe



3/4" - 2" couplings with 1 Bolt only.

STRAUB-GRIP L

Nominal IPS	PIPE OUTSIDE DIAMETER Actual	OD Range	Working Pressure	Agency Approved Pressure*	COUPLING DIMENSIONS B	C	ASSEMBLED DIMENSIONS DV	KV	MAXIMUM DISTANCE BETWEEN PIPE ENDS (Rmax.) Without Strip	With insert	Torque Rate	Approx. Weight Each
Inches	*In./mm*	*In./mm*	*psi/bar*	*psi/bar*	*In./mm*	*In./mm*	*In./mm*	*In./mm*	*In./mm*	*In./mm*	*Ft.lbs./Nm*	*Lbs./kg*
¾	1.050	1.04 - 1.08	670	232	1.8	0.7	1.7	2.8	0.2	0.4		0.4
	26.9	*26.4 - 27.4*	*46*	*16.0*	*46*	*18*	*43*	*71*	*5*	*10*		*0.2*
1	1.315	1.31 - 1.35	550	232	1.8	0.7	2	3	0.2	0.4		0.4
	33.7	*33.2 - 34.2*	*38*	*16.0*	*46*	*18*	*51*	*76*	*5*	*10*		*0.2*
1¼	1.660	1.65 - 1.69	400	232	2.4	1	2.4	3.7	0.2	0.4		0.8
	42.4	*41.9 - 42.9*	*30*	*16.0*	*61*	*25*	*61*	*94*	*5*	*10*		*0.4*
1½	1.900	1.88 - 1.92	440	232	2.4	1	2.6	3.9	0.2	0.4		0.9
	48.3	*47.7 - 48.7*	*30*	*16.0*	*61*	*25*	*66*	*99*	*5*	*10*		*0.4*
2	2.375	2.35 - 2.40	320	232	3	1.5	3.1	4.3	0.4	0.6		1.2
	60.3	*59.6 - 60.9*	*22*	*16.0*	*76*	*38*	*79*	*109*	*10*	*15*		*0.5*
2½	2.875	2.85 - 2.90	450	232	3.7	1.6	3.9	5.3	0.4	0.6		2.7
	73.0	*72.3 - 73.6*	*31*	*16.0*	*94*	*41*	*99*	*135*	*10*	*15*		*1.2*
3	3.500	3.46 -3.54	450	232	3.7	1.6	4.4	5.9	0.4	1.0		2.6
	88.9	*87.8 - 89.9*	*31*	*16.0*	*94*	*41*	*112*	*150*	*10*	*25*		*1.2*
3½	4.000	3.96 - 4.04	320	232	3.7	1.4	5.1	6.3	0.4	1.0		3.3
	101.6	*100.5 - 102.6*	*22*	*16.0*	*94*	*36*	*130*	*160*	*10*	*25*		*1.5*
4	4.500	4.46 - 4.54	232	232	3.7	1.6	5.4	6.7	0.4	1		3.2
	114.3	*113.2 - 115.3*	*16*	*16.0*	*94*	*41*	*137*	*170*	*10*	*25*		*1.5*
5	5.500	5.51 - 5.62	232	232	4.3	2.1	6.5	8.3	0.4	1.4		5.7
	139.7	*139.9 - 142.7*	*16*	*16.0*	*109*	*53*	*165*	*211*	*10*	*36*		*2.6*
6	6.625	6.56 - 6.69	232	188	4.3	2.1	7.6	9.1	0.4	1.4		6.4
	168.3	*166.6 - 169.9*	*16*	*13.0*	*109*	*53*	*193*	*231*	*10*	*36*		*2.9*
8	8.625	8.54 - 8.71	232	145	5.6	3.1	9.8	11.6	0.4	1.4		13.0
	219.1	*216.9 - 221.2*	*16*	*10.0*	*142*	*79*	*249*	*295*	*10*	*36*		*5.9*
10	10.750	10.65 - 10.85	100	67	5.5	3.1	11.9	13	0.4	1.4		12.7
	273.0	*270.5 - 275.5*	*7*	*4.6*	*140*	*79*	*302*	*330*	*10*	*36*		*5.8*
12	12.750	12.62 - 12.87	70	52	5.5	3.1	13.9	15	0.4	1.4		14.3
	323.9	*320.5 - 326.8*	*5*	*3.6*	*140*	*79*	*353*	*381*	*10*	*36*		*6.5*
14	14.000	13.86 - 14.13	60	45	5.5	3.1	15.2	16.3	0.4	1.4		15.4
	355.6	*352.0 - 358.9*	*4*	*3.1*	*140*	*79*	*386*	*414*	*10*	*36*		*7.0*
16	16.000	15.85 - 16.16	45	35	5.5	3.1	17.1	18.3	0.4	1.4		16.9
	406.4	*402.5 - 410.4*	*3*	*2.4*	*140*	*79*	*434*	*465*	*10*	*36*		*7.7*
18	18.00	17.81 - 18.17	30		5.5	3.1	19.2	20.5	0.4	1.4		18.5
	457.2	*452.3 - 461.5*	*2.0*		*140*	*79*	*488*	*521*	*10*	*36*		*8.4*
20	20.00	19.82 - 20.18	30		5.5	3.1	21.2	22.4	0.4	1.4		20.2
	508.0	*503.4 - 512.5*	*2.0*		*140*	*79*	*538*	*569*	*10*	*36*		*9.2*
22	22.00	21.83 - 22.19	30		5.5	3.1	23.2	24.4	0.4	1.4		21.8
	558.8	*554.4 - 563.6*	*2.0*		*140*	*79*	*589*	*620*	*10*	*36*		*21.8*
24	24.00	23.82 - 24.17	15		5.5	3.1	25.2	26.4	0.4	1.4		23.3
	609.6	*605.0 - 613.9*	*1.0*		*140*	*79*	*640*	*671*	*10*	*36*		*10.6*

See label on coupling for proper torque rates

**Agency approved pressures are for applications that require authorization of Classification Societies, such as Marine Approval Bodies.*

¾" - 8": W5 only
10" - 24": W2 or W5

Other sizes available upon request.

All STRAUB couplings require the correct use of a torque wrench for a safe and proper installation. STRAUB couplings must be torqued to the specified value as printed on each individual coupling. Failure to do so can result in injury or death.

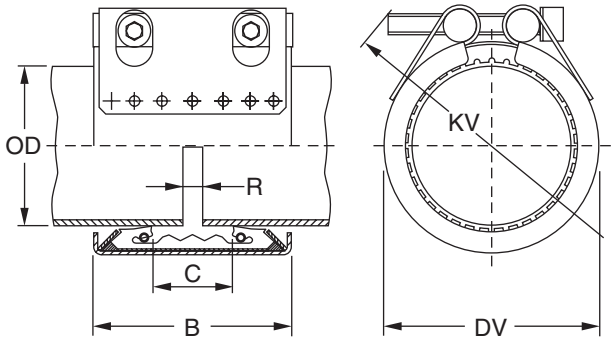


Axial-Restraint Pipe Coupling

STRAUB-METAL GRIP COUPLING



For IPS Outside Diameter Pipe



STRAUB-METAL GRIP

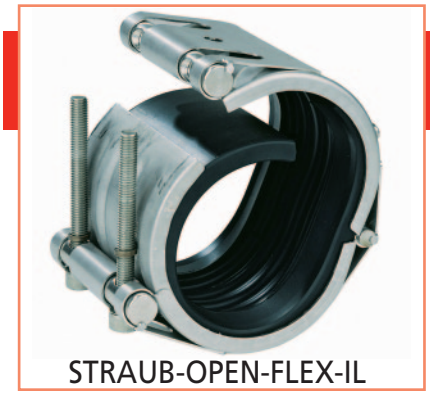
Nominal IPS	PIPE OUTSIDE DIAMETER Actual	OD Range +/-	Working Pressure	Agency Approved Pressure*	COUPLING DIMENSIONS B	C	ASSEMBLED DIMENSIONS DV	KV	MAXIMUM DISTANCE BETWEEN PIPE ENDS (Rmax.) Without Strip insert	With Strip insert	Torque Rate	Approx. Weight Each
Inches	*In./mm*	*In./mm*	*psi/bar*	*psi/bar*	*In./mm*	*In./mm*	*In./mm*	*In./mm*	*In./mm*	*In./mm*	*Ft.lbs./Nm*	*Lbs./kg*
1	1.315 *33.7*	1.31 - 1.35 *33.2 - 34.2*	900 *62.1*	232 *16.0*	2.6 *66*	0.7 *18*	1.7 *43*	2.6 *66*	0.2 *5*	0.6 *15*	7.5 *10*	0.7 *0.3*
1¼	1.660 *42.4*	1.65 - 1.69 *41.9 - 42.9*	770 *53.1*	232 *16.0*	2.4 *61*	0.8 *20*	2.4 *61*	3.5 *89*	0.2 *5*	0.6 *15*	11 *15*	1.1 *0.5*
1½	1.900 *48.3*	1.88 - 1.92 *47.7 - 48.7*	640 *44.1*	232 *16.0*	2.4 *61*	0.8 *20*	2.7 *69*	3.7 *94*	0.2 *5*	0.6 *15*	11 *15*	1.1 *0.5*
2	2.375 *60.3*	2.35 - 2.40 *59.6 - 60.9*	540 *37.2*	232 *16.0*	3 *76*	1.5 *38*	3.2 *81*	4.3 *109*	0.4 *10*	1.0 *25*	15 *20*	1.7 *0.8*
3	3.500 *88.9*	3.46 - 3.54 *87.8 - 89.9*	540 *37.2*	232 *16.0*	3.7 *94*	1.5 *38*	4.6 *117*	5.7 *145*	0.4 *10*	1.0 *25*	26 *35*	3.2 *1.5*
4	4.500 *114.3*	4.46 - 4.54 *113.2 - 115.3*	490 *33.8*	232 *16.0*	3.7 *94*	1.5 *38*	5.5 *140*	6.5 *165*	0.4 *10*	1.0 *25*	26 *35*	3.8 *1.7*
5	5.500 *139.7*	5.44 - 5.56 *138.7 - 141.2*	470 *32.4*	232 *16.0*	4.3 *109*	1.7 *43*	6.6 *168*	7.9 *201*	0.6 *15*	1.4 *36*	45 *60*	7.8 *3.5*
6	6.625 *168.3*	6.56 - 6.69 *166.6 - 169.9*	420 *28.8*	232 *16.0*	4.3 *109*	1.7 *43*	7.9 *201*	9.1 *231*	0.6 *15*	1.4 *36*	45 *60*	8.8 *4.0*
8	8.625 *219.1*	8.54 - 8.71 *216.9 - 221.2*	380 *26.2*	232 *16.0*	5.9 *150*	2.4 *61*	10.2 *259*	11.6 *295*	0.6 *15*	1.4 *36*	75 *100*	20.6 *9.4*
10	10.750 *273.0*	10.65 - 10.85 *270.5 - 275.5*	300 *20.7*	174 *12.0*	5.8 *147*	2.6 *66*	12.5 *318*	14.6 *371*	0.6 *15*	1.4 *36*	135 *180*	33.5 *15.2*
12	12.750 *323.9*	12.62 - 12.87 *320.5 - 326.8*	250 *17.2*	145 *10.0*	5.8 *147*	2.6 *66*	14.5 *368*	16.5 *419*	0.6 *15*	1.4 *36*	170 *230*	37.8 *17.2*
14	14.000 *355.6*	13.86 - 14.13 *352.0 - 358.9*	250 *17.2*	116 *8.0*	5.8 *147*	2.6 *66*	15.8 *401*	17.7 *450*	0.6 *15*	1.4 *36*	170 *230*	40.3 *18.3*
16	16.000 *406.4*	15.85 - 16.16 *402.5 - 410.4*	200 *13.8*	116 *8.0*	5.8 *147*	2.6 *66*	17.8 *452*	19.7 *500*	0.6 *15*	1.4 *36*	170 *230*	54.3 *24.7*
18	18.000 *457.2*	17.81 - 18.19 *452.3 - 462.0*	120 *8.3*	94 *6.4*	5.8 *147*	2.6 *66*	20 *508*	22 *559*	0.6 *15*	1.4 *36*	185 *250*	59.4 *27.0*
20	20.000 *508.0*	19.80 - 20.20 *502.9 - 513.0*	90 *6.2*	80 *5.5*	5.8 *147*	2.6 *66*	22 *559*	24 *610*	0.6 *15*	1.4 *36*	185 *250*	64.2 *29.2*
24	24.000 *609.6*	23.80 - 24.19 *604.5 - 614.4*	70 *4.9*	65 *4.4*	5.8 *147*	2.6 *66*	26 *660*	28 *711*	0.6 *15*	1.4 *36*	221 *300*	74.2 *33.7*

**Agency approved pressures are for applications that require authorization of Classification Societies, such as Marine Approval Bodies.*

Other sizes available upon request.

1" - 8": W2 or W4
10" - 24": W1 only

All STRAUB couplings require the correct use of a torque wrench for a safe and proper installation. STRAUB couplings must be torqued to the specified value as printed on each individual coupling. Failure to do so can result in injury or death.



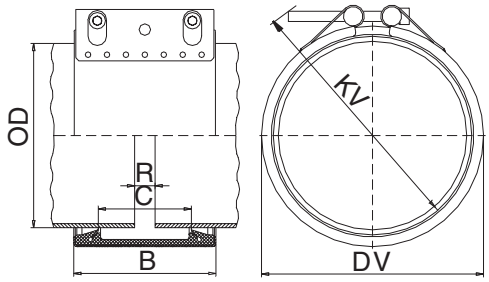
STRAUB-OPEN-FLEX-IL

Non-Axial Restraint Pipe Coupling

STRAUB-FLEX 1L & STRAUB-OPEN-FLEX 1L COUPLING

For IPS Outside Diameter Pipe

- Pipes must be properly anchored and supported.
- STRAUB-FLEX & STRAUB-OPEN-FLEX Couplings are NOT pull-out resistant.

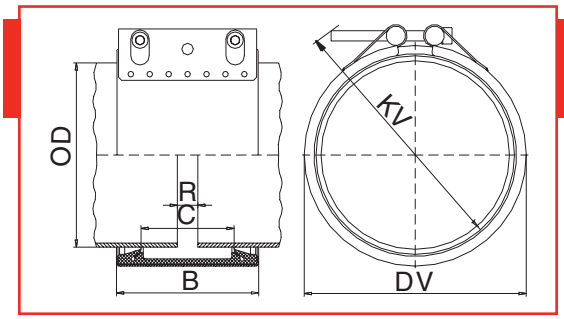


STRAUB-FLEX 1L & STRAUB-OPEN-FLEX 1L

Nominal IPS	PIPE OUTSIDE DIAMETER Actual	OD Range +/-	Working Pressure	COUPLING DIMENSIONS B	C	ASSEMBLED DIMENSIONS DV	KV	MAXIMUM DISTANCE BETWEEN PIPE ENDS (Rmax.) Without Strip insert	With Strip insert	Approx. Weight Each
Inches	*In./mm*	*In./mm*	*psi/bar*	*In./mm*	*In./mm*	*In./mm*	*In./mm*	*In./mm*	*In./mm*	*Lbs./kg*
1½	1.900	1.85 - 1.95	363	3.0	1.4	2.8	3.3	0.2	0.6	1.1
	48.3	*46.9 - 49.5*	*25*	*76*	*35*	*71*	*85*	*5*	*15*	*0.5*
2	2.375	2.32 - 2.42	232	3.0	1.4	3.2	3.7	0.2	0.6	1.3
	60.3	*58.9 - 61.4*	*16.0*	*76*	*35*	*81*	*95*	*5*	*15*	*0.6*
2½	2.875	2.81 - 2.93	232	3.0	1.4	3.2	3.7	0.2	0.6	1.76
	73.0	*71.3 - 74.4*	*16.0*	*76*	*35*	*81*	*95*	*5*	*15*	*.8*
3	3.500	3.44 - 3.56	232	3.7	2.0	4.4	4.9	0.2	1.0	2.1
	88.9	*87.3 - 90.4*	*16.0*	*94*	*51*	*112*	*125*	*5*	*25*	*1.0*
4	4.500	4.43 - 4.57	232	3.7	2.0	5.4	5.9	0.2	1.0	2.3
	114.3	*112.5 - 116.0*	*16.0*	*94*	*51*	*137*	*150*	*5*	*25*	*1.1*
5	5.500	5.45 - 5.57	232	4.2	2.4	6.4	7.1	0.2	1.4	3.1
	139.7	*138 - 141.5*	*16.0*	*107*	*61*	*163*	*180*	*5*	*35*	*1.4*
6	6.625	6.54 - 6.71	232	4.2	2.4	7.5	8.1	0.2	1.4	3.7
	168.3	*166.1 - 170.4*	*16.0*	*107*	*61*	*191*	*206*	*5*	*35*	*1.7*

* W2 or W5 OPEN-FLEX 1L in hinged style only

Other sizes available upon request.



STRAUB-FLEX & STRAUB-OPEN-FLEX COUPLING

Coupling Dimensions

STRAUB-FLEX 2 & STRAUB-OPEN-FLEX 2 Dimensions

STRAUB-FLEX or STRAUB-OPEN-FLEX TYPE	COUPLING DIMENSIONS B	C	ASSEMBLED DIMENSIONS DV	Maximum Distance Between Pipe Ends (Rmax.) Without Strip insert	With Strip insert
	In./mm	*In./mm*	*In./mm*	*In./mm*	*In./mm*
2L	5.4	3.6	OD+.91	0.39	1.38
	138	*91*	*OD+23*	*10*	*35*
2LS	5.5	3.6	OD+.95	0.39	1.38
	140	*91*	*OD+24*	*10*	*35*
2LU	5.5	3.6	OD+.95	0.39	1.38
	141	*91*	*OD+24*	*10*	*35*
2H	5.6	3.6	OD+1.02	0.39	1.38
	142	*91*	*OD+26*	*10*	*35*
2XS	5.8	3.6	OD+1.26	0.39	1.38
	148	*91*	*OD+32*	*10*	*35*

* W1, W2, or W5. consult factory for details

OPEN-FLEX 2 not available in hinged style

STRAUB-FLEX 3 & STRAUB-OPEN-FLEX 3 Dimensions

STRAUB-FLEX or STRAUB-OPEN-FLEX TYPE	COUPLING DIMENSIONS B	C	ASSEMBLED DIMENSIONS DV	Maximum Distance Between Pipe Ends (Rmax.) Without Strip insert	With Strip insert
	In./mm	*In./mm*	*In./mm*	*In./mm*	*In./mm*
3L	8.3	5.0	OD+1.42	0.59	2.36
	210	*127*	*OD+36*	*15*	*60*
3LS	8.3	5.0	OD+1.46	0.59	2.36
	210	*127*	*OD+37*	*15*	*60*
3LU	8.4	5.0	OD+1.50	0.59	2.36
	213.4	*127*	*OD+38*	*15*	*60*
3H	8.35	5.0	OD+1.5	0.59	2.36
	212	*127*	*OD+38*	*15*	*60*
3X	8.58	5.0	OD+1.73	0.59	2.36
	218	*127*	*OD+44*	*15*	*60*

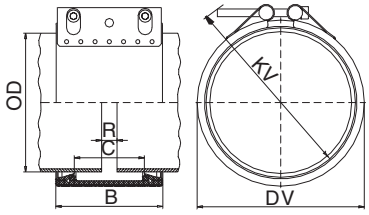
* W1, W2, or W5. consult factory for details

OPEN-FLEX 3 not available in hinged style

All STRAUB couplings require the correct use of a torque wrench for a safe and proper installation. STRAUB couplings must be torqued to the specified value as printed on each individual coupling. Failure to do so can result in injury or death.

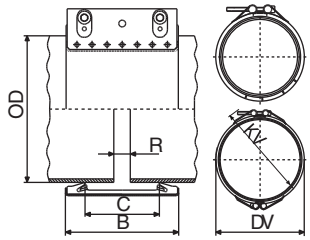
STRAUB-FLEX 2 & STRAUB-OPEN-FLEX 2 COUPLING





STRAUB-FLEX





STRAUB-OPEN-FLEX

(Slotted Type)

Non-Axial Restraint Pipe Couplings

• Pipes must be properly anchored and supported.

• STRAUB-FLEX & STRAUB-OPEN-FLEX Couplings are NOT pull-out resistant.

STRAUB-OPEN-FLEX Installation tool available.

For IPS Outside Diameter Pipe

STRAUB-FLEX 2 & STRAUB-OPEN-FLEX 2 Selection Chart

Nominal IPS Pipe Size	Pipe Outside Diameter	2L Working Pressure	2LS Working Pressure	2LU Working Pressure	2H Working Pressure	2XS Working Pressure
(Inches)	*In./mm*	*psi/bar*	*psi/bar*	*psi/bar*	*psi/bar*	*psi/bar*
6	6.625	189	225	387		
	168.3	*13*	*17.6*	*26.7*		
8	8.625	145	198	367		
	219.1	*10*	*13.5*	*25*		
10	10.750	116	161	323	367	
	273.1	*8*	*11*	*22*	*25*	
12	12.750	102	132	264	367	
	323.9	*7*	*9.5*	*18.5*	*25*	
14	14.000	87	117	249	367	
	355.6	*6*	*8.5*	*17*	*25*	
16	16.000	80	102	220	323	367
	406.4	*5.5*	*7.5*	*15*	*22*	*25*
18	18.000	73	88	191	279	367
	457.2	*5*	*6.5*	*13*	*19*	*25*
20	20.000	65	88	176	249	367
	508.0	*4.5*	*6*	*12*	*17*	*25*
24	24.000	51	73	147	205	367
	609.6	*3.5*	*5*	*10*	*14*	*25*
28	28.000		58	117	176	367
	711.2		*4*	*8*	*12*	*25*
30	30.000		58	117	176	338
	762.0		*4*	*8*	*12*	*23*
32	32.000		51	110	161	323
	812.8		*3.5*	*7.5*	*11*	*22*
36	36.000		51	95	147	294
	914.4		*3.5*	*6.5*	*10*	*20*
42	42.000		44	80	147	249
	1066.8		*3*	*5.5*	*10*	*17*
48	48.000		36	73	102	220
	1219.2		*2.5*	*5*	*7*	*15*

For pressure ratings see **Selection Charts.**

2L, 2LS, 2LU: W2 & W5
2H, 2XS: W1

The selection charts are used to select the proper type of STRAUB-FLEX or STRAUB-OPEN-FLEX coupling for the application pressure. Separate charts are used for the TYPE 2 and 3 designs.

For complete dimensional data, see Page 10 or please consult the factory, STRAUB Technical Manual, or an authorized STRAUB Distributor.

Other sizes available upon request.

*STRAUB-FLEX is also available in a two-piece construction - useful for very tight spaces and for ease of handling.

STRAUB-OPEN-FLEX 2 couplings are available in two different styles depending on model and size:

• Slotted Casing

• 2-Piece Execution

STRAUB-OPEN-FLEX gaskets are cut and riveted to casing.

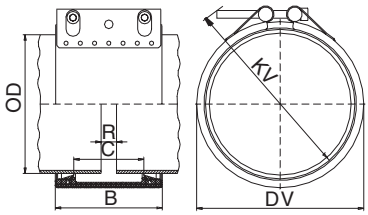
Please consult your STRAUB professional for more information

All STRAUB couplings require the correct use of a torque wrench for a safe and proper installation. STRAUB couplings must be torqued to the specified value as printed on each individual coupling. Failure to do so can result in injury or death.

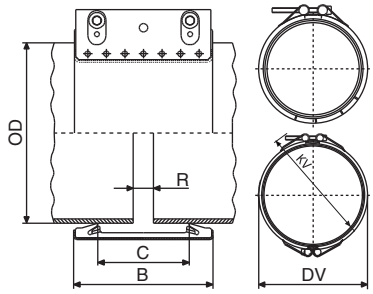
STRAUB-FLEX 3 & STRAUB-OPEN-FLEX 3 COUPLING

For IPS Outside Diameter Pipe





STRAUB-FLEX-3



STRAUB-OPEN-FLEX

Non-Axial Restraint Pipe Couplings

- Pipes must be properly anchored and supported.
- STRAUB-FLEX & STRAUB-OPEN-FLEX Couplings are NOT pull-out resistant.

STRAUB-FLEX 3 & STRAUB-OPEN-FLEX 3 Selection Chart

Nominal IPS Pipe Size (Inches)	Diameter In./mm	3L Working Pressure psi/bar	3LS Working Pressure psi/bar	3LU Working Pressure psi/bar	3H Working Pressure psi/bar	3X Working Pressure psi/bar
8	8.63 219.1	150 10.3	187 12.9			
10	10.75 273.1	150 10.3	187 12.9			
12	12.750 323.9	143 9.9	189 13.0	363 25.0		
14	14.000 355.6	119 8.2	160 11.0	363 25.0		
16	16.000 406.4	107 7.4	140 9.7	328 22.6	363 25.0	
18	18.000 457.2	95 6.6	125 8.6	292 20.1	363 25.0	
20	20.000 508.0	85 5.9	112 7.7	263 18.1	363 25.0	
24	24.000 609.6	71 4.9	94 7.0	203 14	251 17.3	363 25.0
28	28.000 711.2	59 4.1	81 5.6	174 12	218 15.0	363 25.0
30	30.000 762.0	55 3.8	74 5.1	160 11	203 14.0	363 25.0
32	32.000 812.8	55 3.8	71 4.9	152 10.5	189 13.0	363 25.0
36	36.000 914.4	46 3.2	64 4.4	123 8.5	187 11.5	334 23.0
42	42.000 1066.8	39 2.7	54 3.7	107 7.3	145 10.0	261 18.0
48	48.000 1219.2	34 2.3	51 3.5	94 6.5	123 8.5	247 17.0
54	54.000 1371.6	30 2.1	42 2.9	81 5.5	113 7.5	223 15.4
60	60.000 1524.0	26 1.8	36 2.5	73 5.0	102 7.0	203 14.0
66	66.000 1676.4	22 1.5	36 2.4	60 4.1	89 6.0	182 12.5
72	72.000 1828.8	20 1.3	29 2.0	51 3.5	80 5.5	160 11.0

3L, 3LS, 3LU: W2 & W5
3H, 3X: W1

For complete dimensional data, see Page 10 or please consult the factory, STRAUB Technical Manual, or an authorized STRAUB Distributor.

STRAUB-FLEX-3 & STRAUB-OPEN FLEX-3 are designed with 3-BOLTS

Other sizes available upon request.

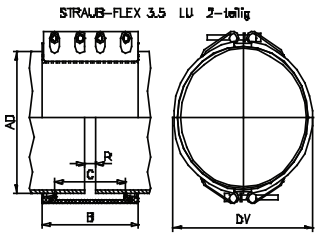
STRAUB-OPEN-FLEX 3 couplings are available in two different styles depending on model and size:

- Slotted Casing
- 2-Piece Execution

OPEN-FLEX gaskets are cut and riveted to casing

Please consult your STRAUB professional for more information

All STRAUB couplings require the correct use of a torque wrench for a safe and proper installation. STRAUB couplings must be torqued to the specified value as printed on each individual coupling. Failure to do so can result in injury or death.



STRAUB-FLEX-3.5

STRAUB-FLEX & STRAUB-OPEN-FLEX COUPLING

NEW PRODUCTS: CONSULT FACTORY FOR COUPLING & FITTING TOLERANCES

1 "= 25.4mm

1 bar=14.7 psi

DV = Outside diameter of the assembled pipe joint (mm) = OD + 38mm
B = Width of the pipe joint (mm)
FLEX 3.5LU = 310mm
FLEX 3.5H = 311mm
C = Distance between sealing lips = 227mm
Rmax. =Distance between pipe ends
Rmax. with strip insert = 120mm
Rmax. without strip insert = 20mm

STRAUB-FLEX 3.5 & STRAUB-OPEN-FLEX 3.5 Selection Chart

Pipe	Clamping range	Working Pressure PS FLEX 3.5		Torque rate FLEX 3.5		Locking bolts FLEX 3.5	
OD (mm)	(mm)	LU (bar)	H (bar)	LU (Nm)	H (Nm)	LU	H
323.9	320 - 327	18	25	30	30		
355.6	352 - 359	17	25	30	30		
406.4	403 - 409	15	22	30	30		
457.2	454 - 460	13	21	30	30		
508.0	505 - 512	12	20	30	40		
558.8	555 - 562	11	19	40	40		
609.6	606 - 613	10	17	40	40		
655.0	652 - 658	9	16	40	40		
711.2	707 - 715	9	15	40	40	4 x M16 with socket head 14 mms	4 x M16 with socket head 14 mm
762.0	758 - 766	8	14	40	50		
812.8	809 - 817	8	13	40	50		
914.4	910 - 918	7	12	50	60		
1016.0	1012 - 1020	6	11	50	60	8x M16 for 2 pcs. type	8x M16 for 2 pcs. type
1117.6	1113 - 1122	6	10	60	70		
1219.2	1215 - 1224	5	9	60	70		
1422.4	1418 - 1427	4	8	70	80		
1524.0	1519 - 1529	4	7	80	90		
1625.0	1621 - 1631	4	7	80	100		
1727.2	1722 - 1732	3	6	90	100		
1828.8	1824 - 1834	3	6	90	110		
1930.4	1925 - 1935	3	5	100	110		
2032.0	2027 - 2037	2	5	100	120		

Available for all pipe sizes from 558.8 mm up to 3000.0 mm (larger and smaller ø to special order)

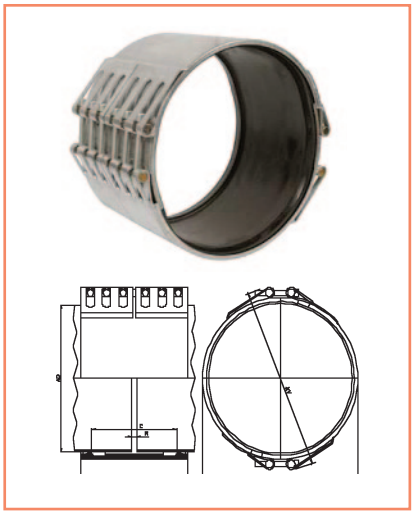
3.5 LU:W5

3.5 H:W1

Non-Axial Restraint Pipe Couplings

- Pipes must be properly anchored and supported.
- STRAUB-FLEX 3.5 & STRAUB-FLEX 4 Couplings are NOT pull-out resistant.

Other sizes available upon request.



STRAUB-FLEX 4

For Both STRAUB-FLEX 3.5 & STRAUB-FLEX 4	*Components/Materials*	*W1*	*W5*
	Casing	*AISI 1024, hot-dip galv.*	*AISI 316 Ti*
	Screws	*AISI 4135***	*AISI 316 L*
	Bolts	*AISI 12L 14, galvanized*	*AISI 316 L*
	Strip insert (option)	*AISI 316 L / HDPE*	*AISI 316 L / HDPE*
STRAUB-FLEX 3.5 ONLY	**Sealing sleeve EPDM**	*Temp.: -4° F up to +212°F* *Medium: all qualities of water, waste water, air, soiids and chemical products*	
	Sealing sleeve NBR	*Temp.: -4°F up to +180°F* *Medium: water, gas, oil, fuel and other hydrocarbons*	

STRAUB-FLEX 4 & STRAUB-OPEN-FLEX 4 Selection Chart

Pipe	Clamping range	Working Pressure PS FLEX 4		Torque rate FLEX 4		Locking bolts FLEX 4	
OD (mm)	(mm)	LU (bar)	H (bar)	LU (Nm)	H (Nm)	LU	H
323.9	320 - 327	18	25	30	60	12 x M20 with socket head 17mms	12 x M20 with socket head 17mm
609.6	606 - 613	10	14	40	60		
762.0	758 - 766	8	11	40	80		
1670.0	1666 - 1674	4	5	80	100		

Available for all pipe sizes from 323.9 mm up to 3000.0 mm (larger and smaller ø to special order)

DV = Outside diameter of the assembled pipe joint (mm) = OD + 48 mm
KV = OD + 90
B = Width of the pipe joint (mm)
FLEX 4LU = 444 mm
FLEX 4H = 445 mm
C = Distance between sealing lips = 350 mm
Rmax. = Distance between pipe ends
Rmax. with strip insert = 200 mm
Rmax. without strip insert = 20 mm

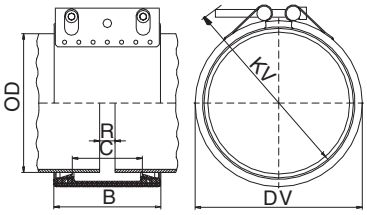
Legend: *- W1 - W5 according to DIN Standard 86128 (ASTM F 1476 / F1548, ISO/NP-15837 / 15838).*
*** Property class 12.9, Dacromet 500 (zinc-chromate with integrated lubricant).*

Remarks:
- Available in 2 pc. only
- Follow fitting / disassembly instructions.
- Test pressure = 1,5 x working pressure
- Admissible maximum axial movement of the pipes Dl : 20 mm.
- Strip insert are required when the gap between the pipe ends is excessive, in presence of swelling, at vacuum/depression (suction line), or external pressure. Strip inserts are available, under separate order, at additional costs.

STRAUB-FLEX & STRAUB-OPEN-FLEX COUPLINGS

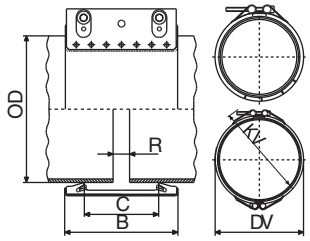
For AWWA Ductile Iron Pipe Sizes





STRAUB-FLEX





STRAUB-OPEN-FLEX 2
(2-piece execution shown)

Non-Axial Restraint Pipe Couplings
*W1, W2, or W5
Consult Factory for details

- Pipes must be properly anchored and supported.
- STRAUB-FLEX & STRAUB-OPEN-FLEX Couplings are NOT pull-out resistant.

STRAUB-FLEX 2 & STRAUB-OPEN-FLEX 2 Selection

Nominal Ductile Iron Pipe Sizes	Pipe Outside Diameter	2L Working Pressure	2LS Working Pressure	2LU Working Pressure	2H Working Pressure	2XS Working Pressure
Inches	*In./mm*	*psi/bar*	*psi/bar*	*psi/bar*	*psi/bar*	*psi/bar*
4	4.800	232				
	121.9	*16.0*				
6	6.900	232				
	175.3	*16.0*				
8	9.050	145	196	363		
	229.9	*10*	*13.5*	*25.0*		
10	11.100	116	160	319		
	281.9	*8*	*11.0*	*22*		
12	13.200	102	145	280	290	
	335.3	*7*	*10.0*	*19.3*	*20.0*	
14	15.300	87	123	230	290	
	388.6	*6*	*8.4*	*15.8*	*20.0*	
16	17.400	80	109	210	287	290
	442.0	*5.5*	*7.5*	*14.4*	*19.8*	*20.0*
18	19.500	73	94	174	260	290
	495.3	*5*	*6.4*	*12.0*	*17.9*	*20.0*
20	21.600	65	80	152	235	290
	548.6	*4.5*	*5.5*	*10.4*	*16.2*	*20.0*
24	25.800	51	70	145	197	290
	655.3	*3.5*	*4.8*	*10*	*13.6*	*20.0*
30	32.000		50	109	148	290
	812.8		*3.4*	*7.5*	*10.2*	*20.0*
36	38.300		45	85	125	290
	972.8		*3.1*	*5.8*	*8.6*	*20.0*
42	44.500		35	80	105	290
	1130.3		*2.4*	*5.5*	*7.2*	*20.0*

STRAUB-FLEX 3 & STRAUB-OPEN-FLEX 3 Selection

Nominal Ductile Iron Pipe Sizes	Pipe Outside Diameter	3L Working Pressure	3LS Working Pressure	3LU Working Pressure	3H Working Pressure	3X Working Pressure
(Inches)	*In./mm*	*psi/bar*	*psi/bar*		*psi/bar*	*psi/bar*
12	13.200	143	189	363		
	335.3	*9.9*	*13.0*	*25.0*		
14	15.300	119	160	363		
	388.6	*8.2*	*11.0*	*25.0*		
16	17.400	105	140	328	363	
	442.0	*7.2*	*9.7*	*22.6*	*25.0*	
18	19.500	95	123	292	363	
	495.3	*6.6*	*8.5*	*20.1*	*25.0*	
20	21.600	85	110	263	363	
	548.6	*5.9*	*7.6*	*18.1*	*25.0*	
24	25.800	71	94	203	251	363
	655.3	*4.9*	*7.0*	*14*	*17.3*	*25.0*
30	32.000	55	74	160	203	363
	812.8	*3.8*	*5.1*	*11*	*14.0*	*25.0*
36	38.300	46	64	123	167	334
	972.8	*3.2*	*4.4*	*8.5*	*11.5*	*23*
42	44.500	39	54	107	145	261
	1130.3	*2.7*	*3.7*	*7.3*	*10.0*	*18*
48	50.800	34	51	94	123	247
	1290.3	*2.3*	*3.5*	*6.5*	*8.5*	*17*
54	57.560	30	42	81	113	223
	1462.0	*2.1*	*2.9*	*5.5*	*7.8*	*15.4*
60	61.610	26	36	73	102	203
	1564.9	*1.8*	*2.5*	*5.0*	*7.0*	*14*
72	75.340	20	29	51	80	160
	1913.6	*1.3*	*2.0*	*3.5*	*5.5*	*11*

All STRAUB couplings require the correct use of a torque wrench for a safe and proper installation. STRAUB couplings must be torqued to the specified value as printed on each individual coupling. Failure to do so can result in injury or death.

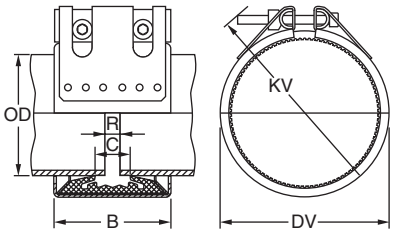


STRAUB-GRIP-L
for Copper Tube

STRAUB COUPLINGS FOR COPPER TUBE

Axial Restraint Pipe Couplings

• Pipes must be properly anchored and supported.



STRAUB-GRIP-L Copper Tube Sizes (CTS)

Nominal Tubing Size	PIPE OUTSIDE DIAMETER Actual	OD Range +/-	Working Pressure	COUPLING DIMENSIONs B	C	ASSEMBLED DIMENSIONS DV	KV	Maximum Distance Between Pipe Ends (Rmax.) Without Strip insert	With	Torque Rate	Approx. Weight Each
Inches	*In./mm*	*In./mm*	*psi/bar*	*In./mm*	*In./mm*	*In./mm*	*In./mm*	*In./mm*	*In./mm*	*Ft. lbs./Nm*	*Lbs./kg*
2"	2.125	2.10 - 2.15	250	3.0	1.5	3.0	4.1	0.4	0.6	See label on coupling for proper torque rates	1.1
	54.0	*53.5 - 54.5*	*17.2*	*76*	*37*	*75*	*105*	*10*	*15*		*0.5*
2½"	2.625	2.55 - 2.65	390	3.7	1.4	3.5	5.0	0.4	0.6		1.54
	66.6	*64.9 - 67.3*	*27*	*94*	*36*	*89*	*127*	*10*	*15*		*0.7*
3"	3.125	3.09 - 3.16	333	3.7	1.4	4.0	5.4	0.4	0.6		2.86
	79.4	*78.7 - 80.3*	*23*	*94*	*36*	*102*	*137*	*10*	*15*		*1.3*
4"	4.125	4.08 - 4.17	250	3.7	1.4	5.3	6.1	0.4	1.0		3.3
	104.8	*103.8 - 105.8*	*17.2*	*94*	*36*	*135*	*155*	*10*	*25*		*1.5*
6"	6.125	6.06 - 6.19	200	4.3	1.9	7.3	8.3	0.4	1.2		6.6
	155.6	*154.1 - 157.1*	*13.8*	*110*	*48*	*185*	*210*	*10*	*30*		*3.0*
8"	8.125	8.04 - 8.20	100	5.5	3.1	9.3	10.4	0.4	1.4		12.1
	206.4	*204.4 - 208.4*	*6.9*	*140*	*80*	*235*	*264*	*10*	*35*		*12.1*

*W5 only

STRAUB-PLAST-PRO

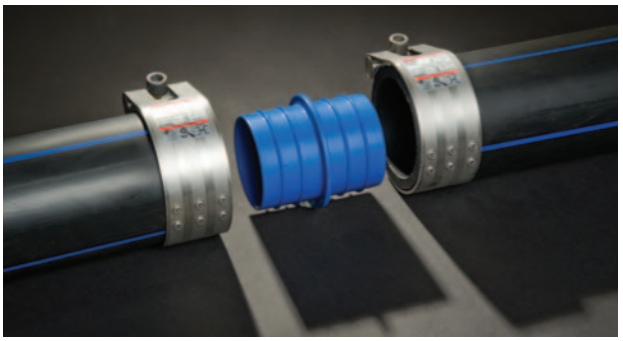
AXIAL RESTRAINT **CONNECTION OF** *PE80 ANDPE100 PIPES*

Axially restrained full set allowing a quick and simple installation of pressure pipes made of polyethylene(PE). The full sets are available for pipes in dimension SDR 11 (63.0 - 110.0 mm, PN16) and SDR 17 (>110.0 -355.0 mm, PN10). STRAUB-PLAST-PRO is particularly suitable for water, waste water, industrial plants and maintenance applications.

STRAUB-PLAST-PRO is applicable, whenever pipes cannot be connected by conventional technologies, like electro fusion. The unique full set offers the great advantage that pipes can easily be connected, without the need for an external power supply and pipe end preparations, even under demanding external circumstances.

The pipes made of PE 80 or PE 100 are connected with a combination of liner and two connectors. STRAUB-PLAST-PRO is highly resistant to corrosion, thanks to the usage of first class materials.

PE pipes with added protective layer and diffusion barrier layer are normally used, when drinking waterlines have to be installed in contaminated soils. If the pipes are connected in a conventional manner, it is essential that the aluminum layer is removed. This operation is not necessary if STRAUB-PLAST-PRO will be used. STRAUB-PLAST-PRO connects such barrier layer pipes easily and safely without any pipe end preparation.



PE80 and PE100 pipes
according to DIN 12201 / DIN 8074



STRAUB-PLAST-PRO Liner
(illustrated STRAUB-PLAST-PRO L)



PE Pipe with aluminum layer

STRAUB-PLAST-PRO (CONTINUED)

Example Installation — STRAUB-PLAST-PRO R (Reducer)



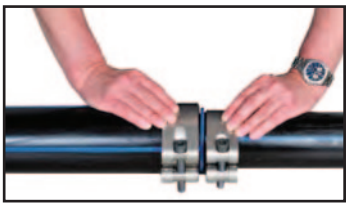
Slide the connectors over both pipes.



Push the reducer into the first tube until it stops



Push the tubes together as far as they will go.



Align the connectors to the pipe ends.



Tighten the locking bolts alternately with a torque wrench to the final torque rate indicated on the label of the connector.

THE FULL SET STRAUB-PLAST-PRO COMPONENTS REQUIRED:

Description	*Liner [As Shown]*	*Qty of Connectors*	
STRAUB-PLAST-PRO L Coupler		*2*	
STRAUB-PLAST-PRO LR Repair-coupler (Repairs up to 100mm,other lengths on request)		*2*	
STRAUB-PLAST-PRO R Reducer		*2*	
STRAUB-PLAST-PRO B90 Elbow 90°		*2*	
STRAUB-PLAST-PRO B45 Elbow 45°		*2*	

Description	*Liner [As Shown]*	*Qty of Connectors*	
STRAUB-PLAST-PRO Equal Tee		*3*	
*STRAUB-PLAST-PRO TFA Flanged Branch Tee **		*2*	
*STRAUB-PLAST-PRO FB90 Duck Foot Bend 90° **		*1*	
*STRAUB-PLAST-PRO FA Flange Adapter * (Loose flange is included)*		*1*	

*Flange bolt set is not supplied (DIN EN 1092-1)
Example for your order:
STRAUB-PLAST-PRO L 90.0, SDR 11
You will find data sheets on our website:
www.straub-couplings.com
containing material specifications and all available diameters.

DIMENSIONS AND MINIMUM PIPE WALL THICKNESS

1 mm = .03937 in

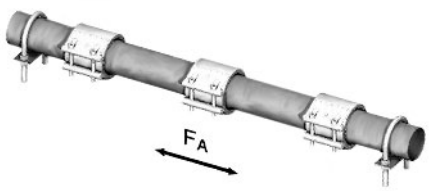
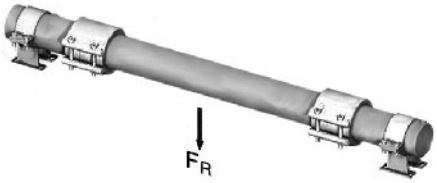
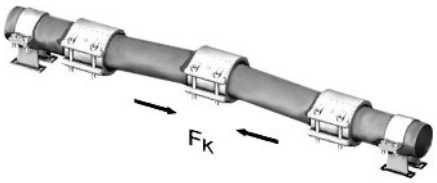
Pipe Diameter		Pipe OD		Minimum Wall Thickness	
IPS	Metric	IPS	Metric	Stainless Steel STRAUB-GRIP-L & METAL-GRIP	Copper-Nickel CuNi Class 200 STRAUB-GRIP-L
(Nominal)	(DIN Std.)	inch	mm	mm	in/mm
¾	20	1.050	26.9	1.5	.04/1.02
	25	1.180	30.0	1.5	
1	25	1.325	33.7	1.5	.05/1.27
	32	1.495	38.0	1.5	
1¼	32	1.670	42.4	1.5	.05/1.27
	40	1.750	44.5	1.5	
1½	40	1.900	48.3	1.5	.05/1.27
	50	2.125	54.0	1.5	
	50	**2.245**	**57.0**	**1.5**	
2	50	2.375	60.3	1.5	.06/1.52
	65	**2.625**	**66.6**	**2.0**	
	65	2.756	70.0	2.0	
2½	65	2.875	73.0	2.0	.07/1.78
	65	3.000	76.1	2.0	
	65	**3.125**	**79.4**	**2.0**	
	80	3.305	84.0	2.0	
3	80	3.500	88.9	2.0	.08/2.03
3½	80	3.960	100.6	2.0	.08/2.03
	90	**4.000**	**101.6**	**2.0**	
	100	4.095	104.0	2.0	
	100	**4.125**	**104.8**	**2.0**	
	100	4.250	108.0	2.0	
4	100	4.500	114.3	2.0	.09/2.29
	100	5.000	127.0	2.3	
	125	**5.080**	**129.0**	**2.3**	
	125	5.125	130.2	2.3	
			131.0*	**3.0**	
	125	5.235	133.0	2.3	
5	125	5.500	139.7	2.3	.10/2.54
	125	5.565	141.3	2.3	
	150	**6.065**	**154.0**	**2.3**	
			155.6*	2.5	
	150	**6.260**	**159.0**	**2.3**	
6	150	6.625	168.3	2.3	.12/3.05
	200	**7.625**	**193.7**	**3.0**	
			206.4		
8	200	8.625	219.1	3.0	.15/3.81
Minimum Wall Data Below For STRAUB-GRIP-L Only *					
	225	**9.625**	**244.5**	**3.0**	
	250	**10.510**	**267.0**	**3.0**	
10	250	10.750	273.0	3.0	.19/4.82
			306.0	**3.0**	
12	300	12.750	323.9	3.0	.22/5.50
14	350	14.000	355.6	3.0	.24/6.10
16	400	16.000	406.4	3.0	.27/6.86
18	450	18.000	457.2	3.0	.30/7.62
20	500	20.000	508.0	3.0	.33/8.38
22	550	22.000	558.8	3.0	.36/9.14
24	600	24.000	609.6	3.0	.40/10.16

standard IPS diameter

*For STRAUB-METAL-GRIP data on these sizes please consult factory.

FORCES TO AVOID

STRAUB PIPE COUPLINGS

Pull-Out Forces	Axial Force (F_A)  OK for STRAUB-GRIP Type. Not resisted by STRAUB-FLEX/OPEN-FLEX
Sheer Loads* **(consult factory for specific data)**	Weight (F_R)  Not resisted by STRAUB-FLEX or STRAUB-GRIP
Knee	Buckling (F_k)  Not resisted by STRAUB-FLEX or STRAUB-GRIP. Pipes must be properly guided.

*Please consult the factory or an authorized STRAUB Distributor for any installation or application questions.

COUPLING/PIPE COMPATIBILITY:

Pipe Materials	Stiffening Ring	STRAUB-METAL GRIP/ STRAUB-GRIP-L	STRAUB-FLEX/STRAUB-OPEN-FLEX	STRAUB-COMBI GRIP/ PLASTI GRIP	Remarks
Steel, Stainless Steel	-	Yes	Yes	Yes	Straub flex must be properly anchored
HDPE, PP, Noryl	Required	-	Yes	Yes	For STRAUB-FLEX pipes must be properly anchored
PVC, ABS, CPVC, C900	-	Yes	Yes	Yes	Stiffening Ring required for temps above 105°F
CFK, CRP, FRP, GRP (Centrifugal wound pipes)	-	-	Yes	-	Seal pipe surface at the cutting edge
Asbestos cement	-	-	Yes	-	
Concrete, CPP	-	-	Yes	-	Equalize rough surface with coating or filler
Cast (ductile, grey)	-	Yes	Yes	Yes	
Glass, Ceramic	-	-	Yes		
Copper-Nickel	-	Yes	Yes	Yes	Soft Copper with Stiffening Ring only
Aluminum	-	Yes	Yes	Yes	

INSTALLATION INFORMATION

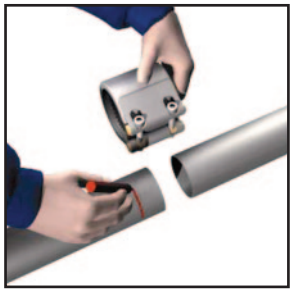
STRAUB PIPE COUPLINGS
INSTALLATION AND REMOVAL INSTRUCTIONS

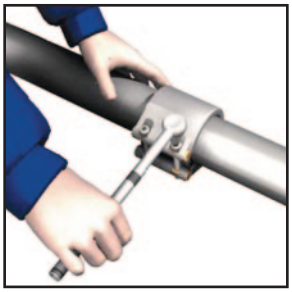
INSTALLATION

Do not disassemble coupling.
Coupling comes ready to install.
Cut pipes to desired lengths.
Clean and de-burr pipe ends.
Pipes must be properly supported.
Center coupling over gap between pipe ends.
Do not exceed maximum allowed gap between pipe ends.
Using a torque wrench, tighten bolts to torque value printed on coupling. Insure that all bolts have been correctly torqued.

REMOVAL

Make sure there is no pressure or product in the system.
Loosen bolts. Do not remove bolts completely.
Carefully pry up and tap casing to release grip ring and gasket from pipe surface.
Slide coupling to side for removal.





CAUTION

Do not attempt to move coupling over pipe after tightening.
After coupling has been correctly installed, do not re-torque.
Do not hang weight of pipe in coupling.
Insure that pipes are properly supported.
STRAUB-FLEX Type couplings require anchored pipes.
STRAUB-FLEX Type couplings are not pull out resistant.

IMPORTANT APPLICATION INFORMATION

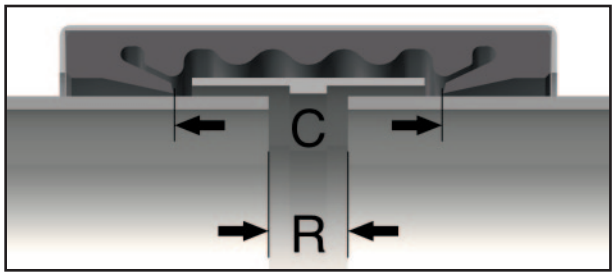
- A strip insert is required for vacuum service or for external pressure. See Column 6 for maximum gap requirements.
- STRAUB couplings are assembled with an internal silicone lubricant, special order when silicone-free product is required.
- STRAUB couplings are not designed to accommodate shear loading, or rotational (torsional) pipe movement. The weight of the pipe and contents must be supported. Only “STRAUB-GRIP” type couplings provide axial restraint.
- STRAUB-FLEX type couplings “DO NOT PROVIDE FOR AXIAL TYPE RESTRAINT”. When using STRAUB-FLEX type couplings, pipes must be properly anchored and supported.
- All STRAUB couplings require the correct use of a torque wrench for a safe and proper installation. STRAUB couplings must be torqued to the specified value as printed on each individual coupling. Failure to do so can result in injury or death.

CONDUCTIVITY CLIPS

STRAUB-GRIP type couplings are conductive by design. STRAUB-FLEX type couplings require the use of STRAUB Conductivity Clips to insure electric current continuity between pipes. Conductivity Clips are not standard and must be ordered separately.

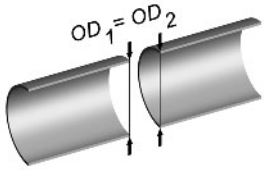
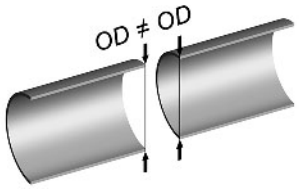
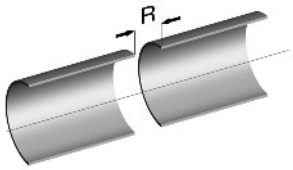
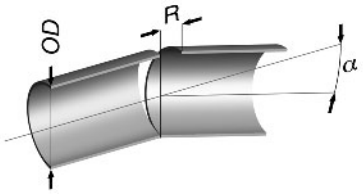
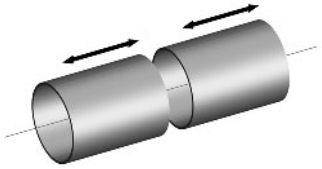
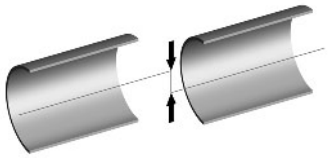
STRIP INSERTS

Strip inserts need only be used if required. Strip inserts protect the sealing sleeve against mechanical or chemical damage in the pipe gap area. Strip inserts are required when the distance between pipe ends is excessive or when axial movement is combined with angular deflection or axial "misalignment". The installation can be pre-fitted for all pipe coupling types. Strip inserts are also required for vacuum service or when aggressive media may be expected to degrade the rubber gasket. Selection of insert material to be dictated by the medium.
"T" type inserts (shown) also available for special applications.



All STRAUB couplings require the correct use of a torque wrench for a safe and proper installation. STRAUB couplings must be torqued to the specified value as printed on each individual coupling. Failure to do so can result in injury or death.

FITTING TOLERANCES

1		**Clamping Range** Connecting of two pipes with same outside diameter.
2		**Different Diameters** Connecting of two pipes with different outside diameter.
3		**Setting Gap Between Pipe Ends R** Connecting of two pipes with or without setting gap [R].
4		**Angular Deflection** α Setting gap between pipe ends through angular deflection. Maximum angular deflection (dynamic and static).
5		**Axial Movement** Δl STRAUB-FLEX/OPEN-FLEX couplings are pipe connectors and expansion joints combined into one unit.
6		**Axial Misalignment** Connecting of two pipes with axial misalignment. Maximum allowed 1% of outside diameter (max. 3 mm).

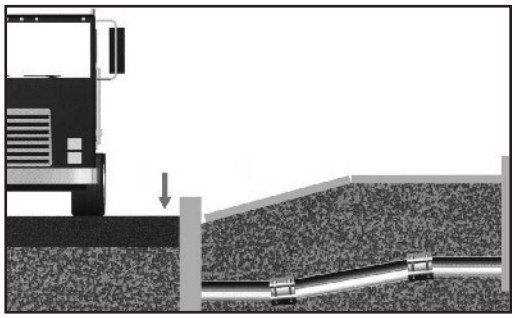
----> For Approximate values see chart on the next page

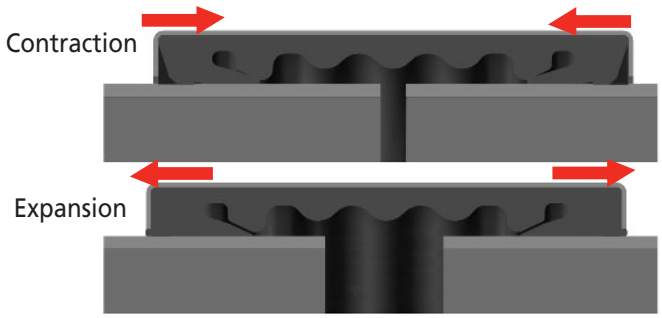
FITTING TOLERANCES

Approximate Values for fitting tolerances.

1 mm = .03937 in

STRAUB Type		Pipe OD	1 Clamping range per OD	2 Different diameters	3 Setting gap between pipe ends R	
					without Strip insert	with Strip insert
		OD-Range mm	+/- mm / %	mm / %	mm	mm
STRAUB-METAL-GRIP		33.7 - 54.0	0.5 mm	2 mm	5	15
		57.0 - 88.9	1.0%	2 mm	10	25
		104.0 - 114.3	1.0%	2%	10	25
		133.0/139.7/159.0/168.3	1.0%	2%	15	30
		129.0/154.0/219.1/273.0	1.0%	2%	15	35
		323.9 - 609.6	1.0%	6 mm	15	35
STRAUB-GRIP-L		26.9 - 33.7	1.0%	2 mm	5	5
		38.0 - 48.3	1.0%	2 mm	5	10
		54.0 - 60.3/84.0	1.0%	2 mm	10	15
		73.0/76.1/88.9	1.0%	2 mm	10	25
		100.6 - 104.8	1,0%	2%	10	15
		108.0/114.3	1.0%	2%	10	25
		154.0	1.0%	2%	10	30
		127.0 - 141.3/159.0 - 273.0	1.0%	2%	10	35
		304.0-609.8	1.0%	6 mm	10	35
STRAUB-FLEX 1	STRAUB-OPEN-FLEX 1	48.3 - 60.3	0.5%	2	5	15
		76.1 - 88.9	1.0%	2	5	25
		100.6 - 114.3	1.0%	2%	5	25
		127.0 - 168.3	1.0%	2%	5	35
STRAUB-FLEX 2	STRAUB-OPEN-FLEX 2	180.0 - 300.0	1.0%	2%	10	35
		301.0 - 1219.2	3 mm	6 mm	10	35
STRAUB-FLEX 3		558.8 - 2032.0	3 mm	6 mm	15	60
STRAUB-OPEN-FLEX 3		558.8 - 1219.2	3 mm	6 mm	15	60





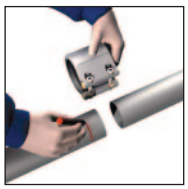
4 Angular Deflection		
Outside Diameter OD mm		Degree
GRIP	FLEX/OPEN-FLEX	
≤ 60.3mm	≤ 60.3mm	5
60.3 mm - 219. 1 mm	60.3 mm - 219. 1 mm	4
≥ 219.1mm	≥ 219.1mm	2

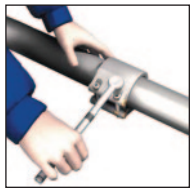
5 Max. Axial Movement	
STRAUB-Type	mm/in
FLEX 1/OPEN-FLEX 1	5 mm/.2"
FLEX 2/OPEN-FLEX 2	10 mm/.4"
FLEX 3/OPEN-FLEX 3	15mm/.6"
FLEX 3.5/OPEN-FLEX 3.5	15mm
FLEX 4/OPEN-FLEX 4	20mm/.8"

INSTALLATION TIMES

INSTALLATION TIMES AND DIMENSION COMPARISON

The installation time includes:
- Marking of half the coupling width on both pipe ends.
- Fitting the coupling over pipe ends and correct alignment.
- Tightening the bolts with a torque wrench.





Nominal Pipe Size		Pipe O.D.		Fitting Time Per Coupling
IPS	Metric	IPS	Metric	
Nominal	DIN Std.	inch	mm	min
0.75	20	1.050	26.7	2
-	25	1.180	30.0	2
1.00	25	1.325	33.7	2
-	32	1.495	38.0	2
1.25	32	1.670	42.4	2
-	40	1.750	44.5	2
1.50	40	1.900	48.3	2
-	50	2.125	54.0	3
-	50	2.245	57.0	3
2.00	50	2.375	60.3	3
	65	2.625	66.6	4
2.50	65	2.875	73.0	4
-	65	(3.000)	76.1	4
-	65	3.125	79.5	4
-	80	3.305	84.0	4
3.00	80	3.500	88.9	4
	80	3.960	100.6	5
3 1/2	90	(4.000)	101.6	5
-	100	4.095	104.0	5
-	100	4.125	104.8	5
-	100	4.250	108.0	5
4.00	100	4.500	114.3	5
-	100	5.000	127.0	6
-	125	5.080	129.0	6
-	125	5.125	130.2	6
-	125	5.235	133.0	6
5	125	(5.500)	139.7	6
-	125	5.565	141.3	6
-	150	6.065	154.0	7
-	150	6.260	159.0	7
6	150	6.625	168.3	7
8	200	8.625	219.1	9
-	225	9.625	244.5	10
-	250	10.510	267.0	10
10	250	10.750	273.0	10
12	300	12.750	323.9	12
14	350	14.000	355.6	12
16	400	16.000	406.4	12
18	450	18.000	457.2	12
20	500	20.000	508.0	12
22	550	22.000	558.8	12
24	600	24.000	609.6	12

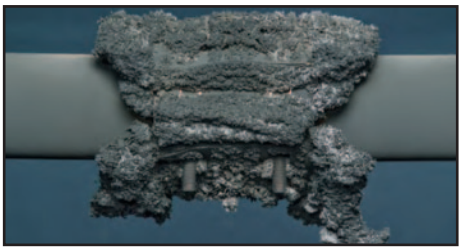
standard IPS diameter

SPECIALTY COUPLINGS

STRAUB Fire Fence

The fire resistant coupling - for use wherever fire protection is required by law.

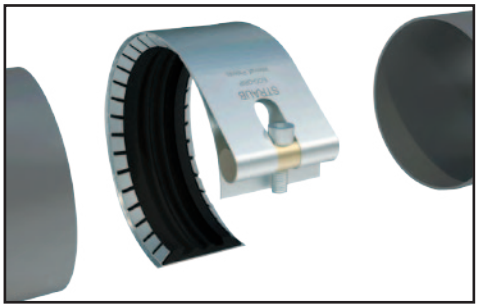




STRAUB Eco-Grip

Economical - for use in lower temperatures and pressure ranges

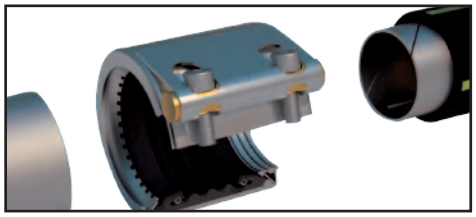
Working pressure up to 6 bar
Outside diameters 26.9 up to 168.3 mm
Temperature range -10 C° up to +40° C

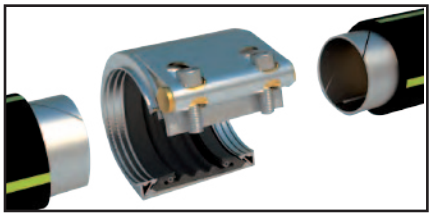


STRAUB Combi Grip/Plast Grip

Practical for Transitions
The STRAUB-COMBI-GRIP ensures a perfect connection at transitions between plastic and metal pipes by compensating for different outside diameters. The advanced technoiogy and high-specification manufacture ensure increased safety and reliability wherever this coupling is used.

Universal for plastic pipe
The STRAUB-PLAST-GRIP is the ideal combination for thick- and thin-walled plastic pipes. It is used for gas and water supply applications, for industrial pipeline constructions, suction and pressure lines.





STRAUB Clamp

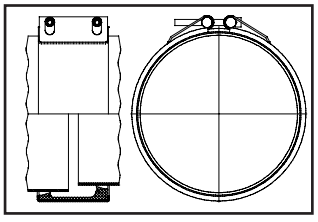
Repair Clamp in one or two piece version

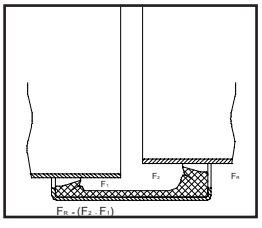


STRAUB Step Flex

The pipe connection for different pipe diameters

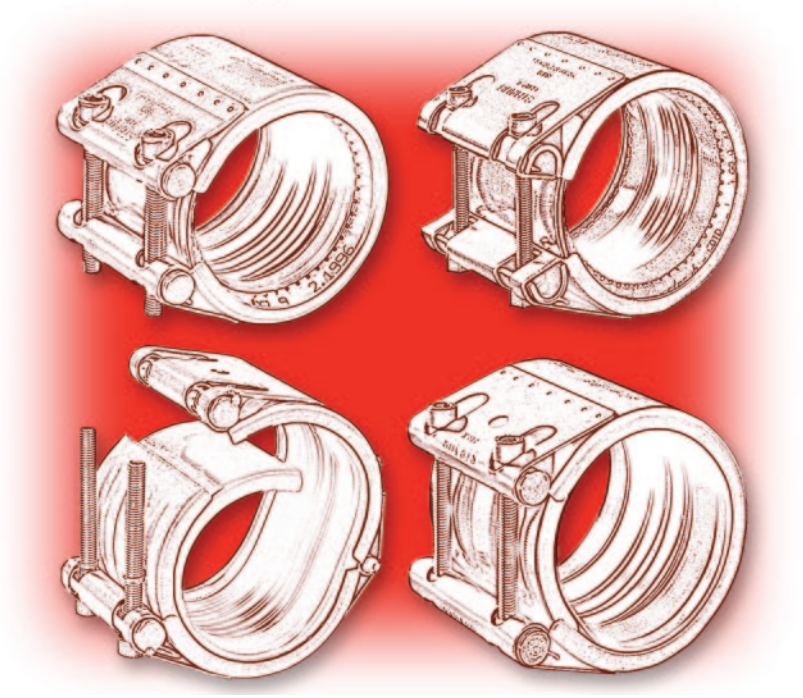
STRAUB STEP FLEX overcomes large diameter differences from 10 to 30 mm. In order to protect the sealing sleeve, a stainless steel strip insert is included.





straub®

the right connection



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KRÜGER

SECTION 3.4.7

SPIKE ANCHORS

VEOLIA WATER
Solutions & Technologies

Spike® *Pin Anchor*

PRODUCT DESCRIPTION

The Spike is a, one-piece, vibration resistant anchor for use in concrete block or stone. Several head styles, including tamperfroof versions, and anchor materials are available. The Spike anchor is formed with an "s" shaped configuration at the working end of the anchor to create an expansion mechanism. Since the anchor is pre-formed, there is no secondary tightening operation required which greatly reduces the overall cost of an anchor installation.

GENERAL APPLICATIONS AND USES

- Tamperproof Applications
- Exterior Applications
- Cable Trays and Strut
- Pipe Hanging
- Metal Track Attachments
- Concrete Formwork
- For roofing applications see the Roofing Spike product information

FEATURES AND BENEFITS

+ Pre-expanded anchor design allows for easy installation
+ Mushroom and flat head Spike anchors are tamper-proof
+ Forming Spike, which is removable, can be used for temporary installations
+ Pipe and Tie-wire Spike is an easy to install alternative to direct fastening

APPROVALS AND LISTINGS

Factory Mutual Research Corporation (FM Approvals) – J.I. ON5A1.AH, 3/8" diameter Pipe Spike *Pipe hanger components for Automatic Sprikler Systems.*
Tested in accordance with ASTM E488 and AC01 criteria

GUIDE SPECIFICATIONS

CSI Divisions: *03151-Concrete Anchoring, 04081-Masonry Anchorage* and *05090-Metal Fastenings.* Pre-expanded anchors shall be Spike as supplied by Powers Fasteners, Inc., Brewster, NY.

MATERIAL SPECIFICATIONS

Carbon Steel (Mushroom Head, Flat Head, Pipe, Tie-Wire and Forming Spike)

Anchor Component	Component Material
Anchor Body	AISI 1038 Carbon Steel
Zinc Plating	ASTM B633, SC1, Type III (Fe/Zn 5)

Stainless Steel (Mushroom Head)

Anchor Component	Component Material
Anchor Body	Type 316L Stainless Steel

SECTION CONTENTS Page No.

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Installation Specifications 2
Performance Data 4
Design Criteria 9
Ordering Information 12



Mushroom Head Spike



Flat Head Spike



Pipe Spike



Tie-Wire Spike



Forming Spike

HEAD STYLES

Mushroom Head
Flat Head
Pipe
Tie-Wire
Forming

ANCHOR MATERIALS

Zinc Plated Carbon Steel
Type 316 Stainless Steel

ANCHOR SIZE RANGE (TYP.)

3/16" diameter to 1/2" diameter

SUITABLE BASE MATERIALS

Normal-Weight Concrete
Structural Lightweight Concrete
Grouted Concrete Masonry (CMU)

INSTALLATION SPECIFICATIONS

Mushroom Head Carbon Steel Spike

Dimension	Nominal Anchor Size, *d*			
	3/16"	1/4"	3/8"	1/2"
ANSI Drill Bit Size, d_{bit} (in.)	3/16	1/4	3/8	1/2
Fixture Clearance Hole, d_h (in.)	1/4	5/16	7/16	9/16
Head Height (in.)	7/64	7/64	7/32	1/4
Head Size, O.D. (in.)	7/16	1/2	3/4	1

Mushroom Head Stainless Steel Spike

Dimension	Nominal Anchor Size, *d*		
	3/16"	1/4"	3/8"
ANSI Drill Bit Size, d_{bit} (in.)	3/16	1/4	3/8
Fixture Clearance Hole, d_h (in.)	1/4	5/16	7/16
Head Height (in.)	7/64	7/64	7/32
Head Size, O.D. (in.)	7/16	1/2	3/4

Flat Head Spike (80°– 82° Head)

Dimension	Nominal Anchor Size, *d*	
	3/16"	1/4"
ANSI Drill Bit Size, d_{bit} (in.)	3/16	1/4
Fixture Clearance Hole, d_h (in.)	1/4	5/16
Head Height (in.)	7/64	9/64
Head Size, O.D. (in.)	3/8	1/2

Pipe Spike

Dimension	Nominal Anchor Size, *d*	
	1/4"	3/8"
ANSI Drill Bit Size, d_{bit} (in.)	3/16	1/4
UNC Thread Size	1/4-20	3/8-16
Head Height (in.)	1/2	5/8
Head Size, O.D. (in.)	13/32	35/64

Tie-Wire Spike

Dimension	Nominal Anchor Size, *d*	
	3/16"	1/4"
ANSI Drill Bit Size, d_{bit} (in.)	3/16	1/4
Tie-Wire Hole (in.)	3/16	9/32
Head Height (in.)	37/64	41/64
Head Width (in.)	9/64 x 7/16	3/16 x 9/16

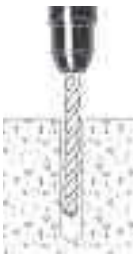
Forming Spike

Dimension	Nominal Anchor Size, *d*	
	3/16"	1/4"
ANSI Drill Bit Size, d_{bit} (in.)	3/16	1/4
Fixture Clearance Hole, d_h (in.)	1/4	5/16
Head Height (in.)	9/16	9/16
Head Size, O.D. (in.)	13/32	1/2

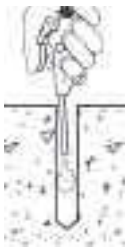
INSTALLATION SPECIFICATIONS

Mushroom/Flat Head Version

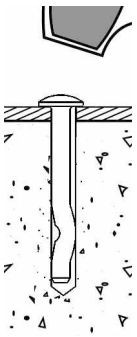
Using the proper diameter bit, drill a hole into the base material to a depth of at least 1/2" or one anchor diameter deeper than the embedment required.
The tolerances of the drill bit used must meet the requirements of ANSI Standard B212.15



Blow the hole clean of dust and other material.



Drive the anchor through the fixture into the anchor hole until the head is firmly seated against the fixture. Be sure the anchor is driven to the required embedment depth.

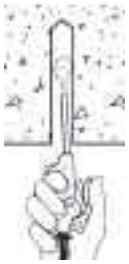


Pipe Spike Version

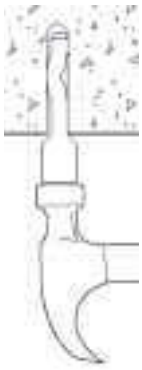
Using the proper diameter bit, drill a hole into the base material to a depth of at least 1/2" or one anchor diameter deeper than the embedment required.
The tolerances of the drill bit used must meet the requirements of ANSI Standard B212.15



Blow the hole clean of dust and other material.



Drive the anchor into the hole until the head is firmly seated against the base material. Be sure the anchor is driven to the required embedment depth.

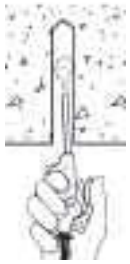


Tie-Wire Version

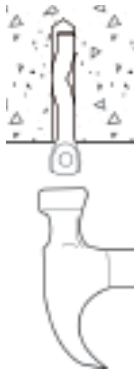
Using the proper diameter bit, drill a hole into the base material to a depth of at least 1/2" or one anchor diameter deeper than the embedment required.
The tolerances of the drill bit used must meet the requirements of ANSI Standard B212.15



Blow the hole clean of dust and other material.l.

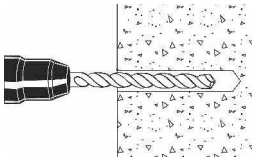


Drive the anchor into the hole until the head is firmly seated against the base material. Be sure the anchor is driven to the required embedment depth.

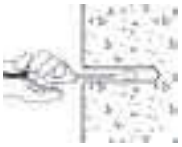


Forming Spike Version

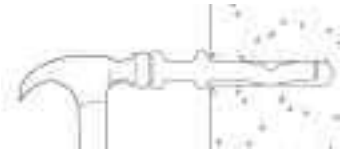
Using the proper diameter bit, drill a hole into the base material to a depth of at least 1/2" or one anchor diameter deeper than the embedment required.
The tolerances of the drill bit used must meet the requirements of ANSI Standard B212.15



Blow the hole clean of dust and other material.



Drive the anchor through the fixture into the anchor hole until the head is firmly seated against the fixture. Be sure the anchor is driven to the required embedment depth.



PERFORMANCE DATA

Ultimate Load Capacities for Carbon Steel Spike in Normal-Weight Concrete[1,2]

Anchor Diameter *d* in. (mm)	Minimum Embedment Depth h_v in. (mm)	Minimum Concrete Compressive Strength (f'_c)							
		2,000 psi (13.8 MPa)		**3,000 psi** (20.7 MPa)		**4,000 psi** (27.6 MPa)		**5,000 psi** (34.5 MPa)	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
3/16 (4.8)	7/8 (22.2)	520 (2.3)	1,080 (4.9)	560 (2.5)	1,270 (5.7)	660 (2.9)	1,310 (5.9)	690 (3.1)	1,350 (6.1)
	1 (25.4)	540 (2.4)	1,230 (5.5)	620 (2.8)	1,725 (7.8)	780 (3.5)	1,860 (8.4)	795 (3.5)	1,860 (8.4)
	1 1/4 (31.8)	780 (3.5)	1,800 (8.1)	900 (4.0)	2,000 (9.0)	1,060 (4.7)	2,155 (9.7)	1,120 (5.0)	2,310 (10.4)
1/4 (6.4)	1 (25.4)	620 (2.8)	1,585 (7.1)	775 (3.4)	1,965 (8.8)	835 (3.7)	2,160 (9.7)	885 (3.9)	2,360 (10.6)
	1 1/4 (31.8)	830 (3.7)	1,815 (8.2)	1,100 (4.9)	2,020 (9.1)	1,210 (5.4)	2,220 (10.0)	1,320 (5.9)	2,585 (11.6)
3/8 (9.5)	1 3/4 (44.5)	1,785 (8.0)	3,645 (16.4)	2,120 (9.5)	4,480 (20.2)	2,630 (11.8)	5,025 (22.6)	2,875 (12.9)	5,075 (22.8)
1/2 (12.7)	2 1/2 (63.5)	3,215 (14.5)	5,345 (24.1)	3,620 (16.3)	8,460 (38.1)	4,015 (18.1)	10,320 (46.4)	4,410 (19.8)	10,860 (48.9)

1. Tabulated load values are for anchors installed in concrete. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Ultimate load capacities must be reduced by a minimum safety factor of 4.0 or greater to determine allowable working load. Consideration of safety factors of 10 or higher may be necessary depending upon the application such as life safety or overhead.

Allowable Load Capacities for Carbon Steel Spike in Normal-Weight Concrete[1,2,3]

Anchor Diameter *d* in. (mm)	Minimum Embedment Depth h_v in. (mm)	Minimum Concrete Compressive Strength (f'_c)							
		2,000 psi (13.8 MPa)		**3,000 psi** (20.7 MPa)		**4,000 psi** (27.6 MPa)		**5,000 psi** (34.5 MPa)	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
3/16 (4.8)	7/8 (22.2)	130 (0.6)	270 (1.2)	140 (0.6)	320 (1.4)	165 (0.7)	330 (1.5)	170 (0.8)	340 (1.5)
	1 (25.4)	135 (0.6)	310 (1.4)	155 (0.7)	430 (1.9)	195 (0.9)	465 (2.1)	200 (0.9)	465 (2.1)
	1 1/4 (31.8)	195 (0.9)	450 (2.0)	225 (1.0)	500 (2.3)	265 (1.2)	540 (2.4)	280 (1.2)	580 (2.6)
1/4 (6.4)	1 (25.4)	155 (0.7)	395 (1.8)	195 (0.9)	490 (2.2)	210 (0.9)	540 (2.4)	220 (1.0)	590 (2.7)
	1 1/4 (31.8)	210 (0.9)	455 (2.0)	275 (1.2)	505 (2.3)	300 (1.3)	555 (2.5)	330 (1.5)	645 (2.9)
3/8 (9.5)	1 3/4 (44.5)	445 (2.0)	910 (4.1)	530 (2.4)	1,120 (5.0)	660 (3.0)	1,255 (5.6)	720 (3.2)	1,270 (5.7)
1/2 (12.7)	2 1/2 (63.5)	805 (3.6)	1,335 (6.0)	905 (4.1)	2,115 (9.5)	1,005 (4.5)	2,580 (11.6)	1,105 (5.0)	2,715 (12.2)

1. Allowable load capacities are calculated using an applied safety factor of 4.0. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.
2. Linear interpolation may be used to determine allowable loads for intermediate embedments and compressive strengths.
3. Allowable load capacities are multiplied by reduction factors found in the Design Criteria section when anchor spacing or edge distances are less than critical distances.

PERFORMANCE DATA

Ultimate Load Capacities for Stainless Steel Spike in Normal-Weight Concrete[1,2]

Anchor Diameter *d* in. (mm)	Minimum Embedment Depth h_v in. (mm)	Minimum Concrete Compressive Strength (f'_c)							
		2,000 psi (13.8 MPa)		**3,000 psi** (20.7 MPa)		**4,000 psi** (27.6 MPa)		**5,000 psi** (34.5 MPa)	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
3/16 (4.8)	7/8 (22.2)	490 (2.2)	920 (4.1)	560 (2.5)	1,155 (5.2)	660 (2.9)	1,220 (5.5)	690 (3.1)	1,290 (5.8)
	1 (25.4)	500 (2.3)	1,175 (5.3)	620 (2.8)	1,650 (7.4)	780 (3.5)	1,740 (7.8)	795 (3.5)	1,830 (8.2)
	1 1/4 (31.8)	740 (3.3)	1,735 (7.8)	900 (4.0)	1,930 (8.7)	1,060 (4.7)	2,040 (9.2)	1,120 (5.0)	2,150 (9.7)
1/4 (6.4)	1 (25.4)	620 (2.8)	1,565 (7.0)	775 (3.4)	1,845 (8.3)	835 (3.7)	2,095 (9.4)	885 (3.9)	2,250 (10.1)
	1 1/4 (31.8)	795 (3.6)	1,765 (7.9)	1,080 (4.9)	1,965 (8.8)	1,175 (5.2)	2,145 (9.7)	1,280 (5.7)	2,325 (10.5)
3/8 (9.5)	1 3/4 (44.5)	1,575 (7.1)	3,155 (14.2)	1,990 (9.0)	3,880 (17.5)	2,420 (10.9)	4,150 (18.7)	2,570 (11.6)	4,425 (19.9)

1. Tabulated load values are for anchors installed in concrete. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Ultimate load capacities must be reduced by a minimum safety factor of 4.0 or greater to determine allowable working load. Consideration of safety factors of 10 or higher may be necessary depending upon the application such as life safety or overhead.

Allowable Load Capacities for Stainless Steel Spike in Normal-Weight Concrete[1,2,3]

Anchor Diameter *d* in. (mm)	Minimum Embedment Depth h_v in. (mm)	Minimum Concrete Compressive Strength (f'_c)							
		2,000 psi (13.8 MPa)		**3,000 psi** (20.7 MPa)		**4,000 psi** (27.6 MPa)		**5,000 psi** (34.5 MPa)	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
3/16 (4.8)	7/8 (22.2)	125 (0.6)	230 (1.0)	140 (0.6)	290 (1.3)	165 (0.7)	305 (1.4)	170 (0.8)	325 (1.5)
	1 (25.4)	125 (0.6)	295 (1.3)	155 (0.7)	415 (1.9)	195 (0.9)	435 (2.0)	200 (0.9)	460 (2.1)
	1 1/4 (31.8)	185 (0.8)	435 (2.0)	225 (1.0)	485 (2.2)	265 (1.2)	510 (2.3)	280 (1.7)	540 (2.4)
1/4 (6.4)	1 (25.4)	155 (0.7)	390 (1.8)	195 (0.9)	460 (2.1)	210 (0.9)	525 (2.4)	220 (1.0)	565 (2.5)
	1 1/4 (31.8)	200 (0.9)	440 (2.0)	270 (1.2)	490 (2.2)	295 (1.3)	535 (2.4)	320 (1.4)	580 (2.6)
3/8 (9.5)	1 3/4 (44.5)	395 (1.8)	790 (3.6)	500 (2.3)	970 (4.4)	605 (2.7)	1,040 (4.7)	645 (2.9)	1,105 (5.0)

1. Allowable load capacities are calculated using an applied safety factor of 4.0. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.
2. Linear interpolation may be used to determine allowable loads for intermediate embedments and compressive strengths.
3. Allowable load capacities are multiplied by reduction factors found in the Design Criteria section when anchor spacing or edge distances are less than critical distances.

PERFORMANCE DATA

Ultimate Load Capacities for Carbon Steel Pipe Spike in Normal-Weight Concrete[1,2]

Anchor Dia. *d* in. (mm)	Drill Bit Dia. d_{bit} in.	Minimum Embed. Depth h_v in. (mm)	Minimum Concrete Compressive Strength (f'_c)							
			2,000 psi (13.8 MPa)		**3,000 psi** (20.7 MPa)		**4,000 psi** (27.6 MPa)		**5,000 psi** (34.5 MPa)	
			Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
1/4 (6.4)	3/16	1 1/4 (31.8)	780 (3.5)	975 (4.4)	1,260 (5.7)	975 (4.4)	1,260 (5.7)	975 (4.4)	1,260 (5.7)	975 (4.4)
3/8 (9.5)	1/4	1 3/4 (44.5)	1,100 (5.0)	1,815 (8.2)	1,660 (7.5)	2,020 (9.1)	2,000 (9.0)	2,100 (9.5)	2,000 (9.0)	2,180 (9.8)

1. Tabulated load values are for anchors installed in concrete. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Ultimate load capacities must be reduced by a minimum safety factor of 4.0 or greater to determine allowable working load. Consideration of safety factors of 10 or higher may be necessary depending upon the application such as life safety or overhead.

Allowable Load Capacities for Carbon Steel Pipe Spike in Normal-Weight Concrete[1,2,3]

Anchor Dia. *d* in. (mm)	Drill Bit Dia. d_{bit} in.	Minimum Embed. Depth h_v in. (mm)	Minimum Concrete Compressive Strength (f'_c)							
			2,000 psi (13.8 MPa)		**3,000 psi** (20.7 MPa)		**4,000 psi** (27.6 MPa)		**5,000 psi** (34.5 MPa)	
			Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
1/4 (6.4)	3/16	1 1/4 (31.8)	195 (0.9)	245 (1.1)	315 (1.4)	245 (1.1)	315 (1.4)	245 (1.1)	315 (1.4)	245 (1.1)
3/8 (9.5)	1/4	1 3/4 (44.5)	275 (1.2)	455 (2.0)	415 (1.9)	505 (2.3)	500 (2.3)	525 (2.4)	500 (2.3)	545 (2.5)

1. Allowable load capacities are calculated using an applied safety factor of 4.0. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.
2. Linear interpolation may be used to determine allowable loads for intermediate compressive strengths.
3. Allowable load capacities are multiplied by reduction factors found in the Design Criteria section when anchor spacing or edge distances are less than critical distances.

Ultimate Load Capacities for Carbon Steel Tie-Wire Spike in Normal-Weight Concrete[1,2]

Anchor Diameter *d* in. (mm)	Minimum Embedment Depth h_v in. (mm)	Minimum Concrete Compressive Strength (f'_c)					
		3,000 psi (20.7 MPa)		**4,000 psi** (27.6 MPa)		**5,000 psi** (34.5 MPa)	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
3/16 (4.8)	1 1/8 (28.6)	975 (4.4)	950 (4.3)	1,050 (4.7)	950 (4.3)	1,120 (5.0)	950 (4.3)
1/4 (6.4)	1 1/8 (28.6)	1,075 (4.8)	1,310 (5.9)	1,150 (5.2)	1,310 (5.9)	1,230 (5.5)	1,310 (5.9)

1. Tabulated load values are for anchors installed in concrete. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Ultimate load capacities must be reduced by a minimum safety factor of 4.0 or greater to determine allowable working load. Consideration of safety factors of 10 or higher may be necessary depending upon the application such as life safety or overhead.

Allowable Load Capacities for Carbon Steel Tie-Wire Spike in Normal-Weight Concrete[1,2,3]

Anchor Diameter *d* in. (mm)	Minimum Embedment Depth h_v in. (mm)	Minimum Concrete Compressive Strength (f'_c)					
		3,000 psi (20.7 MPa)		**4,000 psi** (27.6 MPa)		**5,000 psi** (34.5 MPa)	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
3/16 (4.8)	1 1/8 (28.6)	245 (1.1)	240 (1.1)	265 (1.2)	240 (1.1)	280 (1.3)	240 (1.1)
1/4 (6.4)	1 1/8 (28.6)	270 (1.2)	330 (1.5)	290 (1.3)	330 (1.5)	310 (1.4)	330 (1.5)

1. Allowable load capacities are calculated using an applied safety factor of 4.0. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.
2. Linear interpolation may be used to determine allowable loads for intermediate compressive strengths.
3. Allowable load capacities are multiplied by reduction factors found in the Design Criteria section when anchor spacing or edge distances are less than critical distances.

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PERFORMANCE DATA

Ultimate Load Capacities for Carbon Steel Forming Spike in Normal-Weight Concrete[1,2]

Anchor Diameter d in. (mm)	Minimum Embed. Depth h_v in. (mm)	Minimum Concrete Compressive Strength (f'_c)							
		2,000 psi (13.8 MPa)		**3,000 psi** (20.7 MPa)		**4,000 psi** (27.6 MPa)		**5,000 psi** (34.5 MPa)	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
3/16 (4.8)	1 1/4 (31.8)	780 (3.5)	1,800 (8.1)	1,000 (4.5)	2,000 (9.0)	1,260 (5.7)	2,155 (9.7)	1,260 (5.7)	2,310 (10.4)
1/4 (6.4)	1 1/4 (31.8)	830 (3.7)	1,815 (8.2)	1,200 (5.4)	2,020 (9.1)	1,410 (6.3)	2,220 (10.0)	1,410 (6.3)	2,585 (11.6)

1. Tabulated load values are for anchors installed in concrete. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Ultimate load capacities must be reduced by a minimum safety factor of 4.0 or greater to determine allowable working load. Consideration of safety factors of 10 or higher may be necessary depending upon the application such as life safety or overhead.

Allowable Load Capacities for Carbon Steel Forming Spike in Normal-Weight Concrete[1,2,3]

Anchor Diameter d in. (mm)	Minimum Embed. Depth h_v in. (mm)	Minimum Concrete Compressive Strength (f'_c)							
		2,000 psi (13.8 MPa)		**3,000 psi** (20.7 MPa)		**4,000 psi** (27.6 MPa)		**5,000 psi** (34.5 MPa)	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
3/16 (4.8)	1 1/4 (31.8)	195 (0.9)	450 (2.0)	250 (1.1)	500 (2.3)	315 (1.4)	540 (2.4)	315 (1.4)	580 (2.6)
1/4 (6.4)	1 1/4 (31.8)	210 (0.9)	455 (2.0)	300 (1.4)	505 (2.3)	355 (1.6)	555 (2.5)	355 (1.6)	645 (2.9)

1. Allowable load capacities are calculated using an applied safety factor of 4.0. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.
2. Linear interpolation may be used to determine allowable loads for intermediate compressive strengths.
3. Allowable load capacities are multiplied by reduction factors found in the Design Criteria section when anchor spacing or edge distances are less than critical distances.

Ultimate Load Capacities for Spike in Structural Lightweight Concrete[1,2,3]

Anchor Diameter d in. (mm)	Minimum Embed. Depth h_v in. (mm)	Minimum Concrete Compressive Strength (f'_c)					
		3,000 psi (20.7 MPa)		**4,000 psi** (27.6 MPa)		**5,000 psi** (34.5 MPa)	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
3/16 (4.8)	1 1/4 (31.8)	440 (2.0)	1,280 (5.8)	400 (1.8)	1,280 (5.8)	380 (1.7)	1,280 (5.8)
1/4 (6.4)	1 1/4 (31.8)	480 (2.2)	1,720 (7.7)	440 (2.0)	1,720 (7.7)	400 (1.8)	1,720 (7.7)
3/8 (9.5)	1 3/4 (44.5)	1,140 (5.1)	3,000 (13.5)	960 (4.3)	3,000 (13.5)	800 (3.6)	3,000 (13.5)
1/2 (12.7)	2 1/2 (63.5)	1,860 (8.4)	6,440 (29.0)	1,860 (8.4)	6,440 (29.0)	1,860 (8.4)	6,440 (29.0)

1. Tabulated load values are applicable to carbon and stainless steel anchors.
2. Tabulated load values are for anchors installed in concrete. Concrete compressive strength must be at the specified minimum at the time of installation.
3. Ultimate load capacities must be reduced by a minimum safety factor of 4.0 or greater to determine allowable working load. Consideration of safety factors of 10 or higher may be necessary depending upon the application such as life safety or overhead.

Allowable Load Capacities for Spike in Structural Lightweight Concrete[1,2,3,4]

Anchor Diameter d in. (mm)	Minimum Embed. Depth h_v in. (mm)	Minimum Concrete Compressive Strength (f'_c)					
		3,000 psi (20.7 MPa)		**4,000 psi** (27.6 MPa)		**5,000 psi** (34.5 MPa)	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
3/16 (4.8)	1 1/4 (31.8)	110 (0.5)	320 (1.4)	100 (0.5)	320 (1.4)	95 (0.4)	320 (1.4)
1/4 (6.4)	1 1/4 (31.8)	120 (0.5)	430 (1.9)	110 (0.5)	430 (1.9)	100 (0.5)	430 (1.9)
3/8 (9.5)	1 3/4 (44.5)	285 (1.3)	750 (3.4)	240 (1.1)	750 (3.4)	200 (0.9)	750 (3.4)
1/2 (12.7)	2 1/2 (63.5)	465 (2.1)	1,610 (7.2)	465 (2.1)	1,610 (7.2)	465 (2.1)	1,610 (7.2)

1. Tabulated load values are applicable to carbon and stainless steel anchors.
2. Allowable load capacities are calculated using an applied safety factor of 4.0. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.
3. Linear interpolation may be used to determine ultimate loads for intermediate compressive strengths.
4. Allowable load capacities are multiplied by reduction factors found in the Design Criteria section when anchor spacing or edge distances are less than critical distances.

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PERFORMANCE DATA

Ultimate and Allowable Load Capacities for Carbon and Stainless Steel Spike Anchors Installed Through Metal Deck into Structural Lightweight Concrete[1,2,3,4]

Anchor Diameter d in. (mm)	Minimum Embedment Depth h_v in. (mm)	Lightweight Concrete Over Minimum 20 Ga. Steel Deck $f'_c \geq$ 3,000 psi (20.7 MPa)			
		Minimum 1-1/2" Wide Deck			
		Ultimate Load		Allowable Load	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
3/16 (4.8)	1 1/4 (31.8)	560 (2.5)	2,000 (9.0)	140 (0.6)	500 (2.3)
1/4 (6.4)	1 1/4 (31.8)	560 (2.5)	2,000 (9.0)	140 (0.6)	500 (2.3)
3/8 (9.5)	1 3/4 (44.5)	600 (2.7)	2,620 (11.8)	150 (0.7)	655 (2.9)
1/2 (12.7)	2 1/2 (63.5)	1,120 (5.0)	3,020 (13.6)	280 (1.3)	755 (3.4)

1. Tabulated load values are for carbon steel and stainless steel anchors installed in sand-lightweight concrete over steel deck. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Allowable load capacities are calculated using a safety factor of 4.0. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.
3. Spacing distances shall be in accordance with the spacing table for structural lightweight concrete listed in the Design Criteria section.
4. Anchors are permitted to be installed in the lower or upper flute of the steel deck provided the proper installation procedures are maintained.

Ultimate and Allowable Load Capacities for Carbon Steel and Stainless Steel Spike in Grouted Concrete Masonry[1,2,3,4]

Anchor Diameter d in. (mm)	Minimum Embedment Depth h_v in. (mm)	Normal-Weight CMU, $f'_m \geq$ 1,500 psi (10.4 MPa)							
		Ultimate Load				Allowable Load			
		Carbon Steel Spike		Stainless Steel Spike		Carbon Steel Spike		Stainless Steel Spike	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
3/16 (4.8)	7/8 (22.2)	280 (1.3)	540 (2.4)	280 (1.3)	540 (2.4)	55 (0.2)	110 (0.5)	55 (0.2)	110 (0.5)
	1 (25.4)	410 (1.8)	590 (2.7)	310 (1.4)	590 (2.7)	80 (0.4)	120 (0.5)	60 (0.3)	120 (0.5)
	1 1/4 (31.8)	740 (3.3)	1,090 (4.9)	730 (3.3)	1,980 (8.9)	150 (0.7)	420 (1.9)	145 (0.7)	395 (1.8)
1/4 (6.4)	1 (25.4)	670 (3.0)	1,840 (8.3)	645 (2.9)	1,620 (7.3)	135 (0.6)	370 (1.7)	130 (0.6)	325 (1.5)
	1 1/4 (31.8)	800 (3.6)	2,100 (9.5)	770 (3.5)	1,890 (8.5)	160 (0.7)	420 (1.9)	155 (0.7)	380 (1.7)

1. Tabulated load values are for anchors installed in minimum 6-inch wide, minimum Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units conforming to ASTM C 90. Mortar must be minimum Type N. Masonry cells may be grouted. Masonry compressive strength must be at the specified minimum at the time of installation ($f'm \geq$ 1,500 psi)..
2. Allowable load capacities listed are calculated using and applied safety factor of 5.0. Consideration of safety factors of 10 or higher may be necessary depending upon the application such as life safety, and in sustained tensile loading applications.
3. Linear interpolation may be used to determine allowable load capacities for intermediate embedments.
4. The tabulated values are for anchors installed at a minimum of 16 anchor diameters on center.

DESIGN CRITERIA (ALLOWABLE STRESS DESIGN)

Combined Loading

For anchors loaded in both shear and tension, the combination of loads should be proportioned as follows:

$$\left(\frac{N_u}{N_n}\right) + \left(\frac{V_u}{V_n}\right) \leq 1$$

Where: N_u = Applied Service Tension Load
N_n = Allowable Tension Load
V_u = Applied Service Shear Load
V_n = Allowable Shear Load

Load Adjustment Factors for Spacing and Edge Distances in Concrete

Anchor Installed in Normal-Weight Concrete					
Anchor Dimension	**Load Type**	**Critical Distance (Full Anchor Capacity)**	**Critical Load Factor**	**Minimum Distance (Reduced Capacity)**	**Minimum Load Factor**
Spacing (s)	Tension and Shear	$s_{cr} = 2.0h_v$	$F_{NS} = F_{VS} = 1.0$	$s_{min} = h_v$	$F_{N_S} = F_{V_S} = 0.50$
Edge Distance (c)	Tension	$c_{cr} = 14d$	$F_{NC} = 1.0$	$c_{min} = 5d$	$F_{N_C} = 0.80$
	Shear	$c_{cr} = 14d$	$F_{VC} = 1.0$	$c_{min} = 5d$	$F_{V_C} = 0.50$

Anchor Installed in Structural Lightweight Concrete					
Anchor Dimension	**Load Type**	**Critical Distance (Full Anchor Capacity)**	**Critical Load Factor**	**Minimum Distance (Reduced Capacity)**	**Minimum Load Factor**
Spacing (s)	Tension and Shear	$s_{cr} = 3.0h_v$	$F_{NS} = F_{VS} = 1.0$	$s_{min} = 1.5\ h_v$	$F_{N_S} = F_{V_S} = 0.50$
Edge Distance (c)	Tension	$c_{cr} = 14d$	$F_{NC} = 1.0$	$c_{min} = 7d$	$F_{N_C} = 0.80$
	Shear	$c_{cr} = 14d$	$F_{VC} = 1.0$	$c_{min} = 7d$	$F_{V_C} = 0.50$

1. Allowable load values found in the performance data tables are multiplied by reduction factors when anchor spacing or edge distances are less than critical distances. Linear interpolation is allowed for intermediate anchor spacing and edge distances between critical and minimum distances. When an anchor is affected by both reduced spacing and edge distance, the spacing and edge reduction factors must be combined (multiplied). Multiple reduction factors for anchor spacing and edge distance may be required depending on the anchor group configuration.

DESIGN CRITERIA (ALLOWABLE STRESS DESIGN)

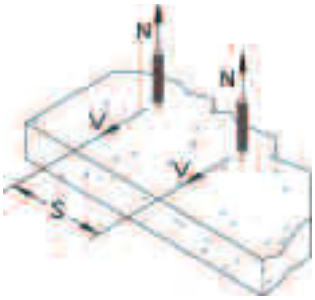
Load Adjustment Factors for Normal-Weight Concrete

Spacing, Tension (F_{NS}) & Shear (F_{VS})

Dia. (in.)		3/16			1/4			3/8	1/2
h_v (in.)		7/8	1	1 1/4	7/8	1	1 1/4	2 1/2	2 3/4
s_{cr} (in.)		1 3/4	2	2 1/2	1 3/4	2	2 1/2	5	5 1/2
s_{min} (in.)		7/8	1	1 1/4	7/8	1	1 1/4	2 1/2	2 3/4
Spacing, s (inches)	7/8	0.50			0.50				
	1	0.57	0.50		0.57	0.50			
	1 1/4	0.71	0.63	0.50	0.71	0.63	0.50		
	1 1/2	0.86	0.75	0.60	0.86	0.75	0.60		
	1 3/4	1.00	0.88	0.70	1.00	0.88	0.70		
	2		1.00	0.80		1.00	0.80		
	2 1/2			1.00			1.00	0.50	
	2 3/4							0.55	0.50
	3							0.60	0.55
	4							0.80	0.73
	5							1.00	0.91
	5 1/2								1.00

Notes: For anchors loaded in tension and shear, the critical spacing *(s_{cr})* is equal to 2 embedment depths ($2\,h_v$) at which the anchor achieves 100% of load.

Minimum spacing *(s_{min})* is equal to 1 embedment depth *(h_v)* at which the anchor achieves 50% of load.

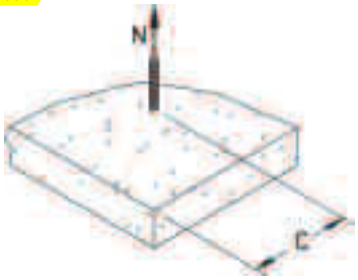


Edge Distance, Tension (F_{NC})

Dia. (in.)		3/16	1/4	3/8	1/2
c_{cr} (in.)		2 5/8	3 1/2	5 1/4	7
c_{min} (in.)		1	1 1/4	1 7/8	2 1/2
Edge Distance, c (inches)	1	0.50			
	1 1/4	0.59	0.50		
	1 7/8	0.78	0.64	0.50	
	2	0.81	0.67	0.52	
	2 1/2	0.96	0.78	0.59	0.50
	2 5/8	1.00	0.81	0.61	0.51
	3		0.89	0.67	0.56
	3 1/2		1.00	0.74	0.61
	4			0.81	0.67
	5			0.96	0.78
	5 1/4			1.00	0.81
	6				0.89
	7				1.00

Notes: For anchors loaded in tension, the critical edge distance *(c_{cr})* is equal to 14 anchor diameters ($14d$) at which the anchor achieves 100% of load.

Minimum edge distance *(c_{min})* is equal to 5 anchor diameters ($5d$) at which the anchor achieves 50% of load.



Edge Distance, Shear (F_{VC})

Dia. (in.)		3/16	1/4	3/8	1/2
c_{cr} (in.)		2 5/8	3 1/2	5 1/4	7
c_{min} (in.)		1	1 1/4	1 7/8	2 1/2
Edge Distance, c (inches)	1	0.25			
	1 1/4	0.39	0.25		
	1 7/8	0.67	0.46	0.25	
	2	0.72	0.50	0.28	
	2 1/2	0.94	0.67	0.39	0.25
	2 5/8	1.00	0.71	0.42	0.27
	3		0.83	0.50	0.33
	3 1/2		1.00	0.61	0.42
	4			0.72	0.50
	5			0.94	0.67
	5 1/4			1.00	0.71
	6				0.83
	7				1.00

Notes: For anchors loaded in shear, the critical edge distance *(c_{cr})* is equal to 14 anchor diameters ($14d$) at which the anchor achieves 100% of load.

Minimum edge distance *(c_{min})* is equal to 5 anchor diameters ($5d$) at which the anchor achieves 25% of load.



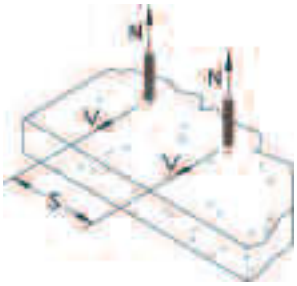
DESIGN CRITERIA (ALLOWABLE STRESS DESIGN)

Load Adjustment Factors for Structural Lightweight Concrete

Spacing, Tension (F_{NS}) & Shear (F_{VS})

Dia. (in.)		3/16			1/4			3/8	1/2
h_v (in.)		7/8	1	1 1/4	7/8	1	1 1/4	2 1/2	2 3/4
s_{cr} (in.)		2 5/8	3	3 3/4	2 5/8	3	3 3/4	7 1/2	8 1/4
s_{min} (in.)		1 3/8	1 1/2	1 7/8	1 3/8	1 1/2	1 7/8	3 3/4	4 1/8
Spacing, s (inches)	1 3/8	0.50			0.50				
	1 1/2	0.57	0.50		0.57	0.50			
	1 7/8	0.71	0.63	0.50	0.71	0.63	0.50		
	1 1/2	0.57	0.50	0.40	0.57	0.50	0.40		
	2 5/8	1.00	0.88	0.70	1.00	0.88	0.70		
	3		1.00	0.80		1.00	0.80		
	3 3/4			1.00			1.00	0.50	
	4							0.53	
	4 1/8							0.55	0.50
	5							0.67	0.61
	6							0.80	0.73
	7							0.93	0.85
	7 1/2							1.00	0.91
	8 1/4								1.00

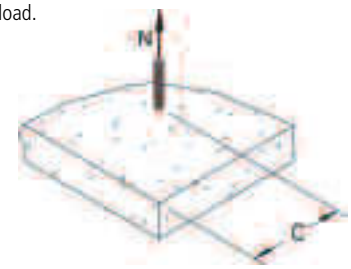
Notes: For anchors loaded in tension and shear, the critical spacing (s_{cr}) is equal to 3 embedment depths ($3h_v$) at which the anchor achieves 100% of load. Minimum spacing (s_{min}) is equal to 1.5 embedment depth ($1.5h_v$) at which the anchor achieves 50% of load.



Edge Distance, Tension (F_{NC})

Dia. (in.)		3/16	1/4	3/8	1/2
c_{cr} (in.)		2 5/8	3 1/2	5 1/4	7
c_{min} (in.)		1 3/8	1 3/4	2 5/8	3 1/2
Edge Distance, c (inches)	1 3/8	0.50			
	1 3/4	0.67	0.50		
	2	0.76	0.57		
	2 5/8	1.00	0.75	0.50	
	3		0.86	0.57	
	3 1/2		1.00	0.67	0.50
	4			0.76	0.57
	5			0.95	0.71
	5 1/4			1.00	0.75
	6				0.86
	7				1.00

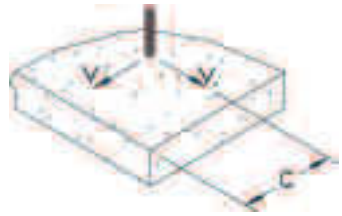
Notes: For anchors loaded in tension, the critical edge distance (c_{cr}) is equal to 14 anchor diameters ($14d$) at which the anchor achieves 100% of load. Minimum edge distance (c_{min}) is equal to 7 anchor diameters ($7d$) at which the anchor achieves 50% of load.



Edge Distance, Shear (F_{VC})

Dia. (in.)		3/16	1/4	3/8	1/2
c_{cr} (in.)		2 5/8	3 1/2	5 1/4	7
c_{min} (in.)		1 3/8	1 3/4	2 5/8	3 1/2
Edge Distance, c (inches)	1 3/8	0.40			
	1 3/4	0.60	0.40		
	2	0.71	0.49		
	2 5/8	1.00	0.70	0.40	
	3		0.83	0.49	
	3 1/2		1.00	0.60	0.40
	4			0.71	0.49
	5			0.94	0.66
	5 1/4			1.00	0.70
	6				0.83
	7				1.00

Notes: For anchors loaded in shear, the critical edge distance (c_{cr}) is equal to 14 anchor diameters ($14d$) at which the anchor achieves 100% of load. Minimum edge distance (c_{min}) is equal to 7 anchor diameters ($7d$) at which the anchor achieves 40% of load.



ORDERING INFORMATION

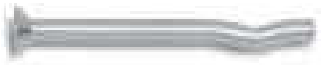
Mushroom Head Carbon Steel Spike (Tamperproof)



Cat. No.	Anchor Size	Drill Diameter	Min. Embed.	Std. Box	Std. Carton	Wt./100
5502	3/16" x 1"	3/16"	7/8"	100	1,000	1 1/4
5503	3/16" x 1 1/4"	3/16"	7/8"	100	1,000	1 1/2
5504	3/16" x 1 1/2"	3/16"	1 1/4"	100	1,000	1 3/4
5506	3/16" x 2"	3/16"	1 1/4"	100	1,000	2
5508	3/16" x 2 1/2"	3/16"	1 1/4"	100	1,000	2
5510	3/16" x 3"	3/16"	1 1/4"	100	1,000	2 1/2
5511	3/16" x 3 1/2"	3/16"	1 1/4"	100	1,000	3 1/2
5512	3/16" x 4"	3/16"	1 1/4"	100	500	4
5522	1/4" x 1"	1/4"	7/8"	100	1,000	1 1/2
5523	1/4" x 1 1/4"	1/4"	1"	100	1,000	2 1/4
5524	1/4" x 1 1/2"	1/4"	1 1/4"	100	1,000	2 1/2
5526	1/4" x 2"	1/4"	1 1/4"	100	1,000	3
5528	1/4" x 2 1/2"	1/4"	1 1/4"	100	1,000	4
5530	1/4" x 3"	1/4"	1 1/4"	100	1,000	4 1/2
5531	1/4" x 3 1/2"	1/4"	1 1/4"	100	1,000	4 1/2
5532	1/4" x 4"	1/4"	1 1/4"	100	1,000	5 1/2
5546	3/8" x 2"	3/8"	1 3/4"	25	250	7 1/2
5548	3/8" x 2 1/2"	3/8"	1 3/4"	25	250	9
5550	3/8" x 3"	3/8"	1 3/4"	25	250	10
5551	3/8" x 3 1/2"	3/8"	1 3/4"	25	250	11
5552	3/8″ x 4	3/8″	1 3/4″	25	250	11
5554	3/8″ x 5	3/8″	1 3/4″	25	250	11
5556	3/8″ x 6	3/8″	1 3/4″	25	250	11
5569	1/2″ x 2 3/4″	1/2″	2-1/2″	50	200	13
5571	1/2″ x 3 1/2″	1/2″	2-1/2″	50	150	13
5572	1/2″ x 4″	1/2″	2-1/2″	25	150	13
5574	1/2″ x 5″	1/2″	2-1/2″	25	150	13
5577	1/2″ x 6 1/2″	1/2″	2-1/2″	25	150	13

The published length is measured from below the head to the end of the anchor.

Flat Head Carbon Steel Spike (Tamperproof)



Cat. No.	Anchor Size	Drill Diameter	Min. Embed.	Std. Box	Std. Carton	Wt./100
5608	3/16" x 2 1/2"	3/16"	1 1/4"	100	1,000	2
5610	3/16" x 3"	3/16"	1 1/4"	100	1,000	2 1/2
5612	3/16" x 4"	3/16"	1 1/4"	100	1,000	4
5624	1/4" x 1 1/2"	1/4"	1 1/4"	100	1,000	2 1/2
5626	1/4" x 2"	1/4"	1 1/4"	100	1,000	3
5628	1/4" x 2 1/2"	1/4"	1 1/4"	100	1,000	3 3/4
5630	1/4" x 3"	1/4"	1 1/4"	100	1,000	4 1/2
5631	1/4" x 3 1/2"	1/4"	1 1/4"	100	1,000	5
5632	1/4" x 4"	1/4"	1 1/4"	100	500	5 3/4

The published length is the overall length of the anchor.

ORDERING INFORMATION

Mushroom Head Type 316 Stainless Spike (Tamperproof)

Cat. No.	Anchor Size	Drill Diameter	Min. Embed.	Std. Box	Std. Carton	Wt./100
6602	3/16" x 1"	3/16"	7/8"	100	1,000	1 1/4
6603	3/16" x 1 1/4"	3/16"	7/8"	100	1,000	1 1/2
6604	3/16" x 1 1/2"	3/16"	7/8"	100	1,000	1 3/4
6606	3/16" x 2"	3/16"	7/8"	100	1,000	2
6623	1/4" x 1 1/4"	1/4"	7/8"	100	1,000	2 1/4
6624	1/4" x 1 1/2"	1/4"	7/8"	100	1,000	2 1/2
6626	1/4" x 2"	1/4"	7/8"	100	1,000	3
6628	1/4" x 2 1/2"	1/4"	7/8"	100	1,000	4
6630	1/4" x 3"	1/4"	7/8"	100	1,000	4 1/2
6646	3/8" x 2"	3/8"	7/8"	25	250	7 1/2
6648	3/8" x 2 1/2"	3/8"	1 3/4"	25	250	9
6650	3/8" x 3"	3/8"	1 3/4"	25	250	10



The published length is measured from below the head to the end of the anchor.

Pipe Spike

Cat. No.	Anchor Size	Drill Diameter	Min. Embed.	Std. Box	Std. Carton	Wt./100
3755	1/4"	3/16"	1 1/4"	100	1,000	4
3758	3/8"	1/4"	1 3/4"	50	500	6



Designed for rod hanging.

Tie-Wire Spike

Catalog Number	Anchor Size	Drill Diameter	Minimum Embed.	Tie Wire Hole Size	Standard Box	Standard Carton	Wt./100
3756	3/16"	3/16"	1 1/8"	3/16"	100	500	2
3759	1/4"	1/4"	1 1/8"	9/32"	100	500	2 1/2



Designed for suspended ceilings.

Forming Spike

Cat. No.	Anchor Size	Drill Diameter	Min. Embed.	Std. Box	Std. Carton	Wt./100
3795	3/16" x 1 1/2"	3/16"	1 1/4"	100	1,000	2 1/2
3796	3/16" x 2"	3/16"	1 1/4"	100	1,000	3
3797	3/16" x 2 3/4"	3/16"	1 1/4"	100	1,000	4
3794	1/4" x 2 3/4"	1/4"	1 1/4"	100	1,000	5



Designed for concrete forming. The published length is measured from below the head to the end of the anchor.

ORDERING INFORMATION

Spike Drivers

While the SPIKE anchor can easily be installed using a hammer, a specially designed series of drivers and manual tools provide a fast, easy to use method for installing SPIKE anchors into concrete and masonry materials. The tools allow the SPIKE anchor to be installed in confined areas and prevent damage to the fixture from stray hammer blows.

Catalog Number	Tool Description	Guide I.D.	Standard Box	Wt./100
3790	Spike Driver 1000	1/2"	1	1/4
3791	Spike Driver 2000	1/2"	1	1/4



The SPIKE Driver 1000 is a one piece tool with an SDS shank formed on one end and a retractable guide on the other. The driver is designed to fit directly into the chuck of an SDS rotary hammer drill to provide maximum impact energy for faster driving. Once the anchor hole is drilled, insert the SPIKE Driver 1000 into the chuck of the rotary hammer drill. Insert the tip of the SPIKE through the fixture into the anchor hole, then place the guide over the head of the SPIKE. Turn the rotary hammer on and drive the SPIKE until it is at the required embedment in the base material and seated flush against the fixture. As the SPIKE is driven into the base material, the guide retracts until the anchor is fully seated. This driver is normally used with a two person installation team where one installer is drilling the anchor holes while the other positions the fixture and sets the anchor.

The SPIKE Driver 2000 is a variation of the 1000 tool which is designed to be used in conjunction with a 3/16" x 4" or 1/4" x 4" SDS carbide tipped bit. The Driver has a recessed end which is slipped over the SDS bit on one end and a retractable guide on the other. Once the anchor hole is drilled, slip the SPIKE Driver 2000 over the 3/16" or 1/4" SDS bit. Drive the SPIKE anchor with the rotary hammer until it is seated flush against the fixture and at the required embedment in the base material. As the SPIKE is driven into the base material, the guide retracts until the anchor is fully seated. Once the SPIKE is installed,remove the driver from the SDS bit and drill the next anchor hole.

Pipe Spike Setting Tool

When installing the 3/8" Pipe SPIKE, this tool is designed to make driving easier. The tool has a guide tip on which the 3/8" Pipe SPIKE is mounted which helps to protect the internal threads during the driving operation. A large handle provides a convenient gripping area and a large bearing surface to accept the hammer blows. Simply position the 3/8" Pipe SPIKE on the tool and insert the tip of the anchor into the hole. Give the end of the handle several sharp hammer blows to drive the 3/8" Pipe SPIKE into the base material until it is at the required embedment.

Catalog Number	Tool Description	Tip O.D.	Standard Box	Wt./100
3760	Pipe Spike Setting Tool	5/16"	1	1



Spike Driver Selection Guide

Style	Size	1000	2000	Pipe
Mushroom	3/16"	X	X	
Mushroom	1/4"	X	X	
Flat Head	3/16"	X	X	
Flat Head	1/4"	X	X	
Pipe	1/4"	X	X	
Pipe	3/8"			X
Tie-Wire	3/16"	X	X	
Forming	3/16"	X	X	
Forming	1/4"	X	X	

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SECTION 3.5

VALVES

VEOLIA WATER Solutions & Technologies

Tag #	Valve Location	Valve Type	Body Style	Size (inches)	Quantity	Closure Type	Operator Type	Purpose
TBD	Main Air Header for Trains 1, 2, and 3	High Performance Butterfly Valve	Lug	12	3	Modulating	Motorized 120 V/1 Ph/60 Hz	Control of air flow to each train
TBD	Deox Zone Drop Pipe for Trains 1, 2, and 3	High Performance Butterfly Valve	Lug	3	3	On/Off	Motorized 120 V/1 Ph/60 Hz	Pulsing of air to deox zone to maintain low DO. Valve will be set to open to degree that allows for minimum airflow required to maintain suspension of MLSS.
TBD	Air Sparge Header for Trains 1, 2, and 3	High Performance Butterfly Valve	Lug	3	3	On/Off	Manual Lever	Manaual open and close air sparge valves that will remain full open while the train is in operation and will only need to close if train is taken offline.

NOTE: Seats are constructed of RTFE which is superior to Nordel EPDM in that it has a much higher temperature rating and durability.

KRÜGER

Equipment Data Sheet

Project Name: Massillon OH **Project Number: 5700235402**
Date: 09/10/2015 **Author: WNM**
Revision: 3 **Tag Number: TBD**

ITEM: Air Flow Control Valve for DeOx Reactor
LOCATION: Air Header for Each Train

General Information	
Service	Air
Valve Type	Butterfly
Size	3”
Quantity	3
Style	Lug
Pressure Rating	150 psi
Temperature Rating	350ºF
Model Information	
Manufacturer	Keystone
Model #	030 362 CSS1TSG 0
Method of Operation	Motor Actuated
Body & Trim	Carbon Steel Body (Blackened), 316 SS Disc, 17-4PH SS Shaft
Seat	RTFE
Shaft Packing	TFE
Actuator Information	
Type	Electric/Continuous Duty Service
Manufacturer	Keystone
Model #	EPI2 600# (E006AHW5000)
Supply	120/1/60
Operation	Open/Close
Loss of Signal	Open or Close
Fail Type	-
Purchasing Information	
Quote	Attached

Additional Information

- Valve shall have 102 254 006 79U 003 adapter for direct mount of electric actuator.

- Actuator Specifications
  - Anodized ESPC aluminum housing approved for NEMA 6
  - Motor shall be a single-phase with thermal overload protection
  - Local HOA switch and push buttons for open close
  - Local valve position indicator
  - Limit and torque switches
  - Remote HOA position indication (discrete out), remote general alarm (discrete out), remote fully opened/closed indication (discrete out)
  - Actuator shall have adjustable open/close times
  - Motor Space Heater
  - Fail Status Output for overload, over-torque, high temp, jam, lost phase, etc.

VEOLIA WATER Solutions & Technologies

KRÜGER

Equipment Data Sheet

Project Name: Massillon OH **Project Number: 5700235402**
Date: 09/10/2015 **Author: WNM**
Revision: 3 **Tag Number: TBD**

ITEM: Air Flow Control Valve for Screen Air Scour
LOCATION: Screen Air Scour Header for Each Train

General Information	
Service	Air
Valve Type	Butterfly
Size	3”
Quantity	3
Style	Lug
Pressure Rating	150 psi
Temperature Rating	350°F
Model Information	
Manufacturer	Keystone
Model #	030 362 CSS1TSG 1
Method of Operation	Manual (Lever Operated)
Body & Trim	Carbon Steel Body (Blackened), 316 SS Disc, 17-4PH SS Shaft
Seat	RTFE
Shaft Packing	TFE

VEOLIA WATER Solutions & Technologies

KRÜGER

Equipment Data Sheet

Project Name: Massillon OH **Project Number: 5700235402**
Date: 09/10/2015 **Author: WNM**
Revision: 3 **Tag Number: TBD**

ITEM: Air Flow Control Valve for IFAS Reactor
LOCATION: Air Header for Each Train

General Information	
Service	Air
Valve Type	Butterfly
Size	12”
Quantity	3
Style	Lug (installed between 150# flanges)
Pressure Rating	150 psi
Temperature Rating	350°F
Model Information	
Manufacturer	Keystone
Model #	120 362 CSS1TSG 0
Method of Operation	Motor Actuated
Body & Trim	Carbon Steel Body (Blackened), 316 SS Disc, 17-4PH SS Shaft
Seat	RTFE
Shaft Packing	TFE
Actuator Information	
Type	Electric/Continuous Duty Service
Manufacturer	Keystone
Model #	EPI2 9100# (E091AHW5000)
Supply	120/1/60
Operation	Modulating
Loss of Signal	Open or Close
Fail Type	-

Additional Information

- Valve shall have 102 254 006 79U 003 adapter for direct mount of electric actuator.

- Actuator Specifications
  - Anodized ESPC aluminum housing approved for NEMA 6
  - Motor shall be a single-phase with thermal overload protection
  - Local HOA switch and push buttons for open close
  - Local valve position indicator
  - Limit and torque switches
  - Actuator shall have 4-20 mA analog output for remote valve position indication, 4-20 mA analog input for valve control, remote HOA position indication (discrete out), remote general alarm (discrete out), remote fully opened/closed indication (discrete out)
  - Actuator shall have adjustable open/close times
  - Motor Space Heater
  - Fail Status Output for overload, over-torque, high temp, jam, lost phase, etc.

VEOLIA WATER Solutions & Technologies

PENTAIR

KEYSTONE

K-LOK® Figures 360/362 – ASME 150
K-LOK® Figures 370/372 – ASME 300

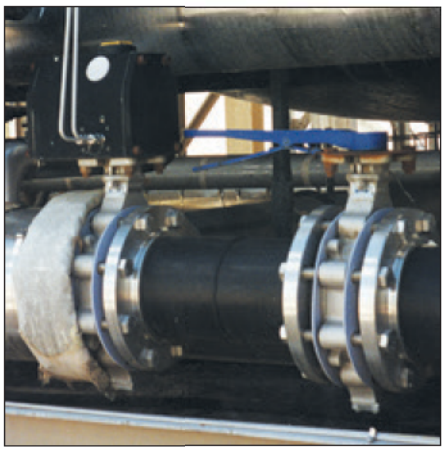
Features and benefits

- Integrally cast mounting pad provides direct mounting of many actuators.
- Rocker-shaped gland bridge compensates for uneven adjustment of gland nuts.
- Extended neck allows for two inches of pipeline insulation.
- Flattened body bore at shaft journal ports positions shaft bearings near disc, providing maximum shaft support.
- Disc taper pins are tangentially positioned half in disc and half in shaft, placing them in compression rather than shear, which eliminates potential for failure.
- Integrally cast disc position stop perfectly locates the disc in seat, achieving maximum seat and seal life.
- K-LOK polymer, elastomer, and fire-safe seats provide bi-directional, drop-tight closure in vacuum and throughout all pressure ranges, as well as at full rated differential pressure. A variety of materials allows optimum seat life in all applications.

General applications

- Airport refueling
- Hydrocarbon processing
- HVAC
- Chemical processing
- Purified gas
- Steam and vacuum services
- Potable water
- Food processing
- Sour gas
- Military
- Oxygen
- Pharmaceutical
- Ammonia
- Chlorine
- Reverse osmosis
- Category 'M' fluids
- Slurry
- Modulating control





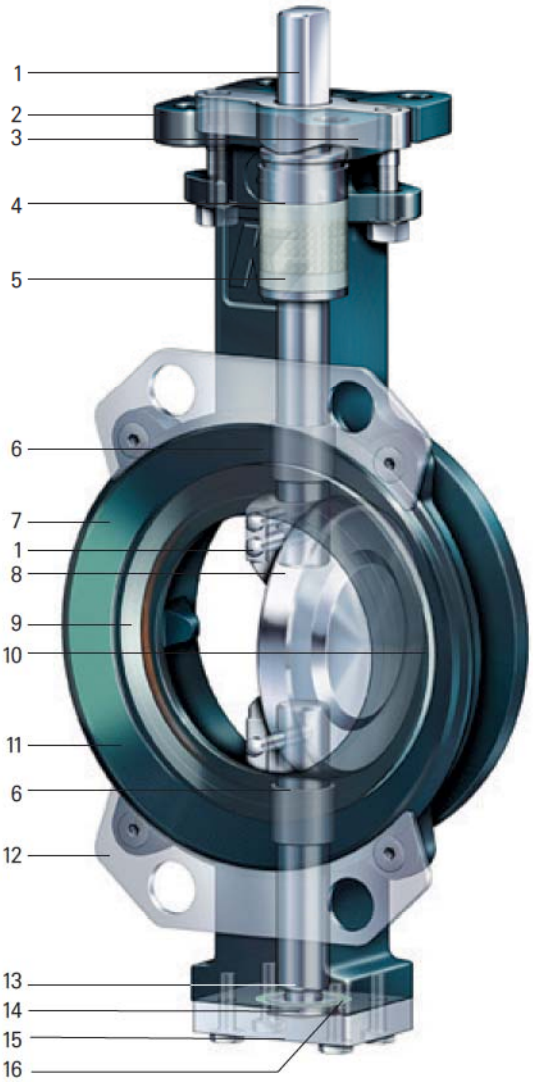
Technical data

Size range:	NPS 2 to NPS 36
Pressure rating:	ASME 150 and 300
Temperature rating:	-20°F to 1000°F
Fire-safe option	

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Materials

No.	Description	Material	Material standard
1	Shaft and taper pins	17-4 PH 316B SS NITRONIC 50® K-Monel® 500 Inconel® 718	ASTM A564 Condition H1075 or H1100 ASTM A276-316 Condition B (NPS 10 and smaller) ASTM A276-XM19 QQ-N-286 UNS N005500 Class A age-hardened
2	Body	Carbon steel Stainless steel Nickel aluminum bronze	ASTM A216-WCB ASTM A351-CF8M MIL B24480 CDA C95800/ASTM B148
3	Gland bridge	17-4PH stainless steel Carbon steel	
4	Packing gland follower	316 stainless steel	
5	Shaft packing	PTFE Graphite Style 9000 EVSP simplified	
6	Shaft bearing	316 stainless steel/Nitride, PTFE/Bronze, PTFE/Composite	
7	Body gasket	Non-asbestos fiber, Graphite PTFE	
8	Disc	316 stainless steel 316 stainless steel/ENP Monel®	ASTM A351-CF8M ASTM A351-CF8M/electroless nickel plated QQ-N-288 Composition A
9	Seat	Polymer Elastomer Metal Fire-safe	PTFE, RTFE, UHMWPE NBR, EPDM, Fluoroelastomer (FKM) 316 stainless steel, Monel® RTFE/316 stainless steel
10	Seat backing ring	Stainless steel	
11	Seat retainer ring	Carbon steel 316 Stainless steel Nickel aluminum bronze	
12	Flange locator plate	Stainless steel Carbon steel/zinc plated	
13	Disc locating shoulder	316 stainless steel	
14	Bottom cover gasket	Non-asbestos fiber or Graphite	
15	Bottom cover plate	316 stainless steel	
16	Thrust washer	Stainless steel/Nitride	



Recommended standards and specifications

ASME	B16.34	Steel valves
	B31.1	Power piping (Sect 107)
	B31.3	Chemical plant and petroleum refinery piping
	B16.5	Steel pipe flanges and flange fittings
MSS	SP-6	Standard finishes for pipe flanges
	SP-25	Standard marking systems for valves
	SP-55	Quality standard for steel casting
	SP-61	Pressure testing of steel valves
	SP-68	High pressure offset disc butterfly valves
API	609	Butterfly valves (most models)
	607	Fire-test for soft seated quarter-turn valves
	598	Valve inspection and test
BS	5146	Inspection and test of steel valves for the petroleum, petrochemical and allied industries
	4504	Flanges and bolting for pipes, valves and fittings
JIS	2215	Basic dimensions for steel pipe flanges
NSF/ANSI Standard 61		Potable water

Principles of operation

Double offset disc/shaft

K-LOK®'s unique two-piece shaft and double-offset disc/shaft design allows for high cycling and creates a lower disc profile with increased capacity and a range of 33:1.

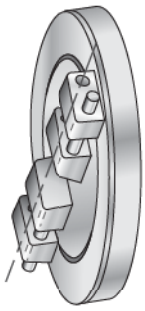
In addition to increasing the flow area across the disc, this design minimizes wear points between seat and disc.

The first offset is achieved by locating the shafts downstream of the center-line of the seat. This allows for a totally unobstructed 360° sealing surface.

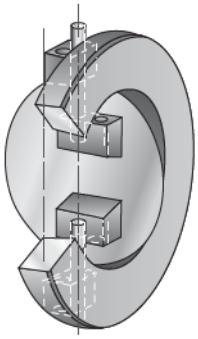
The second offset locates the shafts off-center of the vertical axis of the seat.

The combination of these two offsets creates a camming effect as the disc swings into and out of the seat. The disc lifts quickly out of the seat in the first few degrees of travel and does not contact the seat again until it is nearly closed. There are no wear points between the seat and disc, while operating torques are reduced and seat life is extended.

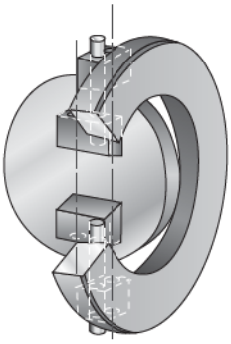
Double offset



First offset

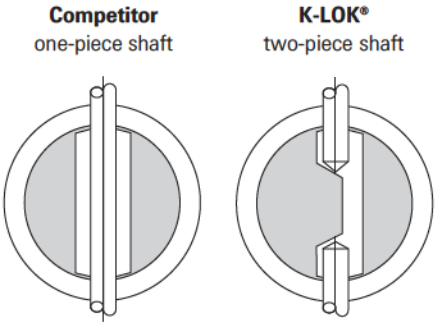


Second offset



Two-piece shaft vs. one-piece shaft

K-LOK®'s disc geometry maximizes flow capacity by increasing the available flow area through the valve. This increase in disc efficiency results in a higher valve C_V.



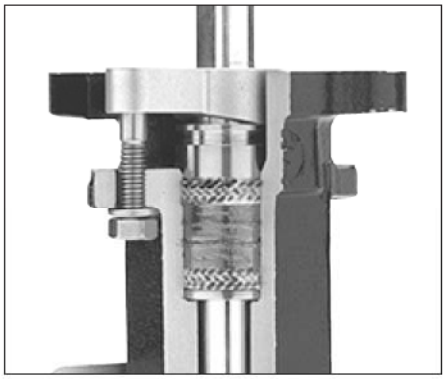
Aspect ratio = open area ÷ disc area

Fire-safe valve
API 607 4th edition approved by third party witness

The K-LOK® fire-safe design uses a stainless steel or alloy seat of convoluted shape that mates with an RTFE member. In the full-closed position, the K-LOK® provides continuous two-plane contact between the disc and both metal and RTFE seats. The fire-safe seat utilizes wire windings to provide the circumferential stiffness necessary to maintain interference between disc and seat.



Fire-safe seat



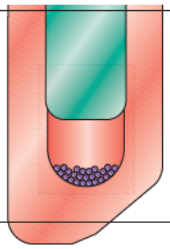
Fire-safe packing

K-LOK® fire-safe packing is composed of three rings of preformed graphite between one ring of woven graphite rope at the top and bottom.

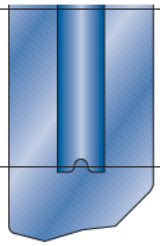
This arrangement creates a superior, high temperature seal against the outer wall of the packing box and around the rotating shaft.

Seat materials

Seat	Material	Typical applications
1. RTFE	Reinforced polytetrafluoroethylene	HVAC, steam, chlorine, ammonia, nitrogen, water, gasoline, vacuum
2. PTFE	Polytetrafluoroethylene	Pharmaceuticals, air, potable water, dyes, white mediums
3. UHMWPE	Ultra high molecular weight polyethylene	Abrasives, suspended solids, scaling mediums
For seats 1 thru 3		
Wire wrap	Stainless steel braided wire	
Seat backing ring	Polyester or phenolic Stainless steel	General purpose services up to 200°F Steam, ammonia, elevated temperature services



Seat	Material	Typical applications
4. EPDM	–	Water based mediums, slurry applications, abrasives
5. NBR	–	Oil based mediums, slurry applications, abrasives
6. Fluoroelastomer (FKM)	–	Elevated temperatures, slurry applications, abrasives
For seats 4 thru 6		
Metal insert	Carbon steel	



Seat	Material	Typical applications
7. Metal	316 stainless steel or alloy (fash chrome coated)	High temperature, low temperature, abrasives, fly ash, slurries
8. Fire-safe	Reinforced polytetrafluoroethylene combined with 316 stainless steel (flash chrome coated)	Fire-safe installations, abrasives, slurries, steam
For seats 7 and 8		
Wire wrap	Stainless steel braided wire	





Seat design

The K-LOK® seat is a true interference seat design and does not rely on line pressure to assist in sealing. All seats seal drop-tight bi-directionally at low pressure as well as high pressure.

Polymer (PTFE, RTFE and UHMWPE) seats incorporate a stainless steel braided wire winding, enclosed in a U-shape envelope to provide seating energy and memory. This wire winding allows axial flexibility in both directions of flow. The winding also allows radial flexibility when the disc is not fully closed, reducing seat/disc interference, seat wear and shaft torque. When the disc closes, it provides circumferential stiffness and assures the required disc/seat seals tight.

Elastomer seats are molded around a stack of V-shaped steel rings that provide the same stability, support and flexure as the wire windings in polymer seats.

Metal seats employ a stainless steel or alloy ring of convoluted shape, reinforced by stainless steel wire windings. The thin, convoluted shape allows for expansion and contraction from thermal cycling. Long life is assured by flash coating the seat with chrome.



ASME/FCI 70-2 control valve seat leakage, tolerances, and test specifications

ASME B16.104-1976	Maximum leakage			Test medium	Pressure and temperature
Class VI	Nominal port diameter (NPS)	Bubbles per minute[3]	ml. per minute	Air or nitrogen	Service ΔP or 50 psig, whichever is lower, at 50°F to 125°F
	2	3	0.45		
	2½	4	0.60		
	3	6	0.90		
	4	11	1.70		
	6	27	4.00		
	8	45	6.75		
Class V	5 x 10^{-4} ml/min/psig/in. port dia.			Water	Service ΔP at 50°F to 125°F
Class IV	0.01% valve capacity at full travel			Air or water	Service ΔP or 50 psig, whichever is lower, at 50°F to 125°F

Notes:

1. K-LOK® polymer and elastomer seats meet or exceeds ASME Class VI shut-off.
2. K-LOK® metal seats and fire-safe seats (post fire exposure) meet or exceeds ASME Class IV shut-off.
3. Using the ASME/FCI specified calibrated measuring device.

Reference ASME/FCI 70-2 for further information.

C_v values vs. travel position

Size (NPS)	Angle of opening 10°	20°	30°	40°	50°	60°	70°	80°	ASME 150 90°	ASME 300 90°
2	6	10	19	34	51	78	105	134	163	160
2½	6	10	19	34	53	80	111	148	175	170
3	8	12	24	43	67	100	139	186	220	215
4	16	23	44	80	130	194	269	360	425	413
5	30	44	83	149	242	366	504	673	795	785
6	50	70	130	230	370	550	760	1,010	1,195	1,140
8	83	117	251	437	695	1,052	1,496	2,001	2,440	2,300
10	144	202	454	754	1,185	1,821	2,611	3,541	4,540	4,333
12	208	304	678	1,051	1,625	2,766	3,838	5,325	6,915	6,600
14	257	360	747	1,186	1,909	3,121	4,416	6,225	8,300	7,920
16	308	432	803	1,422	2,289	3,614	5,251	7,530	10,040	9,580
18	373	548	1,121	1,869	2,990	4,735	6,728	9,845	12,460	11,890
20	463	680	1,390	2,315	4,010	6,175	8,795	12,655	15,430	14,720
24	650	991	2,076	3,803	6,060	9,091	13,301	18,466	21,660	20,665
30	1,015	1,550	3,240	4,670	9,460	14,200	21,400	29,800	36,000	-
36	1,460	2,300	4,640	5,950	13,700	21,000	30,400	44,000	56,000	-

Vacuum rating

The combination of interference fit seats and bi-directional packing makes the K-LOK® especially well suited for vacuum service.

Standard K-LOK® high performance valves are rated to an absolute pressure of 4 x 10^{-5} inch Hg. Higher vacuum applications are available.

Seating and un-seating torque

Seating and un-seating torques are a function of the size of the valve and the shutoff pressure of the system.

Specific torque ratings can be found in the seating/un-seating chart at the intersection of the 'size' row and the 'shutoff pressure' column.

Torques listed are for PTFE and RTFE seated valves. For different seat materials, specific multipliers are to be used as stated.

All torques listed are for normal service conditions (i.e. operating frequency is a minimum of once per month; disc corrosion is expected to be mild or minor, the media is a clean gas, liquid or steam, and is non-abrasive) and chemical effects upon the seat are minor.

PTFE and RTFE bi-directional seating and un-seating torque values

Valve size (NPS)	Shaft mounting code (ASME) 150	300	Seating and un-seating torque (lbs in) System shutoff pressure (psig) 150	200	285	400	500	740
2	BAB	BAB	220	280	380	460	520	580
2½	BAB	BAB	220	280	380	460	520	580
3	BAC	BAC	250	320	430	520	590	650
4	BAD	BAD	475	600	820	995	1,120	1,235
5	BAD	BAD	925	1,125	1,350	1,570	1,750	1,900
6	CAD/CAE*	CAE	1,370	1,600	1,850	2,150	2,390	2,900
8	CAF	CAF	2,060	2,330	3,200	4,020	4,870	6,720
10	CAF/CAG*	CAG	3,340	3,650	4,700	6,250	7,450	9,850
12	DAG	DAG	4,590	5,250	6,400	8,160	9,690	12,940
14	DAH	DAJ	6,750	7,560	9,150	11,450	13,300	17,200
16	DAH	DAK	9,350	10,450	12,600	15,000	17,500	22,200
18	DAJ	DBA	11,900	13,300	15,800	19,500	21,900	28,500
20	DAK	LAX	15,600	17,500	21,000	25,200	28,700	36,140
24	DAK	MAY	21,700	25,340	30,600	36,900	42,100	54,000
30	MAZ	NAW	29,200	35,000	43,500	-	-	-
36	MBE	EBD	52,500	58,500	70,000	-	-	-

*CAE and CAG mounting codes apply for shaft mounting of UHMWPE, metal and fire-safe seats.

Notes:

1. Torques are applicable only to PTFE and RTFE seats in noncorrosive or non-abrasive services such as water. For fire-safe and metal seats, select only the torque for the valve at 285 psig and multiply by 2.0.
2. For other seat materials, select the torque applicable for the maximum differential pressure and multiply by the following factor:

   EPDM/NBR/Fluoroelastomer (FKM): x 1.4
   UHMWPE (clean service): x 1.3

3. For corrosive, abrasive or other services than water, multiply by the following factor:

   High solids slurry: x 1.5
   Dry gas: x 2.0
   Dry powders: x 2.7
   Liquids other than water: x 1.2
   Lubricating fluids: x 0.8

   For services that combine unfriendly conditions such as extreme temperatures and high solids, or corrosive with high temperatures, contact your sales representative.

Extension brackets for various temperatures

Pipeline fluid temperature	Required extension lengths (inches) Handle	Gear	Std. F79U/MRP	High temp. F79U/MRP	Standard F777
-100°F to 375°F	–	–	–	–	–
376°F to 460°F	4	–	–	–	4
461°F to 560°F	6	4	4	–	4
561°F to 650°F	6	4	4	–	4
651°F to 725°F	6	6	6	4	6
726°F to 825°F	8	8	8	6	8
826°F to 925°F	10	8	8	6	8
926°F to 1000°F	10	10	10	8	10

Notes:

1. Surrounding air temperature is assumed to be 70°F. For every degree over 100°F of the surrounding air, deduct 2 degrees from the maximum temperature ranges shown under the Pipeline fluid temperature column. (Example: 125°F external temperature reduces maximum temperature values under the Pipeline fluid temperature column to 325, 410, 510, 600, etc.)
2. Valves may be insulated or uninsulated.
3. Brackets may be open rectangular tubes or the standard closed Keystone tubular shaft extensions.
4. All actuators have a maximum service temperature (outside atmosphere). These temperature limitations apply regardless of K-LOK® extension lengths.

Flange gaskets

The K-LOK® high performance butterfly valve is designed to accommodate the use of standard, non-metallic gaskets for pipe flanges (such as compressed fiber, rubber, non-asbestos, flexible graphite, asbestos or equivalent gasket materials), meeting the dimensional requirements of ASME B16.21-1992. Metallic wound gaskets may also be used, however, please note that any valve with a bolted on retainer requires the wound gaskets material to be manufactured to the following dimensions (inches):

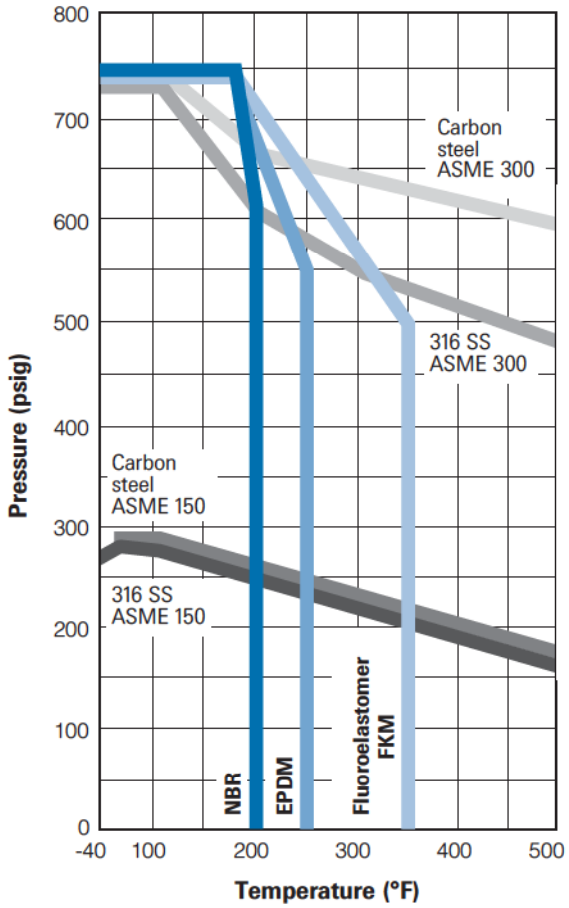
NPS	Outside diameter	Inside diameter
2	3 3/8	2 3/4
2 1/2	3 7/8	3 1/4
3	4 3/4	4
4	5	4 1/8
5	6 1/8	5 1/4
6	7 3/16	6 1/4
8	9 3/16	8
10	11 5/16	10 1/8
12	13	11 1/2
14	14 1/2	13
16	16 1/2	14 3/4
18	18	16
20	19 3/4	18
24	26 1/4	24
30	29 1/2	27 1/2
36	36 1/2	34 1/4

Pressure/temperature ratings for bodies, discs and seats

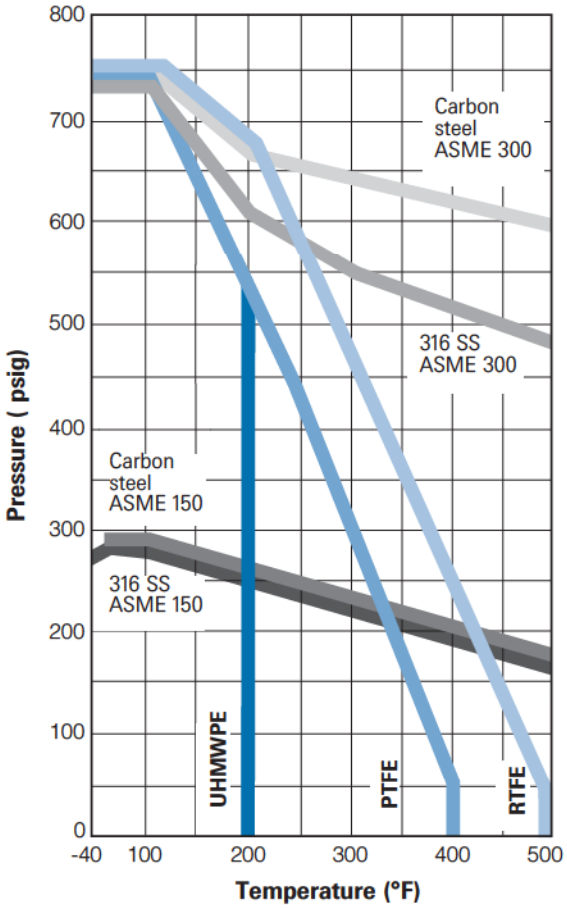
	Temperature (°F)															
Pressure (psi)	**40**	**-20**	**0**	**100**	**180**	**200**	**250**	**300**	**400**	**450**	**500**	**600**	**700**	**800**	**900**	**1000**
ASME 150 body (Fig. 360 wafer style & Fig. 362 lug style)																
Fig. 360/362 Carbon steel	285	285	285	270	260	245	230	200	185	170	140	110	80			
Fig. 360/362 Stainless steel	275	275	275	275	250	240	227	215	195	182	170	140	110	80	50	20
Fig. 360/362 Nickel aluminium bronze	250	250	250	250	240	235	222	210	180	170	160	150				
Fig. 360/362 Ductile iron	250	250	250	240	235	225	215	200	185	170	140					
ASME 300 body (Fig. 370 wafer style & Fig. 372 lug style)																
Fig. 370/372 Carbon steel	740	740	740	700	675	665	655	635	617	600	550	535	410			
Fig. 370/372 Stainless steel	720	720	720	720	645	620	590	560	515	497	480	450	430	415	395	365
Fig. 370/372 Nickel aluminium bronze	700	700	700	700	625	600	675	550	500	475	450	400				
Fig. 370/372 Ductile iron	640	640	640	610	600	583	565	525	510	495	465					
ASME 150 disc																
Fig. 360/362 Stainless steel	275	285	285	285	270	260	245	230	200	185	170	140	110	80	50	20
Fig. 360/362 Nickel aluminium bronze	250	250	250	250	240	235	222	210	180	170	160	150				
Fig. 360/362 Monel®	230	230	230	230	210	200	195	190	185	182	170	140	110	80		
Fig. 360/362 Ductile iron	250	250	250	240	235	225	215	200	185	170	140					
ASME 300 disc																
Fig. 370/372 Stainless steel	720	740	740	740	700	675	665	655	635	617	600	550	535	410	395	365
Fig. 370/372 Nickel aluminium bronze	700	700	700	700	625	600	575	500	500	475	450	400				
Fig. 370/372 Monel®	600	600	600	600	580	530	520	495	480	475	475	475	475	460		
Fig. 370/372 Ductile iron	640	640	640	610	600	583	565	525	510	495	465					
K-LOK® seats																
Teflon (TFE)	740	740	740	740	600	565	450	325								
Reinforced TFE (RTFE)	740	740	740	740	700	680	550	450	225	100						
UHMWPE	740	740	740	740	575	555										
NBR	740	740	740	625												
EPDM	740	740	740	740	740	675	550									
Metal - 316 SS	285	285	285	285	270	255	245	230	200	185	170	135	110	80	50	20
Monel®-400	285	285	285	285	270	255	245	230	200	185	170	135	110	80	50	20
Fire-safe - RTFE/316 SS	285	285	285	285	285	285	285	285	225	100						
Fire-safe - RTFE/Monel®	285	285	285	285	285	285	285	285	225	100						

Pressure/temperature ratings for seat materials

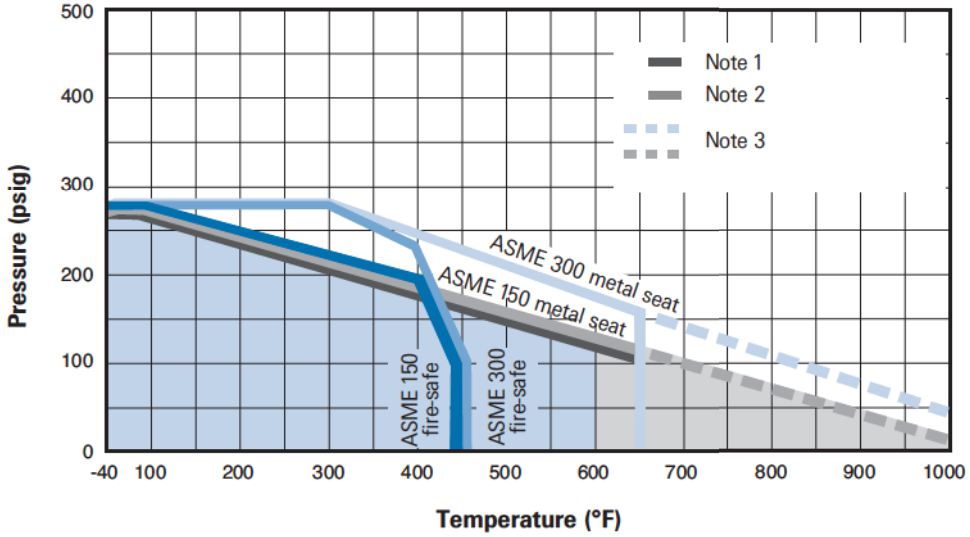
Elastomer seats



Polymer seats



Fire-safe and metal seats



Notes:

1. Carbon steel ASME 150 body
2. 316 SS ASME 150 body
3. For continuous service above 650°F, please consult your sales representative

Recommended flange bolt lengths

Lugged body ASME 150 - Fig. 362

Valve size (in.)	Hex head machine bolt Qty.	Size	Length (in.)	All thread Qty.	Size	Length (in.)
2	4	5/8 - 11UNC	x 1 3/4	4	5/8 - 11UNC	x 2 1/2
	4	5/8 - 11UNC	x 2	4	5/8 - 11UNC	x 2 3/4
2 1/2	8	5/8 - 11UNC	x 1 3/4	8	5/8 - 11UNC	x 2 1/2
3	4	5/8 - 11UNC	x 2	4	5/8 - 11UNC	x 2 3/4
	4	5/8 - 11UNC	x 1 1/2	4	5/8 - 11UNC	x 2 1/2
4	8	5/8 - 11UNC	x 2	8	5/8 - 11UNC	x 2 3/4
	8	5/8 - 11UNC	x 1 3/4	8	5/8 - 11UNC	x 2 1/2
5	16	3/4 - 10UNC	x 2	16	3/4 - 10UNC	x 3
6	8	3/4 - 10UNC	x 2 1/4	8	3/4 - 10UNC	x 3
	8	3/4 - 10UNC	x 2	8	3/4 - 10UNC	x 3 1/4
8	8	3/4 - 10UNC	x 2 1/2	8	3/4 - 10UNC	x 3 1/2
	8	3/4 - 10UNC	x 2	8	3/4 - 10UNC	x 3
10	12	7/8 - 9UNC	x 2 3/4	12	7/8 - 9UNC	x 4
	12	7/8 - 9UNC	x 2 1/4	12	7/8 - 9UNC	x 3 1/4
12	12	7/8 - 9UNC	x 3	12	7/8 - 9UNC	x 4
	12	7/8 - 9UNC	x 2 1/2	12	7/8 - 9UNC	x 3 3/4
14	12	1 - 8UN	x 3 1/2	12	1 - 8UN	x 4 3/4
	12	1 - 8UN	x 3	12	1 - 8UN	x 4 1/4
16	32	1 - 8UN	x 3	32	1 - 8UN	x 4
18	32	1 1/8 - 8UN	x 3 3/4	32	1 1/8 - 8UN	x 5
20	32	1 1/8 - 8UN	x 4	32	1 1/8 - 8UN	x 5 1/2
	8	1 1/8 - 8UN	x 3	8	1 1/8 - 8UN	x 4 1/2
24	20	1 1/4 - 8UN	x 5	20	1 1/4 - 8UN	x 6 1/2
	20	1 1/4 - 8UN	x 4 1/2	20	1 1/4 - 8UN	x 6
30	48	1 1/4 - 8UN	x 6	48	1 1/4 - 8UN	x 7 1/2
	8	1 1/4 - 8UN	x 4 1/2	8	1 1/4 - 8UN	x 6
36	28	1 1/2 - 8UN	x 7 1/2	28	1 1/2 - 8UN	x 9 1/2
	28	1 1/2 - 8UN	x 7	28	1 1/2 - 8UN	x 9
	4	1 1/2 - 8UN	x 5	4	2 - 8UN	x 7
	4	1 1/2 - 8UN	x 6	4	2 - 8UN	x 8

Lugged body ASME 300 - Fig. 372

Valve size (in.)	Hex head machine bolt Qty.	Size	Length (in.)	All thread Qty.	Size	Length (in.)
2	16	5/8 - 11UNC	x 2	16	5/8 - 11UNC	x 3
2 1/2	8	3/4 - 10UNC	x 1 3/4	8	3/4 - 10UNC	x 2 3/4
	8	3/4 - 10UNC	x 2	8	3/4 - 10UNC	x 2 3/4
3	8	3/4 - 10UNC	x 2 1/4	8	3/4 - 10UNC	x 3 1/4
	8	3/4 - 10UNC	x 1 3/4	8	3/4 - 10UNC	x 2 3/4
4	8	3/4 - 10UNC	x 2 1/2	8	3/4 - 10UNC	x 3 1/4
	8	3/4 - 10UNC	x 2	8	3/4 - 10UNC	x 3
5	8	3/4 - 10UNC	x 2 1/2	16	3/4 - 10UNC	x 3 1/2
	8	3/4 - 10UNC	x 2 1/4			
6	12	3/4 - 10UNC	x 2 3/4	24	3/4 - 10UNC	x 3 1/2
	12	3/4 - 10UNC	x 2 1/4			
8	12	7/8 - 9UNC	x 3 1/4	12	7/8 - 9UNC	x 4 1/2
	12	7/8 - 9UNC	x 2 1/2	12	7/8 - 9UNC	x 3 1/2
10	16	1 - 8UN	x 3 3/4	16	1 - 8UN	x 5
	16	1 - 8UN	x 3	16	1 - 8UN	x 4 1/4
12	16	1 1/8 - 8UN	x 4	16	1 1/8 - 8UN	x 5 1/2
	16	1 1/8 - 8UN	x 3 1/2	16	1 1/8 - 8UN	x 4 3/4
14	16	1 1/8 - 8UN	x 4 1/2	16	1 1/8 - 8UN	x 6
	16	1 1/8 - 8UN	x 4	16	1 1/8 - 8UN	x 5 1/2
	4	1 1/8 - 8UN	x 3 1/4	4	1 1/8 - 8UN	x 4 3/4
	4	1 1/8 - 8UN	x 3	4	1 1/8 - 8UN	x 4 1/2
16	16	1 1/4 - 8UN	x 5	16	1 1/4 - 8UN	x 6 1/2
	16	1 1/4 - 8UN	x 4 1/2	16	1 1/4 - 8UN	x 6
	8	1 1/4 - 8UN	x 3 1/2	8	1 1/4 - 8UN	x 5
18	40	1 1/4 - 8UN	x 5	40	1 1/4 - 8UN	x 6 1/2
	8	1 1/4 - 8UN	x 3 1/2	8	1 1/4 - 8UN	x 5
20	40	1 1/4 - 8UN	x 5 1/2	40	1 1/4 - 8UN	x 7
	4	1 1/4 - 8UN	x 4	4	1 1/4 - 8UN	x 5 1/2
	4	1 1/4 - 8UN	x 4 1/2	4	1 1/4 - 8UN	x 6
24	40	1 1/2 - 8UN	x 6	40	1 1/2 - 8UN	x 8
	4	1 1/2 - 8UN	x 5	4	1 1/2 - 8UN	x 7
	4	1 1/2 - 8UN	x 4 1/2	4	1 1/2 - 8UN	x 6 1/2
30	48	1 3/4 - 8UN	x 7	48	1 3/4 - 8UN	x 9
	8	1 3/4 - 8UN	x 5 1/2	8	1 3/4 - 8UN	x 7 1/2

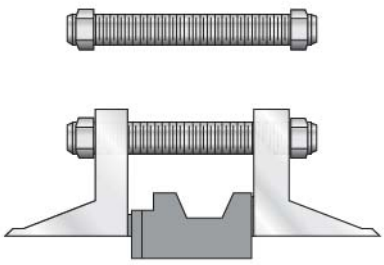
Wafer body ASME 150 - Fig. 360

Valve size (in.)	Hex head machine bolt Qty.	Size	Length (in.)	All thread Qty.	Size	Length (in.)
2	4	5/8 - 11UNC	x 5	4	5/8 - 1UNC	x 5 1/2
2 1/2	4	5/8 - 11UNC	x 4 1/2	4	5/8 - 11UNC	x 5
3	4	5/8 - 11UNC	x 4 1/2	4	5/8 - 11UNC	x 5 1/4
4	8	5/8 - 11UNC	x 4 3/4	8	5/8 - 11UNC	x 5 1/2
5	8	3/4 - 10UNC	x 5	8	3/4 - 10UNC	x 6
6	8	3/4 - 10UNC	x 5 1/4	8	3/4 - 10UNC	x 6
0	0	3/4 - 10UNC	x 5 3/4	0	3/4 - 10UNC	x 6 1/2
10	12	7/8 - 9UNC	x 6 1/4	12	7/8 - 9UNC	x 7
12	12	7/8 - 9UNC	x 7	12	7/8 - 9UNC	x 7 1/2
14	12	1 - 8UN	x 7 1/2	12	1 - 8UN	x 8 1/2
16	16	1 - 8UN	x 8	16	1 - 8UN	x 9
18	16	1 1/8 - 8UN	x 9 1/4	16	1 1/8 - 8UN	x 10 1/2
20	16	1 1/8 - 8UN	x 10	16	1 1/8 - 8UN	x 11
	4	1 1/8 - 8UN	x 3 1/2	4	1 1/8 - 8UN	x 5
	4	1 1/8 - 8UN	x 3	4	1 1/8 - 8UN	x 4 1/2
24	20	1 1/4 - 8UN	x 11 1/2	20	1 1/4 - 8UN	x 12 1/2
30	24	1 1/4 - 8UN	x 13 1/4	24	1 1/4 - 8UN	x 16
	4	1 1/4 - 8UN	x 3 1/2	4	1 1/4 - 8UN	x 5 1/4
	4	1 1/4 - 8UN	x 3 1/4	4	1 1/4 - 8UN	x 4 3/4
36	28	1 1/2 - 8UN	x 15	28	1 1/2 - 8UN	x 18 3/4
	4	1 1/2 - 8UN	x 5	4	1 1/2 - 8UN	x 6 3/4
	4	1 1/2 - 8UN	x 4	4	1 1/2 - 8UN	x 6

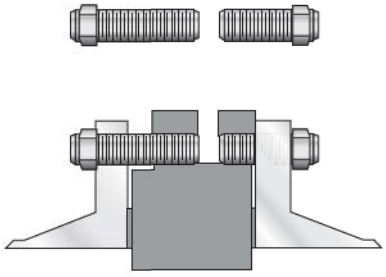
Wafer body ASME 300 - Fig. 370

Valve size (in.)	Hex head machine bolt Qty.	Size	Length (in.)	All thread Qty.	Size	Length (in.)
2	8	5/8 - 11UNC	x 5 1/4	8	5/8 - 11UNC	x 5 3/4
2 1/2	8	3/4 - 10UNC	x 4 3/4	8	3/4 - 10UNC	x 5 1/2
3	8	3/4 - 10UNC	x 5	8	3/4 - 10UNC	x 5 3/4
4	8	3/4 - 10UNC	x 5 1/2	8	3/4 - 10UNC	x 6 1/2
5	8	3/4 - 10UNC	x 6	8	3/4 - 10UNC	x 7
6	12	3/4 - 10UNC	x 6	12	3/4 - 10UNC	x 7
8	12	7/8 - 10UNC	x 7 1/4	12	7/8 - 9UNC	x 8
10	12	1 - 8UN	x 8 1/4	12	1 - 8UN	x 9 1/2
	4	1 - 8UN	x 3 7/8	4	1 - 8UN	x 4 7/8
	4	1 - 8UN	x 3 1/8	4	1 - 8UN	x 4 1/8
12	16	1 1/8 - 8UN	x 9	16	1 1/8 - 8UN	x 10
14	16	1 1/8 - 8UN	x 10 1/4	16	1 1/8 - 8UN	x 11 1/2
	4	1 1/8 - 8UN	x 3 1/4	4	1 1/8 - 8UN	x 4 3/4
	4	1 1/8 - 8UN	x 3	4	1 1/8 - 8UN	x 4 1/2
16	16	1 1/4 - 8UN	x 11 1/2	16	1 1/4 - 8UN	x 12 1/2
	4	1 1/4 - 8UN	x 3 1/4	4	1 1/4 - 8UN	x 4 3/4
	4	1 1/4 - 8UN	x 3	4	1 1/4 - 8UN	x 4 1/2
18	20	1 1/4 - 8UN	x 12	20	1 1/4 - 8UN	x 13 1/2
	4	1 1/4 - 8UN	x 3 1/2	4	1 1/4 - 8UN	x 5
	4	1 1/4 - 8UN	x 3	4	1 1/4 - 8UN	x 4 3/4
20	20	1 1/4 - 8UN	x 13	20	1 1/4 - 8UN	x 14
	8	1 1/4 - 8UN	x 4	8	1 1/4 - 8UN	x 5 1/2
24	20	1 1/2 - 8UN	x 14 1/2	20	1 1/2 - 8UN	x 16
	4	1 1/2 - 8UN	x 4 3/4	4	1 1/2 - 8UN	x 6 1/2
	4	1 1/2 - 8UN	x 4 1/4	4	1 1/2 - 8UN	x 6 1/4
30	24	1 1/2 - 8UN	x 19	24	1 3/4 - 8UN	x 20 1/2
	8	1 3/4 - 8UN	x 5 1/2	8	1 3/4 - 8UN	x 7 3/4

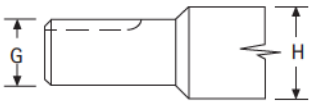
Wafer body



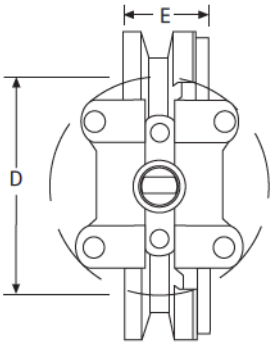
Lugged body



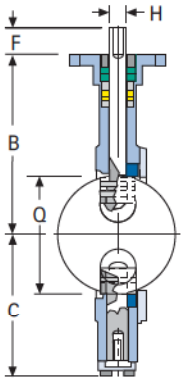
Dimensions – Wafer style



Upper shaft/keyway
NPS 8 to NPS 24



Top plate view



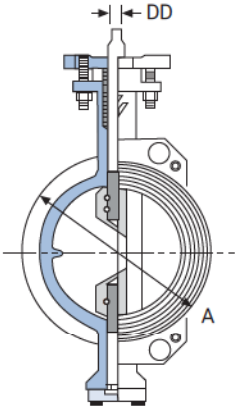


Figure 360, ASME Class 150, wafer style, dimensions (inches)

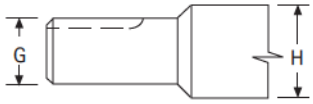
Size (NPS)	A	B	C	D	E	F	G	H	Q	Top plate drilling DD or keyway	Bolt circle	No. holes	Hole dia.	Wt. lbs.	Actuator code
2	4 1/8	6	4 1/4	4	2 3/8	1 1/4	N/A	9/16	1 7/8	3/8	3 1/4	4	7/16	8	BAB
2 1/2	4 1/8	6	4 1/4	4	1 7/8	1 1/4	N/A	9/16	2 5/16	3/8	3 1/4	4	7/16	9	BAB
3	5	6 5/8	4 13/16	4	1 7/8	1 1/4	N/A	5/8	2 3/4	7/16	3 1/4	4	7/16	12	BAC
4	6 3/16	7 1/2	5 13/16	4	2 1/8	1 1/4	N/A	3/4	3 11/16	1/2	3 1/4	4	7/16	20	BAD
5	7 1/4	7 9/16	5 13/16	4	2 1/4	1 1/4	N/A	3/4	4 3/4	1/2	3 1/4	4	7/16	25	BAD
6	8 19/32	8 3/4	6 15/16	6	2 1/4	1 1/4	3/4	7/8	5 5/8	1/2	5	4	9/16	32	CAD
6*	8 19/32	8 3/4	6 15/16	6	2 1/4	1 1/4	N/A	7/8	5 5/8	5/8	5	4	9/16	33	CAE
8	10 5/8	10 1/8	8 3/8	6	2 1/2	2	N/A	1 1/8	7 7/16	1/4 x 1/4 x 1 5/8	5	4	9/16	50	CAF
10	12 3/4	11 3/8	9 11/16	6	2 13/16	2	1 1/8	1 3/8	9 7/16	1/4 x 1/4 x 1 5/8	5	4	9/16	77	CAF
10*	12 3/4	11 3/8	9 11/16	6	2 13/16	3	N/A	1 3/8	9 7/16	5/16 x 5/16 x 2 5/8	5	4	9/16	78	CAG
12	14 3/4	13	10 7/8	8	3 3/16	3	1 3/8	1 1/2	11 1/4	5/16 x 5/16 x 2 5/8	6 1/2	4	13/16	124	DAG
14	16 1/4	13 1/4	11 7/8	8	3 5/8	3	N/A	1 5/8	12 5/16	3/8 x 3/8 x 2 5/8	6 1/2	4	13/16	141	DAH
16	18 1/2	14 1/2	12 7/8	8	4	3	1 5/8	1 3/4	14 1/8	3/8 x 3/8 x 2 5/8	6 1/2	4	13/16	230	DAH
18	21	16	13 7/8	8	4 1/2	4 1/16	N/A	1 7/8	15 15/16	1/2 x 3/8 x 4 1/16	6 1/2	4	13/16	305	DAJ
20	23	17 7/16	15 7/16	8	5	4 5/16	N/A	2 1/4	17 5/8	1/2 x 3/8 x 4	6 1/2	4	13/16	350	DAK
24	27 1/2	19 11/16	17 13/16	8	6 1/16	4 1/4	2 1/4	2 1/2	21 1/16	1/2 x 3/8 x 4	6 1/2	4	13/16	620	DAK
30	33 3/4	24 1/2	21 3/16	9 1/2	7 3/8	7	N/A	3	26 7/8	3/4 x 3/4 x 6	9 3/4	4	1 1/16	1,020	MAZ
36	40 1/4	28 3/8	24 11/16	9 1/2	8 1/2	8	N/A	3 1/2	33 5/16	7/8 x 7/8 x 5 11/16	9 3/4	4	1 1/16	1,850	MBE

Note: * E.N.P. discs require larger upper shaft connection diameters on NPS 6 and NPS 10 valve sizes for UHMWPE seat, metal seat and fire-safe seat trims.

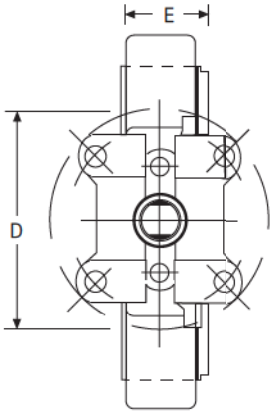
Figure 370, ASME Class 300, wafer style, dimensions (inches)

Size (NPS)	A	B	C	D	E	F	G	H	Q	Top plate drilling DD or keyway	Bolt circle	No. holes	Hole dia.	Tapped lug data No. holes	Bolt circle	Tap	Wt. lbs.	Actuator code
2	4 1/8	6	4 1/4	4	2 3/8	1 1/4	N/A	9/16	1 7/8	3/8	3 1/4	4	7/16	–	–	–	8	BAB
2 1/2	4 1/8	6	4 1/4	4	1 7/8	1 1/4	N/A	9/16	2 5/16	3/8	3 1/4	4	7/16	–	–	–	9	BAB
3	5	6 5/8	4 13/16	4	1 7/8	1 1/4	N/A	5/8	2 11/16	7/16	3 1/4	4	7/16	–	–	–	12	BAC
4	6 3/16	7 1/2	5 13/16	4	2 1/8	1 1/4	N/A	3/4	3 11/16	1/2	3 1/4	4	7/16	–	–	–	20	BAD
5	7 1/4	7 9/16	5 13/16	4	2 5/16	1 1/4	N/A	3/4	4 3/4	1/2	3 1/4	4	7/16	–	–	–	25	BAD
6	8 19/32	8 3/4	6 15/16	6	2 5/16	1 1/4	N/A	7/8	5 5/8	5/8	5	4	9/16	–	–	–	32	CAE
8	10 5/8	10 1/8	8 3/8	6	2 7/8	2	N/A	1 1/8	7 7/16	1/4 x 1/4 x 1 5/8	5	4	9/16	–	–	–	65	CAF
10	12 3/4	11 3/8	9 11/16	6	3 1/4	3	N/A	1 3/8	9 3/8	5/16 x 5/16 x 2 5/8	5	4	9/16	4	15 1/4	1-8UN	95	CAG
12	14 3/4	13	10 7/8	8	3 5/8	3	1 3/8	1 1/2	11 1/4	5/16 x 5/16 x 2 5/8	6 1/2	4	13/16	–	–	–	145	DAG
14	16 1/4	14 3/8	12 5/8	8	4 5/8	4 1/4	N/A	1 7/8	12	1/2 x 3/8 x 4 1/8	6 1/2	4	13/16	4	20 1/4	1 1/8-8UN	270	DAJ
16	18 1/2	16 1/16	13 3/4	8	5 1/4	4 1/8	N/A	2 1/4	13 5/8	1/2 x 3/8 x 4	6 1/2	4	13/16	4	22 1/2	1 1/4-8UN	305	DAK
18	21	17	15 1/8	8	5 7/8	4 7/32	N/A	2 1/2	15 7/16	5/8 x 5/8 x 4	6 1/2	4	13/16	4	24 3/4	1 1/4-8UN	385	DBA
20	23	20 3/16	16 3/4	7 1/2	6 1/4	6 1/2	N/A	2 3/4	17 1/4	5/8 x 5/8 x 6 3/8	8	4	13/16	4	27	1 1/4-8UN	450	LAX
24	27 1/4	23 3/8	19 13/16	9 1/2	7 1/8	6 13/16	N/A	3 1/2	20 3/4	7/8 x 7/8 x 5 11/16	9 3/4	4	1 1/16	4	32	1 1/2-8UN	770	MAY
30	33 3/4	26 5/8	24 9/16	10	9 1/2	7 7/8	N/A	4 1/2	26	1 x 1 x 6 1/2	10	4	1 1/8	4	39 1/4	1 3/4-8UN	1,100	NAW
36	40 1/4	30 7/8	28 7/16	12 1/4	10 3/4	8	N/A	5	32 7/16	1 1/4 x 1 1/4 x 7	12	4	1 1/8	4	46	2-8UN	1,590	EBD

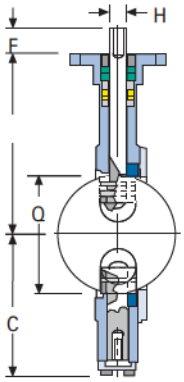
Dimensions – Lug style



Upper shaft/keyway
NPS 8 to NPS 24



Top plate view



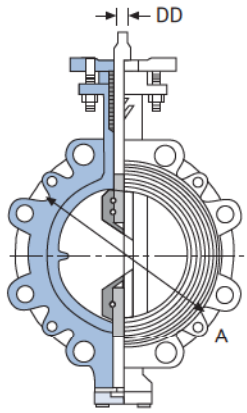


Figure 362, ASME Class 150, lug style, dimensions (inches)

Size										Top plate drilling				Tapped lug data			Wt.	Actuator
(NPS)	A	B	C	D	E	F	G	H	Q	DD or keyway	Bolt circle	No. holes	Hole dia.	No. holes	Bolt circle	Tap	lbs.	code
2	4 1/8	6	4 1/4	4	2 3/8	1 1/4	N/A	9/16	1 7/8	3/8	3 1/4	4	7/16	4	4 3/4	5/8-11UNC	13	BAB
2 1/2	4 1/8	6	4 1/4	4	1 7/8	1 1/4	N/A	9/16	2 5/16	3/8	3 1/4	4	7/16	4	5 1/2	5/8-11UNC	14	BAB
3	5	6 5/8	4 13/16	4	1 7/8	1 1/4	N/A	5/8	2 3/4	7/16	3 1/4	4	7/16	4	6	5/8-11UNC	15	BAC
4	6 3/16	7 1/2	5 13/16	4	2 1/8	1 1/4	N/A	3/4	3 11/16	1/2	3 1/4	4	7/16	8	7 1/2	5/8-11UNC	26	BAD
5	7 1/4	7 9/16	5 13/16	4	2 1/4	1 1/4	N/A	3/4	4 3/4	1/2	3 1/4	4	7/16	8	8 1/2	3/4-10UNC	31	BAD
6	8 19/32	8 3/4	6 15/16	6	2 1/4	1 1/4	3/4	7/8	5 5/8	1/2	5	4	9/16	8	9 1/2	3/4-10UNC	40	CAD
6*	8 19/32	8 3/4	6 15/16	6	2 1/4	1 1/4	N/A	7/8	5 5/8	5/8	5	4	9/16	8	9 1/2	3/4-10UNC	41	CAE
8	10 5/8	10 1/8	8 3/8	6	2 1/2	2	N/A	1 1/8	7 7/16	1/4 x 1/4 x 1 5/8	5	4	9/16	8	11 3/4	3/4-10UNC	63	CAF
10	12 3/4	11 3/8	9 11/16	6	2 13/16	2	1 1/8	1 3/8	9 7/16	1/4 x 1/4 x 1 5/8	5	4	9/16	12	14 1/4	7/8-9UNC	106	CAF
10*	12 3/4	11 3/8	9 11/16	6	2 13/16	3	N/A	1 3/8	9 7/16	5/16 x 5/16 x 2 5/8	5	4	9/16	12	14 1/4	7/8-9UNC	107	CAG
12	14 3/4	13	10 7/8	8	3 3/16	3	1 3/8	1 1/2	11 1/4	5/16 x 5/16 x 2 5/8	6 1/2	4	13/16	12	17	7/8-9UNC	160	DAG
14	16 1/4	13 1/4	11 7/8	8	3 5/8	3	N/A	1 5/8	12 5/16	3/8 x 3/8 x 2 5/8	6 1/2	4	13/16	12	18 3/4	1-8UN	265	DAH
16	18 1/2	14 1/2	12 7/8	8	4	3	1 5/8	1 3/4	14 1/8	3/8 x 3/8 x 2 5/8	6 1/2	4	13/16	16	21 3/4	1-8UN	305	DAH
18	21	16	13 7/8	8	4 1/2	4 1/16	N/A	1 7/8	15 15/16	1/2 x 3/8 x 4 1/16	6 1/2	4	13/16	16	22 3/4	1 1/8-8UN	415	DAJ
20	23	17 7/16	15 7/16	8	5	4 5/16	N/A	2 1/4	17 5/8	1/2 x 3/8 x 4	6 1/2	4	13/16	20	25	1 1/8-8UN	500	DAK
24	27 1/2	19 11/16	17 13/16	8	6 1/16	4 1/4	2 1/4	2 1/2	21 1/16	1/2 x 3/8 x 4	6 1/2	4	13/16	20	29 1/2	1 1/4-8UN	750	DAK
30	33 3/4	24 1/2	21 3/16	9 1/2	7 3/8	7	N/A	3	26 7/8	3/4 x 3/4 x 6	9 3/4	4	1 1/16	28	36	1 1/4-8UN	1,360	MAZ
36	40 1/4	28 3/8	24 1/16	9 1/2	8 1/2	8	N/A	3 1/2	33 5/16	7/8 x 7/8 x 5 1/16	9 3/4	4	1 1/16	32	42 3/4	1 1/2-8UN	2,250	MBE

Note: * E.N.P. discs require larger upper shaft connection diameters on NPS 6 and NPS 10 valve sizes for UHMWPE seat, metal seat and fire-safe seat trims.

Figure 372, ASME Class 300, lug style, dimensions (inches)

Size										Top plate drilling				Tapped lug data			Wt.	Actuator
(NPS)	A	B	C	D	E	F	G	H	Q	DD or keyway	Bolt circle	No. holes	Hole dia.	No. holes	Bolt circle	Tap	lbs.	code
2	4 1/8	6	4 1/4	4	2 3/8	1 1/4	N/A	9/16	1 7/8	3/8	3 1/4	4	7/16	8	5	3/4-10UNC	17	BAB
2 1/2	4 1/8	6	4 1/4	4	1 7/8	1 1/4	N/A	9/16	2 5/16	3/8	3 1/4	4	7/16	8	5 1/8	3/4-10UNC	18	BAB
3	5	6 5/8	4 13/16	4	1 7/8	1 1/4	N/A	5/8	2 11/16	7/16	3 1/4	4	7/16	8	6 5/8	3/4-10UNC	20	BAC
4	6 3/16	7 1/2	5 13/16	4	2 1/8	1 1/4	N/A	3/4	3 11/16	1/2	3 1/4	4	7/16	8	7 7/8	3/4-10UNC	26	BAD
5	7 1/4	7 9/16	5 13/16	4	2 5/16	1 1/4	N/A	3/4	4 3/4	1/2	3 1/4	4	7/16	8	9 1/4	3/4-10UNC	31	BAD
6	8 19/32	8 3/4	6 15/16	6	2 5/16	1 1/4	N/A	7/8	5 5/8	5/8	5	4	9/16	12	10 5/8	3/4-10UNC	55	CAE
8	10 5/8	10 1/8	8 3/8	6	2 7/8	2	N/A	1 1/8	7 7/16	1/4 x 1/4 x 1 5/8	5	4	9/16	12	13	7/8-9UNC	80	CAF
10	12 3/4	11 3/8	9 11/16	6	3 1/4	3	N/A	1 3/8	9 3/8	5/16 x 5/16 x 2 5/8	5	4	9/16	16	15 1/4	1-8UN	137	CAG
12	14 3/4	13	10 7/8	8	3 5/8	3	1 3/8	1 1/2	11 1/4	5/16 x 5/16 x 2 5/8	6 1/2	4	13/16	16	17 3/4	1 1/8-8UN	185	DAG
14	16 1/4	14 3/8	12 5/8	8	4 5/8	4 1/4	N/A	1 7/8	12	1/2 x 3/8 x 4 1/8	6 1/2	4	13/16	20	20 1/4	1 1/8-8UN	340	DAJ
16	18 1/2	16 1/16	13 3/4	8	5 1/4	4 1/8	N/A	2 1/4	13 5/8	1/2 x 3/8 x 4	6 1/2	4	13/16	20	22 1/2	1 1/4-8UN	432	DAK
18	21	17	15 1/8	8	5 7/8	4 7/32	N/A	2 1/2	15 7/16	5/8 x 5/8 x 4	6 1/2	4	13/16	24	24 3/4	1 1/4-8UN	550	DBA
20	23	20 3/16	16 3/4	7 1/2	6 1/4	6 1/2	N/A	2 3/4	17 1/4	5/8 x 5/8 x 6 3/8	8	4	13/16	24	27	1 1/4-8UN	850	LAX
24	27 1/4	23 3/8	19 13/16	9 1/2	7 1/8	6 13/16	N/A	3 1/2	20 3/4	7/8 x 7/8 x 5 1/16	9 3/4	4	1 1/16	24	32	1 1/2-8UN	1,278	MAY
30	33 3/4	26 5/8	24 9/16	10	9 1/2	7 7/8	N/A	4 1/2	26	1 x 1 x 6 1/2	10	4	1 1/8	28	39 1/4	1 3/4-8UN	2,450	NAW
36	40 1/4	30 7/8	28 7/16	12 1/4	10 3/4	8	N/A	5	32 7/16	1 1/4 x 1 1/4 x 7	12	4	1 1/8	32	46	2-8UN	2,850	EBD

Common available trims

Figure number	Valve type
F360	ASME Class 150, Wafer
F362	ASME Class 150, Full-lug
F370	ASME Class 300, Wafer
F372	ASME Class 300, Full-lug

To order a K-LOK®, specify the valve size, the valve figure number (listed above) and the specific application trim code. The most common codes, together with the materials of construction, are listed below.
(Example: NPS 10 F360-104)

General purpose trims (up to 250°F)

Trim code	SAP code	Body	Disc	Shaft	Seat/backing ring	Packing	Bearing	Body gasket
106	CES6TSG	Steel	316 SS/ENP	17-4PH SS	UHMWPE/SS	Teflon®	SS-nitrided	Graphite
107	SES6TSG	316 SS	316 SS/ENP	17-4PH SS	UHMWPE/SS	Teflon®	SS-nitrided	Graphite

General purpose trims (up to 500°F)

Trim code	SAP code	Body	Disc	Shaft	Seat/backing ring	Packing	Bearing	Body gasket
123	CES1TSG	Steel	316 SS/ENP	17-4PH SS	RTFE/SS	Teflon®	SS-nitrided	Graphite
124	SES1TSG	316 SS	316 SS/ENP	17-4PH SS	RTFE/SS	Teflon®	SS-nitrided	Graphite
158	CSS1TSG	Steel	316 SS	17-4PH SS	RTFE/SS	Teflon®	SS-nitrided	Graphite
159	SSS1TSG	316 SS	316 SS	17-4PH SS	RTFE/SS	Teflon®	SS-nitrided	Graphite

Metal seated – high temperature trims

Trim code	SAP code	Body	Disc	Shaft	Seat/backing ring	Packing	Bearing	Body gasket
113	CES14GSG	Steel	316 SS/ENP	17-4PH SS	316 SS chrome plated	Graphite	SS-nitrided	Graphite
114	SES14GSG	316 SS	316 SS/ENP	17-4PH SS	316 SS chrome plated	Graphite	SS-nitrided	Graphite

Corrosion resistant trims

Trim code	SAP code	Body	Disc	Shaft	Seat/backing ring	Packing	Bearing	Body gasket
133	SSP1TSG	316 SS	316 SS	316 SS Cond. B	RTFE/SS	Teflon®	SS-nitrided	Graphite
134	SSN1TSG	316 SS	316 SS	NITRONIC 50®	RTFE/SS	Teflon®	SS-nitrided	Graphite

Fire-safe trims

Trim code	SAP code	Body	Disc	Shaft	Seat/backing ring	Packing	Bearing	Body gasket
115	CES10GFG	Steel	316 SS/ENP	17-4PH SS and RTFE	316 SS chrome plated	Graphite	SS-nitrided/ RTFE-epoxy	Graphite
116	SES10GFG	316 SS	316 SS/ENP	17-4PH SS and RTFE	316 SS chrome plated	Graphite	SS-nitrided/ RTFE-epoxy	Graphite

Note:
Other trims are available; please contact your sales representative.

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KEYSTONE EPI-2 ELECTRIC ACTUATORS

The EPI-2 series are compact, intelligent quarter-turn electric actuators for the accurate control of valves with torques from 35 to 2000 Nm / 308 to 17,700 lb.in.



FEATURES

- Low or high voltage single phase DC or AC power supply with 3-phase option
- Multiple adjustable stroking times to suit specific applications
- Interchangeable base plate and range of shaft inserts enable simple connection to any valve type
- Intelligent control unit prevents overheating
- Epicyclical gearing ensures reliable and smooth operation
- Top-mounted position indicator
- Constantly-engaged, hand wheel-operated manual override in case of power failure
- Bluetooth™ wireless connectivity for non-intrusive configuration, operation and diagnostics
- Optional local control panel for manual valve operation with additional open/close indicator
- Simple upgrade options for modulating control and network communication via DeviceNet or Profibus DP protocols
- Latched-type output contacts for fully open/ fully close remote indication. Output contacts for monitor and blinker/local selector indication are also available

Bluetooth™ is a trademark of Bluetooth SIG. Inc, USA

GENERAL APPLICATION

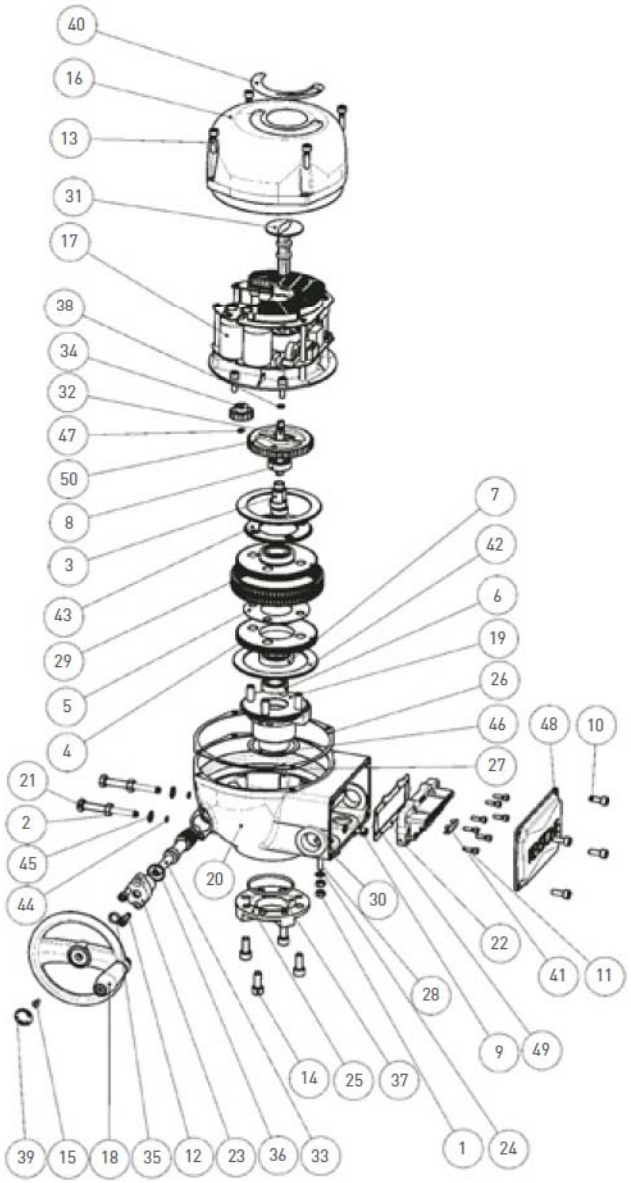
The EPI-2 is available in six sizes and is designed for on/off or modulating control of butterfly, ball, rotary plug valves or dampers in a wide range of heavy industrial, chemical and petrochemical plants on and offshore.

TECHNICAL DATA

Power supply:	Single phase from 24 to 48 V DC or AC at 50/60 Hz Single phase from 100 to 240 V DC or AC at 50/60 Hz 3-phase from 208-240 V AC, 380-480 V AC and 500-575 V AC
Voltage fluctuations:	+/-10%
Frequency:	+/- 5%
Torque output:	From 35 to 2000 Nm / 308 to 17,700 lb.in.
Ambient temperature	
Standard range:	-25°C to +70°C / -13°F to 158°F
Low temp range:	-40°C to +70°C / -40°F to 158°F
Conduit entry:	M25/1" NPT

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Part	Description	Quantity
1	Nut UNI5588 M6	2
2	Nut UNI5588 M8	2
3	Eccentric	1
4	Planocentric gear	2
5	Spacer	1
6	Ball bearing type 16002	1
7	Ball bearing type 16004	2
8	Ball bearing type 6001	1
9	ESH screw UNI5931- M6x8	1
10	HSHC screw UNI5931- M6x16	4
11	HSHC screw UNI5931- M4x14	7
12	HSHC screw UNI5931- M6x18	2
13	HSHC screw UNI5931- M6x25	4
14	HSHC screw UNI5931- M8x20	4
15	HSSC screw UNI5933- M4x10	1
16	Cover assembly	1
17	Drive and control unit	1
18	Handwheel	1
19	Output drive assembly	1
20	Standard housing	1
21	Stopper	2
22	Terminal block	1
23	Worm shaft flange	1
24	Anti-loosening washer UNI 8842-J6	1
25	Base plate ISO 5211 / F05-F07	1
26	Cover gasket	1*
27	Dowel pin UNI EN 22338	1
28	Earth stud	1
29	Fixed anulus	1
30	Gasket	1*
31	Indicator	1
32	Indicator shaft	1
33	Manual worm shaft	1
34	Motor pinion	1
35	O-ring Di=10.77/W=2.62	1*
36	O-ring Di=18.77/W=1.78	1*
37	O-ring Di=52.07/W=2.62	1*
38	O-ring Di=6.07/W=1.78	1*
39	Plug	1
40	Position label	1
41	Power clamps protection	1
42	Ring	2
43	Ring for pins alignement	1
44	Ring RW 7 UNI7433	2
45	Seal washer 8.3	2
46	Sliding ring	1
47	Snap ring for shaft D.6	1
48	Terminal block cover	1
49	Terminal board gasket	1*
50	Wheel	1

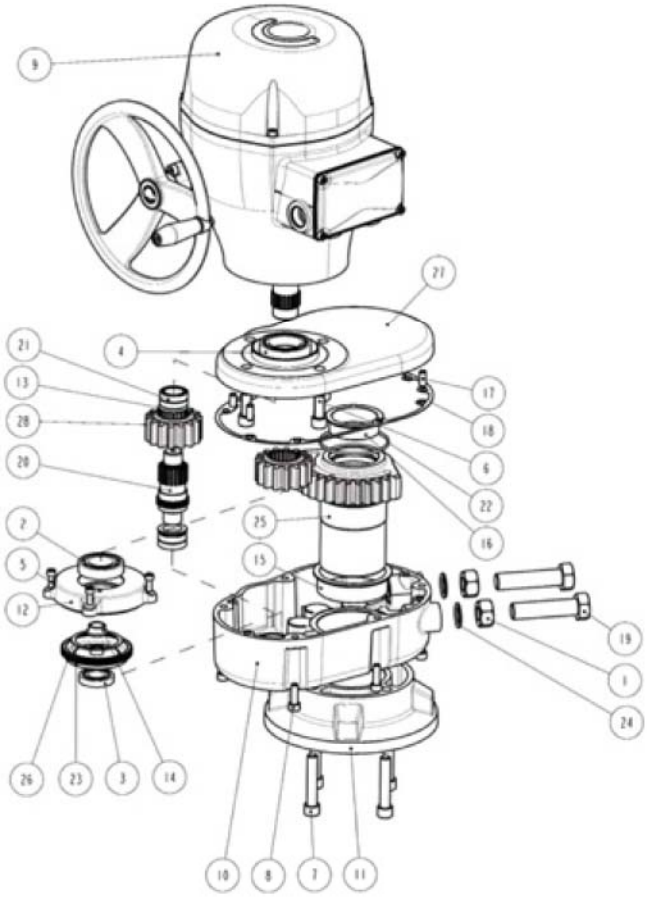


* Indicates recommended spare parts

COMPONENT PARTS - MODEL 2000/E171

Part	Description	Quantity
1	Nut M20 ISO 4032 EN 24032	2
2	Ball bearing type 6006	1
3	Ball bearing type 16004	1
4	Ball bearing type 61908	1
5	HSHC screw UNI5931- M6x16	3
6	HSHC screw UNI5931- M12x30	4
7	HSHC screw UNI5931- M12x65	4
8	HSHC screw UNI5931- M8x25 A4-70	6
9	EPI-2 actuator	1
10	Base housing	1
11	Base plate ISO 5211 / F12-F16	1
12	Bearing support	1
13	Bushing	2
14	Bushing	1
15	Bushing	1
16	Bushing	1
17	Dowel pin UNI EN 22338 D 8x20 type B	4
18	Gasket	1*
19	Hex head screw M20x80 UNI EN 24017	2
20	Idle wheel shaft	1
21	Needle bearing type NKI 22/16	2
22	O-ring Di=82.22/W=2.62	1*
23	Position wheel	1
24	Seal washer 20.3	2
25	Selector gear	1
26	Sliding ring	1
27	Upper vover	1
28	Wheel	2

* Indicates recommended spare parts



Mechanical connection to the valve
EPI-2 actuators feature a multi drilled base plate and a range of drive inserts to allow direct mounting to almost all valve types according the EN ISO 5211 and other manufacturers' standards.

Power supply
EPI-2 can simply be connected to the local power supply. It accepts any single phase input voltages (from 24 to 48 V DC or AC and 100 to 240 V DC or AC). Alternatively 3 phase voltages from 208-240 V AC, 380-480 V AC and 500-575 V AC are also available

Electric motor thermostat
A thermostat to protect the motor temperature in hot applications is included as standard in the control circuit of the electric actuator.

Heater
A heater is standard available within the unit and is powered from the motor power supply. It is automatically activated when the temperature drops below 10°C in order to prevent condensation.

Actuator service
The standard actuator is suitable for open/close and modulating applications.

Compact and light design
EPI-2 actuators are very compact and balanced for easy installation to small valves minimizing pipe work stress or loads to the valve shaft.

Actuator configuration
Each actuator is equipped with 2 rotary switches on the logic board to configure each function and parameter like position, torque, open/close speed and output contacts. Additionally each optional module has its own additional switches for its specific configuration.

Local manual override
A constantly engaged manual override (not rotating during motor operation) is fitted to all EPI-2 actuators.

Torque and sizing
The EPI-2 range comprises of six models, for operating torques of up to 2000 Nm / 17,700 lb.in. with a configurable operation time from 15 to 180 seconds. The nominal output torque value is constant along the entire stroke.

Non-intrusive configuration
With Bluetooth® wireless technology enabled on your PDA or PC all configuration requirements can be undertaken without opening the unit. Direct access to the EPI-2 is then available for configuration and predictive/preventative maintenance information, including valve position, actuator speed, output torque, alarm and status.

Position monitoring
The EPI-2 provides a local mechanical position indication. For remote indication the position is detected by a non-contact sensor. The open and close position are configured via the electronic control card.

Electronic controls
Internal drive to reverse the actuator rotation direction via remote control signals with internal 24 V DC or external 24 V DC/AC up to 120 V DC/AC power supply.

Output contacts
4 latched-type output contacts for fully open/ fully close remote indication; 1 output contact for monitor (loss of power, torque alarm, high temperature alarm, travel alarm, position sensor, hardware malfunction, local interface malfunction, local selector in LOCAL); 1 output contact for blinker/local selector indication (local selector feature only with OM3 installed).

OPTIONAL MODULES

OM1 I/0 additional module
Analog position INPUT 4-20 mA or 0-10 V DC
Analog position OUTPUT 4-20 mA or 0-10 V DC
4 additional SPST output contacts
Optional Bluetooth interface

Monitor relay
Information about loss of input signal and Bluetooth failure are available on monitor relay output contact.

OM3 local interface
Local/remote selector
OP/CL pushbuttons
2 LEDs for local indication
Available in WP version

OM13 3-wire module
110/240 V AC
3-wire control module for open/close

Bus communication – network interfaces
OM9) Profibus DP V0/V1
OM11) DeviceNet

OPTIONAL MODULES SELECTION TABLE

Order code	OM1 I/O additional module	OM3 local interface	Bluetooth component	OM9 PDP V0/V1	OM11 DeviceNet	OM13 3-wires module
P1	✓					
PA	✓	✓	✓			
P6	✓	✓				
P7	✓		✓			
P3		✓				
5P			✓	✓		
6P		✓	✓	✓		
5D			✓		✓	
6D		✓	✓		✓	
PG						✓

NOTES

1. Each optional module (OMx) will be provided with its own installation and maintenance instructions.
2. All modules except OM13 are available for both single phase and 3-phase voltage versions.
3. Bluetooth component is integrated in the OM1, OM9 and OM11 card: not available for integration by local organizations, as a stand alone unit.
4. OM13 is not available with 3-phase supply and for LV version (single phase voltage from 24 to 48 V DC/V AC).

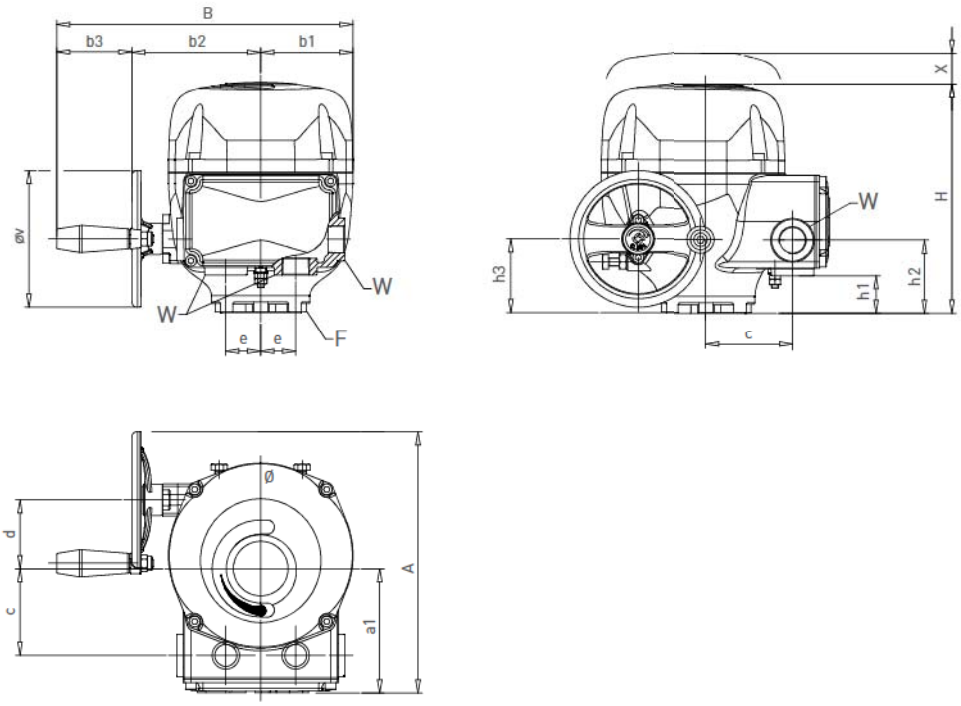
OPERATING TIMES

	Nominal torque	Operating time (secs 90°) at selected step		
Model	**(Nm / lb.in.)**	**8**	**6**	**4**
063/E006	63/600	15	28	48
125/E013	125/1300	15	28	48
250/E025	250/2500	15	28	48
500/E051	500/5100	15	28	48
1000/E091	1000/9100	24	45	80
2000/E171	2000/17700	53	100	180

Times are guaranteed with a tolerance of ±10% on the 90° stroke

Approvals	
Waterproof	IP66/68 or NEMA 4/4X/6 (NEMA ICS6/NEMA 250)
Painting	ESPC for 1000 hrs salt spray resistance (ASTM D 2247-02 and ASTM B117-97)
Vibration and noise	1 to 500 Hz with 2 g peak acceleration (IEC60068-2-6-appendix B) 65 dB (grade A) (EN 21680)

OVERALL DIMENSIONS - MODELS 063/E006-125/E013-250/E025-500/E051-1000/E091



NOTES

W = Nr. 4 cable entries M25x1.5 acc. to ISO 724/965-1 (others available as special versions)

X = Space for cover removal

F = ISO 5211 Standard flange (others available)

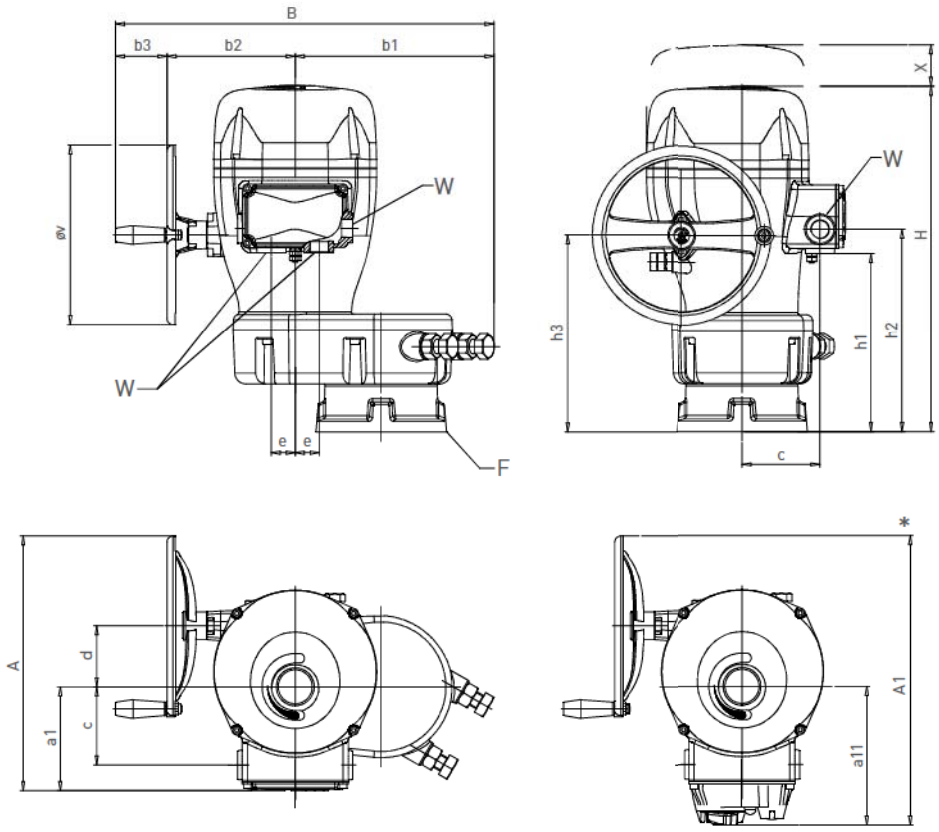
EPI-2 BASE UNIT MODELS 063/E006 TO 1000/E091 - METRIC (mm / kg)

Model	A	B	H	a1	b1	b2	b3	c	d	e	h1	h2	h3	øv	x	F	kg
063/E006	239	272	210	114.0	85	118	69	80.0	63	32	35.5	67.0	67.5	125	175	F07	7.5
125/E013	239	272	230	114.0	85	118	69	80.0	63	32	53.5	86.0	86.5	125	175	F10	9.5
250/E025	295	332	287	129.0	109	154	69	95.0	76	32	63.5	95.0	92.0	180	230	F12	16.5
500/E051	295	332	287	129.0	109	154	69	95.0	76	32	63.5	95.0	92.0	180	230	F12	18.0
1000/E091	340	349	364	138.5	109	171	69	104.5	81	32	140.0	172.5	164.0	240	230	F16	26.0

EPI-2 BASE UNIT MODELS 063/E006 TO 1000/E091 - IMPERIAL (in / lb)

Model	A	B	H	a1	b1	b2	b3	c	d	e	h1	h2	h3	øv	x	F	lb
063/E006	9.4	10.7	8.3	4.5	3.3	4.6	2.7	3.1	2.5	1.3	1.4	2.6	2.7	4.9	6.9	F07	17
125/E013	9.4	10.7	9.1	4.5	3.3	4.6	2.7	3.1	2.5	1.3	2.1	3.4	3.4	4.9	6.9	F10	21
250/E025	11.6	13.1	11.3	5.1	4.3	6.1	2.7	3.7	3.0	1.3	2.5	3.7	3.6	7.1	9.1	F12	36
500/E051	11.6	13.1	11.3	5.1	4.3	6.1	2.7	3.7	3.0	1.3	2.5	3.7	3.6	7.1	9.1	F12	40
1000/E091	13.4	13.7	14.3	5.5	4.3	6.7	2.7	4.1	3.2	1.3	5.5	6.8	6.5	9.4	9.1	F16	57

OVERALL DIMENSIONS - MODEL 2000/E171



NOTES

W = Nr. 4 cable entries M25x1.5 acc. to ISO 724/965-1 (others available as special versions)

X = Space for cover removal

F = ISO 5211 Standard flange (others available)

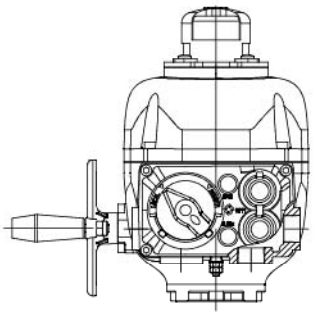
EPI-2 MODEL 2000/E171 - METRIC (mm / kg)

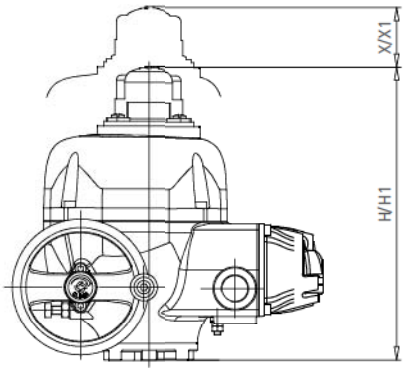
Model	A	A1	B	H	a1	a11	b1	b2	b3	c	d	e	h1	h2	h3	øv	x	F	kg
2000/E171	340	387	506	464	138.5	185.5	266	171	69	104.5	81	32	240	272.5	264	240	230	F10-F14	45.0
2000/E171	340	387	506	464	138.5	185.5	266	171	69	104.5	81	32	240	272.5	264	240	230	F12-F16	46.5

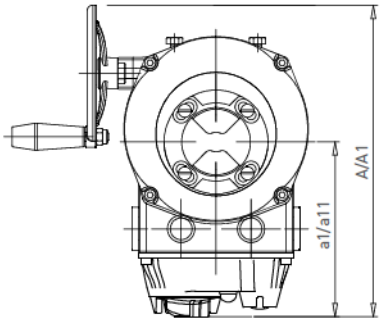
EPI-2 MODEL 2000/E171 - IMPERIAL (in / lb)

Model	A	A1	B	H	a1	a11	b1	b2	b3	c	d	e	h1	h2	h3	øv	x	F	lb
2000/E171	13.4	15.2	19.9	18.3	5.5	7.3	10.5	6.7	2.7	4.1	3.2	1.3	9.4	10.7	10.4	9.4	9.1	F10-F14	99
2000/E171	13.4	15.2	19.9	18.3	5.5	7.3	10.5	6.7	2.7	4.1	3.2	1.3	9.4	10.7	10.4	9.4	9.1	F12-F16	103

OVERALL DIMENSIONS - OPTIONAL MODULES







NOTES

1. Dimensions a1 and A are for the standard unit.
2. Dimensions a11 and A1 are for the standard unit plus a local interface option.
3. Dimensions H and X are for the standard unit.
4. Dimensions H1 and X1 are for the standard unit plus a Beacon type indicator.
5. X / X1 indicates the space for cover removal.
6. All other dimensions are as the standard unit.

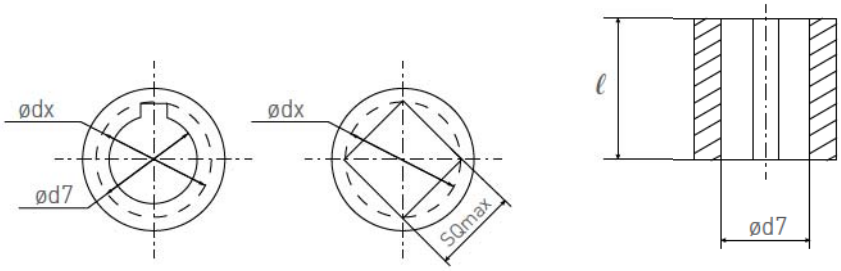
EPI-2 WITH OPTIONAL MODULES - METRIC (mm / kg)

Model	A	A1	a1	a11	H	H1	X	X1	kg[1]	kg[2]
063/E006	239	285	114.0	160.0	210	270	175	265	7.5	8.0
125/E013	239	285	114.0	160.0	230	290	175	265	9.5	10.0
250/E025	295	341	129.0	175.0	287	347	230	330	15.5	16.0
500/E051	295	341	129.0	175.0	287	347	230	330	17.0	17.5
1000/E091	340	387	138.5	185.5	364	425	230	330	23.0	26.5

EPI-2 WITH OPTIONAL MODULES - IMPERIAL (in / lb)

Model	A	A1	a1	a11	H	H1	X	X1	lb[1]	lb[2]
063/E006	9.4	11.2	4.5	6.3	8.3	10.6	6.9	10.4	17	18
125/E013	9.4	11.2	4.5	6.3	9.1	11.4	6.9	10.4	21	22
250/E025	11.6	13.4	5.1	6.9	11.3	13.7	9.1	13.0	34	35
500/E051	11.6	13.4	5.1	6.9	11.3	13.7	9.1	13.0	37	39
1000/E091	13.4	15.2	5.5	7.3	14.3	16.7	9.1	13.0	51	58

1. Weight with Beacon option module
2. Weight with local interface module



NOTES

1. Insert bush supplied with unmachined bore.
   Largest bore can be supplied with solid piece bush.
2. Fixing bolts or rods supplied only on request.
3. dx: the maximum accepted diameter described by key, square or flat machining.
4. Position of the shaft with the valve closed.

OUTPUT DRIVE EN ISO 5211 STANDARD

	EN ISO 5211	Output drive dimensions (mm/in)		Order	Output drive dimensions (mm/in)				Order
Model	flange	Style square	l*	code	Flat	Bore diameter	Key	l*	code
063/E006	F05-F07	17/0.66	35/1.36	D4	14xD20 / 0.55xD0.78	-	-	35/1.36	E3
125/E013	F07-F10	22/0.86	54/2.11	D5	22xD30 / 0.86xD1.18	-	-	54/2.10	E5
250/E025	F07-F10-F12	22/0.86	54/2.11	D5	22xD30 / 0.86xD1.18	-	-	54/2.11	E5
500/E051	F10-F12	27/1.05	62/2.42	D6	-	D35 / D1.37	10x8 / 0.39x0.31	62/2.42	E6
1000/E091	F10-F14	36/1.41	40/1.56	D7	-	-	-	-	-
1000/E091	F12-F16	36/1.41	40/1.56	DA	-	D50 / D1.96	14x9 / 0.55x0.35	80/3.12	E9
2000/E171	F10-F14	36/1.41	40/1.56	D7	-	-	-	-	-
2000/E171	F12-F16	36/1.41	40/1.56	DA	-	D50 / D1.96	14x9 / 0.55x0.35	80/3.12	E9

* Insert length (mm/in)

OUTPUT DRIVE K TYPE NON-ISO FLANGES

		Output drive dimensions (mm/in)				
Model	K flange	Flat	Bore diameter	Key	l*	Order code
063/E006	44.45-82.55 / 1.75-3.25	12.7xD19 / 0.5xD0.74	-	-	35/1.36	U4
125/E013	82.55 / 3.25	-	D28.7 / D1.12	6.35x6.35 / 0.25x0.25	54/2.11	U8
250/E025	82.55-127 / 3.25-5	-	D28.7 / D1.12	6.35x6.35 / 0.25x0.25	54/2.11	U8
500/E051	82.55-127 / 3.25-5	-	D41.38 / D1.62	9.53x9.53 / 0.375x0.375	62/2.42	UA
1000/E091	127-165 / 5-6.5	-	D47.73 / D1.87	12.7x12.7 / 0.5x0.5	108/4.21	UC
2000/E171	127-165 / 5-6.5	-	D47.73 / D1.87	12.7x12.7 / 0.5x0.5	108/4.21	UC

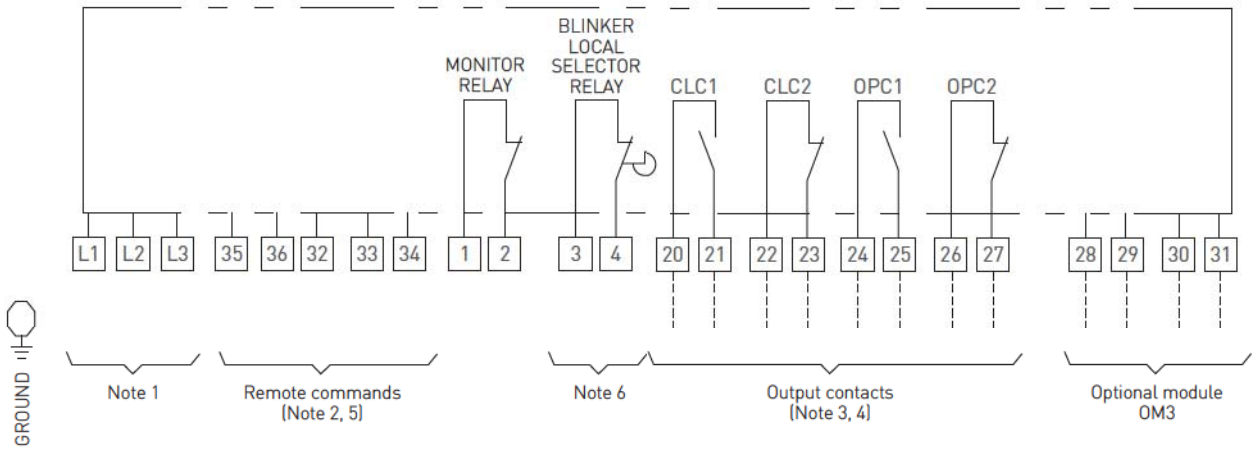
* Insert length (mm/in)

OUTPUT DRIVE NON-STANDARD

	Output drive dimensions (mm/in)			
Model	Ø d7 max	Ø dx max	SQ max	l*
063/E006	17/0.66	23/0.90	17/0.66	35/1.36
125/E013	22/0.89	29/1.13	22/0.89	54/2.11
250/E025	28/1.09	37/1,44	27/1.05	54/2.11
500/E051	28/1.09	37/1,44	27/1.05	62/2.42
1000/E091	40/1.56	49/1.91	36/1.41	108/4.21
2000/E171	40/1.56	49/1.91	36/1.41	108/4.21

* Insert length (mm/in)

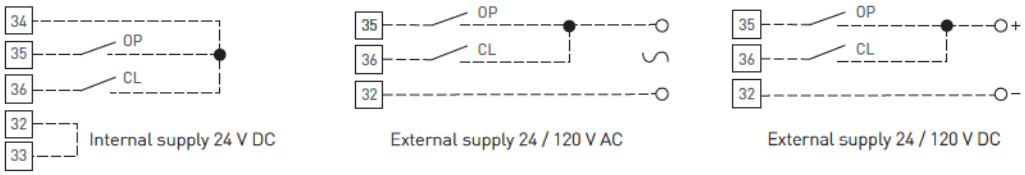
WIRING DIAGRAM - BASE VERSION



NOTES

1. Power connection L1-L2 for V DC or V AC single phase motor supply from 24 V to 48 V or from 100 V to 240 V.
   Power connection L1-L2-L3 for 3 phase motor supply from 208 V to 575 V (check the actuator label for the correct voltage to be applied).

2. Remote command options.



3. Contacts shown in intermediate position CLC1-CLC2 end of travel signaling in closing.
   Contacts shown in intermediate position OPC1-OPC2 end of travel signaling in opening.

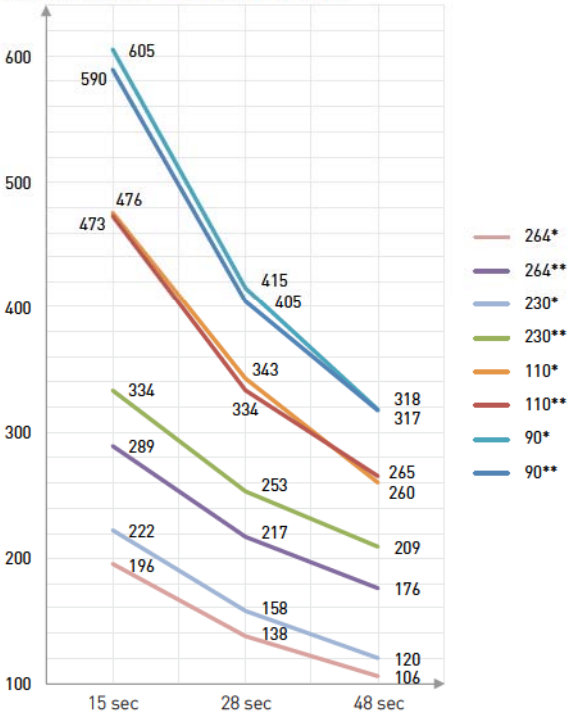
4. Output contact rating 240 V AC / 5 A ; 30 V DC / 5A ; 120 V DC / 0.5 A.

5. Control command rating 24 to 120 V AC or DC.

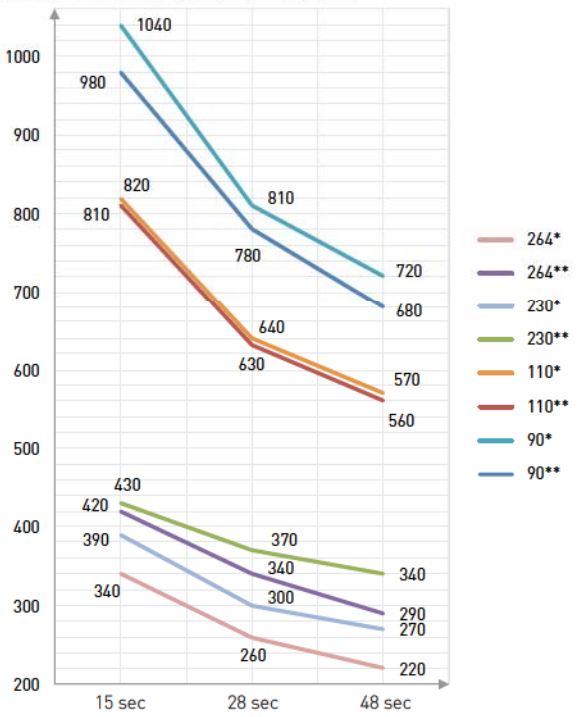
6. Blinker or local selector monitoring function (when OM3 is present) to be configured.

CURRENT ABSORPTION - SINGLE PHASE HIGH VOLTAGE (100-240 V)

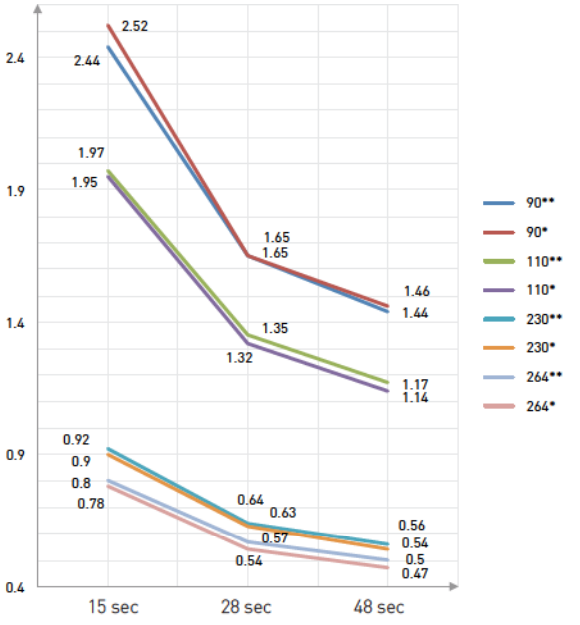
MODEL 63/E006 - ABSORPTION (mA)



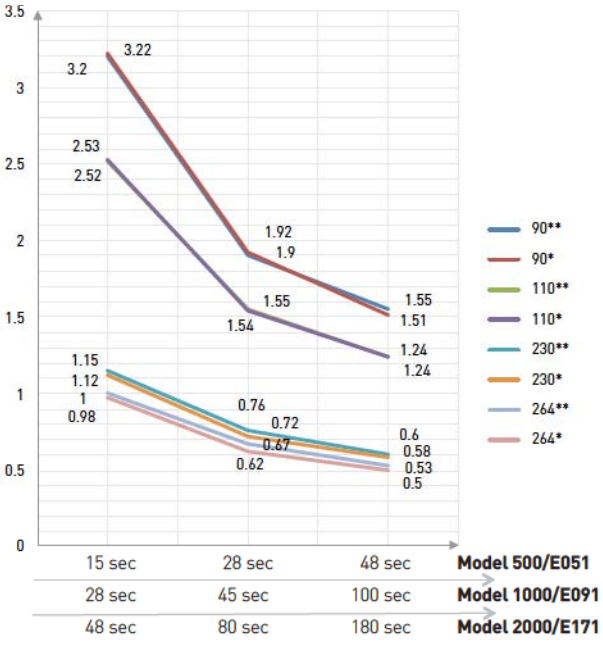
MODEL 125/E013 - ABSORPTION (mA)



MODEL 250/E025 - ABSORPTION (A)



MODELS 500/E051-1000/E091-2000/E171 - ABSORPTION (A)



NOTES

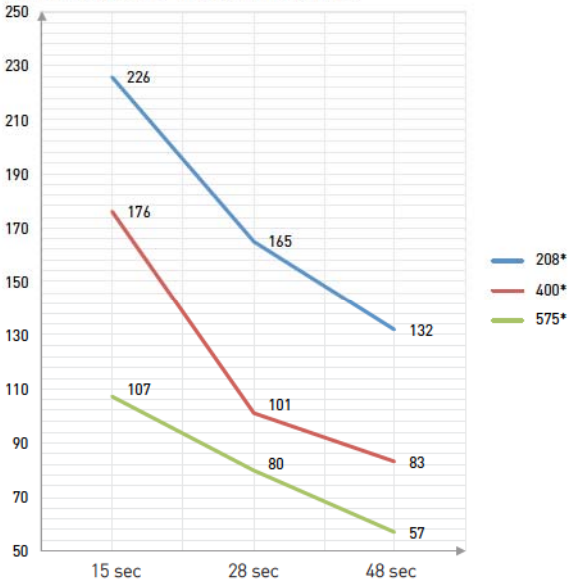
* V DC

** V AC

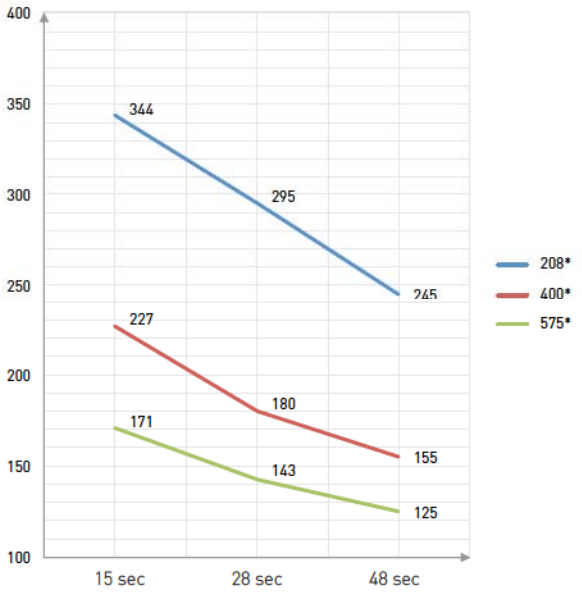
1. A = absorbed current (Amp) at nominal conditions (output torque 100%)
2. Max current (Amp) at stall conditions = 2xA
3. Power factor for V AC supply = 0.60
4. Peak current: max 8xIn
5. Peak current duration: less than 0.1 sec

CURRENT ABSORPTION - THREE PHASE VOLTAGE

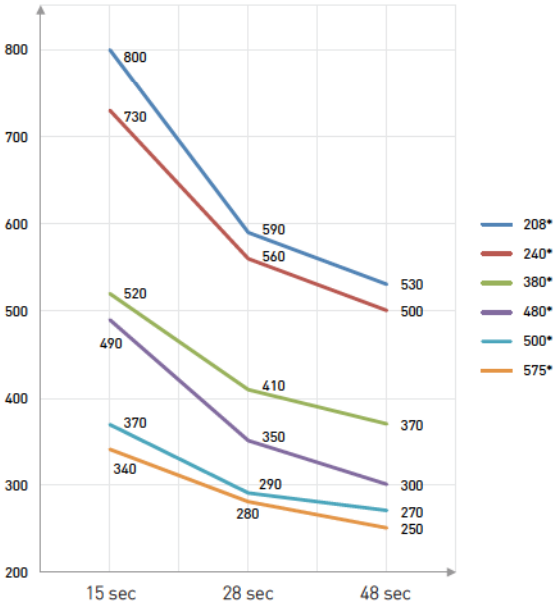
MODEL 063/E006 - ABSORPTION (mA)



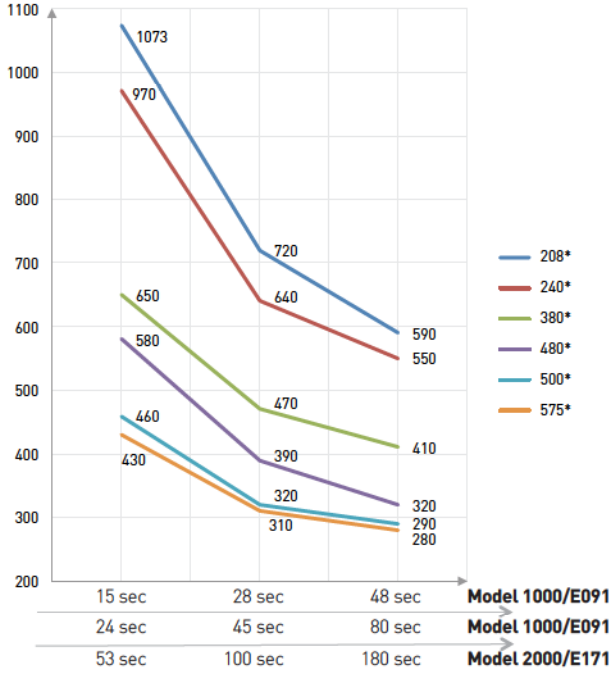
MODEL 125/E013 - ABSORPTION (mA)



MODEL 250/E025 - ABSORPTION (mA)



MODELS 500/E051-1000/E091-2000/E171 - ABSORPTION (mA)



NOTES

* V AC

1. 3-phases supply 50 or 60 Hz
2. A = absorbed current (Amp) at nominal conditions with output torque set at 100%
3. Power factor = 1 approx.
4. Starting current peak less than 10 microsecs

SELECTION GUIDE

Product

KPD	ISO 5211 with double star insert
KPE	ISO 5211 with flat or key insert
KPU	Non-ISO flange
KPB	ISO 5211 flange - insert not machined
KPK	Key non-ISO flange - insert not machined
KEU	(NPT) US version ISO 5211 flange with ISO insert, 4x 1"NPT entries

Models

063	Model 063/E006
125	Model 125/E013
250	Model 250/E025
500	Model 500/E051
1K0	Model 1000/E091
2K0	Model 2000/E171
06B	Model 063/E006 with Beacon
12B	Model 125/E013 with Beacon
25B	Model 250/E025 with Beacon
50B	Model 500/E051 with Beacon
1KB	Model 1000/E091 with Beacon
2KB	Model 2000/E171 with Beacon

Voltage

LV	1-phase voltage 24 to 48 V DC/V AC
HV	1-phase voltage 100 to 240 V DC/V AC
3A	3-phases from 208 to 240 V AC
3B	3-phases from 380 to 480 V AC
3C	3-phases from 500 to 575 V AC

Speed/Duty

PD	Standard speed range and standard duties for model 063/E006 to 500/E051
PE	Standard speed range and standard duties for model 1000/E091
PF	Standard speed range and standard duties for model 2000/E171

Optional modules

00	No optional modules
P1	OM1
PA	OM1/OM3/Bluetooth
P6	OM1/OM3
P7	OM1/Bluetooth
P3	OM3
5P	OM9/Bluetooth
6P	OM9/OM3/Bluetooth
5D	OM11/Bluetooth
6D	OM11/OM3/Bluetooth
PG	OM13

Approvals/Protections

0	Standard protection NEMA 4/4X/6 (IP66/68M) - CSA certificate T°amb from -40°C to +60°C / -40°F to +140°F
2	Standard protection NEMA 4/4X/6 (IP66/68M) T°amb from -25°C to +70°C / -13°F to +158°F
3	Standard protection NEMA 4/4X/6 (IP66/68M) T°amb from -40°C to +70°C / -40°F to +158°F

Flange/Insert

00	No flange insert
B4	Model 063/E006 flange ISO 5211/F05/F07 - insert not machined (KPB)
B5	Model 125/E013 flange ISO 5211/F07/F10 - insert not machined (KPB)
B5	Model 250/E025 flange ISO 5211/F07/F10/F12 - insert not machined (KPB)
B6	Model 500/E051 flange ISO 5211/F10/F12 - insert not machined (KPB)
B7	Model 1000/E091-2000/E171 flange ISO 5211/F10/F14 - insert not machined (KPB)
BA	Model 1000/E091-2000/E171 flange ISO 5211/F12/F16 - insert not machined (KPB)
D4	Model 063/E006 ISO 5211 (KPD)
D5	Models 125/E013-250/E025 ISO 5211 (KPD)
D6	Model 500/E051 ISO 5211 (KPD)
D7	Models 1000/E091-2000/E171 F10 to F14 ISO 5211 (KPD)
DA	Models 1000/E091-2000/E171 F12 to F16 ISO 5211 (KPD)
E3	Model 063/E006 ISO 5211 (KPE)
E5	Models 125/E013-250/E025 ISO 5211 (KPE)
E6	Model 500/E051 ISO 5211 (KPE)
E9	Models 1000/E091-2000/E171 F12 to 16 ISO 5211 (KPE)
K4	Model 063/E006 flange key 44.45-82.6 - insert not machined (KPK)
K8	Model 125/E025 flange key 82.6 - insert not machined (KPK)
K8	Model 250/E025 flange key 82.6-127 - insert not machined (KPK)
KA	Model 500/E051 flange key 82.6-127 - insert not machined (KPK)
KC	Model 1000/E091-2000/E171 flange key 127-165 - insert not machined (KPK)
U4	Model 063/E006 non-ISO (KPU)
U8	Models 125/E013-250/E025 non-ISO (KPU)
UA	Model 500/E051 non-ISO (KPU)
UC	Models 1000/E091-2000/E171 non-ISO (KPU)

KPD	063	LV	PD	P1	2	D4	= Model number **KPD063LVPDP12D4**

PENTAIR

KEYSTONE EPI-2 QUARTER-TURN ELECTRIC ACTUATOR

INSTALLATION & MAINTENANCE INSTRUCTIONS



INDEX

1	General safety instructions	1
2	Machine description	4
3	Storage end pre-installation	6
4	Installation	7
5	Lubrication	15
6	Actuator setting and configuration	15
7	Maintenance and trouble-shooting	21
8	Decommissioning	22
9	Parts list and drawings	22

1. GENERAL SAFETY INSTRUCTIONS

1.1 INTENDED USE

The EPI-2 electric actuators covered in this Instruction and Operating Manual are designed for the operation of any kind of quarter-turn industrial valves (i.e., ball, butterfly, plug and control valves) used in a wide range of applications ranging from heavy industrial, chemical, petrochemical plants, waterworks, water pipelines, waste paper plants and power plants to food, brewing and heating, ventilation, air conditioning, etc.
Pentair Valves & Controls will not be liable for any possible damage or physical injury resulting from use in other than the designated applications or by lack of care during installation, operation, adjustment and maintenance of the machine. Such risks lie entirely with the user. Depending on the specific working conditions, additional precautions may be requested.
Considering that Pentair has no direct control over particular applications, operation or maintenance conditions, it is the operator's responsibility to comply with all applicable safety rules.
Please inform Pentair urgently if you face unsafe situations not described in this IOM. It is the sole responsibility of the operator to ensure that the local health and safety regulations are adhered to.
EPI-2 are tested according to EN 21680.
Noise level is less than 65 dB (grade A) at 1 m distance.

WARNING

It is assumed that the installation, configuration, commissioning, maintenance and repair works are carried out by qualified personnel and checked by responsible specialists.

WARNING

Any repair work, other than the operations outlined in this manual, is strictly reserved to qualified Pentair personnel or to personnel directly authorized by the company itself.

EPI-2 electric actuators are designed in accordance with the applicable international rules and specifications, but the following regulations must be observed in any case:

- The general and safety regulations
- The plant specific regulations and requirements
- The proper use of personal and protective devices (glasses, clothing, gloves, etc.)
- The proper use of tools, lifting and transport equipment
- Electrical installation, use and maintenance on EPI-2 has to be carried out in accordance with the National Legislation and statutory requirement related to the safe use of EPI-2 actuators, applicable to the site of installation
- Should further information and guidance related to the safe use of EPI-2 actuators is requested, please contact Pentair

WARNING

The electronic parts of the EPI-2 and all the optional modules can be damaged by a discharge of static electricity. Before you start, touch a grounded metal surface to discharge any static electricity.

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1.2 TERMS AND CONDITIONS

Pentair guarantees each single product to be free from defects and to conform to current goods specifications. The warranty period is one year from the date of installation by the first user, or eighteen months from the date of shipment to the first user, whichever occurs first.
No warranty is given for products which have been subject to improper storage, improper installation, misuse, or corrosion, or which have been modified or repaired by unauthorized personnel.
Repair work due to improper use will be charged at standard rates.

1.3 MANUFACTURER'S LIABILITY

Pentair declines all liability in the event of:
- Use of the actuator in contravention of local safety at work legislation
- Incorrect installation, disregard or incorrect application of the instructions provided on the actuator nameplate and in this manual
- Modifications without Pentair's authorisation
- Work done on the unit by unqualified or unsuitable persons

1.4 IDENTIFICATION

1.4.1 Water-, dust-proof version

EPI-2 actuators are designed and manufactured according to EN 60529 standards.
Specific types of protection are printed on the label, as follows:
- IP66/68
- NEMA 4/4X/6 according to NEMA ICS6/ NEMA 250

1.4.1.1 Label for application in water-, dust-proof areas

Marking description (see Figure 1A).

1.4.2 Explosionproof version

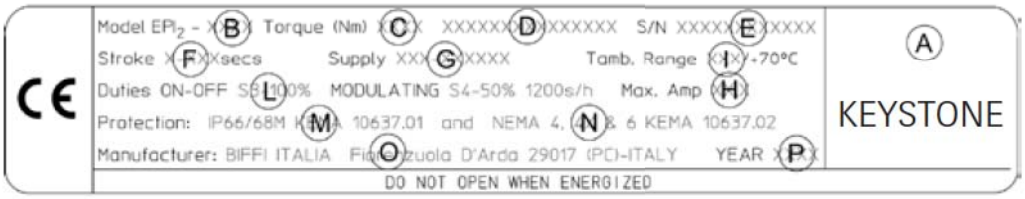
The version of EPI-2 suitable for installation in hazardous areas is designed and manufactured according to EN 50014, 50018, 50019, EN 50281-1-1 standards.
Different types of protection are available, depending on the requirements of the installation site.
The driven valve or associated gear reducer will form part of a separate risk analysis according to Directive ATEX 94/9/EC and following the EN 13463-1 and 13463-5 norms.
Specific types of protection are printed on the label, as follows:
- ATEX Ex de IIB T5 with enclosures in 'explosionproof' version and terminal board enclosure in 'increased safety' version
- FM rated as flameproof for Class I, Zone 1, Group IIB, T5; Class II, III, Div. 1, Groups E, F and G, T4
- NEMA 7 and NEMA 9

The above versions of EPI-2 prevent the risk of explosion in the presence of gas or ignitable dusts.
EPI-2 actuators have IP66/68M protection degree in accordance with EN 60529.

WARNING

Whenever EPI-2 actuators must be installed in a HAZARDOUS AREA as defined by the applicable rules, it is mandatory to check whether the actuator nameplates indicate their suitability to a hazardous area, and the appropriate protection degree. Maintenance and repair works must be carried out by qualified personnel and checked by responsible specialists.

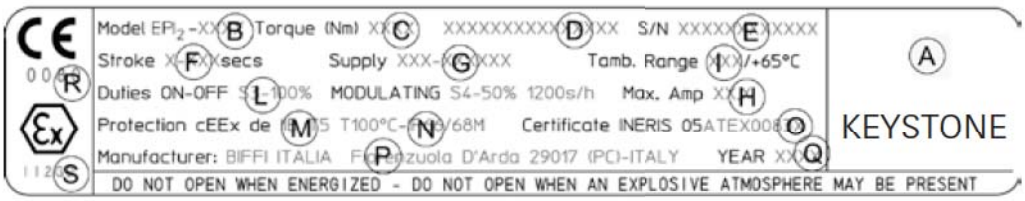
FIGURE 1A



- (A) Manufacturer logo
- (B) Product model
- (C) Nominal output torque value
- (D) Product code
- (E) Serial number
- (F) Stroking time range
- (G) Power supply data
- (H) Max current absorption in ampere
- (I) Environmental data
- (L) Actuator duties
- (M) Weatherproof protection degree (EU & US)
- (N) Weatherproof certificate reference (EU & US)
- (O) Manufacturer details
- (P) Year of construction

1.4.2.1 ATEX label for application in hazardous areas

FIGURE 1B



- (A) Manufacturer logo
- (B) Product model
- (C) Nominal output torque value
- (D) Product code
- (E) Serial number
- (F) Stroking time range
- (G) Power supply data
- (H) Max current absorption in ampere (at 24 V DC)
- (I) Environmental data
- (L) Actuator duties
- (M) Explosionproof protection degree
- (N) Weatherproof protection degree **(IP66/NEMA types 4,4X&6 when labelled FM)**
- (O) ATEX certificate reference
- (P) Manufacturer details
- (Q) Year of construction
- (R) Notified body for ATEX quality assurance (Ineris)
- (S) ATEX marking

1.5 APPLICABLE STANDARDS AND REGULATIONS

EN ISO 12100-1	Safety of machinery - Basic concepts, general principles for design Part 1 - Basic terminology, methodology
EN ISO 12100-2	Safety of machinery - Basic concepts, general principles for design Part 2 - Technical principles and specification
EN 60204-1	Electrical equipment of industrial machines Part 1 - General requirements
98/37/EC	Machinery Directive
2006/95/EC	Low Voltage Directive
2004/108/EC	EMC Directive
94/9/EC	ATEX Directive

1.6 EXTRACT FROM THE STANDARD

Type of hazard zone	Zone	Categories according to 94/9/EC Directive
Gas, mist or vapors	0	1G
Gas, mists or vapors	1	2G
Gas, mists or vapors	2	3G
Dust	20	1D
Dust	21	2D
Dust	22	3D

1.7 MANUFACTURER

Manufacturer with respect to Machinery Directive 98/37 is Biffi Italia, as specified on the actuator label.

2. MACHINE DESCRIPTION

2.1 GENERAL

The EPI-2 is an electric quarter-turn actuator suitable to operate a valve in a 90° manoeuver.

2.2 PRINCIPLE OF OPERATION

The electric motor drives the input to an epicyclical gear train via a spur reduction. The input member of the epicyclical gear train carries two compound planet gears which meshes with one internally toothed gears: the fixed annulus. The fixed annulus gear has external helical teeth meshing with a transversely fixed worm gear. Since the annulus cannot drive the worm gear this provides a fixing point for the annulus, and since the worm gear can drive the annulus, a means of manual operation is provided which needs no declutch.
An end-of-travel-position detection device is operated via a position sensor directly linked to the output shaft. The valve position is continuously monitored in electric mode by means of a position sensor directly connected to the EPI-2 output drive.

2.3 ELECTRICAL OPERATION

- Control command 'open': counter-clockwise or clockwise rotation (selectable on the logic board) moves the valve to a completely or partially open position.
- Control command 'closed': clockwise or counter-clockwise rotation (selectable on the logic board) moves the valve to a completely or partially closed position.

Control system details are shown in the specific wiring diagram.

IMPORTANT
Handwheel rotation
In standard applications clockwise rotation of the handwheel moves the valve to close position and counter-clockwise rotation moves the valve to open position.
Different operation are clearly indicated on the handwheel.

2.4 MANUAL OPERATION

To be used in case of power supply failure or during actuator setting.
The manual operating device is completely independent of the motor drive and can be operated at any time, whether or not the motor is running, without danger to the operator.
The handwheel does not rotate during power operation.
To close the valve turn the handwheel clockwise.
To open the valve, turn the handwheel counter-clockwise.
If the handwheel is turned during electric operator, an error will occur and the actuator will stop. After few seconds the actuator will restart its operation and move the valve to the requested position.

FIGURE 2



2.5 DESCRIPTION OF THE MAIN PARTS

The EPI-2 actuator consists of five main parts:

- Base flange: for coupling the actuator to the valve
- Terminals enclosure: for power and signal cable connection through four available cable entries
- Mechanical gearing: internal epicyclical gear reduction, which increases the torque of the electric motor
- Control unit: integral control unit inclusive of electric motor with the relevant driver, power and logic electronic card. By way of the mechanical gearing, the electric motor operates the valve in normal working conditions
- Manual override: for actuator manual operation in case of power supply failure or during actuator setting

2.6 OPTIONAL MODULES

EPI-2 actuators can be provided with several optional modules, as listed in the table below. Please refer to this table for possible combinations of available modules.

2.7 OPTIONS LABEL

A label is always provided with base actuators where optional modules will have to be checked out once they are installed after delivery at local organisations' care.

OPTIONAL MODULES SELECTION TABLE

Order code	OM1 I/O additional module	OM3 local interface	Bluetooth component	OM9 PDP V0/V1	OM11 DeviceNet	OM13 3 wires module
P1	✓					
PA	✓	✓	✓			
P6	✓	✓				
P7	✓		✓			
P3		✓				
5P			✓	✓		
6P		✓	✓	✓		
5D			✓		✓	
6D		✓	✓		✓	
PG						✓

NOTES

1. Each optional module (OMx) will be provided with its own Installation & Maintenance Instructions. All modules except OM13 are available for both 1-phase and 3-phase voltage versions.
2. Bluetooth component is integrated in the OM1, OM9 and OM11 card: not available for integration by local organizations, as a stand alone unit.
3. OM13 is not available with 3-phase supply. Not available for LV version (1-phase voltage from 24 to 48 V DC/V AC).

Options Label		
S/N:		
OM1	OM3	OM9
OM11	OM13	

FIGURE 3

Please make sure the label is stuck where shown in the picture below.



FIGURE 4

3. STORAGE AND PRE-INSTALLATION

3.1 CHECKS TO BE CARRIED OUT WHEN THE ACTUATOR IS RECEIVED

IMPORTANT
Not performing the following procedures will invalidate the product guarantee.

First of all check if the data on the nameplate (model, serial number, nominal torque, nominal voltage range, protection degree, operating speed range, protection class, etc.) correspond to the expected product data.
If the actuator is received already assembled onto the valve, the setting of the mechanical stops and of the electric end-of-travel should have been already done during actuator assembly onto the valve. An additional check is anyway recommended to verify that all the requested settings have been completed as indicated in the present Instruction and Operating Manual.
If the actuator is received separately from the valve, the setting of the mechanical stops and of the electric end-of-travel must be checked and, if necessary, carried out while assembling the actuator onto the valve. In any case, all the setting operations described in this Instruction and Operating Manual must be carried out.
Check that the actuator was not damaged during transport: in particular, inspect the local position indicator area glass. If necessary, repair all damages to the paint-coat, etc.
Check that the fitted accessories comply with those listed in the order acknowledgement and the delivery note.

3.2 STORAGE PROCEDURE

3.2.1 General
The actuators leave the factory in perfect working conditions and with an excellent finish, in order to maintain these characteristics until the actuator is installed on site, it is necessary to observe a few rules and take appropriate measures during the storage period.
The basic version of EPI-2 actuators is weatherproof to IP66/68. This condition can only be maintained if the units are correctly installed and connected on site, and if they were previously correctly stored. The standard plastic plugs used to close the cable entries are not weatherproof, they just prevent the entry of undesired objects during transport.
Pentair cannot accept responsibility for deterioration caused on site when the covers are removed.

IMPORTANT
The actuator handwheel is removed for transport. If the actuator must be shipped fully assembled, please make sure the handwheel is packed securely to avoid all possible damage.

3.2.2 Storage for a brief period (less than one year)
3.2.2.1 Indoor storage
- Make sure the actuators are kept in a dry place, laid on a wooden pallet (not directly on the floor surface) and protected from dust
- In very humid environments, a moisture absorbent desiccant packet should be introduced in the motor enclosure. (Desiccant is not included in the actuator package)

3.2.2.2 Outdoor storage
- Make sure the actuators are protected from the direct action of weather agents (protection by a canvas tarp or similar). Environment temperature: -20°C to +65°C (-4°F to 149°F)
- Place the actuators on a wooden pallet, or some raised platform, so that they are not in direct contact with the ground, and protected from dust
- In very humid environments, a moisture absorbent desiccant packet should be introduced in the motor enclosure. (Desiccant is not included in the actuator package)
- If the actuators are supplied with standard plastic plugs, remove them from the cable entries and replace them with weatherproof plugs

3.2.3 Long period storage (more than one year)
3.2.3.1 Indoor storage
In addition to the instructions at point 3.2.2.1:
- If the actuators are supplied with standard plastic plugs, replace them with weatherproof plugs
- The coupling parts (i.e. flange, etc.) must be coated with a protective oil or grease; (if possible, blank off the flange by a protection disk)

3.2.3.2 Outdoor storage
In addition to point 3.2.2.2:
- If the actuators are supplied with standard plastic plugs, replace them with weatherproof (metal) plugs
- The coupling parts (i.e. flange, etc.) must be coated with a protective oil or grease; (if possible, blank off the flange by a protection disk)
- Check the actuator general conditions, paying particular attention to the terminal board

4. INSTALLATION

4.1 CHECKS TO BE PERFORMED BEFORE INSTALLATION

To assemble the actuator onto the valve proceed as follows:

- Check that the coupling dimensions of the valve flange and stem, or of the relevant extension, meet the actuator coupling dimensions
- The electrical supply cables must be suitable for the power rating
- Gather the necessary tools for the assembly and configuration of the actuator controls
- Lubricate the valve stem with oil or grease to make the assembly easier: pay attention not to contaminate with lubricant the flange surfaces which transmit the actuator torque
- Clean the valve flange and remove anything that might prevent a perfect adherence to the actuator flange and especially all traces of grease
- Install the actuator onto the valve so that the shaft output drive enters the groove of the stem extension. This coupling must take place without forcing and only with the weight of the actuator. When the actuator output shaft and the valve stem are connected, check the holes of the valve flange. If they do not meet with the holes of the spool piece flange or the stud bolts screwed into them, the actuator shaft output drive must be rotated. Actuate the manual override until coupling is made possible. Tighten the nuts of the connecting stud bolts evenly
- If possible, operate the actuator to verify it moves the valve smoothly

If a long storage period has occurred, before reinstalling the actuator, please:

- Check the status of the O-ring seals
- Check the installation of the plugs or cable glands on the cable entries
- Check whether the enclosure covers or the actuator body are cracked or broken

4.2 WORKING CONDITION

Standard EPI-2 actuators are suitable for the following environment temperatures:

- -25°C to +70°C (-13°F to +158°F)

Special versions are available for extreme environment temperatures:

- -40°C to +70°C (-40°F to +158°F)

4.3 COUPLING BLOCK

The electric actuator is delivered with drive details and flange in accordance with the technical characteristics required by the customer, ready to be installed onto the valve. Only one insert is included in the actuator package delivered to end users.

IMPORTANT
Check the 'ambient temperature range' printed on the nameplate, for the correct utilisation with respect to the ambient temperature. Installation in ambient with temperature range outside the specified values will invalidate the warranty.

WARNING
During normal operation the temperature of the actuator surface can reach 30°C (86°F) above the ambient temperature.

IMPORTANT
In case the screws of the cover, of the terminal compartment and of the OM3 must be replaced, SS Class A4 grade 80 screw must be used with minimum yield strength 600 N/mm².
Every time the main cover, the terminal compartment cover and the OM3 are reassembled, make sure to tight all the screws with 5 Nm torque.



FIGURE 5 - Overview of one type of insert and drive details of the EPI-2.

WARNING
Never lift the valve/actuator assembly without securing slings to both the valve and the actuator.

Never use the handwheel to lift the actuator.

4.4 INSTALLATION OF THE EPI-2 UNIT ONTO A VALVE

Move the valve to the completely open position. Manually bring the EPI-2 to the completely open position (verify the local mechanical indicator) and check the rotation direction of actuator and valve. The actuator should be mounted for counter-clockwise rotation to open and clockwise to close.

The EPI-2 unit can be installed onto the valve in two different ways:

Direct mounting:
Insert the valve shaft into the actuator bottom flange, taking care to correctly connect the insert. Fix the screws on the valve flange to the actuator coupling block.

Bracket mounting:
Install the bracket and the adapter onto the valve; then insert the valve shaft into the actuator bottom flange, taking care to correctly connect the insert.
Fix the screws between the bracket and the valve flange and the actuator coupling block.

4.5 MANUAL OPERATION

EPI-2 electric actuators are supplied with a handwheel for manual override as standard, to operate the actuator in case of power supply failure or during setting.
The handwheel is always engaged. For safe operation, the handwheel does not rotate during electric operation.
Turn the handwheel clockwise to close and counter-clockwise to open.
During manual operation, check the actuator manoeuver on the local mechanical indicator.

WARNING
Do not manually operate the actuator with devices other than the handwheel. Using cheater bars, wheel wrenches, pipe wrenches, or other such devices on the actuator handwheel may cause serious personal injury and/or damage to the actuator or valve.



FIGURE 6 - Manual operation.

4.6 SETTING OF THE ANGULAR STROKE: MECHANICAL STOPS

It is important for the mechanical stops to end the angular stroke at both extreme valve positions (fully open and fully closed).
The setting of the angular stroke is performed by adjusting the travel stop screw mounted on the actuator housing.
For the adjustment of the stop screw proceed as follows:

- Loosen the lock nut
- Screw 1: open
  To set the mechanical stop in opening, manually bring the actuator to the completely open position, then turn screw 1 clockwise to find the correct position, then block it by means of the nut
- Screw 2: close
  To set the mechanical stop in closing, manually bring the actuator to the completely close position, then tighten screw 2

If the actuator angular stroke is stopped before reaching the end position (fully open or closed), proceed as follows:

- Unscrew the stop screw by turning it anticlockwise until the valve reaches the correct position
- When unscrewing the stop screw, keep the lock nut still with a wrench so that the sealing washer does not withdraw together with the screw
- Tighten the lock nut

If the actuator angular stroke is stopped beyond the end position (fully open or closed), proceed as follows:

- Screw the stop screw by turning it clockwise until the valve reaches the correct position
- Tighten the lock nut

4.7 ELECTRICAL CONNECTIONS

Before powering the actuator, check that the supply voltage details on the nameplate are correct for the plant. Access to terminals for electrical connections is through the terminal cover.

WARNING

After electrical on-field installation, please make sure all removal of the cover assembly is done in total observance of the applicable safety rules.

All the accessories (cable glands in particular) must be certified according to the requirements of the installation area and the relevant applicable regulations.

Setting must be done while the actuator is powered on. As a consequence, all setting operations must be carried out by specifically qualified personnel for operations on powered electronic cards.

4.8 PLANT REQUIREMENTS

Protection devices (over-current breakers, magneto-thermal switches or fuses) must be provided by the customer to protect the main lines in case of motor over-current or loss of insulation between phases and earth.

IMPORTANT

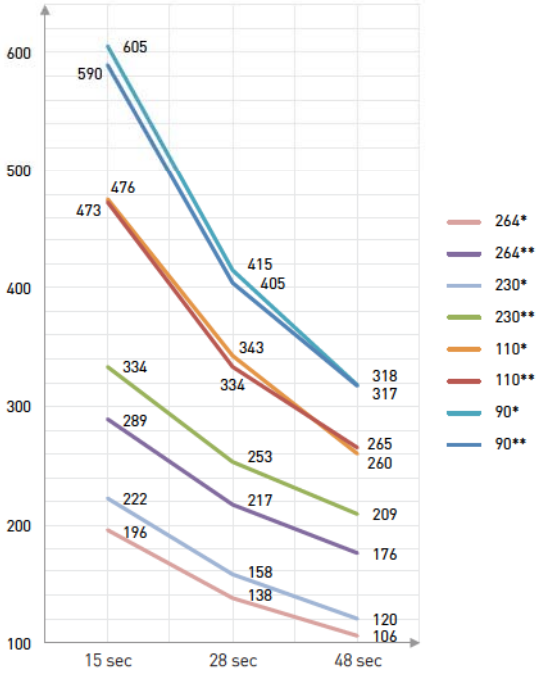
The following circuit breakers were identified on the basis of the actuator technical features:
- Reference: IEC EN 60947-2
- Characteristic: K
It is the plant engineer's or installer's responsibility to select the most appropriate electric protection.



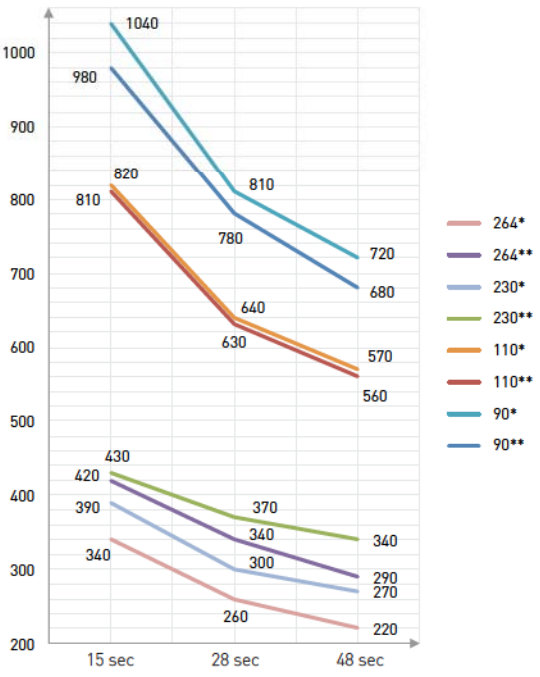
FIGURE 7 - Setting of the mechanical stop.

FIGURE 8 - CURRENT ABSORPTION 1-PHASE POWER SUPPLY HIGH VOLTAGE (100-240 V DC / V AC)

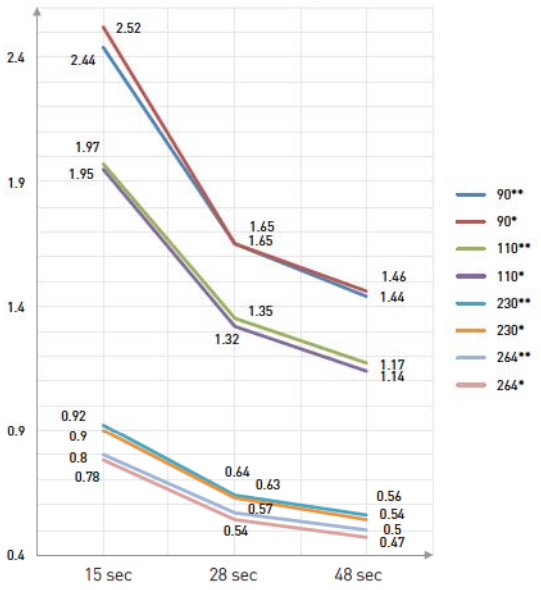
MODEL 63/E006 - ABSORPTION (mA)



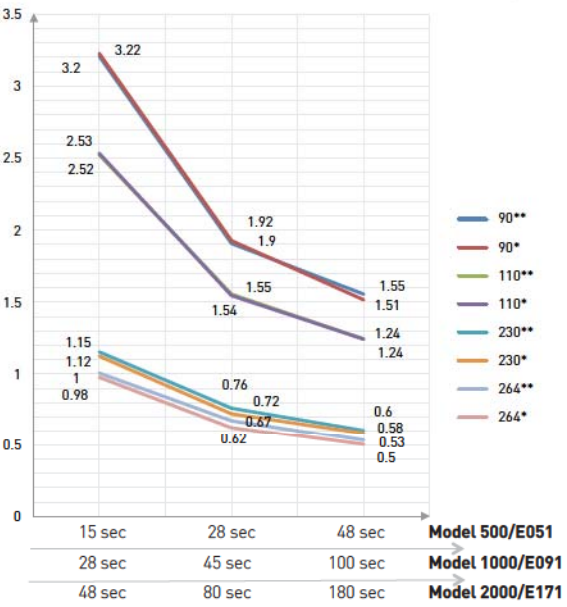
MODEL 125/E013 - ABSORPTION (mA)



MODEL 250/E025 - ABSORPTION (A)



MODELS 500/E051-1000/E091-2000/E171 - ABSORPTION (A)



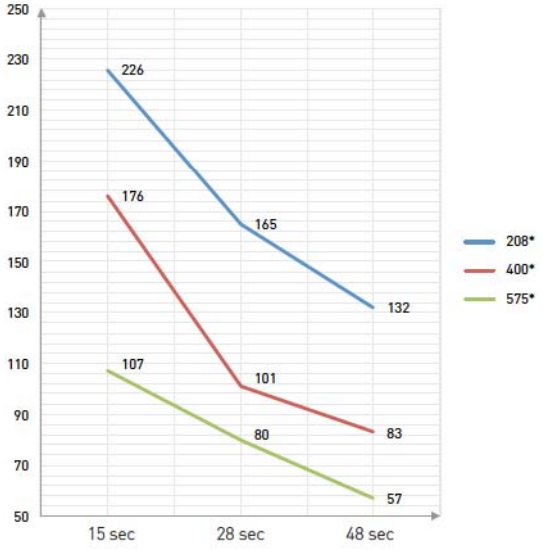
NOTES

* V DC ** V AC

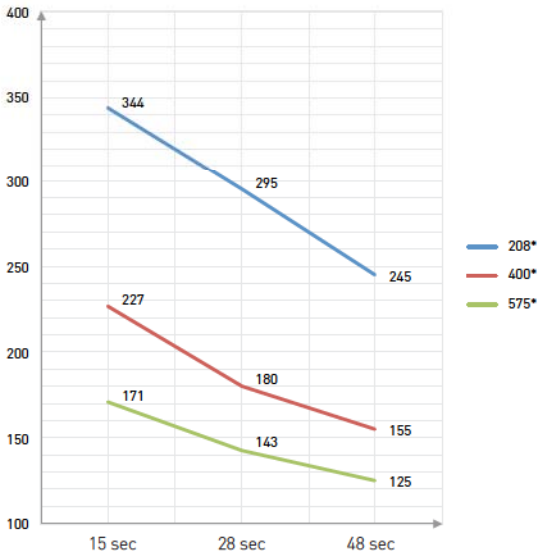
1) A = absorted current (Amp) at nominal conditions (output torque 100%)
2) Max current (Amp) at stall conditions = 2xA
3) Power factor for V AC supply = 0.60
4) Peak current: max 8xIn
5) Peak current duration: less than 0.1 secs

FIGURE 9 - CURRENT ABSORPTION (THREE PHASE VOLTAGE)

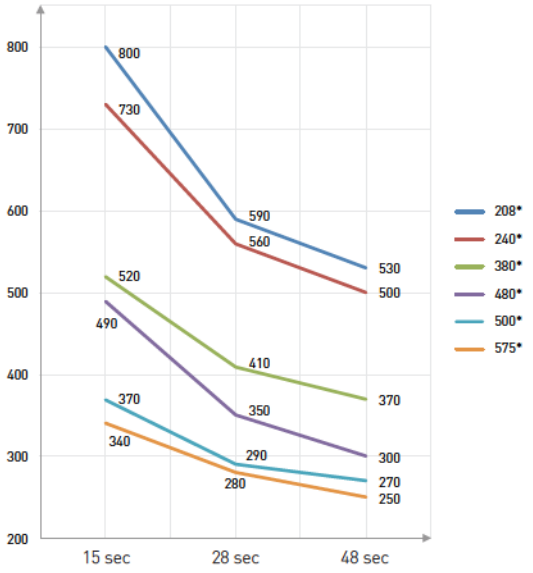
MODEL 063/E006 - ABSORPTION (mA)



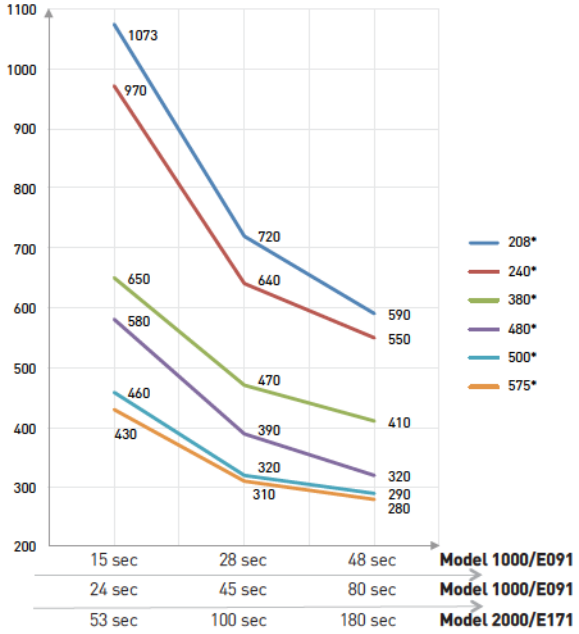
MODEL 125/E013 - ABSORPTION (mA)



MODEL 250/E025 - ABSORPTION (mA)



MODELS 500/E051-1000/E091-2000/E171 - ABSORPTION (mA)



NOTES

* V AC

1) 3-phases supply 50 or 60 Hz
2) A = absorted current (Amp) at nominal conditions with output torque set at 100%
3) Power factor = 1 approx.
4) Starting current peak less than 10 microsecs

4.9 REMOVAL OF THE TERMINAL BOARD ENCLOSURE

Using a 5 mm Allen key, loosen the four screws and remove the cover.



FIGURE 10 - Removal of the terminal board enclosure.

WARNING
Pay attention not to damage the joint surfaces of the cover.

4.10 CABLES CONNECTIONS

Before applying voltage to the EPI-2 check that the electrical parameters (supply voltage and current) shown on the nameplate and on the attached wiring diagram are correct for the installation.



FIGURE 11 - Overview of the electrical connections.

IMPORTANT
All the accessories which equip the EPI-2, in particular the cable glands, must be certified according to the Standard Directive and specific Rules applying to the products.

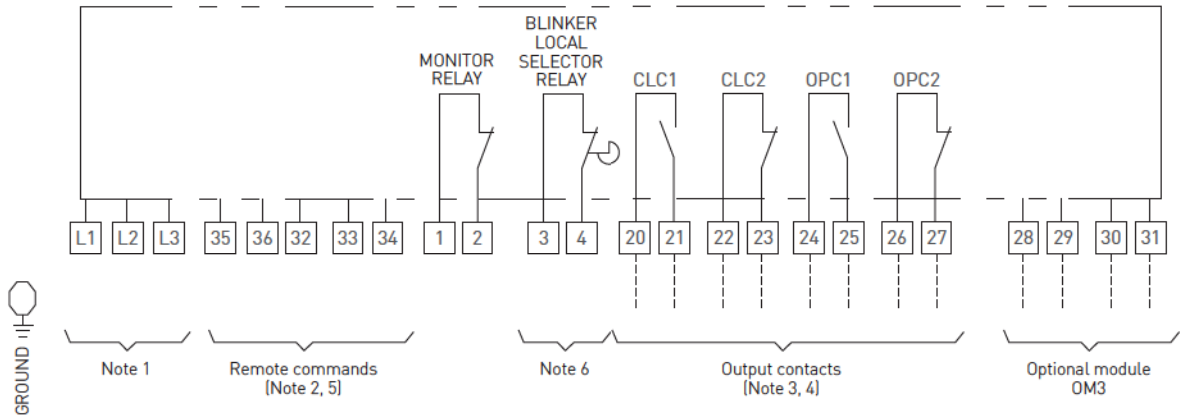
WARNING
Do not remove earth connection X while connecting the actuator to plant earthing.

Remove the plugs from the cable entries.
For electrical connections use components (cable glands, cables, hoses, conduits) which meet the requirements and the applicable codes of the plant specifications (mechanical protection and/or explosionproof protection).
Screw the cable glands (or the conduits) tightly into the threaded entries, in order to guarantee the weatherproof and explosionproof protection (when applicable).
Insert the connection cables into the electrical enclosures through the cable glands (or conduits) and, according to the wiring diagram in the main terminal board enclosure, connect the electrical supply, the control and the signal cables to the actuator, by linking them to the terminal blocks termination as per diagram.
Replace the plastic plugs of the unused cable entries by metal ones, to guarantee perfect weatherproof tightness and to comply with the explosionproof protection codes (where applicable).
Once the connections are completed, check that the controls and signals work properly.
Two ground studs, one internal and one external, are provided to meet all local electric and safety regulations.
Terminate the ground connections at least to the external stud marked GROUND.

Connect the motor supply cable previously sized in accordance with:

- The absorbed current correspondent to the actuator nominal torque with the torque limiting device set at 100 percent
- Cable size; 1 power: 4 mm²/AWG12 (max) 2 controls: 1,5 mm²/AWG 16 (max)
- The applicable plant and safety norms

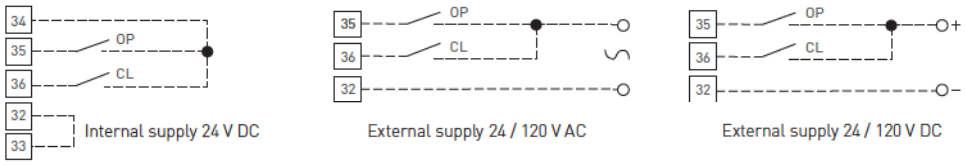
4.11 BASE WIRING DIAGRAM (FIGURE 12)



NOTES

1. Power connection L1-L2 for V DC or V AC single phase motor supply from 24 V to 48 V or from 100 V to 240 V.
   Power connection L1-L2-L3 for 3-phase motor supply from 208 V to 575 V (check the actuator label for the correct voltage to be applied).

2. Remote command options.



3. Contacts shown in intermediate position CLC1-CLC2 end of travel signaling in closing.
   Contacts shown in intermediate position OPC1-OPC2 end of travel signaling in opening.

4. Output contact rating 240 V AC / 5 A ; 30 V DC / 5A ; 120 V DC / 0.5 A.

5. Control command rating 24 to 120 V AC or DC.

6. Blinker or Local Selector monitoring function (when OM3 is present) to be configured.

WARNING

It is under user responsibility to limit the rated impulse voltage level at 1500 V.

4.12 CABLE ENTRIES

The sealing of cables and conduit entries should be carried out in accordance with National Standards or the Regulatory Authorities that have certified the actuators. This is particularly true for units that are certified for use in hazardous areas where the method of sealing must be to an approved standard, and cable glands, reducers, plugs and adapters must be approved and separately certified.

IMPORTANT

- *To prevent any water infiltration through the cable conduits, make sure the cable glands have the minimum protection degree required by the plant.*
- *If rigid conduits are used, we suggest placing a flexible pipe connection between the conduit and the terminal board.*

In order to properly connect the cables, remove the cable entry plugs and make all the necessary connections.
To guarantee the proper weatherproof fit, degree IP66/68 must be ensured: screw the cable glands tightly and block them with a thread sealant. The use of a thread sealant is necessary in case of explosionproof application.

If some parts of the cable glands have been removed while working on the cable entries, put them back into place in order to avoid losing the dismantled parts.
Unused entries:

- For explosionproof construction: unused entries must be plugged with metal explosionproof plugs and blocked with a thread sealant
- For weatherproof construction: replace the standard plastic protection plugs supplied with the actuator with suitable plugs to guarantee the requested protection degree

IMPORTANT

In order to physically separate the power from the signal terminal, place the power clamps protection (provided with the actuator) on the power terminal, once you have completed the power cable connection. This will avoid any accidental contact with the power terminals during the cabeling operation on the signal terminals.



FIGURE 13 - Overview of the cable entries conduits.

4.13 SAFETY INSTRUCTIONS FOR INSTALLATION IN HAZARDOUS AREA

4.13.1 Instructions for explosionproof enclosures

IMPORTANT

EPI-2 electric actuators must be installed and maintained according to the applicable Rules regarding the electrical installation in hazardous areas (other than mines) classified as zone 1 and/or 2 (gas) and zone 21 and/or 22 (dust) according to EN 60079-10 (hazardous area classification). Example: EN 60079-14 (electrical installation), EN 60079-17 (maintenance).

During the dismantling and subsequent reassembling of the explosionproof enclosures (covers, cable glands, joints) be careful to bring these enclosures back to their original condition to maintain their integrity. In particular, be sure the joint surfaces of all enclosures are spread with a film of recommended grease.
Proceed as follows:

- Do not damage the explosionproof mating surfaces on the housing and on the electrical enclosure covers
- Reinstall all the screws that go with the dismantled parts, and block them with a thread sealant after spreading them with a film of copper- or molybdenum-based grease. This will keep screws from sticking and make maintenance operations easier
- Check that the bolts and screws are the same dimension and quality as the original ones (as stated on the nameplate), or a better quality
- Replace the weatherproof seals that may have been removed (O-ring for the covers)

IMPORTANT
In case the screws of the cover must be replaced, SS Class A4 grade 80 screw must be used with minimum yield strength 600 N/mm²

WARNING
Do not electrically operate the EPI-2 when the electrical enclosures are removed. Do not open the actuator covers when an explosive atmosphere may be present. Ignoring the above precautions could cause personal injury.

IMPORTANT
Each time the covers are opened or removed the condition of the seals must be checked.
In case the seals are replaced, original spares must be supplied by Pentair.

IMPORTANT
EPI-2 electric actuators must be installed and maintained according to the applicable rules regarding the electrical installation in hazardous areas (other than mines) classified as zone 21 and/or 22 (dust) according to EN 60079-10 (hazardous area classification).
Example: installation and maintenance according to EN 50281-1-2.

Special attention is requested to the following:
- Before the assembly the joint surfaces must be greased with silicone oil or equivalent
- Cable glands must have minimum protection degree IP66/68 (EN 60529)
- Periodically verify the quantity of dust deposited on the enclosure and clean it if more than 5 mm using a damp cloth to avoid static electricity

5. LUBRICATION

5.1 LUBRICATION INSPECTION

The actuator is grease lubricated for life, therefore under normal working conditions no grease needs to be replaced or added.

In case of maintenance the following grease is recommended:
- AEROSHELL GREASE 7 or equivalent, for ambient temperature -40°C to +70°C (-40°F to +158°F).

6. ACTUATOR CONFIGURATION

Before connecting power to the actuator, check that the voltages are correct and according to the indications on the nameplate. Wrong power supply could cause permanent damage to the electrical components.
The configuration of the EPI-2 actuator can be carried out through the control panel inside the actuator control system. To access the panel, remove the actuator cover and when the configuration is complete replace the cover, following the procedures indicated below.

IMPORTANT
When optional local control panel OM3 is installed and the actuator setting is done by means of the pushbuttons on the logic board, the remote controls do not have to be energized.

6.1 REMOVAL OF THE CONTROL UNIT COVER

Using a 5 mm Allen key, loosen the four screws and remove the cover.

IMPORTANT
When setting the actuator parameters do not operate the actuator neither remotely nor locally.

WARNING
Pay attention not to damage the joint surfaces of the cover.

IMPORTANT
In case the screws of the cover must be replaced, SS Class A4 grade 80 screw must be used with minimum yield strength 600 N/mm²

Once the configuration is completed, reassemble the actuator cover.



FIGURE 14 - Removal of the control unit cover.

6.2 LOCAL CONFIGURATION OF THE EPI-2

WARNING
The configuration must be done while the actuator is powered on. As a consequence, all configuration operations must be carried out by specifically qualified personnel for operations on powered electronic cards.

6.2.1 EPI-2 default general configuration

IMPORTANT
The actuators are set in the workshop with the following configuration (default value):

- *CL limit switch by position*
- *OP limit switch by position*
- *Stroking time in CL (6): 28 secs for models 063/125/250/500, 45 secs for model 1000 and 100 secs for model 2000*
- *Stroking time in OP (6): 28 secs for models 063/125/250/500, 45 secs for model 1000 and 100 secs for model 2000*
- *Torque limiting device in CL set at about 100% of nominal torque*
- *Torque limiting device in OP set at about 100% of nominal torque*
- *Reverse mode off*
- *Monitor Relay NC (in normal condition, i.e. without alarms)*
- *Blinker / Local Selector relay off (always Open)*

If the application requires different actuator configurations, please proceed as described in this chapter.

IMPORTANT
Please note that the actuator configuration does not need to be done in succession as indicated in the following pages. Each parameter can be set independently.

The configuration of the actuator parameters is done through the following tools:

- Two rotary selector switches SW6 and SW4 for actuator configuration
- Enter pushbutton SW5 (confirmation pushbutton)
- Dip switch SW3 (enable configuration function)
- Green LED indicating power ON (switched on when power supply is available)
- Red LED for Enter confirmation (ON once configuration is confirmed)
- Mechanical stops

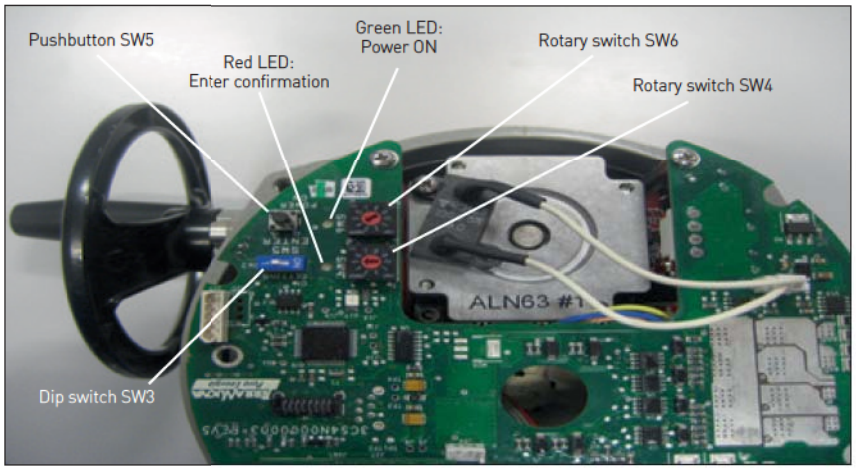


FIGURE 15 - Configuration of the actuator parameters.

SETUP BASE CARD

	Rotary switches position		Dip switch	Enter button	
Setup	**SW4**	**SW6**	**SW3**	**SW5**	**Default**
Close limit	0	0	ON	PUSH	n.d.
Open limit	1	0	ON	PUSH	n.d.
L/S close	2	1: by position	ON	PUSH	1
	2	0: by torque	ON	PUSH	
L/S open	3	1: by position	ON	PUSH	1
	3	0: by torque	ON	PUSH	
Closing speed	4	4	ON	PUSH	6
	4	6	ON	PUSH	
	4	8	ON	PUSH	
Opening speed	5	4	ON	PUSH	6
	5	6	ON	PUSH	
	5	8	ON	PUSH	
% Closing torque	6	2: 50%	ON	PUSH	9
	6	5: 75%	ON	PUSH	
	6	9: 100%	ON	PUSH	
% Opening torque	7	2: 50%	ON	PUSH	9
	7	5: 75%	ON	PUSH	
	7	9: 100%	ON	PUSH	
CW/CCW	8	0: CW;	ON	PUSH	0
	8	1: CCW;	ON	PUSH	
Size	9	0: 63 Nm / 250 Nm	ON	PUSH	0
	9	1: 125 Nm / 500 Nm	ON	PUSH	
	9	3: 1000 Nm	ON	PUSH	
	9	4: 2000 Nm	ON	PUSH	
Nm / Lbs-in	0	8: Nm	ON	PUSH	8
	0	9: Lbs-in	ON	PUSH	
Blinker / Local Selector	4	0: Off	ON	PUSH	0
	4	1: Blinker	ON	PUSH	
	4	2: Local Selector	ON	PUSH	
Heater	8	9: Active	ON	PUSH	9
	8	8: Not active	ON	PUSH	
Inversion colours LED of local control	9	2	ON	PUSH	LED Open: Green LED Close: Red

6.2.2 Close limit configuration by position
Enter set up configuration:
- Move switch SW4 to position 2
- Move switch SW6 to position 1
- Move switch SW3 to position ON
- Confirm by pushing ENTER pushbutton SW5
- When pushing SW5, the red LED switches on for confirmation
- Exit set up configuration, moving switch SW3 to position 1 or proceed with the next parameter

6.2.3 Close limit configuration
- Drive the actuator to the closed position using the handwheel
- Move switch SW4 to position 0
- Move switch SW6 to position 0
- Move switch SW3 to position ON
- Confirm by pushing ENTER pushbutton SW5
- When pushing SW5, the red LED switches on for confirmation
- Exit set up configuration, moving switch SW3 to position 1 or proceed with the next parameter

6.2.4 Open limit configuration by position
- Move switch SW4 to position 3
- Move switch SW6 to position 1
- Move switch SW3 in ON
- Confirm by pushing ENTER pushbutton SW5
- When pushing SW5, the red LED switches on for confirmation
- Exit set up configuration, moving switch SW3 to position 1 or proceed with the next parameter

6.2.5 Open limit configuration
- Drive the actuator to open position using the handwheel.
- Move switch SW 4 to position 1
- Move switch SW 6 to position 0
- Move switch SW 3 to position ON
- Confirm by pushing ENTER pushbutton SW5
- When pushing SW5, the red LED switches ON for confirmation
- Exit set up configuration, moving switch SW3 to position 1 or proceed with the next parameter

6.2.6 Close limit configuration by torque
- Move switch SW4 to position 2
- Move switch SW6 to position 0
- Move switch SW3 to position ON
- Confirm by pushing ENTER pushbutton SW5 (red LED switch on)
- Operate the actuator to closing direction by local/remote control and wait until it stops by torque
- When the setting is completed, the red LED switches off
- Exit set up configuration, moving switch SW3 to position 1 or proceed with the next parameter

6.2.7 Open limit configuration by torque
- Move switch SW4 to position 3
- Move switch SW6 to position 0
- Move switch SW3 to position ON
- Confirm by pushing ENTER pushbutton SW5 (red LED switch on)
- Operate the actuator to opening direction by local/remote control and wait until it stops by torque
- When the setting is completed, the red LED switches off
- Exit set up configuration, moving switch SW3 to position 1 or proceed with the next parameter

IMPORTANT
During the new stroke limit setup, the minimum range between open and close limit position has to be at least 40 degree of the valve position; if the above condition is not respected, the setup will not be successful and stroke limit error alarm will be signalized (red LED blinking).
The red LED will continuously flash when the actuator is in setup functionality (dip switch SW3 in 'on' position) and rotary switches SW4 and SW6 are in one of the following positions:
a. SW4=3 and SW6=0
(stroke limit of open configuration by torque)
b. SW4=2 and SW6=0
(stroke limit of close configuration by torque)
c. SW4=1 and SW6=0
(stroke limit of open configuration by position)
d. SW4=0 e SW6=0
(stroke limit of close configuration by position)
The alarm is then reset by:
a. Switching off and on the actuator
b. Doing a new correct stroke limit setup in one of the 4 possible combinations.

WARNING
In configuration phase, touch only the configuration area of the logic board; don't touch the actuator in its other parts.

6.2.8 Stroking time selection in closing
- Enter set up configuration: move switch SW3 to position ON (configuration function)
- Move switch SW4 to position 4
- Move switch SW6 to positions 4, 6, 8 for the requested stroking time according to the table below
- Push ENTER pushbutton SW5 to confirm
- When pushing SW5, the red LED switches on for confirmation
- The selected stroking time in closing is now set
- Exit set up configuration (move switch SW3 to position 1) or proceed with the next parameter

6.2.9 Stroking time selection in opening
- Enter set up configuration: move switch SW3 to position ON (configuration function)
- Move switch SW4 to position 5
- Move switch SW6 to positions 4, 6, 8 for the requested stroking time according to the table below
- Push ENTER pushbutton SW5 to confirm
- When pushing SW5, the red LED switches on for confirmation
- The selected stroking time in opening is now set
- Exit configuration (move switch SW3 to position 1) or proceed with the next parameter

OPERATING TIMES

	Nominal torque	Operating time (secs 90°) at selected step		
Model	**(Nm / lb.in.)**	**8**	**6**	**4**
063/E006	63/600	15	28	48
125/E013	125/1300	15	28	48
250/E025	250/2500	15	28	48
500/E051	500/5100	15	28	48
1000/E091	1000/9100	24	45	80
2000/E171	2000/17700	53	100	180

NOTE: Time is guaranteed with +/- 10% tolerance on 90° stroke

6.2.10 Setting of the torque limiting device in closing

Closing torque limits: 50%, 75% and 100% of the nominal torque. The nominal torque corresponding to 100% is set in-house and stated in the name plate.

- Enter set up configuration: move switch SW3 to position ON (configuration function)
- Move switch SW4 to position 6
- Move switch SW6 to positions 2, 5 or 9 for the requested torque value (in percentage) in closing
- Push ENTER pushbutton SW5 to confirm
- When pushing SW5, the red LED switches on for confirmation
- The setting of the torque limiting device in closing manoeuver is now complete
- Exit set up configuration (move switch SW3 to position 1) or proceed with the next parameter

WARNING

Torque switches setting must be done only with the authorization of the valve manufacturer, considering the specific valve figures.

6.2.11 Configuration of the torque limiting device in opening

Opening torque limits: 50%, 75% and 100% of the nominal torque. The nominal torque corresponding to 100% is set in-house and stated in the name plate.

- Enter set up configuration: move switch SW3 to position ON (configuration function)
- Move SW4 switch to position 7
- Move switch SW6 to positions 0-9 for the requested Torque value (in percentage) in opening
- Push ENTER pushbutton SW5 to confirm
- When pushing SW5, the red led switches on for confirmation
- The setting of the torque limiting device in opening is now complete
- Exit set up configuration (move switch SW3 to position 1) or proceed with the next parameter

WARNING

Torque switches setting must be done only with the authorization of the valve manufacturer, considering the specific valve figures.

6.2.12 Reverse mode configuration

- Enter set up configuration: move switch SW3 to position ON (configuration function)
- Move switch SW4 to position 8
- Move switch SW6 to position:
  1 counter-clockwise (CCW) ON
  0 counter-clockwise (CCW) OFF
- Push ENTER pushbutton SW5 to confirm
- When pushing SW5, the red LED switches on for confirmation
- Reverse mode (CCW) set is now completed
- Exit set up configuration (move switch SW3 to position 1) or proceed with the next parameter

6.2.13 Actuator model selection

The frames relevant to models 63/125 and 250/500 can be set to operate with a 63 Nm or 125 Nm motor and a 250 Nm or 500 Nm motor respectively.
The difference is based on the technical characteristics of the electric motor itself.

Actuator model 63

- Enter set up configuration: move switch SW3 to position ON (configuration function)
- Move switch SW4 to position 9
- Move switch SW6 to position 0
- Confirm by pushing ENTER pushbutton, SW5
- When pushing SW5, the red LED switches on for confirmation
- Exit set up configuration (move switch SW3 to position 1) or proceed with the next parameter

Actuator model 125

- Enter set up configuration: move switch SW3 to position ON (configuration function)
- Move switch SW4 to position 9
- Move switch SW6 to position 1
- Confirm by pushing ENTER pushbutton SW5
- When pushing SW5, the red LED switches on for confirmation
- Exit set up configuration (move switch SW3 to position 1) or proceed with the next parameter

Actuator model 250

- Enter set up configuration: move switch SW3 to position ON (configuration function)
- Move switch SW4 to position 9
- Move switch SW6 to position 0
- Confirm by pushing ENTER pushbutton SW5
- When pushing SW5, the red LED switches on for confirmation
- Exit set up configuration (move switch SW3 to position 1) or proceed with the next parameter

Actuator model 500

- Enter set up configuration: move switch SW3 to position ON (configuration function)
- Move switch SW4 to position 9
- Move switch SW6 to position 1
- Confirm by pushing ENTER pushbutton SW5
- When pushing SW5, the red LED switches on for confirmation
- Exit set up configuration (move switch SW3 to position 1) or proceed with the next parameter

Actuator model 1000

- Enter set up configuration: move switch SW3 to position ON (configuration function)
- Move switch SW4 to position 9
- Move switch SW6 to position 3
- Confirm by pushing ENTER pushbutton SW5
- When pushing SW5, the red LED switches on for confirmation
- Exit set up configuration (move switch SW3 to position 1) or proceed with the next parameter

Actuator model 2000

- Enter set up configuration: move switch SW3 to position ON (configuration function)
- Move switch SW4 to position 9
- Move switch SW6 to position 4
- Confirm by pushing ENTER pushbutton SW5
- When pushing SW5, the red LED switches on for confirmation
- Exit set up configuration (move switch SW3 to position 1) or proceed with the next parameter

6.2.14 Blinker / Local Selector configuration

Default configuration for Blinker / Local Selector relay is off (always Open)
In Blinker configuration, during actuator movement the relay changes their status each 500 msecs (Motor Running function).
In Local Selector configuration (with Local Interface OM3 installed), the relay is CLOSE when OM3 switch is on REMOTE, while it is OPEN when OM3 switch is on LOCAL.
To configure Blinker or Local Selector monitoring function (when OM3 is present):

- Enter set up configuration: move switch SW3 to position ON (configuration function)
- Move switch SW4 to position 4
- Move switch SW6 to position 1 (Blinker) or 2 (Local Selector)
- Confirm by pushing ENTER pushbutton SW5
- When pushing SW5, the red LED switches on for confirmation
- Exit set up configuration (move switch SW3 to position 1) or proceed with the next parameter

6.3 CONFIGURATION OF THE EPI-2 BY A PDA / PC AND 'A MANAGER' SOFTWARE

If one of the optional module OM1, OM9 or OM11 is installed on the EPI-2 and this card features Bluetooth interface, the actuator configuration can be performed by means of the 'A Manager' software installed on the PDA or PC.
Only Blinker / Local Selector relay cannot be configured by means 'A Manager' software.
The relevant Instruction and Operating Manual is available with the 'A Manager' software.

WARNING

The controls available via Bluetooth allow full actuator operability at a distance. Pentair will not accept any responsibility for damages or injuries caused by an improper use of your Bluetooth PDA.

6.4 HARDWARE CONFIGURATION FOR MONITOR RELAY

The Monitor Relay indicates the followings failures:

- Loss of power
- Stop by Torque out of limits
- Direction failure
- Temperature too high
- Position sensor failure
- Local control panel with selector in local position
- Valve jammed
- Hardware malfunction
- Alarm on the local control panel (if present)
- Stroke failure

The Monitor Relay contacts can be set as CLOSE or OPEN by changing the welding of JUMPER J1 on logic board.
As a default setting, pins 2 and 3 are welded together, and the Monitor Relay contact operates as follows:
- contact CLOSE in normal condition with relay energized, and OPEN in case of malfunction (relay is de-energized).

In case of request, if contact must be OPEN in normal condition and CLOSE in case of malfunction, the contact of JUMPER J1 must be modified welding pins 1 and 2 together.

WARNING

Configuration of Monitor Relay by means JUMPER J1 is a hardware configuration. For this reason, to configure Monitor Relay is mandatory manage actuator without power supply.

7. MAINTENANCE AND TROUBLESHOOTING

7.1 MAINTENANCE

7.1.1 Routine maintenance

Approximately every 2 years:
Under normal operating conditions, the EPI-2 is maintenance-free: no actuator maintenance is formally required, even though visual inspection for grease leakage or external visible damages is recommended every two years. When conditions are severe (frequent operation or high temperatures), replace all seals that allow grease leakage or water inlet.

IMPORTANT
Before starting any maintenance operation, make sure that the mains and all other service voltage connected to the terminal board are switched-off.

The following checks will assure optimum performance:

- Make sure there are no grease leaks from the actuator housing
- Check the external parts for possible damage and replace them immediately, if necessary. In case the window glass is broken, the complete cover must be replaced (see Chapter 8 for individual item numbers)
- Repaint all areas where paint is missing. In chemically aggressive or saline environments, remove rust from surfaces and protect with a rust preventative
- Check that all nuts and bolts securing the actuator to the valve are tight. If necessary, re-tighten with a dynamometric key
- For severe applications or if actuator operation is infrequent, perform maintenance checks more often

7.1.2 Special maintenance

In case of actuator failure, please refer to Section 'Trouble shooting', Chapter 7.2, for possible causes.
Spare parts can be required from Pentair: please refer to the individual item number shown in Chapter 8.
In case of malfunction in the mechanical / electronic components, in case of grease leaks through the seals or in case of scheduled preventive maintenance, the actuator must be disassembled: any damaged parts can be requested from Pentair with reference to the attached exploded view drawings and parts lists.
It is essential that for every component to be required from Pentair the serial number of the actuator together with the item number of the component are indicated in the request.

IMPORTANT
After maintenance work a few operations must be performed to make sure that movement is regular and there is no grease leakage through the seals.

Note: Special maintenance is also recommended when, during operations, the actuator generates an excessive noise.

7.2 TROUBLE-SHOOTING

All EPI-2 actuators have passed the functional test performed by Pentair Quality Assurance personnel.

If the actuator does not work, before trouble-shooting make sure that:

- The main supply is the same as stated in the name plate menu
- The green LED for available power supply is switched on
- Power supply is available to the actuator and no protective device has declutched in the plant
- Check the position of the dip switch SW3; it must be '1'

7.2.1 The electronics do not switch on when powered

- Check that the value of the main voltage on terminals L1 and L2 (and in the same case L3) is correct
- Remove the cover assembly
- Check the continuity of the wires between terminals L1, L2, L3 and the connector of the power card
- If there is no continuity on the L1-L2-L3 cables, replace the terminal board
- If continuity on the L1, L2, L3 cables is ok, replace the entire drive and control unit

7.2.2 24 V DC output voltage not available at the terminals

- Switch the main power supply off and disconnect all wires from terminals 33 and 34
- Switch the main power supply on and check if the voltage on terminals 33 and 34 is between 22 and 26 V DC
- If the voltage is correct check the external wiring and the electrical load. It should not exceed 4 W
- If the voltage is not correct, replace the entire drive and control unit

7.2.3 The actuator does not work from remote controls

Check that:

- The wiring to terminals 32, 35 and 36 is correct
- There is no short circuit between wires
- The electrical load does not exceed 4 W
- If external voltage is used, the value has to be in the 24-120 V AC/DC range

7.2.4 The motor is very hot and does not start

- Wait until the motor cools down before trying to operate the actuator again
- Check that the number of operations per hour and their duration is suitable for the actuator service (see the name-plate)
- Check that the valve operating torque is within the range of the unit's designed operating torque
- Always check the causes of abnormal operation

7.2.5 The motor runs but the actuator does not move the valve

- Verify that the drive insert correctly fits in the actuator base
- Verify that the drive insert has enough engagement with the valve stem
- Verify that the key correctly fits in bore/keyways applications
- Check that the valve works in manual operation. If not, it is necessary to check the manual control area as follows:
  - Loosen the handwheel security dowel
  - Remove the handwheel
  - Check the integrity of the internal parts
  - Proceeding with the assembly, follow the reverse order of the disassembly
  - Make sure there are no foreign bodies. Pay attention not to damage the O-ring seals

7.2.6 The valve does not seat correctly

- If the valve is stopped by torque in closing, increase the actuator output torque limit
- If the valve is stopped by position in closing, check that the valve reaches its seat position, then readjust the setting of the position limit
- The internal trim of the valve may be damaged

7.2.7 Excessive torque for valve operation

- Clean, lubricate and check the valve stem
- Valve packing too tight: loosen the gland bolt nuts
- Check that the internal valve trim or the reducer gears are well lubricated and not damaged

7.2.8 The actuator does not stop in fully open or fully closed position

- Check that the actual open and close positions of the valve respectively correspond to 100% and 0%
- Make sure that the torque and travel limits are correctly set (see Chapter 6)

8. DECOMMISSIONING

8.1 DISPOSAL AND RECYCLING

At the end of the life of EPI-2, the device must be disassembled.
Do not dump non-biodegradable products, lubricants and non-ferrous materials (rubber, PVC, resins etc.) into the environment. Dispose of all such materials as indicated in the following table:

WARNING
Do not re-use parts or components which appear to be in good condition after they have been checked or replaced by qualified personnel and declared unsuitable for use.

IMPORTANT
In all cases check local authority regulation before disposal.

Subject	Hazardous	Recyclable	Disposal
Electrical and electronic equipment	Yes	Yes	Use specialist recyclers
Glass	No	Yes	Use specialist recyclers
Metals	No	Yes	Use licensed recyclers
Plastics	No	Yes	Use specialist recyclers
Rubber (seals and O-rings)	Yes	No	Will require special treatment before disposal, use specialist waste disposal companies
Oil and grease	Yes	Yes	Will require special treatment before disposal, use specialist recyclers or waste disposal companies
Batteries	Yes	Yes	Will require special treatment before disposal, use specialist recyclers or waste disposal companies

9. PARTS LIST AND DRAWINGS

This section includes the drawings and parts list of each component and subassembly of EPI-2 actuators.

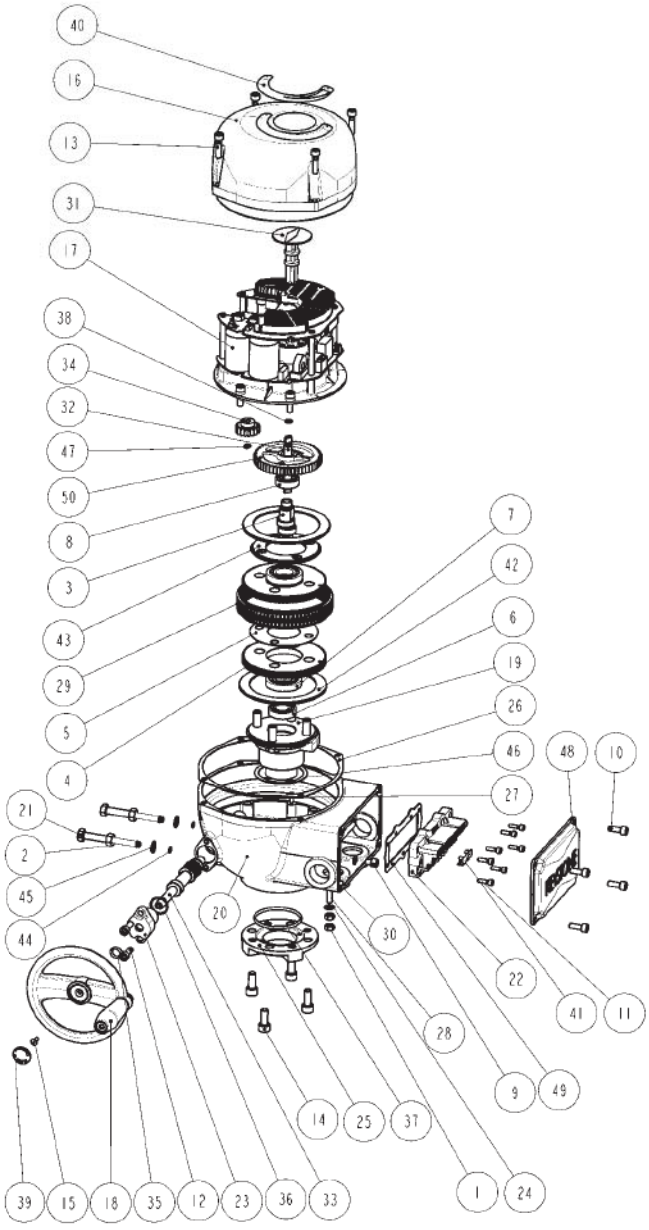
IMPORTANT
When ordering spare parts, please indicate the serial number embossed on the actuator nameplate.

IMPORTANT
When ordering spare parts, please refer to the marked part list items on the attached drawings.

IMPORTANT
*Recommended spares for routine maintenance are marked with this sign * on parts list.*

EPI-2 MODEL 063 - GENERAL ASSEMBLY

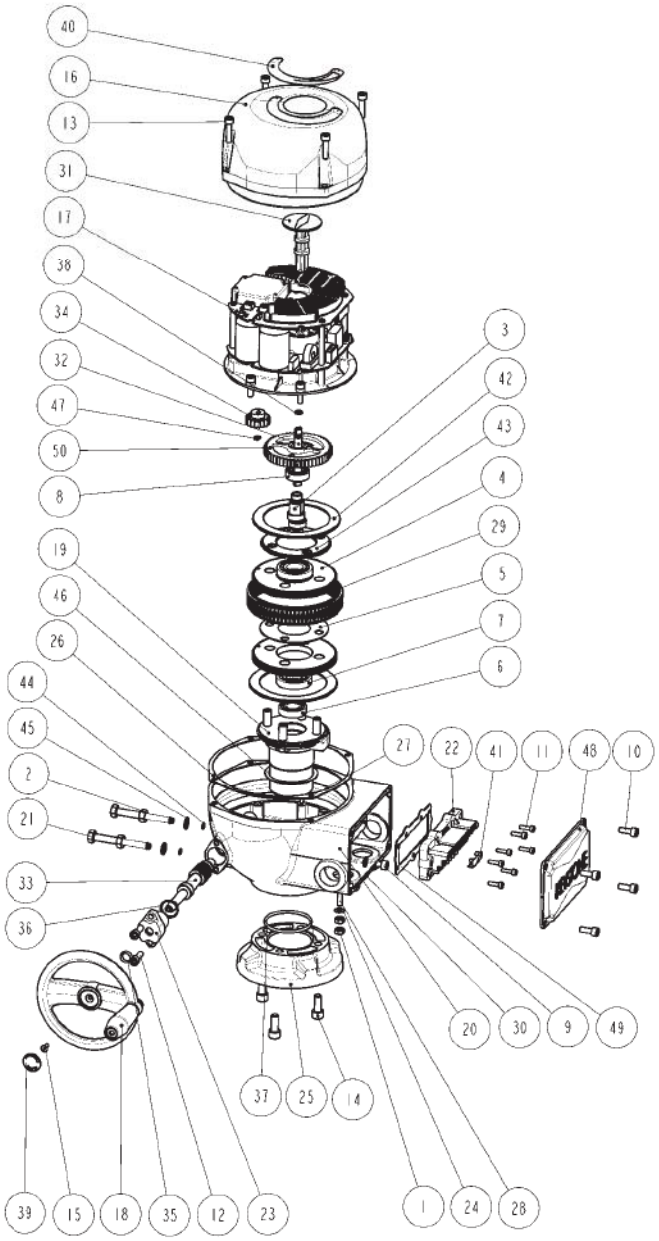
Pos.	Description	Quant.
1	Nut UNI 5588-M6	2
2	Nut UNI 5588-M8	2
3	Eccentric	1
4	Planocentric gear	2
5	Spacer	1
6	Ball bearing type 16002	1
7	Ball bearing type 16004	2
8	Ball bearing type 6001	1
9	ESH screw UNI 5931-M6x8	1
10	HSHC screw UNI 5931-M6x16	4
11	HSHC screw UNI 5931-M4x14	7
12	HSHC screw UNI 5931-M6x18	2
13	HSHC screw UNI 5931-M6x25	4
14	HSHC screw UNI 5931-M8x20	4
15	HSSC screw UNI 5933-M4x10	1
16	Cover assembly	1
17	Drive and control unit	1
18	Handwheel	1
19	Output drive assembly	1
20	Standard housing	1
21	Stopper	2
22	Terminal block	1
23	Worm shaft flange	1
24	Anti-loosening washer UNI 8842-J6	1
25	Base plate ISO 5211 / F05-F07	1
26	Cover gasket	1*
27	Dowel pin UNI EN 22338	1
28	Earth stud	1
29	Fixed anulus	1
30	Gasket	1*
31	Indicator	1
32	Indicator shaft	1
33	Manual worm shaft	1
34	Motor pinion	1
35	O-ring Di=10.77/W=2.62	1*
36	O-ring Di=18.77/W=1.78	1*
37	O-ring Di=52.07/W=2.62	1*
38	O-ring Di=6.07/W=1.78	1*
39	Plug	1
40	Position label	1
41	Power clamps protection	1
42	Ring	2
43	Ring for pins alignement	1
44	Ring RW 7 UNI 7433	2
45	Seal washer 8.3	2
46	Sliding ring	1
47	Snap ring for shaft D.6	1
48	Terminal block cover	1
49	Terminal board gasket	1*
50	Wheel	1



* Indicates recommended spare parts

EPI-2 MODEL 125 - GENERAL ASSEMBLY

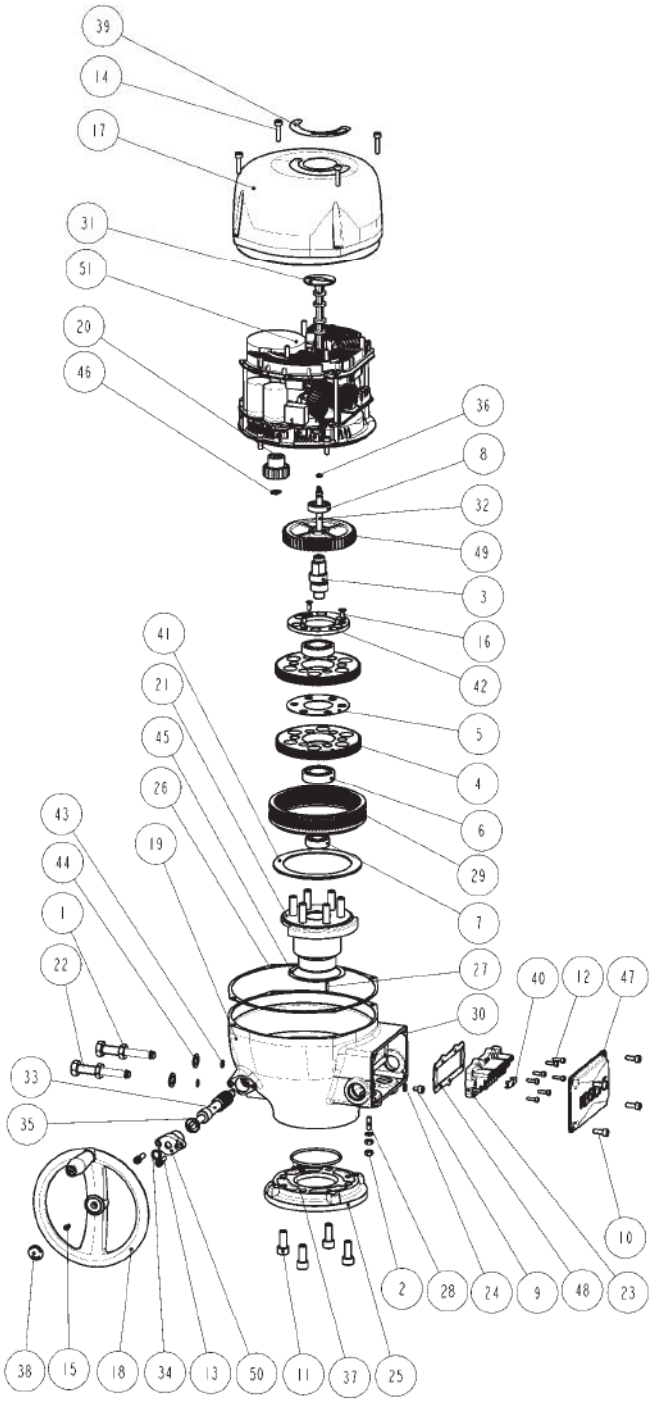
Pos.	Description	Quant.
1	Nut UNI 5588-M6	2
2	Nut UNI 5588-M8	2
3	Eccentric	1
4	Planocentric gear	2
5	Spacer	1
6	Ball bearing type 16002	1
7	Ball bearing type 16004	2
8	Ball bearing type 6001	1
9	ESH screw UNI 5931-M6x8	1
10	HSHC screw UNI 5931-M6x16	4
11	HSHC screw UNI 5931-M4x14	7
12	HSHC screw UNI 5931-M6x18	2
13	HSHC screw UNI 5931-M6x25	4
14	HSHC screw UNI 5931-M8x20	4
15	HSSC screw UNI 5933-M4x10	1
16	Cover assembly	1
17	Drive and control unit	1
18	Handwheel	1
19	Output drive assembly	1
20	Standard housing	1
21	Stopper	2
22	Terminal block	1
23	Worm shaft flange	1
24	Anti-loosening washer UNI 8842-J6	1
25	Base plate ISO 5211 / F07-F10	1
26	Cover gasket	1*
27	Dowel pin UNI EN 22338	1
28	Earth stud	1
29	Fixed anulus	1
30	Gasket	1*
31	Indicator	1
32	Indicator shaft	1
33	Manual worm shaft	1
34	Motor pinion	1
35	O-ring Di=10.77/W=2.62	1*
36	O-ring Di=18.77/W=1.78	1*
37	O-ring Di=52.07/W=2.62	1*
38	O-ring Di=6.07/W=1.78	1*
39	Plug	1
40	Position label	1
41	Power clamps protection	1
42	Ring	2
43	Ring for pins alignement	1
44	Ring RW 7 UNI 7433	2
45	Seal washer 8.3	2
46	Sliding ring	1
47	Snap ring for shaft D.6	1
48	Terminal block cover	1
49	Terminal board gasket	1*
50	Wheel	1



* Indicates recommended spare parts

EPI-2 MODEL 250 - GENERAL ASSEMBLY

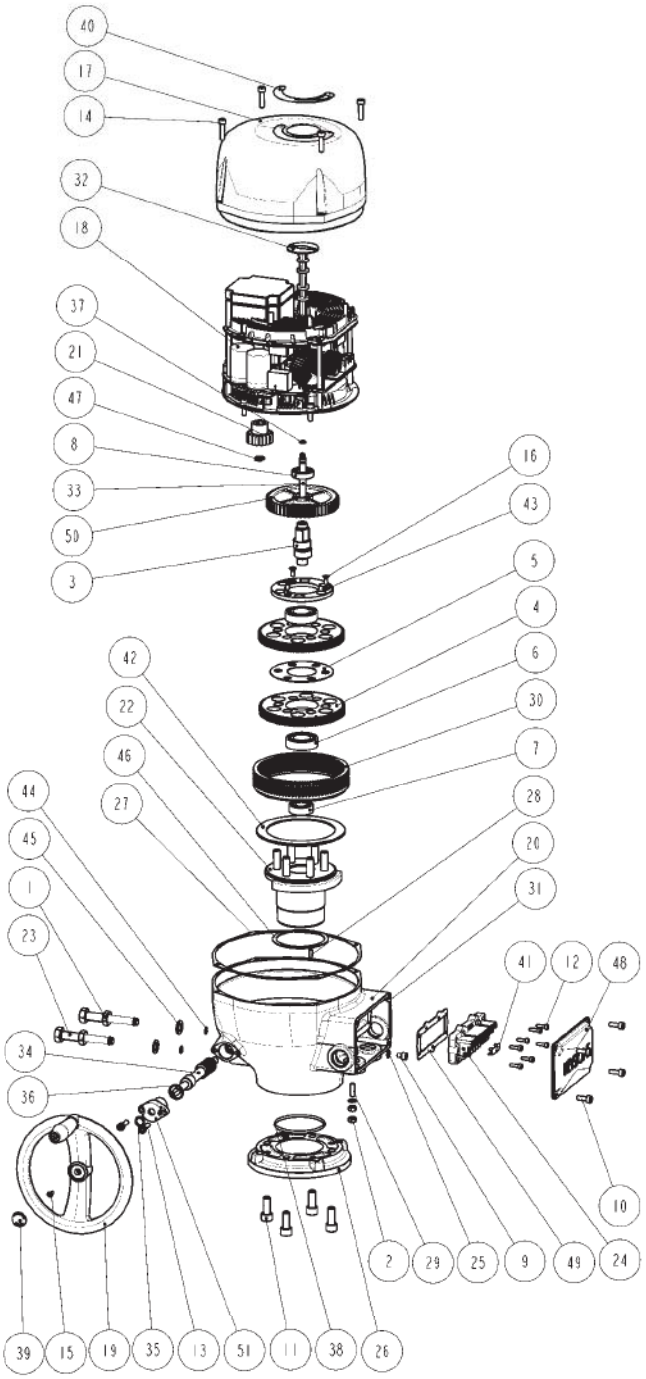
Pos.	Description	Quant.
1	Nut UNI 5588-M12	2
2	Nut UNI 5588-M6	2
3	Eccentric	1
4	Planocentric gear	2
5	Spacer	1
6	Ball bearing type 6005	2
7	Ball bearing type 6202	1
8	Ball bearing type 16002	1
9	ESH screw UNI 5931-M6x8	1
10	HSHC screw UNI 5931-M6x16	4
11	HSHC screw UNI 5931-M10x25	4
12	HSHC screw UNI 5931-M4x14	7
13	HSHC screw UNI 5931-M6x20	2
14	HSHC screw UNI 5931-M6x25	4
15	HSSC screw UNI 5933-M4x10	1
16	HSSC screw UNI 5933-M5x12	3
17	Cover assembly	1
18	Handwheel	1
19	Housing	1
20	Motor pinion	1
21	Output drive assembly	1
22	Stopper	2
23	Terminal block	1
24	Anti-loosening washer UNI 8842-J6	2
25	Base plate ISO 5211 F07-F10-F12	1
26	Cover gasket	1*
27	Dowel pin UNI EN 22338	1
28	Earth stud	1
29	Fixed anulus	1
30	Gasket	1*
31	Indicator	1
32	Indicator shaft	1
33	Manual worm shaft	1
34	O-ring Di=10.77/W=2.62	1*
35	O-ring Di=18.77/W=1.78	1*
36	O-ring Di=6.07/W=1.78	1*
37	O-ring Di=69.52/W=2.62	1*
38	Plug	1
39	Position label	1
40	Power clamps protection	1
41	Ring	1
42	Ring for pins alignement	1
43	Ring RW 10 UNI 7433	2
44	Seal washer 12.3	2
45	Sliding ring	1
46	Snap ring for shaft D.12	1
47	Terminal block cover	1
48	Terminal board gasket	1*
49	Wheel	1
50	Worm shaft flange	1
51	Drive and control assembly	1



* Indicates recommended spare parts

EPI-2 MODEL 500 - GENERAL ASSEMBLY

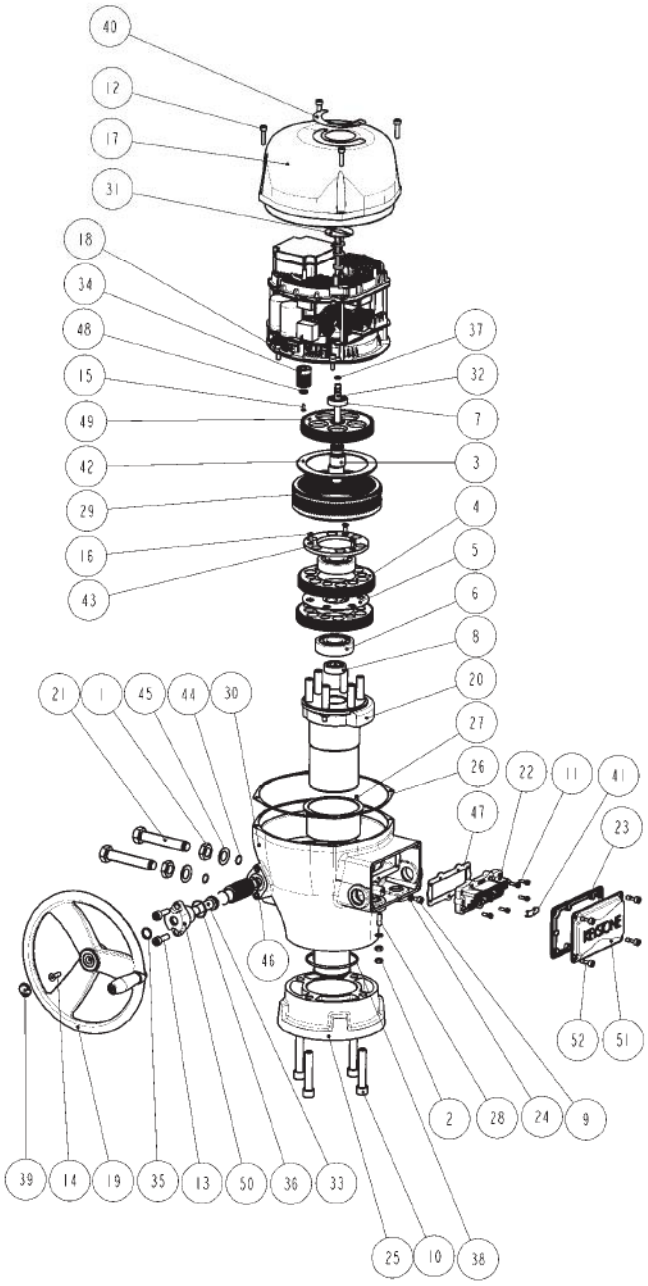
Pos.	Description	Quant.
1	Nut UNI 5588-M12	2
2	Nut UNI 5588-M6	2
3	Eccentric	1
4	Planocentric gear	2
5	Spacer	1
6	Ball bearing type 6005	2
7	Ball bearing type 6202	1
8	Ball bearing type 16002	1
9	ESH screw UNI 5931-M6x8	1
10	HSHC screw UNI 5931-M6x16	4
11	HSHC screw UNI 5931-M10x25	4
12	HSHC screw UNI 5931-M4x14	7
13	HSHC screw UNI 5931-M6x20	2
14	HSHC screw UNI 5931-M6x25	4
15	HSSC screw UNI 5933-M4x10	1
16	HSSC screw UNI 5933-M5x12	3
17	Cover assembly	1
18	Drive and control assembly	1
19	Handwheel	1
20	Housing	1
21	Motor pinion	1
22	Output drive assembly	1
23	Stopper	2
24	Terminal block	1
25	Anti-loosening washer UNI 8842-J6	2
26	Base plate ISO 5211 F10-F12	1
27	Cover gasket	1*
28	Dowel pin UNI EN 22338	1
29	Earth stud	1
30	Fixed anulus	1
31	Gasket	1*
32	Indicator	1
33	Indicator shaft	1
34	Manual worm shaft	1
35	O-ring Di=10.77/W=2.62	1*
36	O-ring Di=18.77/W=1.78	1*
37	O-ring Di=6.07/W=1.78	1*
38	O-ring Di=69.52/W=2.62	1*
39	Plug	1
40	Position label	1
41	Power clamps protection	1
42	Ring	1
43	Ring for pins alignement	1
44	Ring RW 10 UNI 7433	2
45	Seal washer 12.3	2
46	Sliding ring	1
47	Snap ring for shaft D.12	1
48	Terminal block cover	1
49	Terminal board gasket	1*
50	Wheel	1
51	Worm shaft flange	1



* Indicates recommended spare parts

EPI-2 MODEL 1000 - GENERAL ASSEMBLY

Pos.	Description	Quant.
1	Nut UNI 5588-M16	2
2	Nut UNI 5588-M6	2
3	Eccentric	1
4	Planocentric gear	2
5	Spacer	1
6	Ball bearing type 6305	2
7	Ball bearing type 16002	1
8	Ball bearing type NJ202ECP	1
9	ESH screw UNI 5931-M6x8	1
10	HSHC screw UNI 5931-M12x65	4
11	HSHC screw UNI 5931-M4x14	7
12	HSHC screw UNI 5931-M6x25	4
13	HSHC screw UNI 5931-M8x25 A4-70	2
14	HSSC screw UNI 5933-M6x20	1
15	HSSC screw UNI 5933-M4x10	1
16	HSSC screw UNI 5933-M5x12	3
17	Cover assembly	1
18	Drive and control assembly	1
19	Handwheel assembly	1
20	Output drive assembly	1
21	Stopper	2
22	Terminal block	1
23	Terminal cover gasket	2*
24	Anti-loosening washer UNI 8842-J6	2
25	Base plate ISO 5211 F10-F14	1
26	Cover gasket	1*
27	Dowel pin UNI EN 22338	1
28	Earth stud	1
29	Fixed anulus	1
30	Housing	1
31	Indicator	1
32	Indicator shaft	1
33	Manual worm shaft	1
34	Motor pinion	1
35	O-ring Di=13.94/W=2.62	1*
36	O-ring Di=25.12/W=1.78	1*
37	O-ring Di=6.07/W=1.78	1*
38	O-ring Di=82.22/W=2.62	1*
39	Plug	1
40	Position label	1
41	Power clamps protection	1
42	Ring	1
43	Ring for pins alignement	1
44	Ring RW 14 UNI 7433	2
45	Seal washer 16.3	2
46	Sliding ring	2
47	Terminal board gasket	1*
48	Washer	1
49	Wheel	1
50	Worm shaft flange	1
51	Terminal block cover	1
52	HSHC screw UNI 5931-M6x18	4

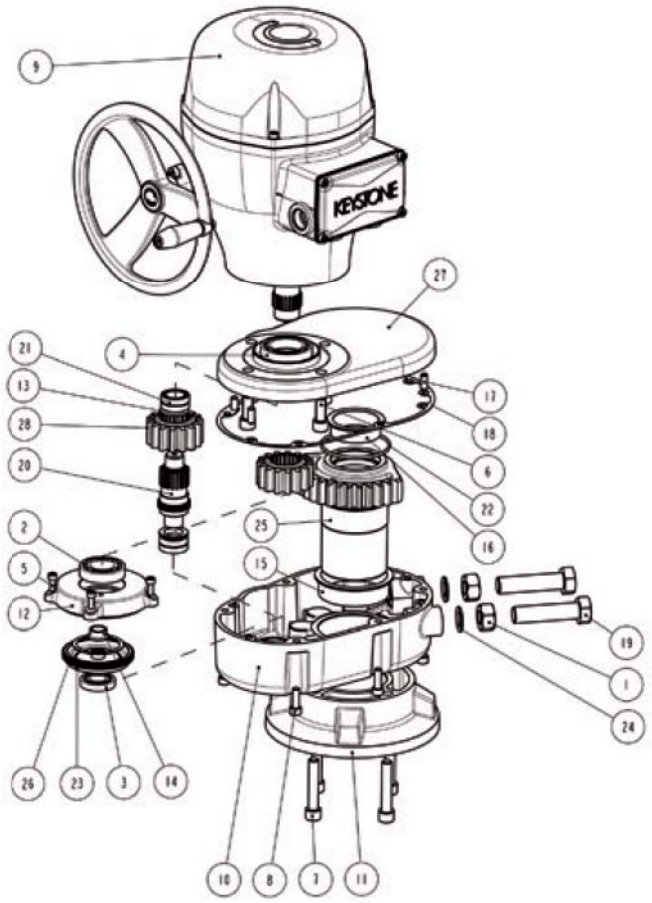


* Indicates recommended spare parts

EPI-2 MODEL 2000 (GEAR REDUCER) - GENERAL ASSEMBLY

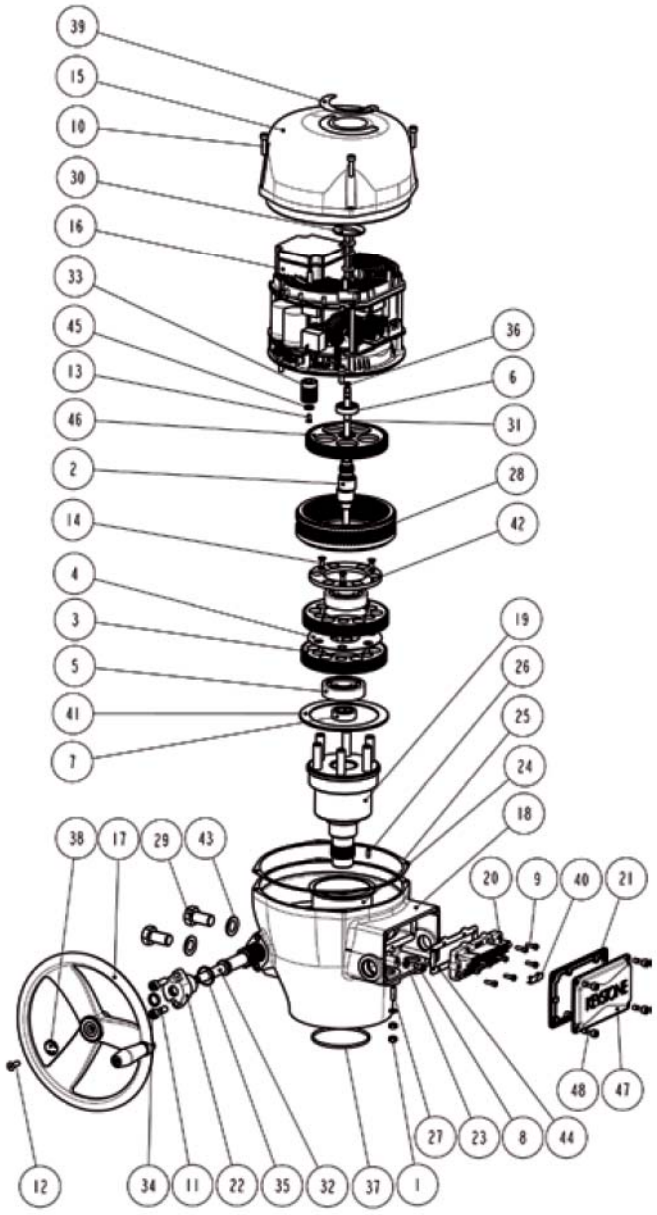
Pos.	Description	Quant.
1	Nut M20 ISO 4032 EN 24032	2
2	Ball bearing type 6006	1
3	Ball bearing type 16004	1
4	Ball bearing type 61908	1
5	HSHC screw UNI 5931-M6x16	3
6	HSHC screw UNI 5931-M12x30	4
7	HSHC screw UNI 5931-M12x65	4
8	HSHC screw UNI 5931-M8x25 A4-70	6
9	EPI-2 actuator	1
10	Base housing	1
11	Base plate F12-F16 EN ISO 5211	1
12	Bearing support	1
13	Bushing	2
14	Bushing	1
15	Bushing	1
16	Bushing	1
17	Dowel pin UNI EN 22338 D.8x20 type B	4
18	Gasket	1*
19	Hex head screw UNI EN 24017-M20x80	2
20	Idle wheel shaft	1
21	Needle bearing type NKI 22/16	2
22	O-ring Di=82.22/W=2.62	1*
23	Position wheel	1
24	Seal washer 20.3	2
25	Sector gear	1
26	Sliding ring	1
27	Upper cover	1
28	Wheel	2

* Indicates recommended spare parts



EPI-2 MODEL 2000 (ACTUATOR) - GENERAL ASSEMBLY

Pos.	Description	Quant.
1	Nut UNI 5588-M6	2
2	Eccentric	1
3	Planocentric gear	2
4	Spacer	1
5	Ball bearing type 6305	2
6	Ball bearing type 16002	1
7	Roller bearing type NJ202ECP	1
8	ESH screw UNI 5931-M6x8	1
9	HSHC screw UNI 5931-M4x14	7
10	HSHC screw UNI 5931-M6x25	4
11	HSHC screw UNI 5931-M8x25 A4-70	2
12	HSSC screw UNI 5933-M6x20	1
13	HSSC screw UNI 5933-M4x10	1
14	HSSC screw UNI 5933-M5x12	3
15	Cover assembly	1
16	Drive and control assembly	1
17	Handwheel assembly	1
18	Housing	1
19	Output drive assembly	1
20	Terminal block	1
21	Terminal cover gasket	1*
22	Worm shaft flange	1
23	Anti-loosening washer UNI 8842-J6	2
24	Bushing	1
25	Cover gasket	1*
26	Dowel pin UNI EN 22338	1
27	Earth stud	1
28	Fixed anulus	1
29	Hex head screw UNI EN 24017-M16x30	2
30	Indicator	1
31	Indicator shaft	1
32	Manual worm shaft	1
33	Motor pinion	1
34	O-ring Di=13.94/W=2.62	1*
35	O-ring Di=25.12/W=1.78	1*
36	O-ring Di=6.07/W=1.78	1*
37	O-ring Di=82.22/W=2.62	1*
38	Plug	1
39	Position label	1
40	Power clamps protection	1
41	Ring	1
42	Ring for pins alignement	1
43	Seal washer 16.3	2
44	Terminal board gasket	1*
45	Washer	1
46	Wheel	1
47	Terminal block cover	1
48	HSHC screw UNI 5931-M6x18	4



* Indicates recommended spare parts

PENTAIR

PENTAIR VALVES & CONTROLS
www.pentair.com/valves

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SECTION 4

INSTRUMENTATION & CONTROLS

4.1 BILL OF MATERIALS
4.2 VENDOR DATASHEETS
4.3 PANEL DRAWINGS
4.4 LOOP DRAWINGS
4.5 DISSOLVED OXYGEN ANALYZER
4.6 Ph ANALYZER
4.7 THERMAL MASS FLOW METER
4.8 GUIDED LEVEL RADAR TRANSMITTER
4.9 FLOAT SWITCH
4.10 INSTRUMENT SURGE PROTECTION
4.11 BLOWER LOCAL CONTROL PANELS
4.12 I/O LIST

Project Name:	Massillon, OH
Project Number:	5700235402
Date:	January 23, 2015
I&C Project Engineer:	Mark Oborne

Comments and Clarifications

General – Anoxic/Anaerobic Mixers Seal Fail and High Temperature:

The Anoxic and Anaerobic Mixers require Seal Fail and High Temperature Interlocks in the MCC circuit design. These interlocks include relays in the MCC that will shutdown down the Mixers and send a signal to the PLC in the event of Seal Fail or High Temperature. Refer to Kruger Loop Drawings for the Anoxic and Anaerobic Mixer. Kruger will provide the Seal Fail relay to be installed in the MCC. The MCC supplier should include the required circuitry and the relay for the High Temperature.

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SECTION 4.1

BILL OF MATERIALS

VEOLIA WATER
Solutions & Technologies

MASSILLON, OH
KRUGER PROJECT 5700235402
IFAS PLC CONTROL PANEL
BILL OF MATERIAL

Qty	Panel Tag	Part Number	Description	Manufacturer
1		SCE-727224FSD	TYPE 12 FREE STANDING ENCLOSURE (72"Hx72"Wx24"D)	SAGINAW
1		SCE-72P72F1	BACKPANEL (60"Hx68"W)	SAGINAW
1	SHELF	SCE-FS1818	PANEL SHELF	SAGINAW
1	SA-L	28 56 70 2	SURGE PROTECTION	PHOENIX CONTACT
3	DC1, DC2, DC3	28 66 75 0	24VDC POWER SUPPLY 5A	PHOENIX CONTACT
20	SA-1 to 16 101-104	28 38 22 8	PT 2X2-24DC-ST PLUGTRAB SURGE ARRESTOR	PHOENIX CONTACT
20	SA-1 to 16 101-104	28 39 20 8	PT 2X2-BE BASE ELEMENT	PHOENIX CONTACT
32	IN1-32	28 64 406	ANALOG ISOLATORS	PHOENIX CONTACT
17	IN1-32	28 69 72 8	DIN RAIL BUS CONNECTOR	PHOENIX CONTACT
1	IN1-32	28 64 13 4	MINI MCR-SL-PTB	PHOENIX CONTACT
2	N,G	30 44 16 0	FEED-THROUGH TERMINAL BLOCKS	PHOENIX CONTACT
1	N,G	30 47 02 8	END BARRIER	PHOENIX CONTACT
AR	TB1,2,9, TB-L	30 47 29 3	D-UTTB 2,5/4 - END COVER	PHOENIX CONTACT
AR	TB1,2,9, TB-L	30 30 27 1	FBS 10-6, PLUG-IN BRIDGE, 10 POLE	PHOENIX CONTACT
AR	TB1,2,9, TB-L	08 00 88 6	END CLAMP	PHOENIX CONTACT
132	TB1,2,9, TB-L	30 44 81 4	UTTB 4 DOUBLE LEVEL TERMINAL BLOCK	PHOENIX CONTACT
15	CB2-10,121,122,141,142,171,191	9080 GCB30	3.0A CIRCUIT BREAKER	SQUARE D
1	MCB2	QOU110	10.0A CIRCUIT BREAKER	SQUARE D
2	CB1, CB-UPS	QOU115	15.0A CIRCUIT BREAKER	SQUARE D
1	MCB-1	QOU130	30.0A CIRCUIT BREAKER	SQUARE D
20	N1, COM1, COM2, COM3	30 44 10 2	UT 4 - CONTROL TERMINAL BLOCK	PHOENIX CONTACT
5	GND	30 44 12 8	UT 4-PE, TERMINAL BLOCK (GND)	PHOENIX CONTACT
AR	N1, COM1, COM2, COM3, GND	30 30 34 9	FBS 5-6, PLUG-IN BRIDGE, 5 POLE	PHOENIX CONTACT
AR	N1, COM1, COM2, COM3, GND	30 47 02 8	D-UT 2,5/10 - END COVER	PHOENIX CONTACT
AR	N1, COM1, COM2, COM3, GND	08 00 88 6	END ANCHOR	PHOENIX CONTACT
33	CR-1 to 32, CR-UPS	700-HN222	RELAY BASES	ALLEN-BRADLEY
1	CR-UPS	700-HK32A1	OUTPUT RELAY, 2PDT, FORM C CONTACT, 120VAC	ALLEN-BRADLEY
32	CR-1 to 32, CR-UPS	700-HK32Z24	OUTPUT RELAY, 2PDT, FORM C CONTACT, 24VDC	ALLEN-BRADLEY
1	PLC	1756-L75	CONTROLLOGIX PROCESSOR	ALLEN-BRADLEY
1	PLC	1756-PA72	CONTROLLOGIX POWER SUPPLY	ALLEN-BRADLEY
1	PLC	1756-EN2T	CONTROLLOGIX ETHERNET COM. MODULE	ALLEN-BRADLEY
4	PLC	1756-TBCH	WIRING ARM FOR IF16, OB16I	ALLEN-BRADLEY
7	PLC	1756-TBNH	WIRING ARM FOR OF8, IB16	ALLEN-BRADLEY
1	PLC	1756-A17	17 SLOT CHASSIS	ALLEN-BRADLEY
2	PLC	1756-IF16	DC POWERED ANALOG INPUT CARD	ALLEN-BRADLEY
1	PLC	1756-OF8	DC POWERED ANALOG OUTPUT CARD	ALLEN-BRADLEY
6	PLC	1756-IB16	DC POWERED DISCRETE INPUT CARD	ALLEN-BRADLEY
2	PLC	1756-OB16I	DC POWERED DISCRETE OUTPUT CARD	ALLEN-BRADLEY
1	HMI	2711P-T10C4A8	PANELVIEW PLUS 6 1000	ALLEN-BRADLEY
1	ETHERNET SWITCH	28 91 41 1	10/100 BASE T ETHERNET SWITCH	PHOENIX CONTACT
1	PATCH PANEL	WCH-02P	FIBER INTERCONNECT PANEL, ST CONN.	CORNING
2	PATCH PANEL	CCH-CP12-15T	CONNECTOR PANEL, 12 ST CONN.	CORNING
1	PATCH PANEL	807853	FIBER PATCH CORD, ST TO ST CONN., 62.5/125 µm, 3 METERS	FIBERTRON
1	UPS	SDU850	UPS 850VA	SOLA
2	UPS OUTLET	AS REQUIRED	RECEPTACLE TO MATCH PLUG FROM UPS/ENET	
2	PB1,2	9001SKR1BH5	PUSH BUTTON, FLUSH, NON-ILL, MOM. N.O. CONTACT	SQUARE D
1	GFCI	AS REQUIRED	RECEPTACLE., W/BOX/COVER, UL LISTED	
1	CAB LIGHT	MINI 28L1	CABINET LIGHT	SIMKAR
1	CAB LIGHT	ALFSWD	DOOR SWITCH	HOFFMAN
1	ALARM HORN	350WB-120	ALARM HORN, 120VAC	FEDERAL SIGNAL
LOT	MISC	AS REQUIRED	MISC. (WIRE, CABLE, WIRE DUCT, DIN RAIL, TERMINAL MARKERS, LEGENDS, NAMEPLATES, ETC.)	

AR- As required

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SECTION 4.2

VENDOR DATASHEETS

VEOLIA WATER
Solutions & Technologies

Saginaw Control & Engineering
95 Midland Road
Saginaw, MI 48638-5770
Phone: (800)234-6871
Fax: (989)799-4524
http://www.saginawcontrol.com

Part Information - SCE-727224FSD

SCE-727224FSD

Application -

Designed to house a variety of electrical and electronic controls and instruments. Provisions for optional surface mounting or rack mounting of almost any type of equipment. Provides protection from dust, dirt, water and oil. The enclosures are extra deep for applications requiring more interior space.

Construction -

- 0.104" carbon steel.
- Removable and interchangeable doors.
- Concealed hinge.
- Seams continuously welded and ground smooth, no holes or knockouts.
- Strong, rigid construction with stiffeners welded on backs of single access boxes.
- Lifting eyes for easy handling.
- Black zinc die cast keylocking/padlocking handle.
- 3-point latching mechanism.
- Latch rods have ramp shoes for easier door closing.
- Flange trough collar around all sides of door opening.
- Removable print pocket provided on door.
- Mounting channels welded horizontally on sides of interior body at top, bottom and middle for mounting optional panels or rack mounting angles.
- Oil resistant gasket.
- Ground stud on door.
- Provisions for fluorescent light kit.

Finish -

White powder coat inside and ANSI-61 gray outside. Optional subpanels are powder coated white.

Industry Standards - (IS3)

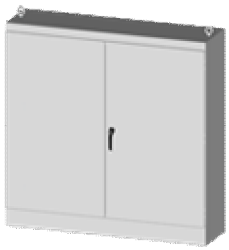
NEMA Type 3R, 12 and Type 13
UL Listed Type 3R and 12
CSA Type 3R and 12
IEC 60529 IP 55

Notes -

Special Instructions apply for IS3, IS4 and IS6 to maintain the environmental rating of Type 3R for these parts. Instructions are located on the enclosure door. Drip shield is required on IS3, drip shield is recommended on IS4 and IS6. Drain holes are required on all.

Product Specifications -

Part Number: SCE-727224FSD
Description: FSD Enclosure
Height: 72.00"
Width: 72.00"
Depth: 24.00"
Price Code: A2
List Price: $2,555.90
Catalog Page: 106
Est. Ship Weight: 663.00 lbs
Body Stiffeners D: 24.00
Body Stiffeners E: 23.88



Download CAD Package
Add to Bill of Material

Optional Accessories -

SCE-20RMW - Wireway, Removable
SCE-60P36F1 - Subpanel, Full
***Requires heavy duty panel supports & center panel support (SCE-72FSHDPS & SCE-72FSCPS)*
SCE-60P36F2 - Subpanel, Half
***Requires heavy duty panel supports & center panel support (SCE-72FSHDPS & SCE-72FSCPS)*
SCE-7236SOF19 - Frame, Swing Out Rack Mounting
***Requires center panel support (SCE-72FSCPS)*
SCE-72FSCPS - Support, Center Panel
SCE-72FSCS - Support, Center
SCE-72FSHDPS - Panel Support Heavy Duty
***Requires center panel support (SCE-72FSCPS)*
SCE-72P36F1 - Subpanel, Full
***Requires center panel support (SCE-72FSCPS)*
SCE-72P36F2 - Subpanel, Half
***Require center panel support (SCE-72FSCPS)*
SCE-72P72F1 - Subpanel, Full
SCE-72P72F2 - Subpanel, Half
SCE-72SMP14 - Subpanel, Side Mount
SCE-72SMP20 - Subpanel, Side Mount
***Cannot be used when other panels are installed.*
SCE-72SP36F3 - Panel, Swingout Full
***Requires center panel support (SCE-72FSCPS)*
SCE-72SP36F4 - Panel, Swingout Half
***Requires center panel support (SCE-72FSCPS)*
SCE-90P36F2 - Subpanel, Half
***Requires heavy duty panel supports & center panel support (SCE-72FSHDPS & SCE-72FSCPS)*
SCE-90P72F2 - Subpanel, Half
***Requires center panel support (SCE-72FSCPS)*

Similar Part Numbers -

SCE-726024FSD - FSD Enclosure
SCE-726018FSD - FSD Enclosure
SCE-726036FSD - FSD Enclosure
SCE-727218FSD - FSD Enclosure

Saginaw Control & Engineering
95 Midland Road
Saginaw, MI 48638-5770
Phone: (800)234-6871
Fax: (989)799-4524
http://www.saginawcontrol.com

Part Information - SCE-72P72F1

SCE-72P72F1

Application -
Panels for two door enclosures can be positioned anywhere along the horizontal mounting channels. Panels are made of heavy gauge steel.

Finish -
Powder Coated White

Industry Standards - (N/A)
N/A

Product Specifications -
Part Number: SCE-72P72F1
Description: Subpanel, Full
Height: 60.00"
Width: 68.00"
Depth: 0.88"
Price Code: p3
List Price: $541.42
Catalog Page: 116
Est. Ship Weight: 180.00 lbs
Enclosure Width: 72.00
Enclosure Height: 72.00



Download CAD Package
Add to Bill of Material

Similar Part Numbers -
SCE-72P60F1 - Subpanel, Full

Saginaw Control and Engineering
95 Midland Road
Saginaw, MI 48638-5770
(800)234-6871
Fax: (989)799-4524
SCE@SaginawControl.com

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95 Midland Road
Saginaw, MI 48638-5770
Phone: (800)234-6871
Fax: (989)799-4524
http://www.saginawcontrol.com

Part Information - SCE-FS1818

SCE-FS1818

Application -

Folding shelves can be installed on the inside or outside of large enclosures. They are designed to support test equipment and programmers. Locks in the horizontal position. When not in use, shelf can be folded down. Made of heavy gauge steel and powder coated white epoxy polyester.

Industry Standards - (N/A)

N/A

Product Specifications -

Part Number: SCE-FS1818
Description: Shelf, Folding
Height: 18.00"
Width: 18.00"
Depth: 1.75"
Price Code: P2
List Price: $183.79
Catalog Page: 271
Est. Ship Weight: 17.00 lbs



Download CAD Package
Add to Bill of Material

Similar Part Numbers -

SCE-FS1212 - Shelf, Folding
SCE-FS2424 - Shelf, Folding

Installation Information -

Folding Shelf Hole Pattern

Saginaw Control and Engineering
95 Midland Road
Saginaw, MI 48638-5770
(800)234-6871
Fax: (989)799-4524
SCE@SaginawControl.com

Extract from the online catalog

SFP 1-20/120AC

Order No.: 2856702



http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=2856702

DIN rail module with device surge protection type 3 and mains suppression filter against high-frequency interference voltages. Integrated power display switches off automatically when there is a malfunction due to overload. Mounting on NS 35.

Commercial data	
GTIN (EAN)	4 017918 952648
sales group	J041
Pack	1 pcs.
Customs tariff	85363010
Catalog page information	Page 230 (TT-2011)

Product notes

WEEE/RoHS-compliant since: 06/23/2006

http://www.download.phoenixcontact.com
Please note that the data given here has been taken from the online catalog. For comprehensive information and data, please refer to the user documentation. The General Terms and Conditions of Use apply to Internet downloads.

Product description

Device protection with interference filter

Technical data

Standards

Housing material	ABS, aluminum
Inflammability class acc. to UL 94	V0
Color	aluminum
Standards for air and creepage distances	DIN VDE 0110-1
	IEC 60664-1: 1992-10
	IEC 61643-1
Surge voltage category	III
Pollution degree	2
Degree of protection	IP20
Design	Rail-mountable module, one-piece
Mounting type	DIN rail: 35 mm
Number of positions	2
Ambient temperature (storage/transport)	-40 °C ... 85 °C
Ambient temperature (operation)	-25 °C ... 40 °C
For country-specific use in	USA, CN, BR
Direction of action	L-N & L(N)-PE
Width	112.00 mm
Height	79.00 mm
Length	93.00 mm

Protective circuit

IEC category	III
	T3
EN type	T3
Nominal voltage U_N	120 V AC
Arrester rated voltage U_C (L-N)	150 V AC
Arrester rated voltage U_C (L-PE)	150 V AC
Nominal frequency f_N	50 Hz
	60 Hz
Nominal current I_N	20 A (40°C)
Operating effective current I_C at U_C	≤ 10 mA
Ground conductor current I_{PE}	≤ 0.5 mA
Nominal discharge surge current I_n (8/20) µs (L-N)	3 kA

Nominal discharge surge current I_n (8/20) µs (L-PE)	3 kA
Max. discharge surge current Imax (8/20) µs maximum (L-N)	10 kA
Max. discharge surge current Imax (8/20) µs maximum (L-PE)	10 kA
Combined surge U_{OC}	6 kV (3 kA)
Energy absorption symmetrical	170 J
Enery absorption, asymmetrical	2x 170 J
Protection level U_P (L-N)	≤ 450 V (at 6 kV/3 kA)
Protection level U_P (L-PE)	≤ 450 V (at 6 kV/3 kA)
Protection level U_P (N-PE)	≤ 450 V (at 6 kV/3 kA)
Residual voltage at In, (L-N)	≤ 450 V
Residual voltage at In, (L-PE)	≤ 450 V
Residual voltage at In, (N-PE)	≤ 450 V
Response time tA (L-N)	≤ 25 ns
Response time tA (L-PE)	≤ 25 ns
Response time tA (N-PE)	≤ 25 ns
Inductivity in series	2x 1 mH ±30 % (with current compensation)
Capacity (L-N)	2 µF ±10 % (X2, FOW X2-250V)
Capacity (L-PE)	2.2 nF ±20 % (Y, FOW X2-250V)
Capacity (L-PEN)	2.2 nF ±20 % (Y, FOW X2-250V)
Max. required back-up fuse	20 A (gL / gG)
	20 A (MCB, > 125 V, AIC: 14 kA)
Input attenuation aE, sym.	Typ. 40 dB (≥ 500 kHz / 50 Ω)
Input attenuation aE, asym.	Typ. 30 dB (≥ 1 MHz / 50 Ω)
Message: Surge protection fault	Remote indicator contact

Non-heating apparatus connection, power supply

Connection name	Input/output
Connection method	Screw terminal blocks
Connection type IN	Screw terminal blocks
Connection type OUT	Screw terminal blocks
Connection method	3-conductor (shielded)
Screw thread	M3
Conductor cross section stranded max.	4 mm²
Conductor cross section solid max.	6 mm²

Conductor cross section AWG/kcmil min.	12
Conductor cross section AWG/kcmil max	10

Remote indicator contact

Connection name	Remote fault indicator contact
Switching function	PDT contact
Connection method	Pluggable screw connection
Screw thread	M2
Tightening torque	0.25 Nm
Conductor cross section stranded min.	0.14 mm²
Conductor cross section stranded max.	1.5 mm²
Conductor cross section solid min.	0.14 mm²
Conductor cross section solid max.	1.5 mm²
Conductor cross section AWG/kcmil min.	28
Conductor cross section AWG/kcmil max	16
Maximum operating voltage $U_{max.}$ AC	250 V AC
Max. operating current I_{max}	1 A (250 V AC)
	0.25 A (250 V DC)
	1 A (48 V DC)
Min. permissible switching capacity	(1.00 A / 48 V DC)
	(100 mA/ 12 V AC)
Switching capacity max. perm.	(0.25 A / 250 V DC)
	(1.0 A / 48 V AC)

Connection, protective circuit

Standards/regulations	IEC 61643-1
	EN 61643-11/A11

Protective circuit, filter

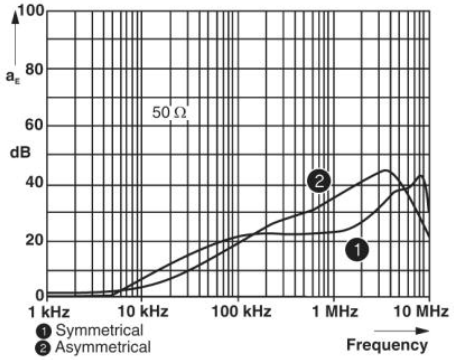
Discharge resistor	≤ 390 kΩ
Clamping voltage ringwave (L-N)	100 V (category A 100 kHz 6 kV/200 A)
	195 V (category B 100 kHz 6 kV/500 A)
Clamping voltage ringwave (L-PE)	390 V (category A 100 kHz 6 kV/200 A)
	390 V (category B 100 kHz 6 kV/500 A)

Certificates / Approvals

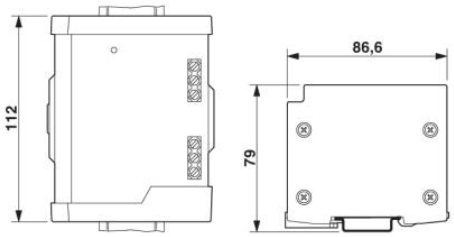
Certification	CSA, CSAus-COMP, CUL, GOST, UL

Diagrams/Drawings

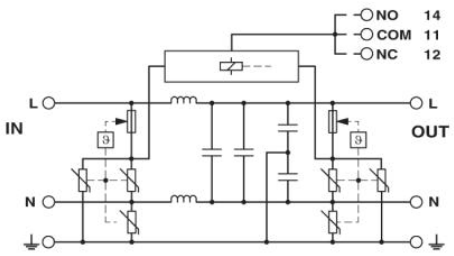
Diagram



Dimensioned drawing



Circuit diagram



Address

PHOENIX CONTACT Inc., USA
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Extract from the online catalog

QUINT-PS/ 1AC/24DC/ 5

Order No.: 2866750



http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=2866750

DIN rail power supply unit 24 V DC/5 A, primary switched-mode, 1-phase. The SFB technology (Selective Fuse Breaking Technology) can now also be used to trigger standard power circuit breakers reliably and quickly.

SFB Technology

Commercial data	
GTIN (EAN)	4 046356 113786
sales group	H031
Pack	1 pcs.
Customs tariff	85044082
Catalog page information	Page 582 (IF-2011)

Product notes

WEEE/RoHS-compliant since: 03/19/2007

http://www.download.phoenixcontact.com
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Product description

QUINT POWER power supply units – Maximum system availability with SFB technology

Compact power supply units of the new QUINT POWER generation maximize the availability of your system. With the SFB technology (Selective Fuse Breaking Technology), six times the nominal current for 12 ms, even the standard power circuit-breakers can now also be triggered reliably and quickly. Faulty current paths are switched off selectively, the fault is located and important system parts continue to operate. Comprehensive diagnostics are provided through constant monitoring of output voltage and current. This preventive function monitoring visualizes critical operating modes and reports them to the control unit before an error can occur.

Technical data

Input data

Nominal input voltage	100 V AC ... 240 V AC
AC input voltage range	85 V AC ... 264 V AC
DC input voltage range	90 V DC ... 350 V DC
Short-term input voltage	300 V AC
AC frequency range	45 Hz ... 65 Hz
DC frequency range	0 Hz
Current consumption	Approx. 1.2 A (120 V AC)
	Approx. 0.6 A (230 V AC)
Inrush surge current	< 15 A (typical)
Power failure bypass	> 30 ms (120 V AC)
	> 30 ms (230 V AC)
Input fuse	5 A (slow-blow, internal)
Permissible backup fuse	B6
	B10
	B16
Additional text	AC: 1 x circuit breaker - recommended fuse
Type of protection	Transient surge protection
Protective circuit/component	Varistor

Output data

Nominal output voltage	24 V DC ±1%
Setting range of the output voltage	18 V DC ... 29.5 V DC (> 24 V constant capacity)
Output current	5 A (-25°C ... 60°C, U_{OUT} = 24 V DC)
	7.5 A (with POWER BOOST, -25°C ... 40°C permanently, U_{OUT} = 24 V DC)
	30 A (SFB technology, 12 ms)
	7.5 A ($U_{In} \geq$ 100 V AC)
Magnetic fuse tripping	C2
Derating	60 °C ... 70 °C (2.5%/K)
Connection in parallel	Yes, for redundancy and increased capacity
Connection in series	Yes
Control deviation	< 1 % (change in load, static 10% ... 90%)
	< 2 % (change in load, dynamic 10% ... 90%)
	< 0.1 % (change in input voltage ±10%)

Residual ripple	< 40 mV_{PP} (with nominal values)
Maximum power dissipation NO-Load	3 W
Power loss nominal load max.	15 W

General data

Width	40 mm
Height	130 mm
Depth	125 mm
Width with alternative assembly	122 mm
Height with alternative assembly	130 mm
	43 mm
Net weight	0.7 kg
Efficiency	> 90 % (for 230 V AC and nominal values)
Insulation voltage input/output	4 kV AC (type test)
	2 kV AC (routine test)
Degree of protection	IP20
Protection class	I
MTBF (IEC 61709, SN 29500)	> 500000 h (According to IEC 61709)
Ambient temperature (operation)	-25 °C ... 70 °C (> 60 °C derating)
Ambient temperature (storage/transport)	-40 °C ... 85 °C
Max. permissible relative humidity (operation)	≤ 95 % (at 25 °C, no condensation)
Mounting position	horizontal DIN rail NS 35, EN 60715
Assembly instructions	Can be aligned: 5 mm horizontally, 15 mm next to active components, 5 cm vertically
Electromagnetic compatibility	Conformance with EMC Directive 2004/108/EC
Noise emission	EN 50081-2
Noise immunity	EN 61000-6-2:2005
Low Voltage Directive	Conformance with LV directive 2006/95/EC
Standard – Electrical equipment of machines	EN 60204
Standard - Safety of transformers	IEC 61558-2-17
Standard - Electrical safety	IEC 60950-1/VDE 0805 (SELV)
Shipbuilding approval	Germanischer Lloyd (EMC 2), ABS, LR, RINA, NK, DNV, BV
Standard – Electronic equipment for use in electrical power installations and their assembly into electrical power installations	EN 50178/VDE 0160 (PELV)
Standard – Safety extra-low voltage	IEC 60950-1 (SELV) and EN 60204 (PELV)

Standard - Safe isolation	DIN VDE 0100-410
	DIN VDE 0106-1010
Standard – Protection against electric shock	DIN 57100-410
Standard – Protection against shock currents, basic requirements for protective separation in electrical equipment	DIN VDE 0106-101
Standard – Limitation of mains harmonic currents	EN 61000-3-2
Standard – Equipment safety	GS (tested safety)
Standard - Approval for medical use	IEC 60601
Approval - requirement of the semiconductor industry with regard to mains voltage dips	SEMI F47-0706 Compliance Certificate
Certificate	CB Scheme
UL approvals	UL Listed UL 508
	UL/C-UL Recognized UL 60950
	UL listed ANSI/ISA-12.12.01 class I, division 2, groups A, B, C, D
Surge voltage category	III
DeviceNet approval	DeviceNet™ Power Supply Conformance Tested

Connection data, input

Connection method	Pluggable screw connection
Conductor cross section solid min.	0.2 mm²
Conductor cross section solid max.	2.5 mm²
Conductor cross section stranded min.	0.2 mm²
Conductor cross section stranded max.	2.5 mm²
Conductor cross section AWG/kcmil min.	20
Conductor cross section AWG/kcmil max	12
Stripping length	7 mm
Screw thread	M3

Connection data, output

Connection method	Pluggable screw connection
Conductor cross section solid min.	0.2 mm²
Conductor cross section solid max.	2.5 mm²
Conductor cross section stranded min.	0.2 mm²
Conductor cross section stranded max.	2.5 mm²
Conductor cross section AWG/kcmil min.	20
Conductor cross section AWG/kcmil max	12
Stripping length	7 mm

Signaling	
Output name	DC OK active
Output description	U_{OUT} > 0.9 x U_N: High signal
Maximum inrush current	min. 20 mA (short-circuit resistant)
Continuous load current	≤ 20 mA
Status display	U_{OUT} > 0.9 x U_N: "DC OK" LED green
Note on status display	U_{OUT} < 0.9 x U_N: Flashing "DC OK" LED
	I_{OUT} < I_N: LED ON
Conductor cross section solid min.	0.2 mm²
Conductor cross section solid max.	2.5 mm²
Conductor cross section stranded min.	0.2 mm²
Conductor cross section stranded max.	2.5 mm²
Conductor cross section AWG/kcmil min.	20
Conductor cross section AWG/kcmil max	12
Tightening torque, min	0.5 Nm
Tightening torque max	0.6 Nm
Screw thread	M3
Output name	DC OK floating
Output description	Relay contact, U_{OUT} > 0.9 x U_N: Contact closed
Maximum switching voltage	≤ 30 V AC/DC
Maximum inrush current	≤ 1 A
Continuous load current	≤ 1 A
Status display	U_{OUT} > 0.9 x U_N: "DC OK" LED green
Note on status display	U_{OUT} < 0.9 x U_N: Flashing "DC OK" LED
Output name	POWER BOOST, active
Output description	I_{OUT} < I_N: High signal
Maximum inrush current	min. 20 mA (short-circuit resistant)
Continuous load current	≤ 20 mA
Status display	I_{OUT} > I_N: LED "BOOST" yellow

Certificates / Approvals

Certification	ABS, BV, CB, CSA, CUL, DNV, GL, GOST, LR, NK, UL, UL Listed

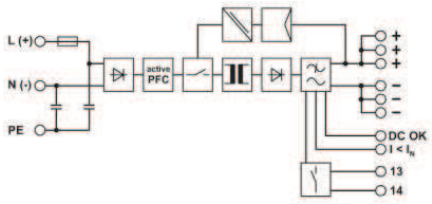
Certification Ex:	CUL-EX LIS, UL-EX LIS

Accessories

Item	Designation	Description
General		
2938196	QUINT-PS-ADAPTERS7/1	Assembly adapter for QUINT-PS... power supply on S7-300 rail
2320076	QUINT-PS/FAN/4	The fan for QUINT-PS/1AC and .../3AC power supply units can be mounted without the need for tools or other accessories. By using the fan, optimum cooling is ensured at high ambient temperatures or if the mounting position is rotated.
2320089	UTA 107/30	Universal DIN rail adapter
2938235	UWA 182/52	Universal wall adapter

Diagrams/Drawings

Block diagram



Address

PHOENIX CONTACT GmbH & Co. KG
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Extract from the online catalog

PT 2X2-24DC-ST

Order No.: 2838228

The illustration shows version PT 2x2- 5DC-ST



http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=2838228

PT protective connector with protective circuit for two 2-wire floating signal circuits. 24 V DC nominal voltage. HART-compatible.

Commercial data	
GTIN (EAN)	4 017918 182649
sales group	J204
Pack	10 pcs.
Customs tariff	85363010
Catalog page information	Page 92 (TT-2011)

Product notes

WEEE/RoHS-compliant since: 05/01/2006

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Technical data

General

Housing material	PA 6.6
Inflammability class acc. to UL 94	V0
Color	black

Standards for air and creepage distances	VDE 0110-1
	IEC 60664-1: 1992-10
Total surge current (8/20) µs	20 kA
Ambient temperature (operation)	-40 °C ... 85 °C
Mounting type	On base element
Design	DIN rail module, two-section, divisible
Degree of protection	IP20
Direction of action	Line-Line & Line-Signal Ground/Shield & optional Signal Ground/ Shield-Earth Ground
Arrester can be tested with CHECKMASTER from software version:	From SW rev. 1.00
Width	17.70 mm
Height	52.00 mm
Length	45.00 mm
Pitch unit	1 Div.

Protective circuit

IEC category	C1
	C2
	C3
	D1
VDE requirement class	C1
	C2
	C3
	D1
Nominal voltage U_N	24 V DC
Maximum continuous operating voltage U_C	28 V DC
	20 V AC
Maximum continuous voltage UC (wire-wire)	28 V DC
	20 V AC
Maximum continuous voltage U_C (wire-ground)	28 V DC
	20 V AC
Nominal current I_N	450 mA (45°C)
Operating effective current I_C at U_C	≤ 5 µA
Ground conductor current I_{PE}	≤ 1 µA (BE: 2x2+F)
	≤ 4 µA

Nominal discharge surge current I_n (8/20) µs (Core-Core)	10 kA
Nominal discharge surge current I_n (8/20) µs (Core-Earth)	10 kA
Total surge current (8/20) µs	20 kA
Max. discharge surge current Imax (8/20) µs maximum (Core-Core)	10 kA
Max. discharge surge current Imax (8/20) µs maximum (Core-Earth)	10 kA
Lightning test current (10/350) µs, peak value I_{imp}	2.5 kA (per path)
Output voltage limitation at 1 kV/µs (Core-Core) spike	≤ 40 V
Output voltage limitation at 1 kV/µs (Core-Earth) spike	≤ 450 V
Output voltage limitation at 1 kV/µs (Core-Core) static	≤ 40 V
Output voltage limitation at 1 kV/µs (Core-Earth) static	≤ 450 V
Residual voltage at I_n, (conductor-conductor)	≤ 40 V
Residual voltage at In, (conductor-GND)	≤ 450 V
Residual voltage with Ian (10/1000)µs (conductor-conductor)	≤ 50 V
Response time tA (Core-Core)	≤ 1 ns
Response time tA (Core-Earth)	≤ 100 ns
Input attenuation aE, sym.	0.5 dB (≤ 1 MHz)
Cut-off frequency fg (3 dB), sym. in 50 Ohm system	Typ. 6 MHz
Capacity (Core-Core)	1.4 nF
Resistance in series	2.2 Ω (Path 1-2/5-6)
	2.2 Ω (Path 7-8, 11-12)
Max. required back-up fuse	500 mA (e.g. T (IEC 127-2/III))
Surge carrying capacity in acc. with IEC 61643-21 (Core-Core)	C2 (10 kV/5 kA)
Surge carrying capacity in acc. with IEC 61643-21 (Core-Earth)	C2 (10 kV/5 kA)
	D1 (2.5 kA)

Connection data

Connection method	Screw connection (in connection with the base element)
Connection type IN	PLUGTRAB plug-in system

Connection type OUT	PLUGTRAB plug-in system
Screw thread	M3
Tightening torque	0.8 Nm
Stripping length	8 mm
Conductor cross section stranded min.	0.2 mm²
Conductor cross section stranded max.	2.5 mm²
Conductor cross section solid min.	0.2 mm²
Conductor cross section solid max.	4 mm²
Conductor cross section AWG/kcmil min.	24
Conductor cross section AWG/kcmil max	12

Connection, protective circuit

Standards/regulations	IEC 61643-21
	DIN EN 61643-21
	UL 497B

Certificates / Approvals

Certification	GOST, UL Listed
Certification Ex:	CUL-EX LIS, UL-EX LIS

Accessories

Item	Designation	Description
Marking		
0811228	X-PEN 0,35	Marker pen without ink cartridge, for manual labeling of markers, labeling extremely wipe-proof, line thickness 0.35 mm
0814717	ZBF 15:SO/CMS	Zack strip, flat, 10-section, divisible, special printing, marking according to customer requirements
0808671	ZBF 5,LGS:FORTL.ZAHLEN	Zack marker strip, flat, printed horizontally: 10-section, with the numbers 1 - 10, 11 - 20, and so on up to 491 - 500, color: white
0810821	ZBF 5,LGS:GERADE ZAHLEN	Zack marker strip, flat, printed horizontally: 10-section, with even numbers, printed with the numbers: 2-20, 22-40, etc. up to 82-100

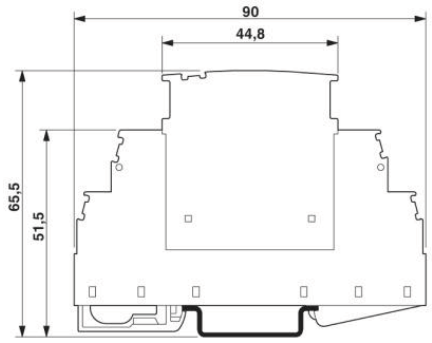
0810863	ZBF 5,LGS:UNGERADE ZAHLEN	Zack strip, flat, printed horizontally: 10-section, with odd numbers, printed with the numbers: 1-19, 21-39 etc. up to 81-99
0808697	ZBF 5,QR:FORTL.ZAHLEN	Zack marker strip, flat, printed vertically: 10-section, with the numbers 1 - 10, 11 - 20, and so on up to 91 - 100, color: white
0808668	ZBF 5/WH-100:UNBEDRUCKT	Zack strip, flat, unprinted: 10-section, for individual labeling with M-PEN or ZBF-T, large batch, sufficient for labeling 1000 terminal blocks, color: white
0808642	ZBF 5:UNBEDRUCKT	Zack strip, flat, unprinted: 10-section, for individual labeling with M-PEN or ZBF-T, sufficient for 100 terminal blocks, color: white
0800763	ZBN 18:SO/CMS	Marker labels, 5-section, special printing, labeled according to customer requirements (Please specify the required marking with order), for terminal width: 17.5 mm, color: White
2809128	ZBN 18:UNBEDRUCKT	Unprinted marker labels, strips with 5 labels for individual labeling with M-PEN or CMS system, for terminal block width: 17.5 mm, color: White

Additional products

Item	Designation	Description
Assembly		
2839295	SSA 3-6	shield fast connections for conductor diameter 3 - 6 mm. Potential connection cable: 200 mm, black
2839512	SSA 5-10	Shield fast connection for conductor diameters 5 - 10 mm. Potential connection cable: 200 mm, black
General		
2839224	PT 2X2+F-BE	Base element for protective plug PT with protective circuit for two 2-wire floating signal circuit, gas-filled surge arrester between the connections 3-4 (GND) and 9-10, for mounting on NS 35/7.5 and NS 35/15, housing width: 17.5 mm
2839208	PT 2X2-BE	Base element for protective plug PT with protective circuit for two 2-wire floating signal circuit, bridge between the connections 3-4 (GND) and 9-10, for mounting on NS 35/7.5 and NS 35/15, housing width: 17.5 mm

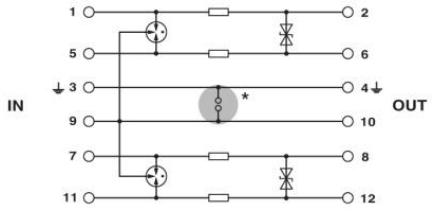
Diagrams/Drawings

Dimensioned drawing



The figure shows the complete module consisting of a base element and connector

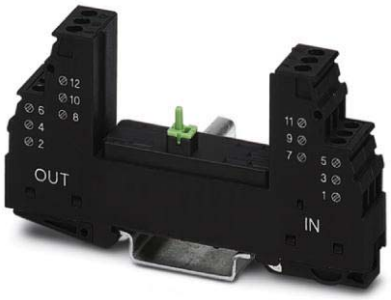
Circuit diagram



Extract from the online catalog

PT 2X2-BE

Order No.: 2839208



http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=2839208

Base element for protective plug PT with protective circuit for two 2-wire floating signal circuit, bridge between the connections 3-4 (GND) and 9-10, for mounting on NS 35/7.5 and NS 35/15, housing width: 17.5 mm

Commercial data	
GTIN (EAN)	4 017918 182748
sales group	J201
Pack	10 pcs.
Customs tariff	85363010
Catalog page information	Page 92 (TT-2011)

Product notes

WEEE/RoHS-compliant since: 03/03/2006

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Technical data

General

Inflammability class acc. to UL 94	V0
Color	black
Ambient temperature (operation)	-40 °C ... 85 °C

Mounting type	DIN rail: 35 mm
Design	DIN rail module, two-section, divisible
Degree of protection	IP20
Width	17.70 mm
Height	52.00 mm
Length	89.80 mm
Pitch unit	1 Div.

Connection data

Connection method	Screw connection
Connection type IN	Screw terminal blocks
Connection type OUT	Screw terminal blocks
Screw thread	M3
Tightening torque	0.5 Nm
Stripping length	8 mm
Conductor cross section stranded min.	0.2 mm²
Conductor cross section stranded max.	2.5 mm²
Conductor cross section solid min.	0.2 mm²
Conductor cross section solid max.	4 mm²
Conductor cross section AWG/kcmil min.	24
Conductor cross section AWG/kcmil max	12

Certificates / Approvals

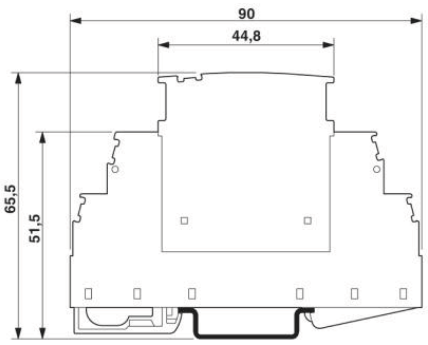
Certification	GOST, UL Listed
Certification Ex:	CUL-EX LIS, UL-EX LIS

Accessories

Item	Designation	Description
Assembly		
2839295	SSA 3-6	shield fast connections for conductor diameter 3 - 6 mm. Potential connection cable: 200 mm, black
2839512	SSA 5-10	Shield fast connection for conductor diameters 5 - 10 mm. Potential connection cable: 200 mm, black
Marking		
1051993	B-STIFT	Marker pen, for manual labeling of unprinted Zack strips, smear-proof and waterproof, line thickness 0.5 mm
0811228	X-PEN 0,35	Marker pen without ink cartridge, for manual labeling of markers, labeling extremely wipe-proof, line thickness 0.35 mm
1050004	ZB 5 :UNBEDRUCKT	Zack strip, unprinted, 10-section, for individual labeling with M-PEN, ZB-T or CMS system, pack is sufficient for 100 terminal blocks, for a terminal width of 5.2 mm, color: White
2715212	ZB 5,8,LGS:FORTL.ZAHLEN	Zack marker strip, 10-section, printed horizontally: with consecutive numbers, 1-10, 11-20 etc. up to 991-1000, color: white
1050305	ZB 5,8:SO/CMS	Zack strip, 10-section, divisible, special printing, marking according to customer requirements
2715209	ZB 5,8:UNBEDRUCKT	Zack strip, unprinted, strips with 10 labels for individual labeling with M-PEN or CMS system, for terminal block width: 5.8 mm, color: White
1050295	ZB 5:SO/CMS	Zack strip, 10-section, divisible, special printing, marking according to customer requirements
0808642	ZBF 5:UNBEDRUCKT	Zack strip, flat, unprinted: 10-section, for individual labeling with M-PEN or ZBF-T, sufficient for 100 terminal blocks, color: white

Diagrams/Drawings

Dimensioned drawing



The figure shows the complete module consisting of a base element and connector

Extract from the online catalog

MINI MCR-SL-I-I

Order No. 2864406



http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=2864406

MCR 3-way isolating amplifier, for electrical isolation of analog signals, with screw connection, input signal: 0(4) mA ... 20 mA, output signal: 0(4) mA ... 20 mA

D W H

Product notes

WEEE/RoHS-compliant since: 03/09/2006

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Commercial data

GTIN (EAN)	4 017918 956158
sales group	H520
Pack	1 pcs.
Customs tariff	85437090
Catalog page information	Page 357 (IF-2011)

Product description

The 6.2 mm wide standard signal 3-way isolating amplifier MINI MCR-SL-I-I(-SP) is used for electrical isolation, amplification and filtering of standard signals.

On the input and output side, the analog standard signals 0...20 mA or 4...20 mA are available, electrically isolated.

Power (19.2 V DC to 30 V DC) can be supplied through connection terminal blocks on the modules or in conjunction with the DIN rail connector.

Technical data

Input data

Configurable/programmable	No
Current input signal	0 mA ... 20 mA
	4 mA ... 20 mA
Max. input current	50 mA
Input resistance current input	Approx. 50 Ω

Output data

Configurable/programmable	No
Current output signal	0 mA ... 20 mA
	4 mA ... 20 mA
Max. output current	28 mA
Load/output load current output	< 500 Ω (at 20 mA)

Power supply

Nominal supply voltage	24 V DC
Supply voltage range	19.2 V DC ... 30 V DC (to bridge the supply voltage, the DIN rail connector (ME 6,2 TBUS-2 1,5/5-ST-3,81 GN, Order No. 2869728) can be used. It can be snapped onto a 35 mm DIN rail according to EN 60715)
Max. current consumption	< 20 mA
Power consumption	< 450 mW

Connection data

Connection method	Screw connection
Conductor cross section solid min.	0.14 mm²
Conductor cross section solid max.	2.5 mm²
Conductor cross section stranded min.	0.2 mm²
Conductor cross section stranded max.	2.5 mm²
Conductor cross section AWG/kcmil min.	26
Conductor cross section AWG/kcmil max	12
Stripping length	12 mm
Screw thread	M3

General data

No. of channels	1
Width	6.2 mm

Height	93.1 mm
Depth	102.5 mm
Maximum transmission error	≤ 0.1 % (of final value)
Maximum temperature coefficient	< 0.01 %/K
Temperature coefficient, typical	< 0.002 %/K
Limit frequency (3 dB)	Approx. 100 Hz
Step response (10-90%)	Approx. 3.2 ms
Protective circuit	Transient protection
Ambient temperature (operation)	-20 °C ... 65 °C
Ambient temperature (storage/transport)	-40 °C ... 85 °C
Degree of protection	IP20
Electrical isolation	Basic insulation according to EN 61010
Surge voltage category	II
Pollution degree	2
Rated insulation voltage	50 V AC/DC
Test voltage, input/output/supply	1.5 kV (50 Hz, 1 min.)
Electromagnetic compatibility	Conformance with EMC Directive 2004/108/EC
Noise emission	EN 50081-2
Noise immunity	EN 61000-6-2:2005
Color	green
Housing material	PBT
Mounting position	Any
Assembly instructions	The DIN rail bus connector (TBUS) can be used for bridging the supply voltage. It can be snapped onto a 35 mm EN 60715 DIN rail.
Conformance	CE-compliant
ATEX	Ex II 3 G Ex nA II T4 X
UL, USA / Canada	UL 508 Recognized
	Class I, Div. 2, Groups A, B, C, D T5
GL	GL EMC 2 D

Certificates / Approvals

Certification	CUL, GL, UL

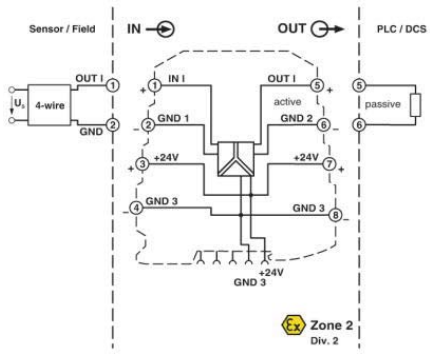
Certification Ex:	CUL-EX LIS, PxC-EX, UL-EX LIS

Accessories

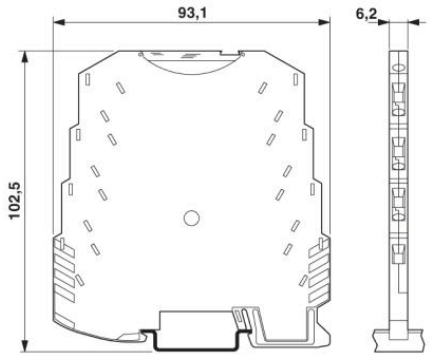
Item	Designation	Description
General		
2869728	ME 6,2 TBUS-2 1,5/5-ST-3,81 GN	DIN rail connector (TBUS), 5-pos., for bridging the supply voltage, can be snapped onto NS 35/... DIN rails according to EN 60715
2308111	MINI MCR DKL	Fold up transparent cover for MINI MCR modules with additional labeling option using insert strips and flat Zack marker strip 6.2 mm
2810272	MINI MCR-DKL-LABEL	Label for extended marking of MINI MCR modules in connection with the MINI MCR-DKL
2864134	MINI MCR-SL-PTB	MCR power terminal block for supplying several MINI Analog modules via the DIN rail connectors, with screw connection, current consumption up to max. 2 A
2864147	MINI MCR-SL-PTB-SP	MCR power terminal block for supplying several MINI-ANALOG modules via the DIN rail connectors, with spring-cage connection, current consumption up to max. 2 A
2866653	MINI-PS-100-240AC/24DC/1.5/ EX	DIN rail power supply unit, primary-switched mode, slim design, output: 24 V DC / 1.5 A, ATEX approval
2866983	MINI-SYS-PS-100-240AC/24DC/1.5	DIN rail power supply unit, primary-switched mode, slim design, output: 24 V DC / 1.5 A

Diagrams/Drawings

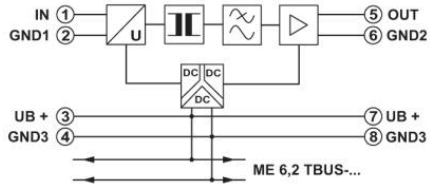
Block diagram



Dimensioned drawing



Circuit diagram



Address

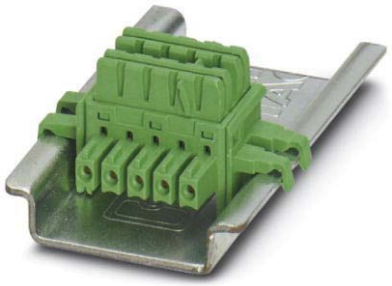
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Extract from the online catalog

ME 6,2 TBUS-2 1,5/5-ST-3,81 GN

Order No.: 2869728



http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=2869728

DIN rail connector (TBUS), 5-pos., for bridging the supply voltage, can be snapped onto NS 35/... DIN rails according to EN 60715

Commercial data	
GTIN (EAN)	4 017918 983093
sales group	F052
Pack	10 pcs.
Customs tariff	85366990
Catalog page information	Page 370 (IF-2011)

Product notes

WEEE/RoHS-compliant since: 11/04/2003

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Certificates / Approvals

Certification	CUL, UL

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Extract from the online catalog

MINI MCR-SL-PTB

Order No. 2864134



http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=2864134

MCR power terminal block for supplying several MINI Analog modules via the DIN rail connectors, with screw connection, current consumption up to max. 2 A

Commercial data	
GTIN (EAN)	4 017918 974770
sales group	H529
Pack	1 pcs.
Customs tariff	85389091
Catalog page information	Page 370 (IF-2011)

Product notes

WEEE/RoHS-compliant since: 06/14/2006

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Product description

The 6.2 mm wide MINI MCR-SL-PTB... power terminal is used for supplying the DIN rail connector with supply voltage.

Two separate voltage inputs allow a redundant voltage supply of 24 V DC and a maximum current of 2 A.

A green LED on the front panel lights up when there is supply voltage on the DIN rail connector. Red LEDs indicate supply voltages connected with reversed polarity. When the supply voltage has been connected correctly, the red LED extinguishes.

Technical data

Input data

DC input voltage range	0 V DC ... 30 V DC
Current consumption	max. 2 A

Output data

Output voltage range	(Input voltage - 0.8 V)
Output current	max. 2 A

General data

Width	6.2 mm
Height	93.1 mm
Depth	102.5 mm
Degree of protection	IP20
Ambient temperature (operation)	-20 °C ... 65 °C
Ambient temperature (storage/transport)	-40 °C ... 85 °C
Mounting position	Any
Assembly instructions	The DIN rail bus connector (TBUS) can be used for bridging the supply voltage. It can be snapped onto a 35 mm EN 60715 DIN rail.
Electromagnetic compatibility	Conformance with EMC Directive 2004/108/EC
Noise emission	EN 61000-6-4
Noise immunity	EN 61000-6-2:2005
ATEX	Ex II 3 G Ex nA II T4 X

Connection data, input

Connection method	Screw connection
Conductor cross section solid min.	0.14 mm²
Conductor cross section solid max.	2.5 mm²
Conductor cross section stranded min.	0.2 mm²
Conductor cross section stranded max.	2.5 mm²
Conductor cross section AWG/kcmil min.	26
Conductor cross section AWG/kcmil max	12

Certificates / Approvals

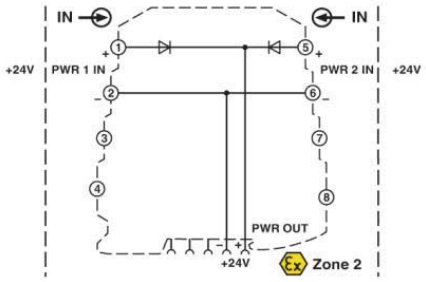
Certification	CUL, GL, UL
Certification Ex:	CUL-EX LIS, PxC-EX, UL-EX LIS

Accessories

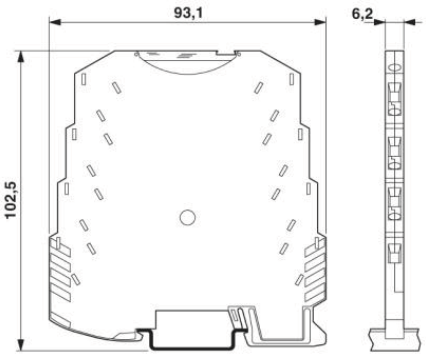
Item	Designation	Description
General		
2869728	ME 6,2 TBUS-2 1,5/5-ST-3,81 GN	DIN rail connector (TBUS), 5-pos., for bridging the supply voltage, can be snapped onto NS 35/... DIN rails according to EN 60715

Diagrams/Drawings

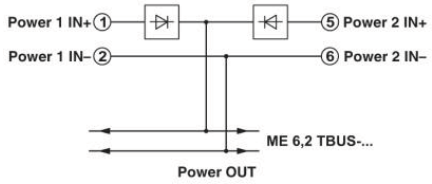
Block diagram



Dimensioned drawing



Circuit diagram



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Extract from the online catalog

UT 10

Order No.: 3044160



http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=3044160

Feed-through modular terminal block, Connection method: Screw connection, Screw connection, Cross section: 0.5 mm² - 16 mm², AWG 20 - 6, Width: 10.2 mm, Color: gray, Mounting type: NS 35/7.5, NS 35/15

Product notes

WEEE/RoHS-compliant since: 01/01/2003

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Commercial data

GTIN (EAN)	4 017918 960445
sales group	A800
Pack	50 pcs.
Customs tariff	85369010
Catalog page information	Page 27 (CL1-2011)

Technical data

General

Number of levels	1
Number of connections	2
Color	gray

Insulating material	PA
Inflammability class acc. to UL 94	V0

Dimensions

Width	10.2 mm
Length	47.7 mm
Height NS 35/7.5	47.5 mm
Height NS 35/15	55 mm

Technical data

Maximum load current	76 A (with 16 mm^2 conductor cross section)
Rated surge voltage	8 kV
Pollution degree	3
Surge voltage category	III
Insulating material group	I
Connection in acc. with standard	IEC 60947-7-1
Nominal current I_N	57 A
Nominal voltage U_N	1000 V
Open side panel	ja

Connection data

Note	Note: Product releases, connection cross sections and notes on connecting aluminum cables can be found in the download area.
Conductor cross section solid min.	0.5 mm²
Conductor cross section solid max.	16 mm²
Conductor cross section stranded min.	0.5 mm²
Conductor cross section stranded max.	16 mm²
Conductor cross section AWG/kcmil min.	20
Conductor cross section AWG/kcmil max	6
Conductor cross section stranded, with ferrule without plastic sleeve min.	0.5 mm²
Conductor cross section stranded, with ferrule without plastic sleeve max.	10 mm²
Conductor cross section stranded, with ferrule with plastic sleeve min.	0.5 mm²
Conductor cross section stranded, with ferrule with plastic sleeve max.	10 mm²
2 conductors with same cross section, solid min.	0.5 mm²
2 conductors with same cross section, solid max.	4 mm²

2 conductors with same cross section, stranded min.	0.5 mm²
2 conductors with same cross section, stranded max.	4 mm²
2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, min.	0.5 mm²
2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, max.	6 mm²
2 conductors with same cross section, stranded, ferrules without plastic sleeve, min.	0.5 mm²
2 conductors with same cross section, stranded, ferrules without plastic sleeve, max.	2.5 mm²
Connection method	Screw connection
Stripping length	10 mm
Internal cylindrical gage	A6
Screw thread	M4
Tightening torque, min	1.5 Nm
Tightening torque max	1.8 Nm

Certificates / Approvals

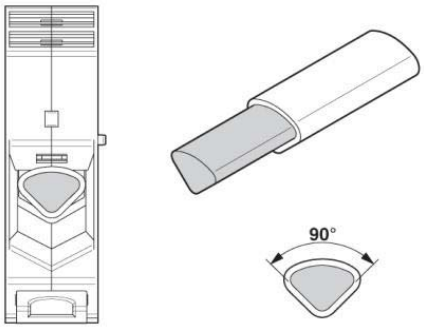
Certification	CB, CSA, CUL, DNV, GL, LR, UL, VDE-PZI
Certification Ex:	IECEx, KEMA-EX

Diagrams/Drawings

Circuit diagram



Schematic diagram



Connecting aluminum cables. Further notes can be found in the download area

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Extract from the online catalog

D-UT 2,5/10

Order No. 3047028



http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=3047028

End cover, Length: 47.7 mm, Width: 2.2 mm, Height: 48.4 mm, Color: gray

Commercial data	
GTIN (EAN)	4 017918 960346
sales group	A892
Pack	50 pcs.
Customs tariff	85389099
Catalog page information	Page 26 (CL1-2011)

Product notes

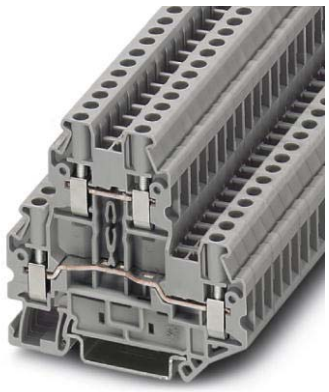
WEEE/RoHS-compliant since: 01/01/2003

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Extract from the online catalog

UTTB 4

Order No.: 3044814



http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=3044814

Double-level terminal block with a screw connection, cross section: 0.14 mm² - 6 mm², AWG: 26 - 10, width: 6.2 mm, color: Gray

Product notes

WEEE/RoHS-compliant since: 08/17/2005

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Commercial data

GTIN (EAN)	4 046356 055512
sales group	A832
Pack	50 pcs.
Customs tariff	85369010
Catalog page information	Page 43 (CL1-2011)

Technical data

General

Number of levels	2
Number of connections	4
Color	gray

Insulating material	PA
Inflammability class acc. to UL 94	V0

Dimensions

Width	6.2 mm
Length	69.9 mm
Height NS 35/7.5	65 mm
Height NS 35/15	72.5 mm

Technical data

Rated surge voltage	8 kV
Pollution degree	3
Surge voltage category	III
Insulating material group	I
Connection in acc. with standard	IEC 60947-7-1
Nominal current I_N	30 A
Nominal voltage U_N	800 V

Connection data

Conductor cross section solid min.	0.14 mm²
Conductor cross section solid max.	6 mm²
Conductor cross section stranded min.	0.14 mm²
Conductor cross section stranded max.	6 mm²
Conductor cross section AWG/kcmil min.	26
Conductor cross section AWG/kcmil max	10
Conductor cross section stranded, with ferrule without plastic sleeve min.	0.14 mm²
Conductor cross section stranded, with ferrule without plastic sleeve max.	4 mm²
Conductor cross section stranded, with ferrule with plastic sleeve min.	0.14 mm²
Conductor cross section stranded, with ferrule with plastic sleeve max.	4 mm²
2 conductors with same cross section, solid min.	0.14 mm²
2 conductors with same cross section, solid max.	1.5 mm²
2 conductors with same cross section, stranded min.	0.14 mm²
2 conductors with same cross section, stranded max.	1.5 mm²

2 conductors with same cross section, stranded, ferrules without plastic sleeve, min.	0.14 mm²
2 conductors with same cross section, stranded, ferrules without plastic sleeve, max.	1.5 mm²
2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, min.	0.5 mm²
2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, max.	2.5 mm²
Connection method	Screw connection
Stripping length	9 mm
Internal cylindrical gage	A4
Screw thread	M3
Tightening torque, min	0.6 Nm
Tightening torque max	0.8 Nm

Certificates / Approvals

Certification	CSA, CUL, GL, UL
Certification Ex:	IECEx, KEMA-EX

Diagrams/Drawings

Circuit diagram





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D-UTTB 2,5/4

Order No.: 3047293



http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=3047293

End cover, Length: 69.9 mm, Width: 2.2 mm, Height: 57.5 mm, Color: gray

Commercial data	
GTIN (EAN)	4 017918 997267
sales group	A892
Pack	50 pcs.
Customs tariff	85389099
Catalog page information	Page 42 (CL1-2011)

Product notes

WEEE/RoHS-compliant since: 01/18/2005

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Extract from the online catalog

FBS 10-6

Order No.: 3030271



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Plug-in bridge, Number of positions: 10, Color: red

Commercial data	
GTIN (EAN)	4 017918 188580
sales group	A690
Pack	10 pcs.
Customs tariff	85389099
Catalog page information	Page 390 (CL1-2011)

Product notes

WEEE/RoHS-compliant since: 01/01/2003

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E/NS 35 N

Order No.: 0800886



http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=0800886

End clamp, width: 9.5 mm, color: gray

Commercial data	
GTIN (EAN)	4 017918 129309
sales group	B220
Pack	50 pcs.
Customs tariff	39269097
Catalog page information	Page 345 (CL2-2011)

Product notes

WEEE/RoHS-compliant since: 02/01/2005

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Technical data

General data

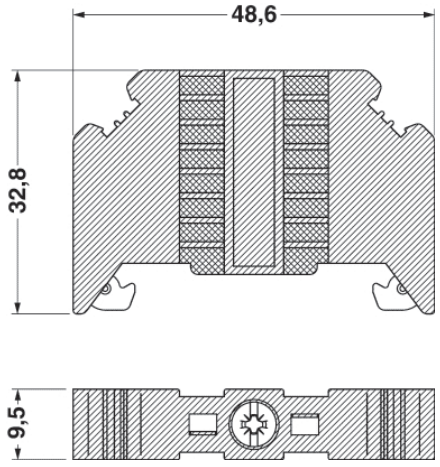
Height	32.8 mm
Length	48.6 mm
Width	9.5 mm
Material	PA
Color	gray

Accessories

Item	Designation	Description
Assembly		
0801762	NS 35/ 7,5 CU UNPERF 2000MM	DIN rail, material: Copper, unperforated, height 7.5 mm, width 35 mm, length: 2 m
0801733	NS 35/ 7,5 PERF 2000MM	DIN rail, material: steel galvanized and passivated with a thick layer, perforated, height 7.5 mm, width 35 mm, length: 2000 mm
0801681	NS 35/ 7,5 UNPERF 2000MM	DIN rail, material: Steel, unperforated, height 7.5 mm, width 35 mm, length: 2 m
1201756	NS 35/15 AL UNPERF 2000MM	DIN rail, deep drawn, high profile, unperforated, 1.5 mm thick, material: aluminum, height 15 mm, width 35 mm, length 2000 mm
1201895	NS 35/15 CU UNPERF 2000MM	DIN rail, material: Copper, unperforated, 1.5 mm thick, height 15 mm, width 35 mm, length: 2 m
1201730	NS 35/15 PERF 2000MM	DIN rail, material: steel galvanized and passivated with a thick layer, perforated, height 15 mm, width 35 mm, length: 2000 mm
1201714	NS 35/15 UNPERF 2000MM	DIN rail, material: Steel, unperforated, height 15 mm, width 35 mm, length: 2 m
1201798	NS 35/15-2,3 UNPERF 2000MM	DIN rail, material: Steel, unperforated, 2.3 mm thick, height 15 mm, width 35 mm, length: 2 m
Marking		
1007235	SBS 8:UNBEDRUCKT	Marker cards for modular terminal blocks, color: white
1050512	ZB 8:SO/CMS	Zack strip, 10-section, divisible, special printing, marking according to customer requirements

Diagrams/Drawings

Dimensioned drawing



Address

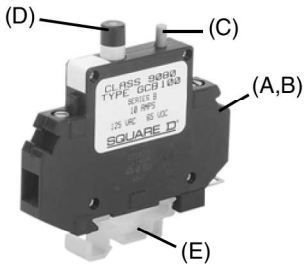
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Terminal Blocks, Type AB1

Circuit protectors, 9080GCB

One-pole, thermal-magnetic control



A. Thermal-magnetic circuit protector
B. 14 stocked current ratings, from 0.1 to 15 A
C. On-Off switch
D. Visible trip indication
E. Mounts on Class 9080 Type GH track and on 35 mm DIN3 mounting track.

9080GCB••• circuit protectors:

- Have solderless box lugs.
- Accept one #10–16 AWG Cu wire.
- Come with track adapter 9080GH64 for mounting on 9080GH track. Remove this adapter for mounting on 9080MH2••, MH3••, and AM1 track. Use mounting adapter 9080MH62 for the DZ5MB201 DIN1 track.

Technical data

Maximum interrupting rating	200 A, but not exceeding 10,000% (100 x) rated current
Dielectric strength	1500 Vac
Insulation resistance	100 MΩ
Weight	2.2 oz (62.4 g)
Terminals	Box lug type
Tightening torque	8–10 lb-in (0.91–1.1 N•m)
Approvals	File E152841 CCN QVNU2, File LR25490
Fingersafe per DIN 57470	Yes

Maximum Current (A) ●	**Internal Resistance (Ω)**	**Maximum voltage**	**Catalog Number**
0.1	1.33	250 Vac 65 Vdc	**9080GCB01**
0.5	6.6		**9080GCB05**
0.8	2.55		**9080GCB08**
1.0	1.97		**9080GCB10**
1.2	1.22		**9080GCB12**
1.5	0.86		**9080GCB15**
2.0	0.49		**9080GCB20**
2.5	0.31		**9080GCB25**
3.0	0.20		**9080GCB30**
4.0	0.10		**9080GCB40**
5.0	0.08		**9080GCB50**
7.0	0.03		**9080GCB70**
10.0	< 0.02	125 Vac 65 Vdc	**9080GCB100**
15.0			**9080GCB150**

● *These maximum current values assume the use of insulated copper conductors with 75 °C temperature rating, and are calculated based on NEC Article 310, Table 310-16. In most cases this value is the maximum ampacity of that wire or combination of wires (as listed in the table to the right) which has the greatest current carrying capacity. The actual allowable current for a particular application depends on the number, size, insulation class, and other characteristics of the wires used.*

Selection

To properly select a Class 9080 Type GCB circuit protector:

1. Determine the inrush correction factor from Table A.
2. Determine the temperature correction factor from Table B.
3. Determine the sealed current of the load that is being protected.
4. Multiply the sealed current by the two correction factors and choose the closest circuit protector.

Example: Solenoid with a sealed current of 0.75 A, with an inrush ratio of 1:6, and in an ambient temperature of 85 °F (29.4 °C).

0.75 x 1.5 x 1.05 = 1.18

Choose the **1.2 A** protector

Note: Choosing a circuit protector with a value lower than the calculated value might result in nuisance tripping, while choosing the larger might provide a protector that will not properly protect the load.

Table A: Inrush ratio correction

Note: For resistive loads, use an inrush correction factor of 1.0.

Inrush ratio	1:1 to 1:4	1:5	1:6	1:7	1:8
Correction factor	1.3	1.4	1.5	1.6	1.7

Table B: Ambient temperature correction

Ambient temperature	°F	70	100	120	140	160	180	200
	°C	21.1	37.8	48.9	60	71.1	82.2	93.3
Correction factor		1.0	1.1	1.2	1.3	1.4	1.5	1.6

Tripping time of the circuit protector is determined from Table C below. Divide the circuit protector value by the temperature correction factor from Table B above to determine actual rated current referenced in Table C.

Table C: Tripping times in seconds @ 70 °F (21.1 °C)

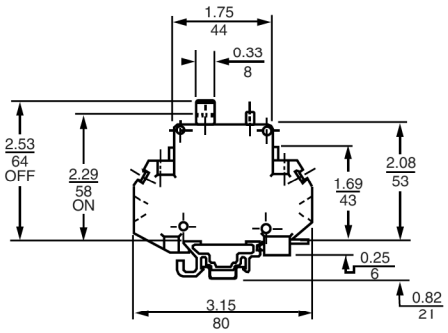
Percent of rated current	100%	200%	300%	400%	500%	600%	1000%	2000% & greater
Trip time (seconds)	no trip	10-40	38	1.5-9	0.8-6	0.003-4	0.003-2	0.02 max.

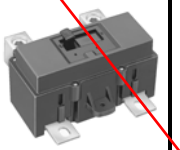
Note: When several protectors are channel mounted adjacent to each other, the No Trip current will be 80% of rated current at 70 °F (21.1 °C).

Track Adapter

Description	**Catalog Number**
For mounting 9080GCB circuit protectors on DZ5MB201 track or DIN1 track	**9080MH62**

Dimensions

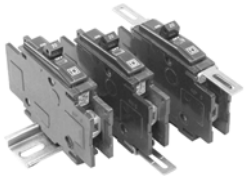


		QOU Circuit Breakers				QOM1 and QOM2 Main Circuit Breakers		Multi 9™ Circuit Breakers and Supplementary Protectors								EDB Circuit Breakers					
																					
Circuit Breaker Type	**Plug-on**	—			—	—	—	—			—					—		—		—	
	Bolt-on	—			—	QOM1-VH	QOM2-VH	—			—			New!		EDB		EGB		EJB	
	Unit Mount	QOU			QYU▲	—	—	UL 489 C60N			UL1077 C60N■			C60H-DC		—		—		—	
Number of Poles		1	2	3	1	2	2	1	2	3	1	2	3,4	1	2	1	2,3	1	2,3	1	2,3
Current Range		10–100	10–125	10–100	10–30	50–125	100–225	0.5–35	0.5–35	0.5–35	0.5–63	1–63	1–63	0.5–40	0.5–40	15–70	15–125	15–70	15–125	15–70	15–125
Interrupting Ratings																					
UL/CSA Rating (kA RMS) (50/60 Hz)	120 Vac	10	10	10	—	22	22	10	—	—	10	10	10	—	—	25	25	65	65	100	100
	120/240 Vac	10	10	10	—	22	22	5	10	10	10	10	10	—	—	18	25	35	65	65	100
	240 Vac♦	—	—	10	—	—	—	5	10	10	10	10	10	—	—	18	25	35	65	65	100
	277 Vac	—	—	—	5	—	—	—	—	—	5	5	5	—	—	18	18	35	35	65	65
	480Y/277 Vac	—	—	—	—	—	—	10	10	10	—	5	5	—	—	—	18	—	35	—	65
DC Ratings	48 Vdc	5★	5★	5★	—	—	—	—	—	—	10	10	—	5	5	—	—	—	—	—	—
	60 Vdc	5▼	5▼	5▼	—	—	—	10	10	—	—	—	—	5	5	—	—	—	—	—	—
	65 Vdc	—	—	—	—	—	—	—	—	—	10	10	—	5	5	—	—	—	—	—	—
	125 Vdc	—	—	—	—	—	—	—	10	—	—	10	—	5	5	—	—	—	—	—	—
	250 Vdc	—	—	—	—	—	—	—	—	—	—	—	—	5	5	—	—	—	—	—	—
	500 Vdc	—	—	—	—	—	—	—	—	—	—	—	—	—	5◒	—	—	—	—	—	—
IEC 60947-2 (50/60 Hz) Icu	240 Vac	—	—	—	—	—	—	20	20	20	10	10	10	20	10	20	—	—	—	—	—
	415 Vac	—	—	—	—	—	—	—	10	10	—	5	5	—	—	10	—	—	—	—	—
Special Ratings																					
Fed. Specs W-C-375B/GEN		X	X	X	X	X	X	X	X	X	—	—	—	—	—	X	X	X	X	X	X
Other Standard		HACR △			—	—	—	—	—	—	□	—	—	—	—	HACR					
Accessories and Modifications																					
Shunt Trip		X◊	X◊	X◊	X◊	—	X ◊	X	X	X	X	X	X	X	X	X ◊	X ◊	X ◊	X ◊	X ◊	X ◊
Undervoltage Trip		—	—	—	—	—	—	X	X	X	X	X	X	X	X	—	—	—	—	—	—
Auxiliary Switches		X◊	X◊	X◊	X◊	—	—	X	X	X	X	X	X	X	X	X◊	X◊	X◊	X◊	X◊	X◊
Alarm Switch		X◊	X◊	X◊	X◊	—	—	X	X	X	X	X	X	X	X	X◊	X◊	X◊	X◊	X◊	X◊
Handle Operators		—	—	—	—	—	—	X	X	X	X	X	X	X	X	—	—	—	—	—	—
Handle Padlock Attachment		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Trip System Type																					
Thermal-magnetic		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Molded Case Switch		—	X	X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dimensions (1P Unit Mount)																					
Dimensions (1P Unit Mount) in. (mm)	Height	4.05 (103)				5.09 (129)☆	5.60 (142)☆	4.21 (107)▽			3.19 (81)			3.19 (81)		5.66 (144)					
	Width	0.75 (19)				5.00 (127)☆	5.07 (129)☆	0.71 (18)			0.71 (18)			0.71 (18)	1.42 (36)	0.98 (25)					
	Depth	2.92 (74)				3.47 (88)☆	3.60 (91)☆	2.76 (70)			2.76 (70)			2.56 (65)		4.05 (103)					
Pages		Pages 7-14				Pages 1-2		Pages 7-16 through 7-19								Page 9-17					

Note: All circuit breakers on this chart are UL Listed and CSA Certified unless otherwise noted.

- ▲ QYU is a UL 1077 supplementary protector.
- ■ C60N are recognized components per UL 1077.
- ♦ For information regarding 3Ø corner grounded systems see the Supplemental Digest.
- ★ 1P and 2P, 10–70 A and 3P 10–60 A only.
- ▼ QOU is UL Listed for 60 Vdc per pole 80–100 A, 1P; 80–125 A, 2P; and 70–100 A, 3P.
- △ HACR on QOU 1P and 3P 15–100 A, 2P 15–125 A;
- □ UL 489A for DC Telecom applications (1-pole only).
- ◊ Factory-installed option only
- ☆ QOM1 and QOM2 dimensions are for 2-pole unit.
- ▽ 480 V C60 height is 5.56 in. (141 mm).
- ◒ 2 poles must be wired in series for 500 Vdc.

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Low Ampere QOU

Low Ampere QOU Miniature Circuit Breakers

QOU unit mount miniature circuit breakers (cable-in/cable-out) are ideal for OEM applications. They have Square D's unique Visi-Trip® feature and can be DIN rail-mounted or surface- or flush-mounted using mounting feet.

General Specifications Common to All Low Ampere QOU Circuit Breakers

- For convenient flush mount, surface mount or DIN mount (symmetrical rail 35 x 7.5 DIN/EN 50 022)
- Single handle with internal common trip
- Terminal lug wire size (1) 14–2 AWG Cu or Al
- Reversible line and load lugs
- Field-installable quick connectors
- UL Listed 48 Vdc (5 k AIR)
- UL Listed as HACR Type—10–70 A
- High magnetic trip circuit breakers (QOU-HM) are recommended for applications where high initial inrush may occur and for individual dimmer applications.
- For DIN mounting rails, see IEC Starters and Relays, Section 18

Table 7.20: QOU Low Ampere Miniature Circuit Breakers

Ampere Rating	1P 120/240 Vac		2P 120/240 Vac		2P 240 Vac		3P 240 Vac	
	Cat. No.	$ Price	Cat. No.	$ Price	Cat. No.▲	$ Price	Cat. No.	$ Price
10 k AIR								
10 A	QOU110		QOU210		—		QOU310	
15 A	QOU115		QOU215		QOU215H		QOU315	
20 A	QOU120		QOU220		QOU220H	168.00	QOU320	
25 A	QOU125		QOU225		QOU225H		QOU325	
30 A	QOU130	40.20	QOU230	87.00	QOU230H		QOU330	285.00
35 A	QOU135		QOU235		—	—	QOU335	
40 A	QOU140		QOU240		—	—	QOU340	
45 A	QOU145		QOU245		—	—	QOU345	
50 A	QOU150		QOU250		—	—	QOU350	
60 A	QOU160		QOU260		—	—	QOU360	
70 A	QOU170	78.00	QOU270	171.00	—	—	QOU370	363.00
22 k AIR								
15 A	QOU115VH		QOU215VH		—	—	QOU315VH	
20 A	QOU120VH		QOU220VH		—	—	QOU320VH	426.00
25 A	QOU125VH		QOU225VH		—	—	QOU325VH	
30 A	QOU130VH		QOU230VH		—	—	QOU330VH	
35 A	QOU135VH	101.00	QOU235VH	189.00	—	—	—	—
40 A	QOU140VH		QOU240VH		—	—	—	—
45 A	QOU145VH		QOU245VH		—	—	—	—
50 A	QOU150VH		QOU250VH		—	—	—	—
60 A	QOU160VH		QOU260VH		—	—	—	—

▲ QOU-H interrupting rating is 10 kA at 240 Vac.

Table 7.21: QOU-HM Miniature Circuit Breakers (10 k AIR)

Ampere Rating	1P 120/240 Vac		2P 120/240 Vac		2P 240 Vac		3P 240 Vac	
	Cat. No.	$ Price	Cat. No.	$ Price	Cat. No.	$ Price	Cat. No.	$ Price
15 A	QOU115HM	40.20	—	—	—	—	—	—
20 A	QOU120HM		—	—	—	—	—	—



High Ampere QOU

Table 7.22: QYU UL1077 Recognized Supplementary Protectors (5 k AIR)

Ampere Rating	1P 277 Vac		2P 120/240 Vac		2P 240 Vac		3P 240 Vac	
	Cat. No.	$ Price	Cat. No.	$ Price	Cat. No.	$ Price	Cat. No.	$ Price
10 A	QYU110		—	—	—	—	—	—
15 A	QYU115		—	—	—	—	—	—
20 A	QYU120	122.00	—	—	—	—	—	—
25 A	QYU125		—	—	—	—	—	—
30 A	QYU130		—	—	—	—	—	—

High Ampere QOU Circuit Breakers

General Specifications Common to All High Ampere QOU Circuit Breakers

- Flush mount, surface mount, and DIN rail mount.
- Internal common trip.
- Non-reversible line and load lugs.
- Terminal lug wire size (1) 12– 2/0 AWG Cu or Al.
- UL Listed 60 Vdc per pole (5 k AIR). (**Note:** except switches)
- UL Listed as HACR type, 80–125 A.
- Non-automatic switches have the same physical packaging as miniature circuit breakers, but provide no overcurrent or short circuit protection. They are UL Listed per UL1087 and are CSA certified.

Table 7.23: QOU High Ampere Miniature Circuit Breakers (10 k AIR)

Ampere Rating	1P 120/240 Vac		2P 120/240 Vac		2P 240 Vac		3P 240 Vac	
	Cat. No.	$ Price	Cat. No.	$ Price	Cat. No.	$ Price	Cat. No.	$ Price
80 A	QOU180		QOU280		—	—	QOU380	
90 A	QOU190	176.00	QOU290	246.00	—	—	QOU390	416.00
100 A	QOU1100		QOU2100		—	—	QOU3100	
125 A	—	—	QOU2125	452.00	—	—	—	—

Table 7.24: QOU Non-Automatic Switches

Ampere Rating	1P 120 Vac	$ Price	2P 120/240 Vac	$ Price	2P 240 Vac	$ Price	3P 240 Vac	$ Price
	Cat. No.		Cat. No.		Cat. No.		Cat. No.	
60 A	—	—	—	—	QOU200	87.00	QOU300	285.00
100 A	—	—	—	—	QOU2000	246.00	QOU3000	416.00
125 A	—	—	—	—	QOU20001	452.00	QOU30001	716.00

Interrupting Ratings . . . . . Page 7-3
Accessories . . . . . Page 7-12, 7-15
Dimensions. . . . . Page 7-54

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Extract from the online catalog

UT 4

Order No.: 3044102



http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=3044102

Feed-through modular terminal block, Connection method: Screw connection, Screw connection, Cross section: 0.14 mm² - 6 mm², AWG 26 - 10, Width: 6.2 mm, Color: gray, Mounting type: NS 35/7.5, NS 35/15

Product notes

WEEE/RoHS-compliant since: 01/01/2003

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Commercial data

GTIN (EAN)	4 017918 960391
sales group	A800
Pack	50 pcs.
Customs tariff	85369010
Catalog page information	Page 27 (CL1-2011)

Technical data

General

Number of levels	1
Number of connections	2
Color	gray

Insulating material	PA
Inflammability class acc. to UL 94	V0

Dimensions

Width	6.2 mm
Length	47.7 mm
Height NS 35/7.5	47.5 mm
Height NS 35/15	55 mm

Technical data

Maximum load current	41 A (with 6 mm^2 conductor cross section)
Rated surge voltage	8 kV
Pollution degree	3
Surge voltage category	III
Insulating material group	I
Connection in acc. with standard	IEC 60947-7-1
Nominal current I_N	32 A (with 4 mm² conductor cross section)
Nominal voltage U_N	1000 V
Open side panel	ja

Connection data

Note	Note: Product releases, connection cross sections and notes on connecting aluminum cables can be found in the download area.
Conductor cross section solid min.	0.14 mm²
Conductor cross section solid max.	6 mm²
Conductor cross section stranded min.	0.14 mm²
Conductor cross section stranded max.	6 mm²
Conductor cross section AWG/kcmil min.	26
Conductor cross section AWG/kcmil max	10
Conductor cross section stranded, with ferrule without plastic sleeve min.	0.14 mm²
Conductor cross section stranded, with ferrule without plastic sleeve max.	4 mm²
Conductor cross section stranded, with ferrule with plastic sleeve min.	0.14 mm²
Conductor cross section stranded, with ferrule with plastic sleeve max.	4 mm²
2 conductors with same cross section, solid min.	0.14 mm²
2 conductors with same cross section, solid max.	1.5 mm²

2 conductors with same cross section, stranded min.	0.14 mm²
2 conductors with same cross section, stranded max.	1.5 mm²
2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, min.	0.5 mm²
2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, max.	2.5 mm²
2 conductors with same cross section, stranded, ferrules without plastic sleeve, min.	0.14 mm²
2 conductors with same cross section, stranded, ferrules without plastic sleeve, max.	1.5 mm²
Connection method	Screw connection
Stripping length	9 mm
Internal cylindrical gage	A4
Screw thread	M3
Tightening torque, min	0.6 Nm
Tightening torque max	0.8 Nm

Certificates / Approvals

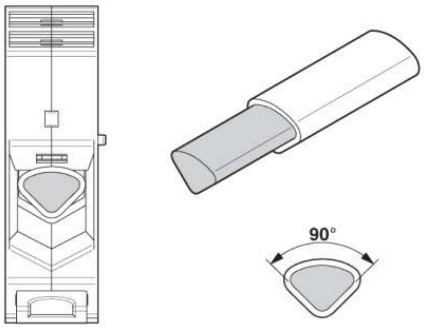
Certification	CB, CSA, CUL, DNV, GL, LR, UL, VDE-PZI
Certification Ex:	IECEx, KEMA-EX

Diagrams/Drawings

Circuit diagram



Schematic diagram



Connecting aluminum cables. Further notes can be found in the download area

Address

PHOENIX CONTACT Inc., USA
586 Fulling Mill Road
Middletown, PA 17057,USA
Phone (800) 888-7388
Fax (717) 944-1625
http://www.phoenixcon.com

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Extract from the online catalog

D-UT 2,5/10

Order No. 3047028



http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=3047028

End cover, Length: 47.7 mm, Width: 2.2 mm, Height: 48.4 mm, Color: gray

Commercial data	
GTIN (EAN)	4 017918 960346
sales group	A892
Pack	50 pcs.
Customs tariff	85389099
Catalog page information	Page 26 (CL1-2011)

Product notes

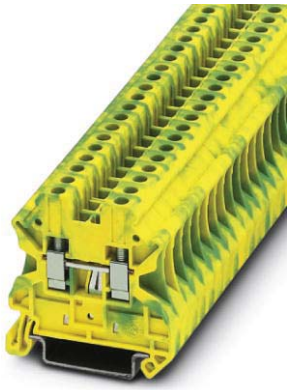
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UT 4-PE

Order No.: 3044128



http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=3044128

Universal ground terminal block, Connection method: Screw connection, Cross section: 0.14 mm² - 6 mm², AWG 26 - 10, Width: 6.2 mm, Color: green-yellow, Mounting type: NS 35/7.5, NS 35/15

Product notes

WEEE/RoHS-compliant since: 01/01/2003

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Commercial data

GTIN (EAN)	4 017918 960407
sales group	A803
Pack	50 pcs.
Customs tariff	85369010
Catalog page information	Page 35 (CL1-2011)

Technical data

General

Number of levels	1
Number of connections	2
Color	green-yellow

Insulating material	PA
Inflammability class according to UL 94	V0

Dimensions

Width	6.2 mm
Length	47.7 mm
Height NS 35/7.5	47.5 mm
Height NS 35/15	55 mm

Technical data

Rated surge voltage	8 kV
Pollution degree	3
Surge voltage category	III
Insulating material group	I
Connection in acc. with standard	IEC 60947-7-2
Open side panel	ja

Connection data

Note	Note: Product releases, connection cross sections and notes on connecting aluminum cables can be found in the download area.
Conductor cross section solid min.	0.14 mm²
Conductor cross section solid max.	6 mm²
Conductor cross section stranded min.	0.14 mm²
Conductor cross section stranded max.	6 mm²
Conductor cross section AWG/kcmil min.	26
Conductor cross section AWG/kcmil max	10
Conductor cross section stranded, with ferrule without plastic sleeve min.	0.14 mm²
Conductor cross section stranded, with ferrule without plastic sleeve max.	4 mm²
Conductor cross section stranded, with ferrule with plastic sleeve min.	0.14 mm²
Conductor cross section stranded, with ferrule with plastic sleeve max.	4 mm²
2 conductors with same cross section, solid min.	0.14 mm²
2 conductors with same cross section, solid max.	1.5 mm²
2 conductors with same cross section, stranded min.	0.14 mm²

2 conductors with same cross section, stranded max.	1.5 mm²
2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, min.	0.5 mm²
2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, max.	2.5 mm²
2 conductors with same cross section, stranded, ferrules without plastic sleeve, min.	0.14 mm²
2 conductors with same cross section, stranded, ferrules without plastic sleeve, max.	1.5 mm²
Connection method	Screw connection
Stripping length	9 mm
Internal cylindrical gage	A4
Screw thread	M3
Tightening torque, min	0.6 Nm
Tightening torque max	0.8 Nm

Certificates / Approvals

Certification	CB, CSA, CUL, DNV, GL, LR, RS, UL, VDE-PZI
Certification Ex:	IECEx, KEMA-EX

Accessories

Item	Designation	Description
Assembly		
3047167	ATP-UT	Partition plate, Length: 50 mm, Width: 2 mm, Height: 48 mm, Color: gray
3022276	CLIPFIX 35-5	Snap-on end bracket, for NS 35/7.5 or NS 35/15 DIN rail, can be fitted with Zack strip ZB 5 and ZBF 5, terminal strip marker KLM 2 and KLM, parking facility for FBS...5, FBS...6, KSS 5, KSS 6, width: 5,15 mm, color: gray
3047028	D-UT 2,5/10	End cover, Length: 47.7 mm, Width: 2.2 mm, Height: 48.4 mm, Color: gray
0801762	NS 35/ 7,5 CU UNPERF 2000MM	DIN rail, material: Copper, unperforated, height 7.5 mm, width 35 mm, length: 2 m

1207640	NS 35/ 7,5 PERF 755MM	DIN rail, material: steel galvanized and passivated with a thick layer, perforated, height 7.5 mm, width 35 mm, length: 755 mm
1207653	NS 35/ 7,5 PERF 955MM	DIN rail, material: steel galvanized and passivated with a thick layer, perforated, height 7.5 mm, width 35 mm, length: 955 mm
1207666	NS 35/ 7,5 PERF 1155MM	NS 35 DIN rail, height 7.5 mm, length 1155 mm
0801733	NS 35/ 7,5 PERF 2000MM	DIN rail, material: steel galvanized and passivated with a thick layer, perforated, height 7.5 mm, width 35 mm, length: 2000 mm
0801681	NS 35/ 7,5 UNPERF 2000MM	DIN rail, material: Steel, unperforated, height 7.5 mm, width 35 mm, length: 2 m
1201756	NS 35/15 AL UNPERF 2000MM	DIN rail, deep drawn, high profile, unperforated, 1.5 mm thick, material: aluminum, height 15 mm, width 35 mm, length 2000 mm
1201895	NS 35/15 CU UNPERF 2000MM	DIN rail, material: Copper, unperforated, 1.5 mm thick, height 15 mm, width 35 mm, length: 2 m
1207679	NS 35/15 PERF 755MM	DIN rail, material: steel galvanized and passivated with a thick layer, perforated, height 15 mm, width 35 mm, length: 755 mm
1207682	NS 35/15 PERF 955MM	DIN rail, material: steel galvanized and passivated with a thick layer, perforated, height 15 mm, width 35 mm, length: 955 mm
1207695	NS 35/15 PERF 1155MM	DIN rail, material: steel galvanized and passivated with a thick layer, perforated, height 15 mm, width 35 mm, length: 1155 mm
1201730	NS 35/15 PERF 2000MM	DIN rail, material: steel galvanized and passivated with a thick layer, perforated, height 15 mm, width 35 mm, length: 2000 mm
1201714	NS 35/15 UNPERF 2000MM	DIN rail, material: Steel, unperforated, height 15 mm, width 35 mm, length: 2 m
1201798	NS 35/15-2,3 UNPERF 2000MM	DIN rail, material: Steel, unperforated, 2.3 mm thick, height 15 mm, width 35 mm, length: 2 m

Bridges

3030336	FBS 2-6	Plug-in bridge, Number of positions: 2, Color: red
3030242	FBS 3-6	Plug-in bridge, Number of positions: 3, Color: red
3030255	FBS 4-6	Plug-in bridge, Number of positions: 4, Color: red
3030349	FBS 5-6	Plug-in bridge, Number of positions: 5, Color: red
3030271	FBS 10-6	Plug-in bridge, Number of positions: 10, Color: red
3030365	FBS 20-6	Plug-in bridge, Number of positions: 20, Color: red
3032224	FBS 50-6	Plug-in bridge, Number of positions: 50, Color: red

Marking

3047332	WS UT 4	Warning sign for UT terminal blocks
0811228	X-PEN 0,35	Marker pen without ink cartridge, for manual labeling of markers, labeling extremely wipe-proof, line thickness 0.35 mm
1051016	ZB 6,LGS:FORTL.ZAHLEN	Zack marker strip, 10-section, printed horizontally: with the numbers 1 - 10, 11 - 20 and so on up to 491 - 500, color: white

5060935	ZB 6/WH-100:UNBEDRUCKT	Zack strip, unprinted: For individual labeling with M-PEN, ZB-T or CMS system, large batch, sufficient for labeling 1000 terminal blocks, for a terminal width of 6.2 mm, color: White
1050499	ZB 6:SO/CMS	Zack strip, 10-section, divisible, special printing, marking according to customer requirements

Plug/Adapter

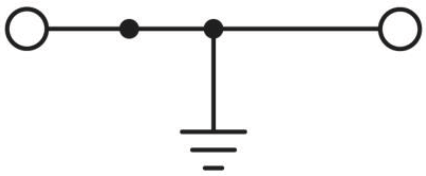
0201689	MPS-IH BU	Insulating sleeve, Color: blue
0201676	MPS-IH RD	Insulating sleeve, Color: red
0201663	MPS-IH WH	Insulating sleeve, Color: white
0201744	MPS-MT	Test plugs
3030925	PAI-4	Test adapter, Color: gray
3030996	PS-6	Test adapter, Color: red

Tools

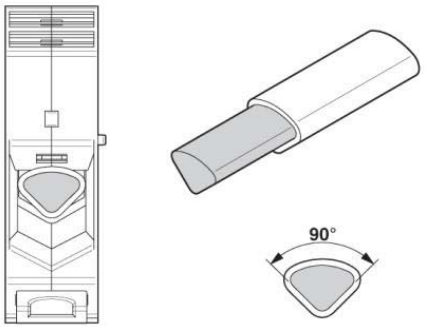
1205053	SZS 0,6X3,5	Actuation tool, for ST terminal blocks, insulated, also suitable for use as a bladed screwdriver, size: 0.6 x 3.5 x 100 mm, 2-component grip, with non-slip grip

Diagrams/Drawings

Circuit diagram



Schematic diagram



Connecting aluminum cables. Further notes can be found in the download area

Address

PHOENIX CONTACT Inc., USA
586 Fulling Mill Road
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Fax (717) 944-1625
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Extract from the online catalog

FBS 5-6

Order No.: 3030349



http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=3030349

Plug-in bridge, Number of positions: 5, Color: red

Commercial data	
GTIN (EAN)	4 017918 188801
sales group	A690
Pack	50 pcs.
Customs tariff	85389099
Catalog page information	Page 390 (CL1-2011)

Product notes

WEEE/RoHS-compliant since: 01/01/2003

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Extract from the online catalog

E/NS 35 N

Order No.: 0800886



http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=0800886

End clamp, width: 9.5 mm, color: gray

Commercial data	
GTIN (EAN)	4 017918 129309
sales group	B220
Pack	50 pcs.
Customs tariff	39269097
Catalog page information	Page 345 (CL2-2011)

Product notes

WEEE/RoHS-compliant since: 02/01/2005

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Technical data

General data

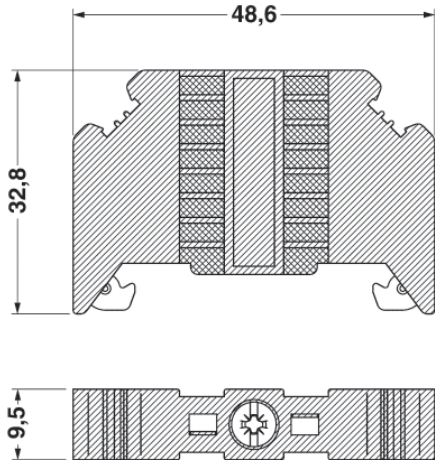
Height	32.8 mm
Length	48.6 mm
Width	9.5 mm
Material	PA
Color	gray

Accessories

Item	Designation	Description
Assembly		
0801762	NS 35/ 7,5 CU UNPERF 2000MM	DIN rail, material: Copper, unperforated, height 7.5 mm, width 35 mm, length: 2 m
0801733	NS 35/ 7,5 PERF 2000MM	DIN rail, material: steel galvanized and passivated with a thick layer, perforated, height 7.5 mm, width 35 mm, length: 2000 mm
0801681	NS 35/ 7,5 UNPERF 2000MM	DIN rail, material: Steel, unperforated, height 7.5 mm, width 35 mm, length: 2 m
1201756	NS 35/15 AL UNPERF 2000MM	DIN rail, deep drawn, high profile, unperforated, 1.5 mm thick, material: aluminum, height 15 mm, width 35 mm, length 2000 mm
1201895	NS 35/15 CU UNPERF 2000MM	DIN rail, material: Copper, unperforated, 1.5 mm thick, height 15 mm, width 35 mm, length: 2 m
1201730	NS 35/15 PERF 2000MM	DIN rail, material: steel galvanized and passivated with a thick layer, perforated, height 15 mm, width 35 mm, length: 2000 mm
1201714	NS 35/15 UNPERF 2000MM	DIN rail, material: Steel, unperforated, height 15 mm, width 35 mm, length: 2 m
1201798	NS 35/15-2,3 UNPERF 2000MM	DIN rail, material: Steel, unperforated, 2.3 mm thick, height 15 mm, width 35 mm, length: 2 m
Marking		
1007235	SBS 8:UNBEDRUCKT	Marker cards for modular terminal blocks, color: white
1050512	ZB 8:SO/CMS	Zack strip, 10-section, divisible, special printing, marking according to customer requirements

Diagrams/Drawings

Dimensioned drawing



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Bulletin 700-HK — "Slim Line" Relay

- 8 A/16 A contact ratings
- DPDT/SPDT
- Plug-in blade-style terminals
- Retainer clip with sockets
- Options: LED, push-to-test and manual override, socket-mounted surge suppressor module, or timer module
- Standard ON/OFF flag indicator
- Relay faceplate accepts optional Bulletin 1492 snap-in markers
- Choice of standard silver/nickel contacts or silver/nickel with gold plated contacts
- Maximum duty version available

Table of Contents

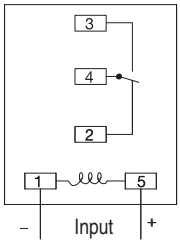
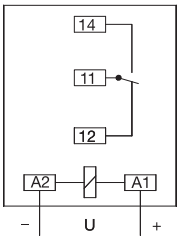
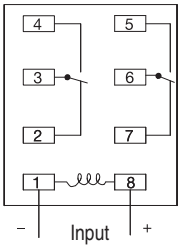
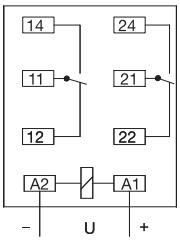
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Standards Compliance and Certifications

See Specification table in this section, page 9-42.

Product Selection

Slim Line Relay with Plug-in Quick Connect Terminations

	Description	Contact Rating	Wiring Diagrams U.S./Canada	Wiring Diagrams International	Coil Voltage	Cat. No.∗❄‡
	SPDT 1-Pole 1 Form C AgNi Contacts	16 A			6V AC	700-HK36A06
					12V AC	**700-HK36A12**
					24V AC	**700-HK36A24**
					120V AC	§ **700-HK36A1**
					240V AC	§ **700-HK36A2**
					6V DC	700-HK36Z06
					12V DC	**700-HK36Z12**
					24V DC	§ **700-HK36Z24**
					48V DC	**700-HK36Z48**
Bulletin 700-HK SPDT	Socket		***700-HN121, 700-HN221, 700-HN223***	***700-HN121, 700-HN221, 700-HN223***	110V DC	700-HK36Z1
	DPDT 2-Pole 2 Form C AgNi Contacts	8 A			6V AC	700-HK32A06
					12V AC	**700-HK32A12**
					24V AC	**700-HK32A24**
					120V AC	**700-HK32A1**
					240V AC	**700-HK32A2**
					6V DC	**700-HK32Z06**
					12V DC	**700-HK32Z12**
					24V DC	**700-HK32Z24**
					48V DC	700-HK32Z48
Bulletin 700-HK DPDT	Socket		***700-HN122, 700-HN222, 700-HN224***	***700-HN122, 700-HN222, 700-HN224***	110V DC	**700-HK32Z1**

∗ LED Option: Add suffix (**-4**) to the selected Bulletin 700-HK relay Cat. No. except for the 240V AC units, add (**-4L**).
❄ For AgNi Contact with Gold Plating: Replace "3" with "X" in Cat. No. For example, if Cat. No. 700-HK36A1 is required with Gold Plating, the new catalog number is 700-HKX6A1.
‡ Push-to-Test + Manual Override + LED Option: Add suffix (-3-4) to the selected 700-HK Relay catalog number, except for the 240V AC Units, add (-3-4L).
§ For high inductive, Tungsten, or Capacitive load applications, replace the "3" with a "M" in the catalog number. Only available in a SPDT configuration and with 24V DC, 120V AC or 240V AC coil voltages.

Accessories

	Description	Pkg. Qty.	Cat. No.
 *Cat. No. 700-HN121*	**Screw Terminal Socket — Panel or DIN Rail Mounting** 5-blade miniature socket with 10 A rating for use with 1-pole, Bulletin 700-HK relays. Accepts forked lug conductors. Socket includes a retainer clip.	10	**700-HN121**
 *Cat. No. 700-HN221*	**Screw Terminal Socket — Panel or DIN Rail Mounting** 5-blade miniature socket with 16 A rating for use with 1-pole, Bulletin 700-HK relays. Retainer clips are packaged separately with socket. Guarded terminal construction and compatible with optional plug-in module accessories.	10	**700-HN221**
	Spring Clamp Terminal Socket — Panel or DIN Rail Mounting 5-blade miniature socket for use with 1-pole, Bulletin 700-HX relays.	10	**700-HN223**
 *Cat. No. 700-HN122*	**Screw Terminal Socket — Panel or DIN Rail Mounting** 8-blade miniature socket with 5 A rating for use with 2-pole, Bulletin 700-HK relays. Accepts forked lug conductors. This socket includes a retainer clip.	10	**700-HN122**
 *Cat. No. 700-HN222*	**Screw Terminal Socket — Panel or DIN Rail Mounting** 8-blade miniature socket with 8 A rating for use with 2-pole, Bulletin 700-HK relays. Retainer clips are packaged separately with socket. Guarded terminal construction and compatible with optional plug-in module accessories.	10	**700-HN222**
	Spring Clamp Terminal Socket — Panel or DIN Rail Mounting 8-blade miniature socket for use with 2-pole Bulletin 700-HX relays.	10	**700-HN224**
 *Cat. No. 700-HN226*	**Flange Mount Adapter** Used for panel-mounting bulletin 700-HK relays. Order must be for 10 adapters or multiples of 10.	10	700-HN226
 *Cat. No. 700-HN227*	**35 mm Rail Mount Adapter** Mounts bulletin 700-HK relays to a 35 mm rail. Order must be for 10 adapters or multiples of 10.	10	700-HN227
 *Cat. No. 700-HN229*	**Socket Retainer Clip and Ejection Lever** For use with 700-HN22, -HN222, -HN223, and -HN224 sockets. Orders must be for 10 clips or multiples of 10.	10	700-HN229

	Description		Pkg. Qty.	Cat. No.
	**Diode Surge Suppressor** Voltage Range: 6…220V DC used with 700-HN221, 700-HN222 sockets		10	**700-ADR**
	Diode with LED Surge Suppressor Voltage Range: 6…24V DC used with 700-HN221, 700-HN222 sockets		10	**700-ADL1R**
	Diode with LED Surge Suppressor Voltage Range: 28…60V DC used with 700-HN221, 700-HN222 sockets		10	700-ADL2R
	Diode with LED Surge Suppressor Voltage Range: 110…220V DC used with 700-HN221, 700-HN222 sockets		10	700-ADL3R
	Varistor with LED Surge Suppressor Voltage Range: 6…24V AC used with 700-HN221, 700-HN222 sockets		10	**700-AV1R**
	Varistor with LED Surge Suppressor Voltage Range: 110…240V AC used with 700-HN221, 700-HN222 sockets		10	**700-AV3R**
	RC Surge Suppressor Voltage Range: 6…24V AC/DC used with 700-HN221, 700-HN222 sockets		10	**700-AR1**
	RC Surge Suppressor Voltage Range: 110…240V AC/DC used with 700-HN221, 700-HN222 sockets		10	**700-AR2**
	**Timing Module** On-Delay or One-Shot selectable voltage range: 12…24V AC/DC used with sockets that accept plug-in accessory modules.	On-Delay U (A1/A2) LED & R t One-Shot U (A1/A2) LED & R t	1	**700-AT3**
	Timing Module On-Delay or One-Shot selectable voltage range: 110…125V AC used with sockets that accept plug-in accessory modules.			700-AT3A1
	Timing Module On-Delay or One-Shot selectable voltage range: 230…240V AC used with sockets that accept plug-in accessory modules.			700-AT3A2
 *Cat. No. 700-HN180*	8-Way Jumper can be cut to required length. Rated 10 A – 250V. Used with 700-HN221, 700-HN222 sockets.	Red	1	**700-HN180R**
		Grey		**700-HN180G**
		Blue		**700-HN180B**
 *Cat. No. 199-DR1*	**DIN (#3) symmetrical hat rail** 35 x 7.5 x 1 m		10	**199-DR1**
	Relay Identification Snap-in Markers Snap-in markers fit on top of product covers. The following are blank cards.		100	**1492-MS6X9** **1492-MS6X12** **1492-MS8X12**

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Note: Spring clamp sockets are also available. Cat. No. 700-HN223 for Cat. No. 700-HK36 and Cat. No. 700-HN224 for 700-HK32.

Bulletin 700-HK Slim Line Relay, Socket, and Retainer Clip Reference Chart

Relay Type	Socket Cat. No.	Retainer Clip Cat. No.
700-HK32	700-HN122, 700-HN222, 700-HN224	Provided
700-HK36	700-HN121, 700-HN221, 700-HN223	

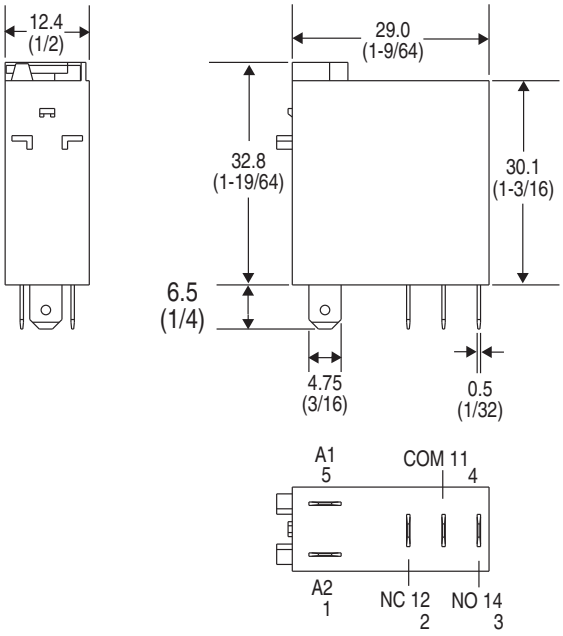
Interposing/Isolation Relays

Specifications

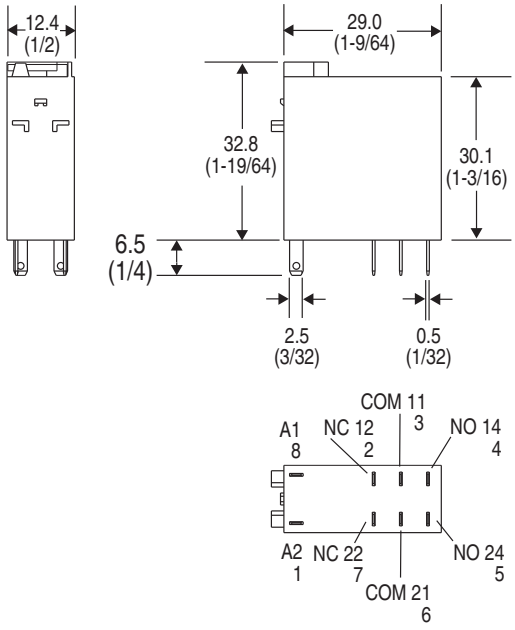
		Cat. No. 700-HK...			
Electrical Ratings					
Rated Thermal Current (I_{th})		1-Pole, 1 CO, SPDT — 16 A		2-Pole, 2 CO, DPDT — 8 A	
Rated Insulation Voltage (U_i)		250V IEC, 300V UL/CSA			
Contacts	Inductive V AC	120V AC	AC-15, 6.2 A B300 Pilot Duty, 3 A A300 (700-HKM_) 1/3 Hp (0.24 kW) 1-phase	120V AC	AC-15, 2.9 A B300 Pilot Duty, 3.0 A 1/4 Hp (0.18 kW), 1-phase
		240V AC	AC-15, 3.1 A B300 Pilot Duty, 1.5 A A300 (700-HKM_) 3/4 Hp (0.55 kW), 1-phase	240V AC	AC-15, 1.4 A B300 Pilot Duty, 1.5 A 1/2 Hp (0.37 kW), 1-phase
		230V AC	0.55 kW, 1-phase	230V AC	0.37 kW, 1-phase
	Inductive V DC	24V DC	DC-13, 5.0 A	24V DC	DC-13, 3.0 A
		125V DC	DC-13, 0.2 A R300 Pilot Duty, 0.22 A	125V DC	DC-13, 0.2 A R300 Pilot Duty, 0.22 A
		250V DC	DC-13, 0.1 A R300 Pilot Duty, 0.11 A	5 A, 250V AC	DC-13, 0.1 A R300 Pilot Duty, 0.11 A
	Resistive	230V AC	AC-1, 16 A	230V AC	AC-1, 8 A
		277V AC	16 A, General Use	277V AC	8 A, General Use
	Make, Break & Continuous	30V DC	DC-1, 12 A 10 A, Resistive	30V DC	DC-1, 6 A 6 A, Resistive
Min. Permissible Contact Ratings		300 mW (5V/60 mA or 60V/5 mA) for AgNi Contacts (700-HK3_) 50 mW (5V/10 mA or 25V/2 mA) for AgNi + Gold Contacts (700-HKX_) 500 mW (100V/5 mA or 5V/100 mA) for $AgSnO_2$ Contacts (700-HKM_)			
Permissible Coil Voltage Variation	Pickup: holding Voltage: Must Dropout Voltage:	80...110% of Nominal Voltage at 50/60 Hz, 73...110% of Nominal Voltage at DC 80% of Nominal V AC at 50/60 Hz, 40% of Nominal V DC 20% of Nominal V AC at 50/60 Hz, 10% Nominal V DC			
Power Consumption		1.2V A (V AC Coils), 0.5 W (V DC Coils)			
Coil Voltages		See Overview/Product Selection			
Design Specification/Test Requirements					
Dielectric Withstand Voltage	Between Open Contacts (VRMS)	1000V AC			
	Contact to Coil (VRMS)	1600V AC			
Mechanical					
Degree of Protection		IP 20 (guarded terminal sockets), RT II — Flux-proof (Relay)			
Mechanical Life Operations		10×10^6			
Electrical Life Cycles		230V AC, 16 A Resistive: 100 000 min. 277V AC, 16 A Resistive: 30 000 min. 30V DC, 10 A Resistive: 30 000 min. B300, R300, Hp (kW): 6000 min. A300 (700-HKM_): 100,000 min.		230V AC, 8 A Resistive: 100 000 min. 277V AC, 8 A Resistive: 30 000 min. 30V DC, 6 A Resistive: 30 000 min. B300, R300, Hp (kW): 6000 min.	
Switching Frequency		Mechanical: 18,000 cycles/hr. Electrical: 900 cycles/hr.			
Operating Time at Nominal Voltage at 20 °C (ms)	Pickup	15 ms max.			
	Dropout	5 ms max.			
Vibration	Operational	10...2000 Hz, 0.76 mm (0.03 in.) 2.5 G			
	Non-Operational	10...2000 Hz, 0.76 mm (0.03 in.) 5.0 G			
Shock	Operational	15 G			
	Non-Operational	50 G			
Environmental					
Temperature	Operating	–40...+70 °C (–40...+158 °F)			
	Storage	–40...+85 °C (–40...+185 °F)			
Altitude		2000 m (6560 ft)			
Construction					
Insulating Material		Molded High Dielectric Material			
Enclosure		Transparent Dust Cover			
Contact Material		700-HK3_: Silver nickel (AgNi); 700-HKX_: Silver Nickel + Gold Plating (AgNi + Au); 700-HKM_: Silver Tin Oxide ($AgSnO_2$)			
Terminal Markings on Socket		In accordance with EN 50005			
Sockets		**1-Pole**		**2-Pole**	
	Screw Terminal	700-HN121 (10 A @ 70 °C) 700-HN221 (16 A @ 50 °C, 12 A @ 70 °C)		700-HN122 (2 x 5 A @ 70 °C) 700-HN222 (2 x 8 A @ 70 °C)	
	Spring Clamp (Available September 2006)	700-HN223 (15 A @ 40 °C with 2 conductors per terminal) (10 A @ 70 °C with 1 conductor per terminal)		700-HN224 (2 x 8 A@ 70 °C)	
Approvals					
Certifications		CSA Certified, File 75088, UL Recognized, File E3125 Guide NLDX2/NLCX8, cULus Listed with Allen-Bradley sockets (File No. 3125 Guide NLDX/NLDX7), CE Marked			
Standards		EN61810-1, CSA 22.2 No. 14, UL 508			

Approximate Dimensions

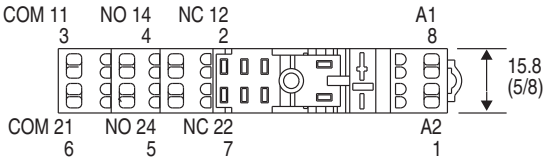
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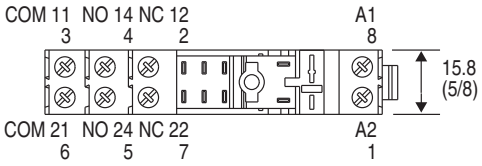
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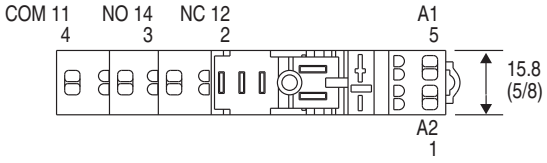
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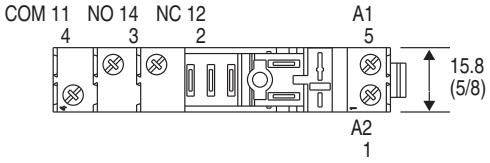
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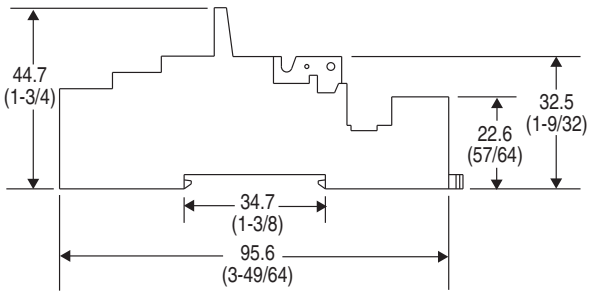
Cat. No. 700-HN222



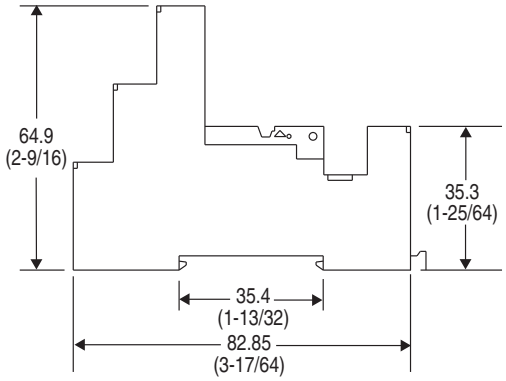
Cat. No. 700-HN223



Cat. No. 700-HN221



Cat. No. 700-HN223, 700-HN224
Wire Size: 0.2 mm^2...1.5 mm^2 (#24 AWG....#14 AWG)
Either Solid or Stranded
Strip Length: 8 mm (5/16 in)



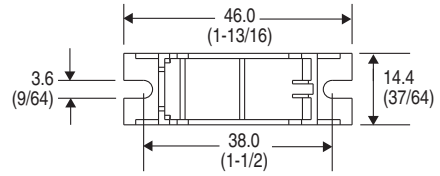
Cat. No. 700-HN221, 700-HN222
Wire Size: 0.2 mm^2...2.5 mm^2 (#24 AWG....#12 AWG)
Either Solid or Stranded
Strip Length: 8 mm (5/16 in), Torque: 0.8Nm (7.0 lb.-in.)

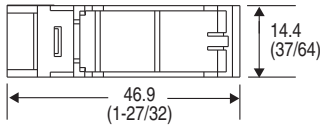
9

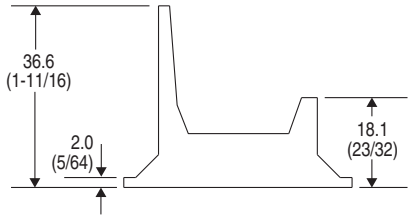
Interposing/Isolation Relays

Approximate Dimensions

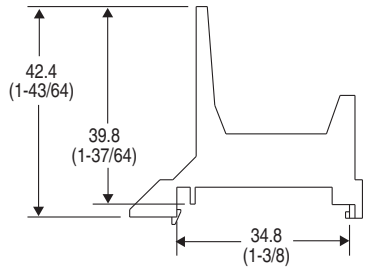
Approximate Dimensions are shown in millimeters (inches). Approximate Dimensions are not intended to be used for manufacturing purposes.



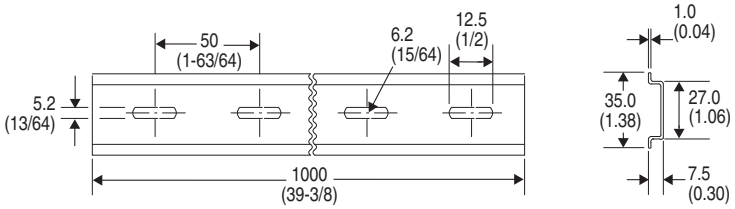




Cat. No. 700-HN226

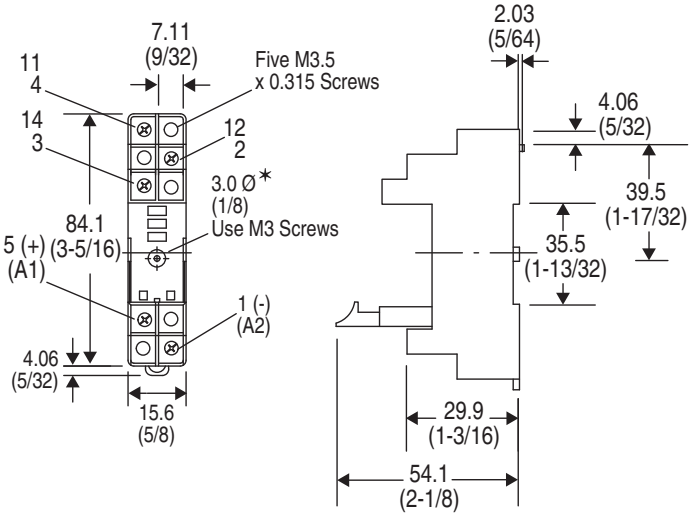


Cat. No. 700-HN227

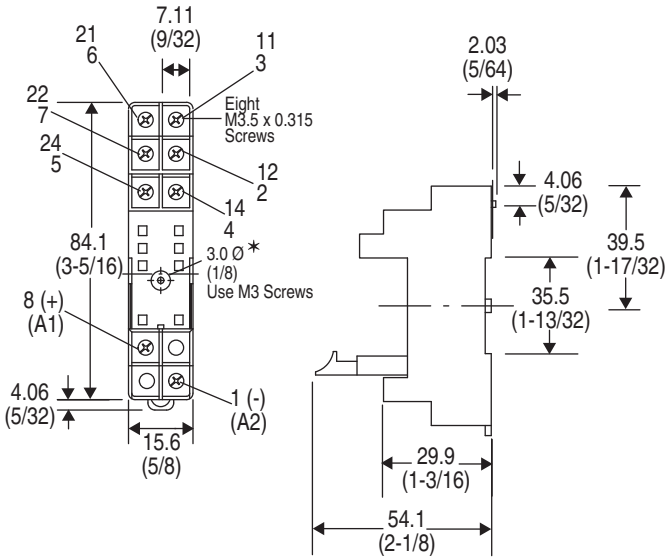


Cat. No. 199-DR4 DIN Mounting Rail Series B Has No Mounting Holes
Cat. No. 199-DR1 DIN Mounting Rail Series B

Cat. No.	A	B	C	D	Approx. Shipping Wt.
199-DR1	35 (1-3/8)	27 (1-1/16)	7.5 (19/64)	1.02 (1/64)	1.85 kg (4.07 lb) (10/pkg)
199-DR4	35 (1-3/8)	27 (1-1/16)	15 (19/32)	2.3 (3/32)	3.68 kg (8 lb) (5/pkg)



Cat. No. 700-HN121
Wire Size: 2 x 2.5 mm² Single Wire – Up to #14 AWG Double Wire – 2 x 2.5 mm² (#2–14 AWG... #2–20 AWG) (Either Solid or Stranded) Strip Length: 9 mm (3/8 in.) – Torque: 0.8 N•m (7 lb•in)



Cat. No. 700-HN122
Wire Size: 2 x 2.5 mm² Single Wire – Up to #14 AWG Double Wire – 2 x 2.5 mm² (#2–14 AWG... #2–20 AWG) (Either Solid or Stranded) Strip Length: 9 mm (3/8 in.) – Torque: 0.8 N•m (7 lb•in)

* Holes required for mounting [3 mm (1/8 in.) diameter].

Allen-Bradley

1756 ControlLogix Controllers Specifications



ControlLogix Controller Catalog Numbers
1756-L61, 1756-L62, 1756-L63, 1756-L63XT, 1756-L64, 1756-L65, 1756-L71, 1756-L72, 1756-L73, 1756-L73XT, 1756-L74, 1756-L75

GuardLogix Controller Catalog Numbers
1756-L61S, 1756-L62S, 1756-L63S, 1756-LSP, 1756-L72S, 1756-L73S, 1756-L7SP, 1756-L73SXT, 1756-L7SPXT

ControlLogix Redundancy Catalog Numbers 1756-RM, 1756-RMXT

Topic	Page
1756 ControlLogix Controllers	2
1756 ControlLogix-XT Controllers	8
1756 GuardLogix Controllers	8
1756 GuardLogix-XT Controllers	18
Controller Memory Use	20
Controller Compatibility	20
ControlLogix Redundancy	24
ControlLogix Connections	26
ControlLogix Controller Accessories	28

1756 ControlLogix Controllers

The ControlLogix® controller provides a scalable controller solution that is capable of addressing a large amount of I/O points. The ControlLogix controller can be placed into any slot of a ControlLogix I/O chassis and multiple controllers can be installed in the same chassis.

ControlLogix controllers can monitor and control I/O across the ControlLogix backplane, as well as over network links. To provide communication for a ControlLogix controller, install the appropriate communication interface module into the chassis.

1756-L7*x* ControlLogix Controllers Features and Specifications

Feature	1756-L71, 1756-L72, 1756-L73, L73XT, 1756-L74, 1756-L75
Controller tasks	• 32 tasks • 100 programs/task • Event tasks: all event triggers
Built-in communication ports	1 port USB(1)
Communication options	• EtherNet/IP • ControlNet • DeviceNet • Data Highway Plus™ • Remote I/O • SynchLink™ • Third-party process and device networks
USB port communication	Programming, configuration, firmware flash and on-line edits only
Controller connections supported, max	500
Network connections, per network module	• 100 ControlNet (1756-CN2/A) • 40 ControlNet (1756-CNB/D, 1756-CNB/E) • 128 ControlNet (1756-CN2/B) • 256 EtherNet/IP; 128 TCP (1756-EN2*x*) • 128 EtherNet/IP; 64 TCP (1756-ENBT)
Controller redundancy	Full support
Integrated motion	• SERCOS interface • Analog options (encoder input, LDT input, SSI input) • EtherNet/IP (CIP Motion)
Programming languages	• Relay ladder • Structured text • Function block • SFC

(1) The USB port is intended for temporary local programming purposes only and not intended for permanent connection. Do not use the USB port in hazardous locations.

Table 1 - Technical Specifications - 1756-L7*x* ControlLogix Controllers

Attribute	1756-L71	1756-L72	1756-L73	1756-L74	1756-L75
User memory	2 MB	4 MB	8 MB	16 MB	32 MB
I/O memory	0.98 MB				
Optional nonvolatile memory storage	1 GB (1784-SD1 ships with every controller) 2 GB (1784-SD2)				
Digital I/O, max	128,000				
Analog I/O, max	4000				
Total I/O, max	128,000				
Energy storage module	• 1756-ESMCAP capacitor energy storage module (removable, ships installed with every controller) • 1756-ESMNSE capacitor energy storage module (removable, no residual WallClockTime power backup) • 1756-ESMNRM capacitor energy storage module (nonremovable, secures controller by preventing USB connection an d SD card use)				
Current draw @ 1.2V DC	5 mA				
Current draw @ 5.1V DC	800 mA				
Power dissipation	2.5 W				
Thermal dissipation	8.5 BTU/hr				
Isolation voltage	30V (continuous), basic insulation type, USB port-to-system Type tested at 500V AC for 60 s				
USB port(1)	USB 2.0, full speed (12 Mbps)				
Weight, approx	0.25 kg (0.55 lb)				
Slot width	1				
Module location	Chassis-based, any slot				
Chassis	1756-A4, 1756-A7, 1756-A10, 1756-A13, 1756-A17				
Power supply, standard	1756-PA72, 1756-PA75, 1756-PB72, 1756-PB75				
Power supply, redundant	1756-PA75R, 1756-PB75R, 1756-PSCA2				
Wire category(2)	3 - on USB port				
North American temperature code	T4A				
IEC temperature code	T4				
Enclosure type rating	None (open-style)				

(1) The USB port is intended for temporary local programming purposes only and not intended for permanent connection. Do not use the USB port in hazardous locations.

(2) Use this conductor category information for planning conductor routing. Refer to Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Table 2 - Environmental Specifications - 1756-L7*x* ControlLogix Controllers

Attribute	1756-L71, 1756-L72, 1756-L73, 1756-L74, 1756-L75
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0…60 °C (32…140 °F)
Temperature, nonoperating IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…85 °C (-40…185 °F)
Temperature, surrounding air, max	60 °C (140 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Damp Heat)	5…95% noncondensing
Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g @ 10…500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g (45 g with SD card installed)
Emissions CISPR 11	Group 1, Class A
ESD immunity IEC 61000-4-2	6 kV contact discharges 8 kV air discharges
Radiated RF immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80…2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000…2700 MHz

Table 3 - Certifications - 1756-L7*x* ControlLogix Controllers

Certification(1)	1756-L71, 1756-L72, 1756-L73, 1756-L74, 1756-L75
c-UL-us	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E65584. UL Listed for Class I, Division 2 Group A,B,C,D Hazardous Locations, certified for U.S. and Canada. See UL File E194810.
CE	European Union 2004/108/EC EMC Directive, compliant with: • EN 61326-1; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions • EN 61131-2; Programmable Controllers (Clause 8, Zone A & B)
C-Tick	Australian Radio communications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Ex	European Union 94/9/EC ATEX Directive, compliant with: • EN 60079-15; Potentially Explosive Atmospheres, Protection 'n' • EN 60079-0; General Requirements • II 3 G Ex nA IIC T4 X
KC	Korean Registration of Broadcasting and Communications Equipment, compliant with: Article 58-2 of Radio Waves Act, Clause 3

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

Standard AC Power Supplies

Table 1 - Technical Specifications - ControlLogix Standard AC Power Supplies

Attribute	1756-PA72/C	1756-PA75/B
Input voltage range	85…265V AC	
Input voltage, nom	120V/240V AC	
Input frequency range	47…63 Hz	
Input power, max	100VA/100 W	
Output power, max	75 W @ 0…60 °C (32…140 °F)(2)	
Power consumption	25 W @ 0…60 °C (32…140 °F)	
Power dissipation	85.3 BTU/hr	
Hold up time(1)	5 cycles @ 85V AC, 50/60 Hz 6 cycles @ 120V AC, 50/60 Hz 6 cycles @ 200V AC, 50/60 Hz 6 cycles @ 240V AC, 50/60 Hz	
Inrush current, max	20 A	
Current capacity at 1.2V DC	1.5 A	
Current capacity at 3.3V DC	4 A	
Current capacity at 5.1V DC	10 A	13 A
Current capacity at 24V DC	2.8 A	
Overcurrent protection, max	User-supplied 15 A(3)	
Fusing	Non-replaceable fuse is soldered in place(4)	
Transformer load, max	100VA	
Isolation voltage	250V (continuous), reinforced insulation type Type tested @ 3500V DC for 60 s, power input-to-backplane	
Weight, approx.	0.95 kg (2.10 lb)	
Dimensions	140 x 112 x 145 mm (5.51 x 4.41 x 5.71 in.)	
Module location	Left side of 1756 chassis	Left side of 1756 chassis (series B only)
Chassis	1756-A4, 1756-A7, 1756-A10, 1756-A13, 1756-A17	
Chassis compatibility	Series A Series B	Series B
Wire size	2.5 mm^2 (14 AWG) solid or stranded copper wire rated at 90 °C (194 °F), or greater, 1.2 mm (3/64 in.) insulation max	
Wire category	1 - on power ports(5)	
Conductor screw torque	0.8 N•m (7 lb•in)	
North American temperature code	T4	
Enclosure type rating	None (open-style)	

(1) The hold up time is the time between input voltage removal and DC power failure.
(2) The combination of all output power (5.1V backplane, 24V backplane, 3.3V backplane, and 1.2V backplane) cannot exceed 75 W.
(3) Use time-delay type overcurrent protection in all ungrounded conductors.
(4) This fuse is intended to guard against fire hazard due to short circuit conditions.
(5) Use this conductor category information for planning conductor routing as described in the system level installation manual. See the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Table 2 - Environmental Specifications - ControlLogix Standard AC Power Supplies

Attribute	1756-PA72/C, 1756-PA75/B
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0…60 °C (32…140 °F)
Temperature, surrounding air, max	60 °C (140 °F)
Temperature, non-operating IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…85 °C (-40…185 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Damp Heat)	5…95% noncondensing
Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g @ 10…500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g
Emissions	CISPR 11: Group 1, Class A
ESD immunity IEC 61000-4-2	6 kV contact discharges 8 kV air discharges
Radiated RF immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80... 2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 3V/m with 1kHz sine-wave 80% AM from 2000...2700 MHz
EFT/B immunity IEC 61000-4-4	±4 kV at 5 kHz on power ports
Surge transient immunity IEC 61000-4-5	±1 kV line-line (DM) and ±2 kV line-earth (CM) on power ports
Conducted RF immunity IEC 61000-4-6	10 Vrms with 1 kHz sine-wave 80% AM from 150 kHz...80 MHz
Oscillatory surge withstand IEEE C37.90.1	3 kV
Voltage variation IEC 61000-4-11	30% dips for 1 period at 0° and 80° on AC supply ports 60% dips for 5 and 50 periods on AC supply ports ±10% fluctuations for 15 min on AC supply ports >95% interruptions for 250 periods on AC supply ports

Table 3 - Certifications - ControlLogix Standard AC Power Supplies

Certification[1]	1756-PA72/C, 1756-PA75/B
UL	UL Listed Industrial Control Equipment. See UL File E65584.
CSA	CSA Certified Process Control Equipment. See CSA File LR54689C. CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations. See CSA File LR69960C.
FM	FM Approved Equipment for use in Class I Division 2 Group A,B,C,D Hazardous Locations
CE	European Union 2004/108/EC EMC Directive, compliant with: EN 61326-1; Meas./Control/Lab., Industrial Requirements EN 61000-6-2; Industrial Immunity EN 61000-6-4; Industrial Emissions EN 61131-2; Programmable Controllers (Clause 8, Zone A & B) European Union 2006/95/EC LVD, compliant with: EN 61131-2; Programmable Controllers (Clause 11)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
KC	Korean Registration of Broadcasting and Communications Equipment, compliant with: Article 58-2 of Radio Waves Act, Clause 3

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

Environmental Specifications - 1756 Standard Network Modules

Attribute	1756-EN2F, 1756-EN2T, 1756-ENBT, 1756-EWEB, 1756-CN2, 1756-CN2R, 1756-CNB, 1756-CNBR, 1756-DNB, 1756-DHRIO, 1756-RIO, 1756-SYNCH
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0…60 °C (32…140 °F)
Temperature, storage IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…85 °C (-40…185 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Nonoperating Damp Heat)	5…95% noncondensing
Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g at 10…500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g

Environmental Specifications - 1756 ControlLogix-XT Network Modules

Attribute	1756-EN2TXT, 1756-CN2RXT, 1756-DHRIOXT
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	-25…70 °C (-13…158 °F)
Temperature, storage IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…85 °C (-40…185 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Nonoperating Damp Heat)	5…95% noncondensing
Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g at 10…500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g

EtherNet/IP Network



The Ethernet Industrial (EtherNet/IP) network protocol is an open industrial-networking standard that supports both real-time I/O messaging and message exchange. The EtherNet/IP network uses off-the-shelf Ethernet communication chips and physical media.

If your application	Select this interface	Description
• Controls I/O modules and drives • Requires an adapter for distributed 1756 I/O on EtherNet/IP links • Communicates with other EtherNet/IP devices (messages and HMI) • Bridges EtherNet/IP links to route messages to devices on other networks	1756-EN2F 1756-EN2T 1756-ENBT	The EtherNet/IP communication module: • controls I/O and drives over an EtherNet/IP network. • acts as an adapter for distributed I/O on remote EtherNet/IP links. • routes messages to devices on other networks.
• Provides control in environments where temperatures range from -20...70 °C (-4...158 °F).	1756-EN2TXT	The EtherNet/IP communication module: • controls I/O and drives over an EtherNet/IP network. • acts as an adapter for distributed I/O on remote EtherNet/IP links. • routes messages to devices on other networks.
• Requires remote access via an Internet browser to tags in a local ControlLogix controller • Communicates with other EtherNet/IP or generic Ethernet devices (messaging only; no I/O control) • Bridges EtherNet/IP links to route messages to devices on other networks	1756-EWEB	The enhanced web-server module provides Internet browser access so you can monitor and modify data remotely via XML web pages. The web-server module supports: • data access (read and write) to ControlLogix controllers. • bridging and routing of messages. • custom Web pages. • email capability. • open socket services.

Technical Specifications - 1756 Standard EtherNet/IP Modules

Attribute	1756-EN2F	1756-EN2T	1756-ENBT	1756-EWEB
EtherNet/IP communication rate	100 Mbps	10/100 Mbps	10/100 Mbps	10/100 Mbps
Logix communication connections	256	256	128	128
TCP/IP communication connections	128	128	64	64
Current draw @ 5.1V DC	1000 mA	1000 mA	700 mA	700 mA
Current draw @ 24V DC	3 mA	3 mA	3 mA	3 mA
Power dissipation	5.1 W	5.1 W	3.65 W	3.65 W

Attribute	1756-EN2F	1756-EN2T	1756-ENBT	1756-EWEB
Isolation voltage	No isolation between USB and system	30V (continuous), Basic Insulation Type No isolation between USB and system Tested at 707V DC for 60 s, Ethernet to system	30 V (continuous), Basic Insulation Type Tested at 707V DC for 60 s, Ethernet to system	30 V (continuous), Basic Insulation Type Tested at 707V DC for 60 s, Ethernet to system
Slot width	1			
Module location	Chassis-based, any slot			
Chassis	1756-A4, 1756-A7, 1756-A10, 1756-A13, 1756-A17			
Power supply, standard	1756-PA72/C, 1756-PA75/B, 1756-PB72/C, 1756-PB75/B, 1756-PC75/B, 1756-PH75/B			
Power supply, redundant	756-PA75R, 1756-PB75R, 1756-PSCA2			
Ports	1 Ethernet fiber 1 USB 1.1	1 Ethernet RJ45 Category 5 1 USB 1.1	1 Ethernet RJ45 Category 5	1 Ethernet RJ45 Category 5
Ethernet cable	Multimode fiber, LC connector	802.3 compliant shielded or unshielded twisted pair		
USB cable	Samtec cable, PN RSP-119350	Samtec cable, PN RSP-119350	—	—
Wire category	2 - on communication ports[1]			
North American temperature code	T5	T5	—	—
Enclosure type rating	None (open-style)			

(1) Use this conductor category information for planning conductor routing as described in the system level installation manual. See the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Certifications - 1756 Standard EtherNet/IP Modules

Certification[1]	1756-EN2F, 1756-EN2T	1756-ENBT, 1756-EWEB
c-UL-us	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E65584. UL Listed for Class I, Division 2 Group A,B,C,D Hazardous Locations, certified for U.S. and Canada. See UL File E194810.	
CSA	CSA Certified Process Control Equipment. See CSA File LR54689C. CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations. See CSA File LR69960C.	
ATEX	na	European Union 94/9/EC ATEX Directive, compliant with: EN 60079-15; Potentially Explosive Atmospheres, Protection "n" (Zone 2)
CE	European Union 2004/108/IEC EMC Directive, compliant with: • EN 61326-1; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions • EN 61131-2; Programmable Controllers (Clause 8, Zone A & B)	
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions	
ODVA - EtherNet/IP	ODVA conformance tested to EtherNet/IP specifications	
FM	FM Approved Equipment for use in Class I Division 2 Group A,B,C,D Hazardous Locations	

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

1756 Removable Terminal Blocks



Removable terminal blocks (RTBs) provide a flexible interconnection between your plant wiring and 1756 I/O modules. The RTB plugs into the front of the I/O module. The type of module determines which RTB you need. You can choose screw-clamp or spring-clamp RTBs.

RTBs are not shipped with I/O modules. You must order them separately. The standard housing on the front of the wiring arm is not deep enough for 2.5 mm^2 (14 AWG) wiring. If you plan to use 2.5 mm^2 (14 AWG) wiring, also order the extended housing.

ATTENTION: If separate power sources are used, do not exceed the specified isolation voltage: referring to each individual module's specifications on the preceding pages.

Table 210 - RTB Specifications - 1756-TBNH, 1756-TBSH, 1756-TBCH, 1756-TBS6H, 1756-TBE

Attribute	1756-TBNH	1756-TBSH	1756-TBCH	1756-TBS6H	1756-TBE
Description	20-position NEMA screw-clamp removable block	20-pin spring-clamp removable terminal block with standard housing	36-pin cage-clamp removable terminal block with standard housing	36-pin spring-clamp removable terminal block with standard housing	Extended depth terminal block housing
Screw torque	1.36 N•m (12 lb•in)	N/A	0.5 N•m (4.4 lb•in)	N/A	N/A
Wire size(1)	0.33…2.1 mm^2 (22…14 AWG) solid or stranded copper wire rated at 90 °C (194 °F), or greater, 1.2 mm (3/64 in.) insulation max Do not wire more than two conductors on any single terminal.	0.33…2.1 mm^2 (22…14 AWG) solid or stranded copper wire rated at 90 °C (194 °F), or greater, 1.2 mm (3/64 in.) insulation max Do not wire more than two conductors on any single terminal.	Single wire connection: 0.33…2.1 mm^2 (22…14 AWG) solid or stranded copper wire rated at 90 °C (194 °F), or greater, 1.2 mm (3/64 in.) insulation max Double wire connection: 0.33…1.3 mm^2 (22…16 AWG) solid or stranded copper wire rated at 90 °C (194 °F), or greater, 1.2 mm (3/64 in.) insulation max Do not wire more than two conductors on any single terminal.	0.33…2.1 mm^2 (22…14 AWG) solid or stranded copper wire rated at 90 °C (194 °F), or greater, 1.2 mm (3/64 in.) insulation max Do not wire more than two conductors on any single terminal.	
Screwdriver width	8 mm (5/16 in.) max	N/A	3.2 mm (1/8 in.)	N/A	N/A

(1) Maximum wire size requires extended housing, catalog number 1756-TBE.

1756 Standard Chassis

The chassis backplane provides a high-speed communication path between modules and distributes power to each of the modules within the chassis.

Environmental Specifications - 1756 Standard Chassis

Attribute	1756-A4, 1756-A7, 1756-A10, 1756-A13, 1756-A17
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0…60 °C (32…140 °F)
Temperature, storage IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…85 °C (-40…185 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Nonoperating Damp Heat)	5…95% noncondensing
Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g @ 10…500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g

Technical Specifications - 1756 Standard Chassis

Attribute	1756-A4	1756-A7	1756-A10	1756-A13	1756-A17
Backplane current, chassis/slot max @ 1.2V DC	1.5 A/1.5 A				
Backplane current, chassis/slot max @ 3.3V DC	4 A/4 A				
Backplane current, chassis/slot max @ 5.1V DC	15 A/6 A				
Backplane current, chassis/slot max @ 24V DC	2.8 A/2.8 A				
Power dissipation	6.1 BTU/hr				
Power consumption	1.8 W				
Slots	4	7	10	13	17
Mounting method	Horizontal only				
Dimensions (WxHxD), approx.[1]	263 x 169 x 145 mm (10.35 x 6.65 x 5.71 in.)	368 x 169 x 145 mm (14.49 x 6.65 x 5.71 in.)	483 x 169 x 145 mm (19.0 x 6.65 x 5.71 in.)	588 x 169 x 145 mm (23.15 x 6.65 x 5.71 in.)	738 x 169 x 145 mm (29.06 x 6.65 x 5.71 in.)
Cabinet size (WxHxD), min	507 x 507 x 203 mm (20 x 20 x 8 in.)	507 x 609 x 203 mm (20 x 24 x 8 in.)	762x 507 x 203 mm (30 x 20 x 8 in.)	762 x 609 x 203 mm (30 x 24 x 8 in.)	914 x 762 x 203 mm (36 x 30 x 8 in.)
Weight, approx.	0.75 kg (1.7 lb)	1.10 kg (2.4 lb)	1.45 kg (3.2 lb)	1.90 kg (4.2 lb)	2.20 kg (4.8 lb)
Location	Panel				
North American temperature code	T5				
IEC temperature code	T6				
Enclosure type rating	None (open-style)				

(1) Dimensions include mounting tabs and power supply. Depth with extended terminal housing (1756-TBE) is 160 mm (6.3 in.).

Certifications - 1756 Standard Chassis

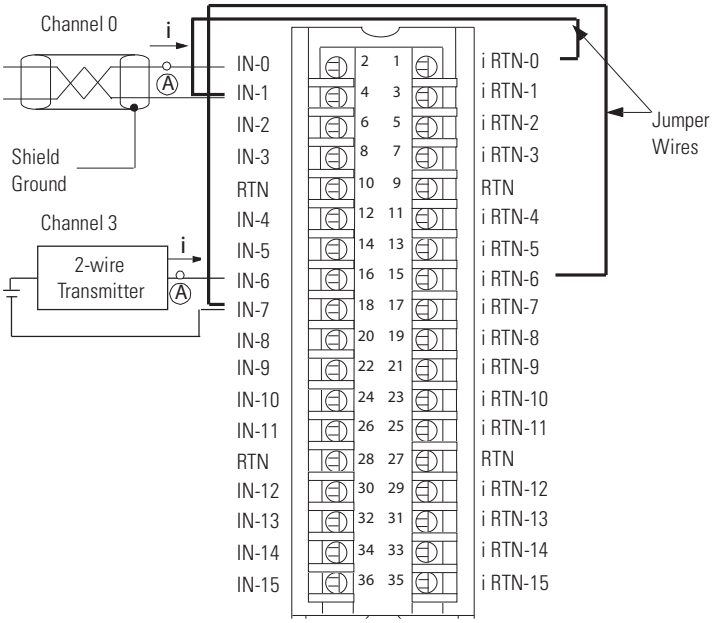
Certification[1]	1756-A4, 1756-A7, 1756-A10, 1756-A13, 1756-A17
c-UL-us	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E65584. UL Listed for Class I, Division 2 Group A,B,C,D Hazardous Locations, certified for U.S. and Canada. See UL File E194810.
CSA	CSA Certified Process Control Equipment. See CSA File LR54689C. CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations. See CSA File LR69960C.
ATEX	European Union 94/9/EC ATEX Directive, compliant with: EN 60079-15; Potentially Explosive Atmospheres, Protection "n" (Zone 2)
CE	European Union 2004/108/IEC EMC Directive, compliant with: • EN 61326-1; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions • EN 61131-2; Programmable Controllers (Clause 8, Zone A & B)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
FM	FM Approved Equipment for use in Class I Division 2 Group A,B,C,D Hazardous Locations
TÜV	TÜV Certified for Functional Safety: up to and including SIL 2

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

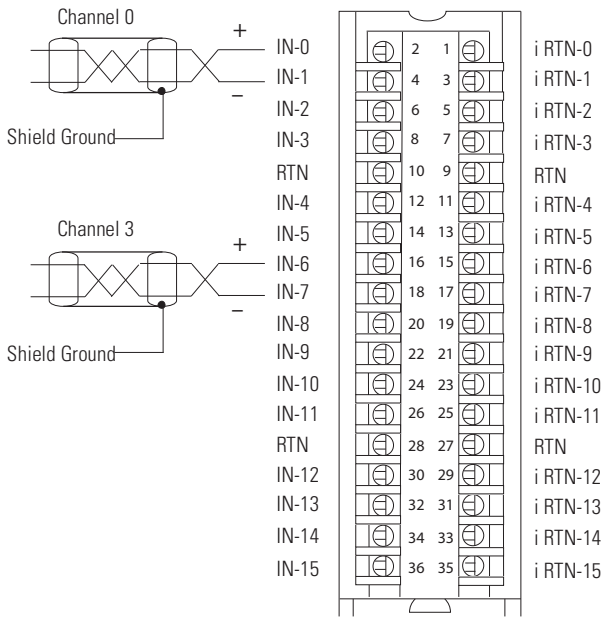
1756-IF16

ControlLogix voltage/current analog input module

1756-IF16 Differential Current



1756-IF16 Differential Voltage



- Use this table when wiring your module in Differential mode.

This channel	Uses these terminals
Channel 0	IN-0 (+), IN-1 (-), i RTN-0
Channel 1	IN-2 (+), IN-3 (-), i RTN-2
Channel 2	IN-4 (+), IN-5 (-), i RTN-4
Channel 3	IN-6 (+), IN-7 (-), i RTN-6
Channel 4	IN-8 (+), IN-9 (-), i RTN-8
Channel 5	IN-10 (+), IN-11 (-), i RTN-10
Channel 6	IN-12 (+), IN-13 (-), i RTN-12
Channel 7	IN-14 (+), IN-15 (-), i RTN-14

- All terminals marked RTN are connected internally.
- A 249 Ω current loop resistor is located between IN-*x* and i RTN-*x* terminals.
- If multiple (+) or multiple (-) terminals are tied together, connect that tie point to a RTN terminal to maintain the module's accuracy.
- Place additional loop devices (such as strip chart recorders) at the A location in the current loop.
- Do not connect more than two wires to any single terminal.

IMPORTANT: When operating in 4 channel, High Speed mode, only use channels 0, 2, 4, and 6.

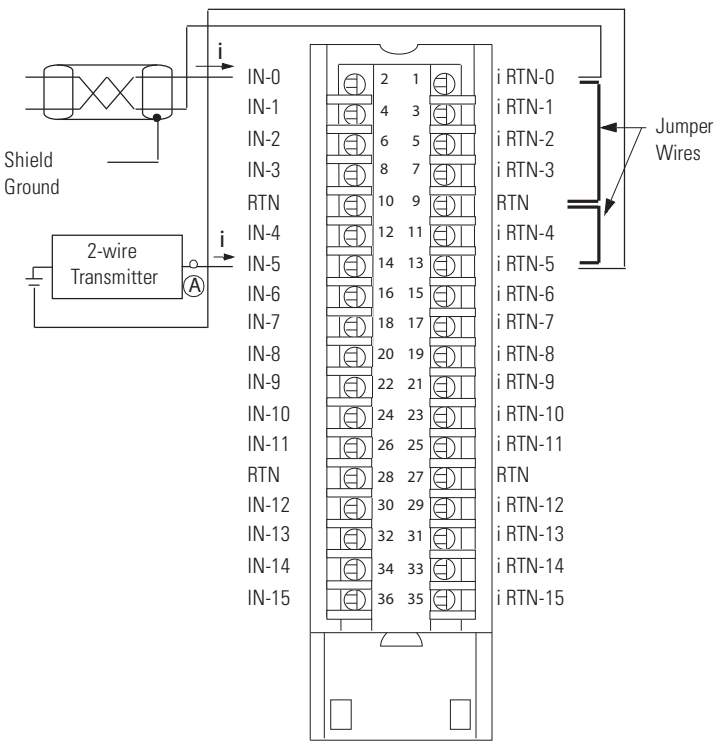
- Use this table when wiring your module in Differential mode.

This channel	Uses these terminals
Channel 0	IN-0 (+), IN-1 (-)
Channel 1	IN-2 (+), IN-3 (-)
Channel 2	IN-4 (+), IN-5 (-)
Channel 3	IN-6 (+), IN-7 (-)
Channel 4	IN-8 (+), IN-9 (-)
Channel 5	IN-10 (+), IN-11 (-)
Channel 6	IN-12 (+), IN-13 (-)
Channel 7	IN-14 (+), IN-15 (-)

- All terminals marked RTN are connected internally.
- If multiple (+) or multiple (-) terminals are tied together, connect that tie point to a RTN terminal to maintain the module's accuracy.
- Terminals marked RTN or i RTN are not used for differential voltage wiring.
- Do not connect more than two wires to any single terminal.

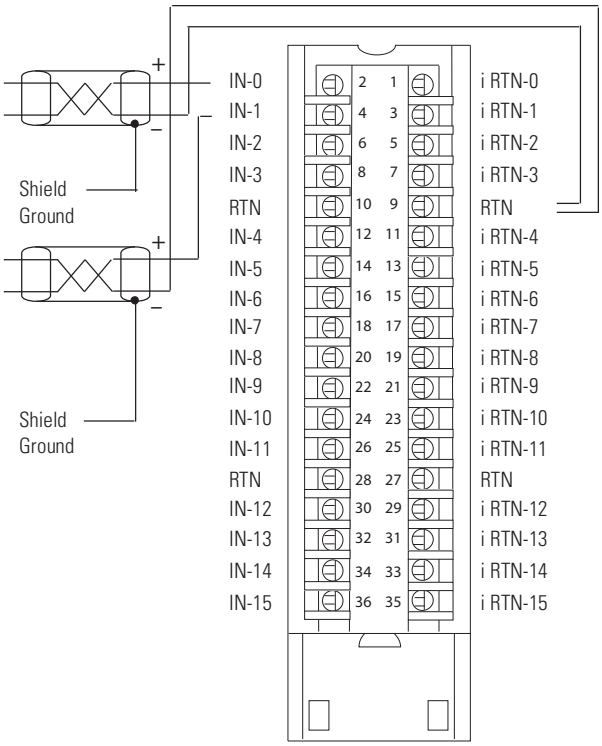
IMPORTANT: When operating in 4 channel, High Speed mode, only use channels 0, 2, 4, and 6.

1756-IF16 Single-ended Current

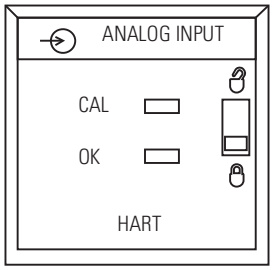


- All terminals marked RTN are connected internally.
- For current applications, all terminals marked i RTN must be wired to terminals marked RTN.
- A 249 Ω current loop resistor is located between IN-*x* and iRTN-*x* terminals.
- Place additional loop devices (such as strip chart recorders) at the A location in the current loop.
- Do not connect more than two wires to any single terminal.

1756-IF16 Single-ended Voltage



- All terminals marked RTN are connected internally.
- Terminals marked i RTN are not used for single-ended voltage wiring.
- Do not connect more than two wires to any single terminal.



Attribute	1756-IF16
Inputs	16 single ended, 8 differential or 4 differential (high speed)
Input range	±10.25V 0…10.25V 0…5.125V 0…20.5 mA
Resolution	±10.25V (15 bits + sign bipolar) 0…10.25V (16 bits) 0…5.125V (16 bits) 0…20.5 mA (16 bits)
Current draw @ 5.1V	150 mA
Current draw @ 24V	65 mA
Power dissipation, max	Voltage: 2.3 W Current: 3.9 W

Attribute	1756-IF16
Thermal dissipation	Voltage: 7.84 BTU/hr Current: 13.3 BTU/hr
Input impedance	Voltage: >10 MΩ Current: 249 Ω
Open circuit detection time	Differential voltage - Positive full scale reading within 5 s Single-ended/differential current - Negative full scale reading within 5 s Single-ended voltage - Even numbered channels go to positive full scale reading within 5 s, odd numbered channels go to negative full scale reading within 5 s
Overvoltage protection, max	Voltage: 30V DC Current: 8V DC
Normal mode noise rejection	>80 dB @ 60 Hz(1)
Common mode noise rejection	100 dB @ 50/60 Hz
Channel bandwidth	15 Hz (-3 dB)(1)
Settling time	<80 ms to 5% of full scale(1)
Calibrated accuracy 25 °C (77 °F)	Voltage: Better than 0.05% of range Current: Better than 0.15% of range
Offset drift	45 μV/°C
Gain drift with temperature	Voltage: 15 ppm Current: 20 ppm
Module error	Voltage: 0.1% of range Current: 0.3% of range
Module input scan time, min	16 pt single-ended: 16...488 ms 8 pt differential: 8...244 ms 4 pt differential: 5...122 ms(1)
Isolation voltage	250V (continuous), reinforced insulation type, inputs-to-backplane No isolation between individual inputs Routine tested at 1350V AC for 2 s
Removable terminal block	1756-TBCH 1756-TBS6H
Slot width	1
Wire size	0.33... 2.1 mm^2 (22...14 AWG) solid or stranded copper wire rated at 90 °C (194 °F), or greater, 1.2 mm (3/64 in.) insulation max(2)
Wire category	2(3)
North American temperature code	T4A
IEC temperature code	T4
Enclosure type	None (open-style)

(1) Notch filter dependent.

(2) Maximum wire size requires extended housing, catalog number 1756-TBE.

(3) Use this conductor category information for planning conductor routing as described in the system-level installation manual. See the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Attribute	1756-IF16
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0…60 °C (32…140 °F)
Temperature, surrounding air	60 °C (140 °F)
Temperature, storage IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…85 °C (-40…185 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Nonoperating Damp Heat)	5…95% noncondensing
Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g @ 10…500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g
Emissions	CISPR 11: Group 1, Class A
ESD immunity IEC 61000-4-2	6 kV contact discharges 8 kV air discharges
Radiated RF immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80... 2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000...2700 MHz
EFT/B immunity IEC 61000-4-4	±2 kV at 5 kHz on shielded signal ports
Surge transient immunity IEC 61000-4-5	±2 kV line-earth (CM) on shielded signal ports
Conducted RF immunity IEC 61000-4-6	10Vrms with 1 kHz sine-wave 80% AM from 150 kHz...80 MHz on shielded signal ports

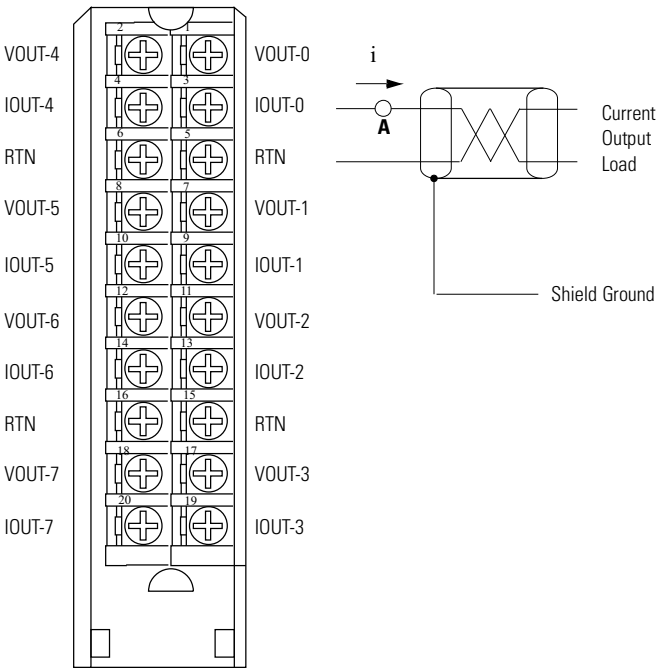
Certification(1)	1756-IF16
UL	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E65584.
CSA	CSA Certified Process Control Equipment. See CSA File LR54689C. CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations. See CSA File LR69960C.
CE	European Union 2004/108/IEC EMC Directive, compliant with: • EN 61326-1; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions • EN 61131-2; Programmable Controllers (Clause 8, Zone A & B) European Union 2006/95/EC LVD, compliant with: • EN 61131-2; Programmable Controllers (Clause 11)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Ex	European Union 94/9/EC ATEX Directive, compliant with: • EN 60079-15; Potentially Explosive Atmospheres, Protection "n" • EN 60079-0; General Requirements II 3 G Ex nA IIC T4 X
FM	FM Approved Equipment for use in Class I Division 2 Group A,B,C,D Hazardous Locations
TÜV	TÜV Certified for Functional Safety: Capable of SIL 2

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

1756-OF8

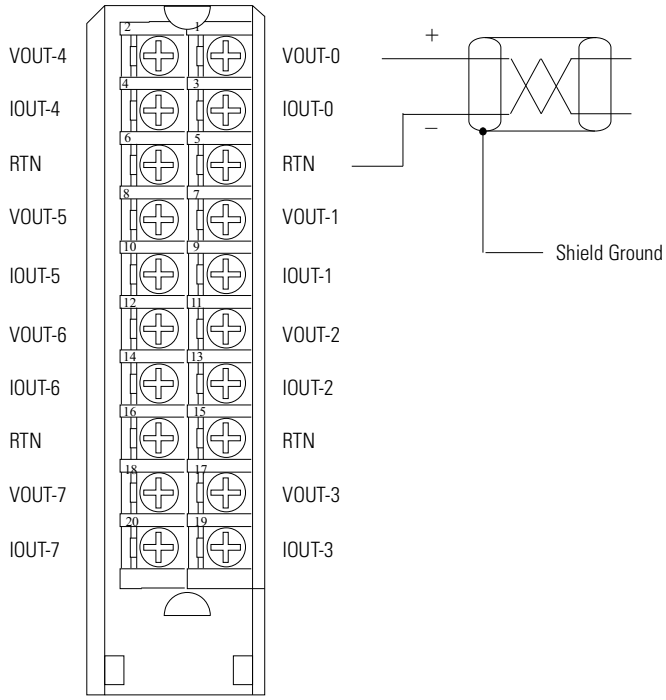
ControlLogix voltage/current output analog module

1756-OF8 Current



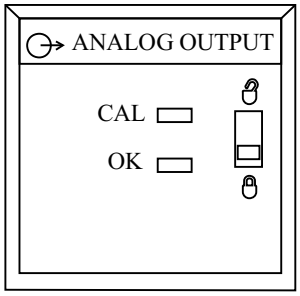
- Place additional loop devices (such as strip chart recorders) at the A location noted above.
- Do not connect more than two wires to any single terminal.
- All terminals marked RTN are connected internally.

1756-OF8 Voltage



- Do not connect more than two wires to any single terminal.
- All terminals marked RTN are connected internally.

Range	Low Signal and User Counts	High Signal and User Counts
0...20 mA	0 mA -32768 counts	21.2916 mA 32767 counts
±10V	-10.4336V -32768 counts	10.4336V 32767 counts



Attribute	1756-OF8
Outputs	8 voltage or current
Output range	± 10.4V 0…21 mA
Resolution	15 bits across 21 mA - 650 nA/bit 15 bits across 10.4V - 320 µV/bit
Current draw @ 5.1V	150 mA
Current draw @ 24V	210 mA

Attribute	1756-OF8
Power dissipation, max	4.92 W, 4 channel current
Thermal dissipation	16.78 BTU/hr
Open circuit detection	Current output only (Output must be set to >0.1 mA)
Overvoltage protection	24V DC
Short circuit protection	Electronically current limited to 21 mA or less
Drive capability	Voltage: > 2000 Ω Current: 0…750 Ω
Settling time	< 2 ms to 95% of final value with resistive loads
Calibrated accuracy @ 25 °C (77 °F)	Better than 0.05% of range from 4…21 mA, -10.4…10.4V
Calibration interval	12 months typical
Offset drift	50 μV/°C typical 100 nA/°C1 μA/°C typical
Gain drift with temperature, max	Voltage: 25 ppm/°C max Current: 50 ppm/°C max
Module error	Voltage: 0.15% of range Current: 0.3% of range
Module scan time, min	12 ms floating point 8 ms integer
Isolation voltage	250V (continuous), reinforced insulation type, output channels-to-backplane No isolation between individual output channels Routine tested at 1350V AC for 2 s
Removable terminal block	1756-TBNH 1756-TBSH
Slot width	1
Wire size	0.33... 2.1 mm^2 (22...14 AWG) solid or stranded copper wire rated at 90 °C (194 °F), or greater, 1.2 mm (3/64 in.) insulation max(1)
Wire category	2(2)
North American temperature code	T4A
IEC temperature code	T4
Enclosure type	None (open-style)

(1) Maximum wire size requires extended housing, catalog number 1756-TBE.

(2) Use this conductor category information for planning conductor routing as described in the system-level installation manual. See the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Attribute	1756-OF8
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0…60 °C (32…140 °F)
Temperature, surrounding air	60 °C (140 °F)
Temperature, storage IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…85 °C (-40…185 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Nonoperating Damp Heat)	5…95% noncondensing

Attribute	1756-OF8
Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g @ 10…500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g
Emissions	CISPR 11: Group 1, Class A
ESD immunity IEC 61000-4-2	6 kV contact discharges 8 kV air discharges
Radiated RF immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80... 2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000...2700 MHz
EFT/B immunity IEC 61000-4-4	±2 kV at 5 kHz on shielded signal ports
Surge transient immunity IEC 61000-4-5	±2 kV line-earth (CM) on shielded signal ports
Conducted RF immunity IEC 61000-4-6	10Vrms with 1 kHz sine-wave 80% AM from 150 kHz...80 MHz on shielded signal ports

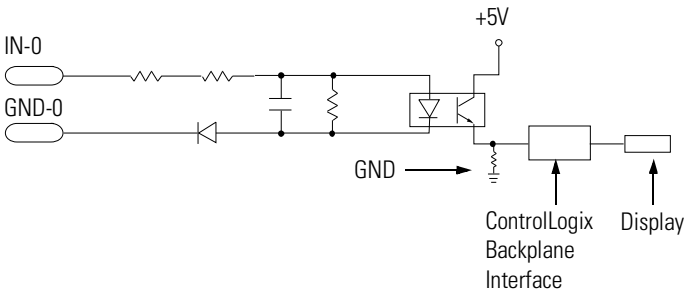
Certification[1]	1756-OF8
UL	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E65584.
CSA	CSA Certified Process Control Equipment. See CSA File LR54689C. CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations. See CSA File LR69960C.
CE	European Union 2004/108/IEC EMC Directive, compliant with: • EN 61326-1; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions • EN 61131-2; Programmable Controllers (Clause 8, Zone A & B) European Union 2006/95/EC LVD, compliant with: • EN 61131-2; Programmable Controllers (Clause 11)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Ex	European Union 94/9/EC ATEX Directive, compliant with: • EN 60079-15; Potentially Explosive Atmospheres, Protection "n" • EN 60079-0; General Requirements II 3 G Ex nA IIC T4 X
FM	FM Approved Equipment for use in Class I Division 2 Group A,B,C,D Hazardous Locations
TÜV	TÜV Certified for Functional Safety: Capable of SIL 2

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

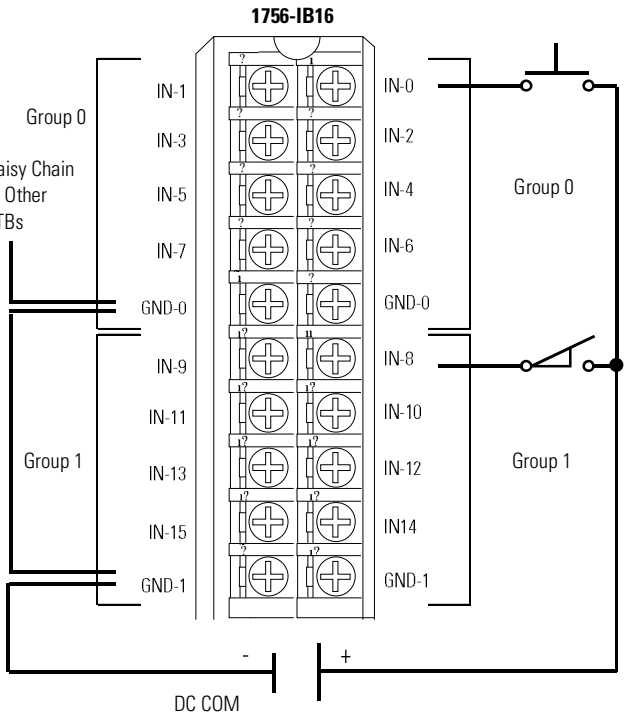
1756-IB16

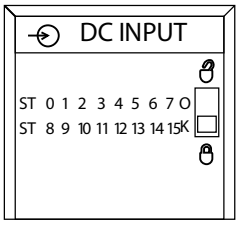
ControlLogix DC (10...31.2V) input module

Simplified Schematic



1756-IB16





Attribute	1756-IB16
Inputs	16 (8 points/group)
Voltage category	12/24V DC sink
Operating voltage range	10...31.2V DC
Input voltage, nom	24V DC
Input delay time OFF to ON ON to OFF	 Hardware delay: 290 µs nom/1 ms max + filter time User-selectable filter time: 0, 1, or 2 ms Hardware delay: 700 µs nom/2 ms max + filter time User-selectable filter time: 0, 1, 2, 9, or 18 ms
Current draw @ 5.1V	100 mA
Current draw @ 24V	2 mA
Power dissipation, max	5.1 W @ 60 °C (140 °F)
Thermal dissipation	17.39 BTU/hr
Off-state voltage, max	5V
Off-state current, max	1.5 mA
On-state current, min	2 mA @ 10V DC
On-state current, max	10 mA @ 31.2V DC

Attribute	1756-IB16
Inrush current, max	250 mA peak (decaying to < 37% in 22 ms, without activation)
Input impedance, max	3.12 kΩ @ 31.2V DC
Cyclic update time	200 µs...750 ms
Isolation voltage	250V (continuous), basic insulation type, inputs-to-backplane, and input group-to-group No isolation between individual group inputs Routine tested @ 1350V AC for 2 s
Removable terminal block housing	1756-TBNH 1756-TBSH
Slot width	1
Wire size	0.33... 2.1 mm^2 (22...14 AWG) solid or stranded copper wire rated at 90 °C (194 °F), or greater, 1.2 mm (3/64 in.) insulation max(1)
Wire category	1(2)
North American temperature code	T3C
IEC temperature code	T3
Enclosure type	None (open-style)

(1) Maximum wire size requires extended housing, catalog number 1756-TBE.

(2) Use this conductor category information for planning conductor routing as described in the system-level installation manual. See the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Attribute	1756-IB16
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0…60 °C (32…140 °F)
Temperature, surrounding air	60 °C (140 °F)
Temperature, storage IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…85 °C (-40…185 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Nonoperating Damp Heat)	5…95% noncondensing
Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g @ 10…500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g
Emissions	CISPR 11: Group 1, Class A
ESD immunity IEC 61000-4-2	6 kV contact discharges 8 kV air discharges
Radiated RF immunity IEC 61000-4-3	10V/m with 1kHz sine-wave 80% AM from 80... 2000 MHz 10V/m with 200Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200Hz 50% Pulse 100% AM @ 1890 MHz 3V/m with 1kHz sine-wave 80% AM from 2000...2700 MHz
EFT/B immunity IEC 61000-4-4	±4 kV at 5 kHz on signal ports

Attribute	1756-IB16
Surge transient immunity IEC 61000-4-5	±1 kV line-line (DM) and ±2 kV line-earth (CM) on signal ports
Conducted RF immunity IEC 61000-4-6	10Vrms with 1 kHz sine-wave 80% AM from 150 kHz...80 MHz
Oscillatory surge withstand IEEE C37.90.1	3 kV

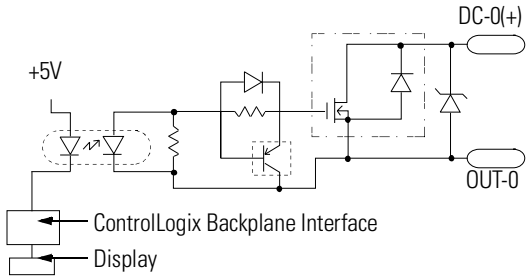
Certification[1]	1756-IB16
UL	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E65584.
CSA	CSA Certified Process Control Equipment. See CSA File LR54689C. CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations. See CSA File LR69960C.
CE	European Union 2004/108/IEC EMC Directive, compliant with: • EN 61326-1; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions • EN 61131-2; Programmable Controllers (Clause 8, Zone A & B) European Union 2006/95/EC LVD, compliant with: • EN 61131-2; Programmable Controllers (Clause 11)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Ex	European Union 94/9/EC ATEX Directive, compliant with: • EN 60079-15; Potentially Explosive Atmospheres, Protection "n" • EN 60079-0; General Requirements II 3 G Ex nA IIC T3 X
FM	FM Approved Equipment for use in Class I Division 2 Group A,B,C,D Hazardous Locations

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

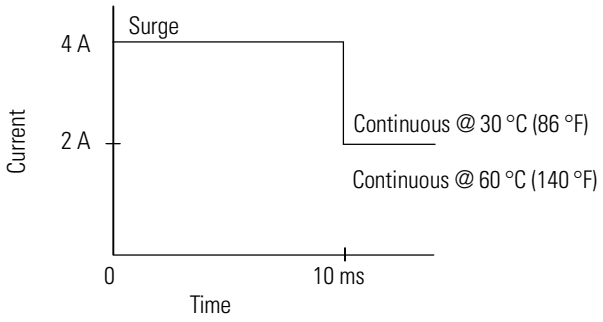
1756-OB16I

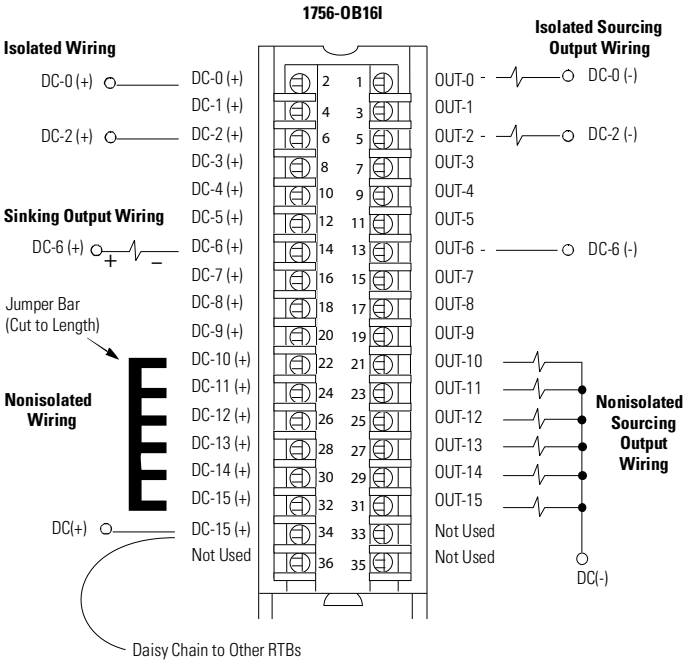
ControlLogix DC (10...30V) isolated output module

Simplified Schematic

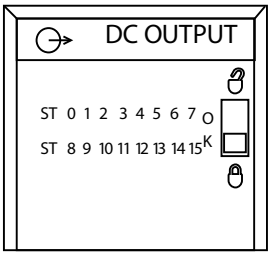


Surge Current Chart





Additional jumper bars are available as cat. no. 1756-JMPR.



Attribute	1756-OB16I
Outputs	16 individually isolated
Voltage category	12/24V DC sink/source
Operating voltage range	10...30V DC
Output delay time OFF to ON ON to OFF	 1 ms max 2 ms max
Current draw @ 5.1V	350 mA
Current draw @ 24V	2.5 mA
Power dissipation, max	3.6 W @ 60 °C (140 °F)
Thermal dissipation	12.28 BTU/hr
Off-state leakage current per point, max	0.5 mA per point
On-state voltage drop, max	1.2V DC @ 2 A
Current per point, max	2 A @ 30 °C (86 °F) 1 A @ 60 °C (140 °F)
Current per module, max	8 A @ 30 °C (86 °F) 4 A @ 60 °C (140 °F)
Surge current per point	4 A for 10 ms per point, repeatable every 2 s
Load current, min	1 mA per point

Attribute	1756-OB16I
Isolation voltage	250V (continuous), basic insulation type, outputs-to-backplane 125V (continuous), basic insulation type, output-to-output Routine tested @ 1350V AC for 2 s
Removable terminal block	1756-TBCH 1756-TBS6H
Slot width	1
Wire size	0.33... 2.1 mm^2 (22...14 AWG) solid or stranded copper wire rated at 90 °C (194 °F), or greater, 1.2 mm (3/64 in.) insulation max(1)
Wire category	1(2)
North American temperature code	T4A
IEC temperature code	T4
Enclosure type	None (open-style)

(1) Maximum wire size requires extended housing, catalog number 1756-TBE.

(2) Use this conductor category information for planning conductor routing as described in the system-level installation manual. See the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Attribute	1756-OB16I
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0…60 °C (32…140 °F)
Temperature, surrounding air	60 °C (140 °F)
Temperature, storage IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40…85 °C (-40…185 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Nonoperating Damp Heat)	5…95% noncondensing
Vibration IEC 60068-2-6 (Test Fc, Operating)	2 g @ 10…500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g
Emissions	CISPR 11: Group 1, Class A
ESD immunity IEC 61000-4-2	6 kV contact discharges 8 kV air discharges
Radiated RF immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80... 2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 3V/m with 1 kHz sine-wave 80% AM from 2000...2700 MHz
EFT/B immunity IEC 61000-4-4	±4 kV at 5 kHz on signal ports
Surge transient immunity IEC 61000-4-5	±1 kV line-line (DM) and ±2 kV line-earth (CM) on signal ports
Conducted RF immunity IEC 61000-4-6	10Vrms with 1 kHz sine-wave 80% AM from 150 kHz...80 MHz

Certification[1]	1756-OB16I
UL	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E65584.
CSA	CSA Certified Process Control Equipment. See CSA File LR54689C. CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations. See CSA File LR69960C.
CE	European Union 2004/108/IEC EMC Directive, compliant with: • EN 61326-1; Meas./Control/Lab., Industrial Requirements • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions • EN 61131-2; Programmable Controllers (Clause 8, Zone A & B) European Union 2006/95/EC LVD, compliant with: • EN 61131-2; Programmable Controllers (Clause 11)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Ex	European Union 94/9/EC ATEX Directive, compliant with: • EN 60079-15; Potentially Explosive Atmospheres, Protection "n" • EN 60079-0; General Requirements II 3 G Ex nA IIC T4 X
FM	FM Approved Equipment for use in Class I Division 2 Group A,B,C,D Hazardous Locations
TÜV	TÜV Certified for Functional Safety: Capable of SIL 2

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

Allen-Bradley

PanelView Plus Specifications

Catalog Numbers 2711P, 2711PC



Topic	Page
Environmental Specifications	2
Certifications	3
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PanelView Plus 400 and 600 Terminals	11
PanelView Plus Compact Terminals	15
External Power Supply	18
HMI Software	20
Communication Cables	21
Migration Hardware	25
Additional Resources	26

PanelView™ Plus HMI terminals are used for applications with a need to monitor, control, and display information graphically, allowing operators to quickly understand the status of their application. All PanelView Plus applications are programmed with FactoryTalk® View Studio for Machine Edition (ME) software and have FactoryTalk View ME Station runtime installed on each terminal.

This family provides a broad range of rugged terminals offering these features:

- Premier integration with the Integrated Architecture™ platform
- Scalable 4- to 15-inch displays with touch screen, keypad, or both for input
- Common development software
- Real-time monitoring of a terminal's displays via a web browser

Use this document along with the Visualization Solutions Selection Guide, publication VIEW-SG001, to make decisions on the visualization solutions best suited for your system requirements.

Environmental Specifications

The environmental certifications apply to all PanelView Plus terminals:

- PanelView Plus 6 terminals including logic, communication modules, and 700, 1000, 1250, 1500 display modules
- PanelView Plus 400 and 600 terminals
- PanelView Plus Compact 400, 600, and 1000 terminals

Table 1 - Environmental Certifications - PanelView Plus Terminals

Attribute	2711P, 2711PC
Temperature, operating	0…55 °C (32…131 °F)
Temperature, storage	-25…70 °C (-13…158 °F)
Heat dissipation 400, 600 700, 1000, 1250, 1500	 85 BTU/hr 240 BTU /hr
Relative humidity	5...95% noncondensing
Vibration	0.012 in. peak-peak 10…57 Hz 2 g at 57…500 Hz
Altitude, operating	2000 m (6561 ft)
Shock, operating	15 g at 11 ms
Shock, nonoperating	30 g at 11 ms
Enclosure ratings	NEMA/UL Type 12, 13, 4X (indoor use only), IEC IP54, IP65
Airborne contaminants	For PanelView Plus conformal-coated PCBA level products with catalogs numbers ending in K, these apply: ANSI/ISA S71.04 - 1985 Severity Level G3 EN60654-4: 1998 Class 3

Certifications

The certifications apply to all PanelView Plus terminals:

- PanelView Plus 6 terminals including logic, communication modules, and 700, 1000, 1250, 1500 display modules
- PanelView Plus 400 and 600 terminals
- PanelView Plus Compact 400, 600, and 1000 terminals

Table 2 - Certifications - PanelView Plus Terminals

Certification[1]	2711P, 2711PC
c-UL-us	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E10314. UL Listed Industrial Control Equipment for use in: • Class I, Div 2, Groups A, B, C, D • Class I, Zone 2, Group IIC [3] • Class II, Div 2 Groups F, G • Class III Hazardous Locations
CE (EMC)	European Union 2004/108/EC EMC Directive, compliant with: EN 61000-6-2; Industrial Immunity EN 61000-6-4; Industrial Emissions
CE (LVD)	European Union 2006/95/EC Low Voltage Directive, compliant with: EN 61131-2; Programmable Controllers
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
Marine[2]	Components identified as marine-certified meet the requirements of one or more marine societies. For marine-certified components, refer to the Product Certification link below this table.

(1) When marked or otherwise declared. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

(2) The touch and combination keypad/touch versions of the 700 and 1000 display modules and all logic modules are marine certified.

(3) Applies only to the 1250 high-bright display module.

PanelView Plus 6 Terminals



The PanelView Plus 6 terminals use modular components allowing for flexible configuration, installation, and upgrades. Factory-assembled terminals, with a display module (700, 1000, 1250, 1500) and logic module, are available as a single catalog number or as separate components for field installation. Optional communication modules can be ordered for additional network communication.

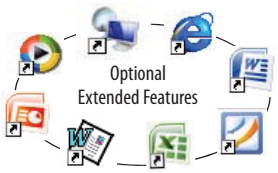
The field-replaceable 6.5, 10.4, 12.1, and 15.1-in. flat-panel color displays come with keypad, touch screen, or keypad/touch-screen input. Other display options are available to meet more stringent environmental conditions:

- High-bright display module for outdoor applications
- Conformal-coated displays
- Marine-certified displays and logic modules
- Displays with built-in antiglare overlays

For a complete listing of catalog number selections, refer to the Visualization Solutions Selection Guide, publication VIEW-SG001.

The high-performance logic module runs the Windows CE 6.0 operating system allowing you to run HMI applications with the ability to also access the desktop. For users with more complex application requirements, the platform and logic module can be ordered with optional, extended features and file viewers.

Table 3 - Logic Module Features

Features	Description
High memory capacity	512 MB nonvolatile flash and 512 MB RAM
Power input	AC or DC
Network interface	For optional DH+™, DH-485, or ControlNet communication module
Communication ports	Ethernet, RS-232 serial
USB ports	• 2 USB host ports for connecting a USB mouse, keyboard, printer, and USB flash drives that are hot swappable • 1 USB device port for connecting a host personal computer
Secure Digital (SD) card slot	Hot-swappable card slot supports 1784-SD*x* SD cards for transferring files, upgrading firmware, or logging data
Operating system 	All terminals run the Windows CE 6.0 operating system (OS) providing OS functionality needed for most users needs: • FTP server • VNC client/server • PDF reader • Active X controls • Third-party device support Additional functionality is available by ordering terminals with optional, extended features: • Internet Explorer web browser • Remote desktop connection • Media player • Microsoft file viewers for PowerPoint, Excel, and Word • WordPad text editor • PDF reader
FactoryTalk View software	• FactoryTalk View Machine Edition software, version 6.0 or later, is preloaded and activated on each terminal • Single license support for FactoryTalk ViewPoint software, version 1.2 or later, gives remote users access to a terminal's displays via standard web browser • HMI applications are developed with FactoryTalk View Studio for Machine Edition software, which is purchased separately
Reset and default switches	Provide easy access to diagnostic and repair operations

Technical Specifications - PanelView Plus 6 Terminals

Table 4 - Technical Specifications - PanelView Plus 6 Terminals

Attribute	700 Color[2] 2711P-K7C4D*x*, 2711P-T7C4D*x*, 2711P-B7C4D*x*, 2711P-K7C4A*x*, 2711P-T7C4A*x*, 2711P-B7C4A*x*	1000 Color[2] 2711P-K10C4D*x*, 2711P-T10C4D*x*, 2711P-B10C4D*x*, 2711P-K10C4A*x*, 2711P-T10C4A*x*, 2711P-B10C4A*x*	1250 Color[2] 2711P-K12C4D*x*, 2711P-T12C4D*x*, 2711P-B12C4D*x*, 2711P-K12C4A*x*, 2711P-T12C4A*x*, 2711P-B12C4A*x*	1500 Color[2] 2711P-K15C4D*x*, 2711P-T15C4D*x*, 2711P-B15C4D*x*, 2711P-K15C4A*x*, 2711P-T15C4A*x*, 2711P-B15C4A*x*
Operator input	Keypad, Touch, or Key/Touch	Keypad, Touch, or Key/Touch	Keypad, Touch, or Key/Touch	Keypad, Touch, or Key/Touch
Display type	Color active-matrix TFT	Color active-matrix TFT	Color active-matrix TFT	Color active-matrix TFT
Display size	6.5 in.	10.4 in.	12.1 in.	15 in.
Display area (WxH)	132 x 99 mm (5.2 x 3.9 in.)	211 x 158 mm (8.3 x 6.2 in.)	246 x 184 mm (9.7 x 7.2 in.)	304 x 228 mm (12.0 x 9.0 in.)
Resolution	640 x 480, 18-bit color graphics		800 x 600, 18-bit color graphics	1024 x 768, 18-bit color graphics
Luminance	300 cd/m^2 Nits		300 cd/m^2 Nits[3]	
Backlight	50,000 h life, min., field replaceable Backlight for 1250 high-bright display module is not replaceable			
Touch screen	8-wire analog resistive Actuation: 1 million presses; operating force: 10…110 g			
Keypad description	Stainless-steel membrane Numeric, navigation, and function keys Actuation: 1 million presses; operating force: 340 g			
Keypad function keys	22 function keys F1…F10 and K1…K12	32 function keys F1…F16 and K1…K16	40 function keys F1…F20 and K1…K20	40 function keys F1…F20 and K1…K20
Real-time clock	Battery-backed clock timestamps critical data, ±2 minutes per month Battery life: 4 year min. @ 25 °C (77 °F) Field-replaceable: cat. no. 2711P-RY2032			
Memory	512 MB nonvolatile flash and 512 MB RAM			
External storage	Secure Digital (SD) card, cat. no.1784-SDx, supported by hot-swappable SD card slot USB flash drives supported by high-speed, hot-swappable, 2.0 USB host ports			
Operating system	Windows CE 6.0 operating system with or without extended features/file viewers			
Software	FactoryTalk View Machine Edition, version 6.0 or later FactoryTalk ViewPoint, version 1.2 or later			
Communication ports	Ethernet (10/100 Mbps, Auto-MDI/MDI-X), RS-232, (2) USB host, (1) USB device Network interface for optional DH+™/DH-485, or ControlNet (scheduled or unscheduled) communication module			
Input voltage, DC	18…32V DC (24V DC nom)			
Power consumption, DC	70 W max (2.9 A at 24V DC)			
External power supply	Cat. no. 2711P-RSACDIN, Class 2 or Safety Extra-Low Voltage (SELV) power supply for 700 to 1500 DC powered terminals; 85…264V AC, 120VA max			
Input voltage, AC	85…264V AC, 47…63 Hz			
Power consumption, AC	160VA max			
Weight, approx.[1]	Keypad: 1.8 kg (4.1 lb) Touch: 1.7 kg (3.7 lb)	Keypad: 2.8 kg (6.2 lb) Touch: 2.5 kg (5.6 lb)	Keypad: 3.4 kg (7.5 lb) Touch: 3.2 kg (7.0 lb)	Keypad: 4.5 kg (9.9 lb) Touch: 4.2 kg (9.2 lb)
Dimensions (HxWxD), approx. [1]	Keypad: 193 x 290 x 55 mm 7.58 x 11.40 x 2.18 in. Touch: 179 x 246 x 55 mm 7.04 x 9.68 x 2.18 in.	Keypad: 248 x 399 x 55 mm 9.77 x 15.72 x 2.18 in. Touch: 248 x 329 x 55 mm 9.77 x 12.97 x 2.18 in.	Keypad: 282 x 416 x 55 mm 11.12 x 16.36 x 2.18 in. Touch: 282 x 363 x 55 mm 11.12 x 14.30 x 2.18 in.	Keypad: 330 x 469 x 65 mm 12.97 x 18.46 x 2.55 in. Touch: 330 x 416 x 65 mm 12.97 x 16.37 x 2.55 in.
Cutout dimensions (HxWxD)	Keypad: 167 x 264 mm 6.57 x 10.39 in. Touch: 154 x 220 mm 6.08 x 8.67 in.	Keypad: 224 x 375 mm 8.8 x 14.75 in. Touch: 224 x 305 mm 8.8 x 12.0 in.	Keypad: 257 x 390 mm 10.11 x 15.35 in. Touch: 257 x 338 mm 10.11 x 13.29 in.	Keypad: 305 x 419 mm 12.0 x 16.5 in. Touch: 305 x 391 mm 12.0 x 15.4 in.

(1) Weights and dimensions do not include the communication module. Add 95 g (0.21 lb) to the weight for a communication module.

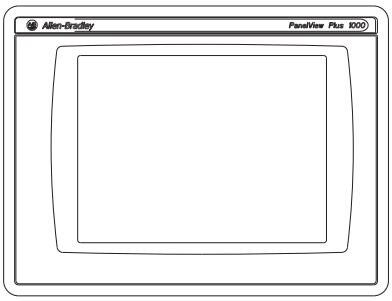
(2) Replace *x* in catalog number with an 8 or 9. For catalog numbers ending in 9, the Windows CE operating system includes extended features and file viewers; catalog numbers ending in 8 do not support these features.

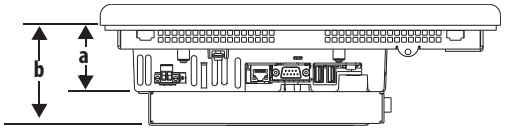
(3) The 1250 high-bright display module, cat. no. 2711P-RDT12H, for outdoor operations, has a luminance of 1000 cd/m^2 Nits. The backlight is not replaceable.

Terminal Dimensions - PanelView Plus 6 Terminals

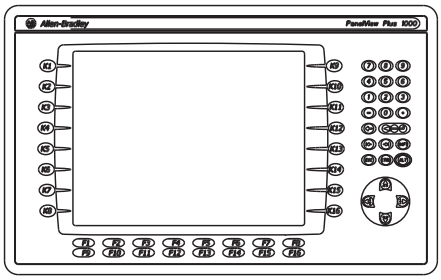
The table provides overall dimensions and cutout dimensions for the PanelView Plus 6 terminals. The 1000 keypad and touch terminal is shown for reference. Other models look similar.

1000 Touch





1000 Keypad



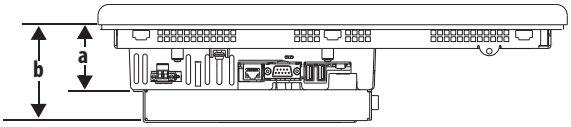


Table 5 - PanelView Plus 6 Terminal Dimensions

Terminal Type	Width	Height	Depth a[1]	Depth b[2]	Cutout Width	Cutout Height
700 Keypad or Keypad/Touch	290 mm 11.40 in.	193 mm 7.58 in.	55 mm 2.18 in.	83 mm 3.27 in.	264 mm 10.39 in.	167 mm 6.59 in.
700 Touch	246 mm 9.68 in.	179 mm 7.04 in.	55 mm 2.18 in.	83 mm 3.27 in.	220 mm 8.67 in.	154 mm 6.08 in.
1000 Keypad or Keypad/Touch	399 mm 15.72 in.	248 mm 9.77 in.	55 mm 2.18 in.	83 mm 3.27 in.	375 mm 14.75 in.	224 mm 8.8 in.
1000 Touch	329 mm 12.97 in.	248 mm 9.77 in.	55 mm 2.18 in.	83 mm 3.27 in.	305 mm 12.00 in.	224 mm 8.8 in.
1250 Keypad or Keypad/Touch	416 mm 16.36 in.	282 mm 11.12 in.	55 mm 2.18 in.	83 mm 3.27 in.	390 mm 15.35 in.	257 mm 10.11 in.
1250 Touch	363 mm 14.30 in.	282 mm 11.12 in.	55 mm 2.18 in.	83 mm 3.27 in.	338 mm 13.29 in.	257 mm 10.11 in.
1250 High-bright Touch	363 mm 14.30 in.	282 mm 11.12 in.	74 mm 2.9 in.	101 mm 3.99 in.	338 mm 13.29 in.	257 mm 10.11 in.
1500 Keypad or Keypad/Touch	469 mm 18.46 in.	330 mm 12.97 in.	65 mm 2.55 in.	93 mm 3.65 in.	419 mm 16.50 in.	305 mm 12.00 in.
1500 Touch	416 mm 16.37 in.	330 mm 12.97 in.	65 mm 2.55 in.	93 mm 3.65 in.	391 mm 15.40 in.	305 mm 12.00 in.

(1) Dimension is from display to logic module.
(2) Dimension is from display to communication module.

Accessories - PanelView Plus 6 Terminals

Tables 6...17 lists accessories for the PanelView Plus 6 platform.

Table 6 - Display Modules

Cat. No.	Input Type	Display	Marine Certified	Conformal Coated	Built-in Antiglare Overlay
700 Model					
2711P-RDK7C	Keypad	7-in. color			
2711P-RDK7CK	Keypad			•	
2711P-RDT7C	Touch				
2711P-RDT7CK	Touch			•	
2711P-RDT7CM	Touch		•		
2711P-RDB7C	Keypad/Touch				
2711P-RDB7CK	Keypad/Touch			•	
2711P-RDB7CM	Keypad/Touch		•		
1000 Model					
2711P-RDK10C	Keypad	10.4-in. color			
2711P-RDT10C	Touch				
2711P-RDT10CM	Touch		•		
2711P-RDB10C	Keypad/Touch				
2711P-RDB10CM	Keypad/Touch		•		
1250 Model					
2711P-RDK12C	Keypad	12.1-in. color			
2711P-RDK12CK	Keypad			•	
2711P-RDT12C	Touch				
2711P-RDT12CK	Touch			•	
2711P-RDT12AG	Touch				•
2711P-RDT12H(1)	Touch				
2711P-RDB12C	Keypad/Touch				
2711P-RDB12CK	Keypad/Touch			•	
1500 Model					
2711P-RDK15C	Keypad	15-in. color			
2711P-RDT15C	Touch				
2711P-RDT15AG	Touch				•
2711P-RDB15C	Keypad/Touch				

(1) This catalog number is a high-bright display module, indicated by the H at end of cat. no., that is designed for outdoor applications. The high-bright display module can only be used with DC-powered logic modules.

Table 7 - Logic Modules

Cat. No.	Power Input	Memory RAM/Nonvolatile	Communication	Marine Certified	Conformal Coated	Included Software
Logic Modules without Extended Features						
2711P-RP8A	AC	512 MB/512 MB	• Ethernet • RS-232 • Network interface for communication module	•		• Windows CE 6.0 operating system without extended features/file viewers • FactoryTalk View Machine Edition runtime, version 6.0 or later • FactoryTalk ViewPoint software, version 1.2 or later
2711P-RP8D	DC	512 MB/512 MB		•		
2711P-RP8DK	DC	512 MB/512 MB		•	•	
Logic Modules with Extended Features						
2711P-RP9A	AC	512 MB/512 MB	• Ethernet • RS-232 • Network interface communication module	•		• Windows CE 6.0 operating system with extended features/file viewers • FactoryTalk View Machine Edition runtime, version 6.0 or later • FactoryTalk ViewPoint software, version 1.2 or later
2711P-RP9D	DC	512 MB/512 MB		•		
2711P-RP9DK	DC	512 MB/512 MB		•	•	

Table 8 - Communication Modules

Cat. No.	Communication			Conformal Coated	Marine Certified
	DH+	DH-485	ControlNet (1)		
2711P-RN6	•	•			
2711P-RN6K	•	•		•	
2711P-RN15S			•		•
2711P-RN15SK			•	•	

(1) Scheduled and unscheduled communication.

Table 9 - Secure Digital (SD) Cards

Cat. No.	Description
1784-SD1	1 GB Secure Digital (SD) card
1784-SD2	2 GB Secure Digital (SD) card
2711C-RCSD	USB to SD adapter for secure Digital card (SD)

Table 10 - Antiglare Overlays

Cat. No.[1]	PanelView Plus 6 Terminal Model	Operator Input		
		Keypad	Touch	Key/Touch
2711P-RGK7	700	•		•
2711P-RGT7			•	
2711P-RGK10	1000	•		•
2711P-RGT10			•	
2711P-RGK12	1250	•		•
2711P-RGT12			•	
2711P-RGK15	1500	•		•
2711P-RGT15			•	

(1) Three overlays are shipped with each catalog number.

Table 11 - Solar Visor

Cat. No.	Description
2711P-RVT12	Solar visor for 1250 high-bright display module, cat. no. 2711P-RDT12H

Table 12 - Mounting Hardware

Cat. No.	Description	Quantity
2711P-RTMC	Mounting clips	8

Table 13 - Battery Replacement

Cat. No.	Description	Quantity
2711P-RY2032	Replacement battery	1

Table 14 - Power Supply and Power Terminal Blocks

Cat. No.	Description	Quantity
2711P-RSACDIN	DIN-rail power supply, AC-to-DC, 85…265V AC, 47…63 Hz	1
2711P-RTBAC3	AC power terminal block	10
2711P-RTBDC2	2-pin DC power terminal block	10

Table 15 - Programming Cable

Cat. No.	Description	Length
2711C-CBL-UU02	USB host to USB device programming cable	2 m (6.5 ft)

Table 16 - Backlight Replacements

Cat. No.	PanelView Plus 6 Display Module	Series	Number of Backlights
2711P-RL7C	700	A and B	1
2711P-RL7C2		C and D	1
2711P-RL10C	1000	A	1
2711P-RL10C2		B and C	1
2711P-RL12C	1250	A and B	2
2711P-RL12C2		C	1
2711P-RL15C	1500	B	2

Table 17 - Bezel Replacements

Cat. No.	PanelView Plus 6 Terminal Model	Operator Input		
		Keypad	Touch	Key/Touch
2711P-RBK7	700	•		
2711P-RBT7			•	
2711P-RBB7				•
2711P-RBK10	1000	•		
2711P-RBT10			•	
2711P-RBB10				•
2711P-RBK12	1250	•		
2711P-RBT12			•	
2711P-RBT12H(1)			•	
2711P-RBB12				•
2711P-RBK15	1500	•		
2711P-RBT15			•	
2711P-RBB15				•

(1) Applies to the cat. no. 2711P-RDT12H 1250 high-bright display module.

Extract from the online catalog

FL SWITCH SFN 6TX/2FX ST

Order No.: 2891411



http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=2891411

Ethernet switch, 6 TP RJ45 ports, 2 FO ports, 100 Mbps full duplex in ST-D format, automatic detection of data transmission speed of 10 or 100 Mbps (RJ45), autocrossing function

Commercial data	
GTIN (EAN)	4 046356 100861
sales group	K000
Pack	1 pcs.
Customs tariff	85176200
Catalog page information	Page 85 (AX-2011)

Product notes

WEEE/RoHS-compliant since: 09/07/2007

http://www.download.phoenixcontact.com
Please note that the data given here has been taken from the online catalog. For comprehensive information and data, please refer to the user documentation. The General Terms and Conditions of Use apply to Internet downloads.

Technical data

Interfaces

Interface 1	Ethernet (RJ45)
No. of ports	6 (RJ45 ports)
Connection method	RJ45 female connector, auto negotiation and autocrossing
Transmission physics	Ethernet in RJ45 twisted pair

Transmission speed	10/100 MBit/s (RJ45)
Interface 2	Fiber optic interface
No. of ports	2 (FO ports)
Connection method	ST format
Transmission physics	Multimode glass fiber
Transmission speed	100 MBit/s (ST, full duplex)
Transmission length	2000 m (Glass fiber 50/125)
	2000 m (Glass fiber 62.5/125)
Wavelength	1300 nm

Function

Basic functions	Unmanaged switch / autonegotiation, complies with IEEE 802.3, store and forward switching mode
Status and diagnostic indicators	LEDs: U_S, link and activity per port

Network expansion parameters

Cascading depth	Network, linear, and star structure: any
Maximum conductor length ((twisted pair)	100 m

Supply voltage

Supply voltage	24 V DC
Residual ripple	3.6 V_{PP} (within the permitted voltage range)
Supply voltage range	18.5 V DC ... 30.2 V DC
Typical current consumption	Typ. 230 mA

General data

Width	50 mm
Height	120 mm
Depth	70 mm
Mounting type	DIN rail
Type AX	Block-oriented
Weight	365 g
Degree of protection	IP20
Ambient temperature (operation)	0 °C ... 60 °C
Ambient temperature (storage/transport)	-20 °C ... 70 °C
Permissible humidity (operation)	5 % ... 95 % (no condensation)
Permissible humidity (storage/transport)	5 % ... 95 % (no condensation)
Air pressure (operation)	86 kPa ... 108 kPa (up to 1500 m above mean sea level)

Air pressure (storage/transport)	66 kPa ... 108 kPa (up to 3500 m above mean sea level)
Housing material	Aluminum
Noise emission	EN 61000-6-4
Noise immunity	EN 61000-6-2:2005

Certificates / Approvals

Certification	CUL, UL
Certification Ex:	CUL-EX LIS, UL-EX LIS

Accessories

Item	Designation	Description
Cable/conductor		
2832250	FL CAT5 PATCH 0,3	Patch cable, CAT5, assembled, 0.3 m
2832263	FL CAT5 PATCH 0,5	Patch cable, CAT5, assembled, 0.5 m
2832276	FL CAT5 PATCH 1,0	Patch cable, CAT5, assembled, 1.0 m
2832221	FL CAT5 PATCH 1,5	Patch cable, CAT5, assembled, 1.5 m
2832629	FL CAT5 PATCH 10,0	Patch cable, CAT5, assembled, 10.0 m
2832289	FL CAT5 PATCH 2,0	Patch cable, CAT5, assembled, 2.0 m
2832292	FL CAT5 PATCH 3,0	Patch cable, CAT5, assembled, 3.0 m
2832580	FL CAT5 PATCH 5,0	Patch cable, CAT5, assembled, 5.0 m
2832616	FL CAT5 PATCH 7,5	Patch cable, CAT5, assembled, 7.5 m
General		
0800886	E/NS 35 N	End clamp, width: 9.5 mm, color: gray
2832991	FL RJ45 PROTECT CAP	Dust protection caps for RJ45 female connector
2832865	FL SEC PAC 4TX	Layer1 security elements for four RJ45 network connections for use with patch boxes and panels

Address

PHOENIX CONTACT Inc., USA
586 Fulling Mill Road
Middletown, PA 17057,USA
Phone (800) 888-7388
Fax (717) 944-1625
http://www.phoenixcon.com

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Wall-Mountable Connector Housings (WCH)

A LANscape® Solutions Product

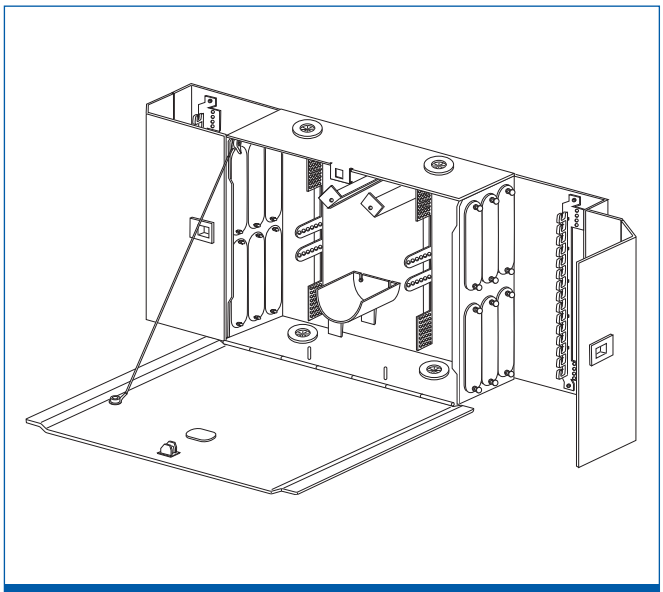
features and benefits |

Interconnect and cross-connect capabilities	Variety of applications
Drop down access door	Allows for temporary work area during installation
Jumper routing guides	Easy fiber management
Rugged metal construction	Durability
Field-installable lock kit (optional)	Additional security

The Corning Cable Systems Wall-Mountable Connector Housing (WCH) provides interconnect or cross-connect capabilities between the outside plant, riser or distribution cables and the opto-electronics. Available in two, four, six and 12 panels, the rugged metal housings can be wall-mounted in main cross-connects or telecommunication rooms. Units accept standard closet connector housing (CCH) connector panels and modules and options include jumper routing guides and a bracket for securing buffer tube fan-out kits. The cable strain-relief kit (WCH-STRNRLF-KIT) is designed for easier installation and the standoff bracket (WCH-STDOFF-BKT) extends the WCH from the wall to allow cable routing behind the housing. Brackets can also be stacked to increase the amount of space for routing. An optional field-installable lock kit is available for additional security.



Wall-Mountable Connector Housings | Photo LAN703

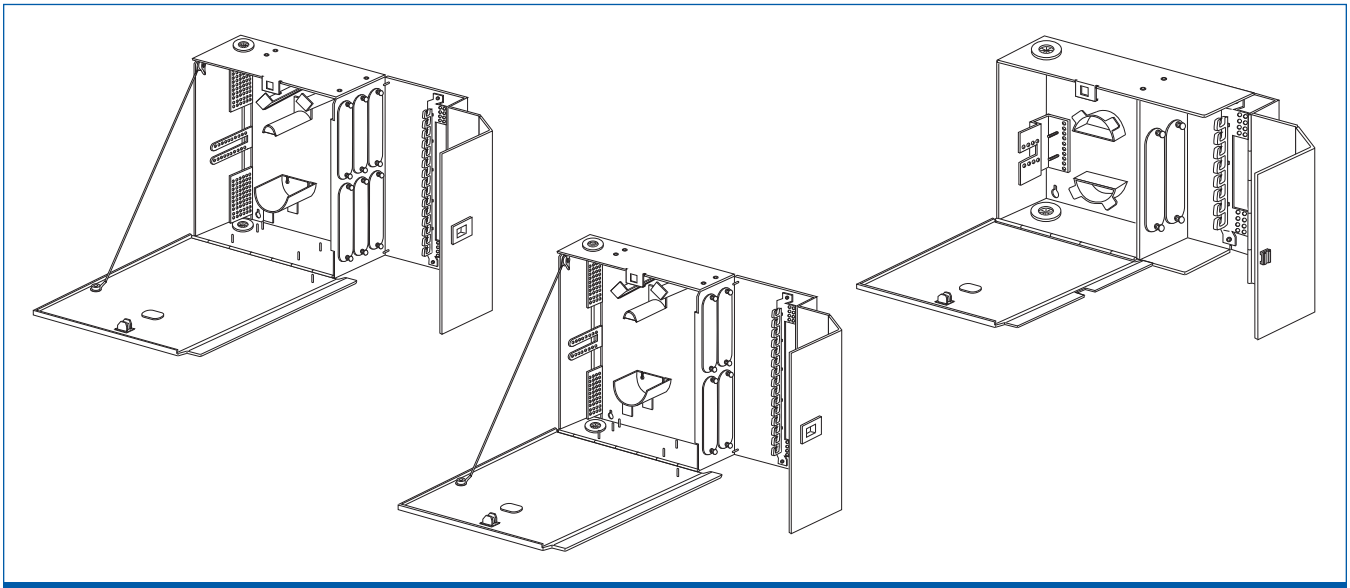


WCH-12P (up to 144 fibers) | Drawing CPC-220/5/31

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Wall-Mountable Connector Housings (WCH)

A LANscape® Solutions Product



WCH-06P (up to 72 fibers), WCH-04P (up to 48 fibers) and WCH-02P (up to 24 fibers) (shown left to right) | Drawing ZA-3319

specifications |

	Dimensions* (H x W x D) cm (in)	Shipping Weight kg (lb)
WCH-12P	34.3 x 57.1 x 13 (13.5 x 22.5 x 5.125)	4.1 (9)
WCH-06P	34.3 x 40.8 x 13 (13.5 x 16.062 x 5.125)	3.3 (7.2)
WCH-04P	34.3 x 40.8 x 10.3 (13.5 x 16.062 x 4.062)	2.8 (6.2)
WCH-02P	23.5 x 33.2 x 8.2 (9.25 x 13.25 x 3.25)	2.5 (5.4)

**Doors in closed position.*

CORNING | LANscape® Solutions

Wall-Mountable Connector Housings (WCH)

A LANscape® Solutions Product

ordering information |

Part Number	Description
WCH-12P	Wall-Mountable Connector Housing; accepts up to 12 CCH panels
WCH-06P	Wall-Mountable Connector Housing; accepts up to 6 CCH panels
WCH-04P	Wall-Mountable Connector Housing; accepts up to 4 CCH panels
WCH-02P	Wall-Mountable Connector Housing; accepts up to 2 CCH panels
Accessories	
WJG-02R	Wall-Mountable Jumper Storage Guides that provide jumper management; kit includes 2 routing guides and mounting screws
WCH-STDOFF-BKT	Wall-Mountable Connector Housing Wall Stand-off Brackets for -04P, -06P, -08P and -12P; brackets provide a 1 in spacing from wall
WCH-STDOFF-BKT-2P	Wall-Mountable Connector Housing Wall Stand-off Brackets for -02P; brackets provide a 1 in spacing from wall
BKT-ALL-R23-75	Universal Rack-Mount Bracket for 19-in or 23-in equipment racks; allows for rack-mounting of the wall-mountable units
WCH-STRNRLF-KIT	Optional External Cable Strain-Relief Kit that utilizes Corning Cable Systems Universal Cable Clamp; includes bracket, mounting hardware, 1 strain-relief clamp and 1 multicable insert that will hold up to 5 cables less than 0.4 in diameter
WCH-DUST-CVR	Optional Dust Cover for -04P and -08P housing; covers jumper exits; includes 2 covers and mounting hardware
WCH-DUST-CVR-D	Optional Dust Cover for -06P and -12P housing; covers 2 jumper exits; includes 2 covers and mounting hardware; 2 kits required for -12P
WCH-LBL-KIT	Replacement Label Kit for WCH
HDWR-LOCK-KIT	Lock Kit for front door of housing; contains 1 lock and 2 keys

Wall-Mountable Connector Housings (WCH)

A LANscape® Solutions Product

ordering information | (continued)

Part Number	Description
Optional Splice Tray Holders	
WCH-SPLC-12	Splice Tray Holder for WCH-12P; accommodates (12) 0.2 in Type 2R or (6) 0.4 in Type 4R reduced-length splice trays
WCH-SPLC-4-8	Splice Tray Holder for WCH-04P, WCH-06P and WCH-08P; accommodates (8) 0.2 in Type 2R or (4) 0.4 in Type 4R reduced-length splice trays
WCH-SPLC-2P	Splice Tray Holder for WCH-02P; accommodates (2) 0.2 in Type 2R or (1) 0.4 in Type 4R reduced-length splice trays
Slack Storage	
WCH-SSH-2	Wall-Mountable Slack Storage Housing for WCH-02P; accommodates (4) 0.2 in Type 2R or (2) 0.4 in Type 4R reduced-length splice trays
WCH-SSH-4-12	Wall-Mountable Slack Storage Housing for WCH-04P, WCH-06P, WCH-08P and WCH-12P; accommodates (8) 0.2 in Type 2R or 2S, or (4) 0.4 in Type 4R or 4S standard or reduced-length splice trays, or 4 UST splice trays

Note: Splice trays and connector panels must be ordered separately.

Corning Cable Systems LLC • PO Box 489 • Hickory, NC 28603-0489 USA
800-743-2675 • FAX: 828-901-5973 • International: +1-828-901-5000 • www.corning.com/cablesystems

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Closet Connector Housing Panels (CCH-CP)

A LANscape® Solutions Product

Applications

- Provides an efficient way to securely mate two connectors
- Utilized for interconnecting or cross-connecting at main cross-connects (MCs), intermediate cross-connects (ICs), telecommunication rooms (TRs) or work areas

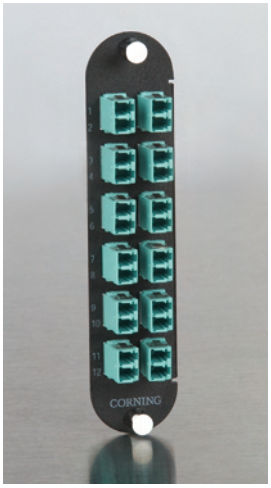
Description

Closet Connector Housing Panels are offered in a wide variety of fiber counts for use with the LANscape® Solutions hardware products. The panels are used with factory-installed or field-installable connectors to provide interconnect or cross-connect capability in a housing.

The panels are available with a variety of industry-standard adapter types. All standard LANscape Solutions hardware accepts the Closet Connector Housing Panels (CCH-CP) for a universal, "one-size-fits-all" approach. The closet connector housing panels are designed for applications where specified labeling and connector identification are required. This can be accomplished by the use of colored icons, which come standard on many panels.

Features / Benefits

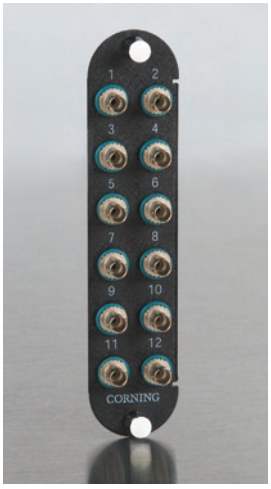
- Designed to accommodate all industry-standard adapter types
- Universal approach is used; one panel size fits in all standard LANscape Solutions hardware (for example, CCH, PCH, CCS, WCH, ICH, EDC, FZB, SPH, PWH)
- Available in 6-, 8- and 12-fiber count options in most adapter styles; 16- and 24-fiber count options also available in MT-RJ and LC duplex styles ; 36-, 72-, 96-, and 144-fiber count options available in MTP® Connector
- Unique color-coded connector labeling system



24-Fiber LC Duplex Connector | Photo LAN661



72-Fiber MTP Connector Panel | Photo LAN659



12-Fiber ST® Compatible Connector Panel | Photo LAN662



12-Fiber SC Duplex Connector Panel | Photo LAN658

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Closet Connector Housing Panels (CCH-CP)

A LANscape® Solutions Product

Ordering Information

Select adapter/connector code.

Adapter Code	Fiber Type	Alignment	Housing	UPC/ APC	Fiber/ Adapter	Available Fibers/Panel Counts 6	8	12	16	24	36	72	96	144
LC Duplex														
A8	62.5 µm Multimode	Ceramic	Composite		2		X	X	X	X				
D3	50 µm Multimode	Ceramic	Composite		2		X	X	X	X				
E4	LOMMF*	Ceramic	Composite		2		X	X	X	X				
A9	Single-mode	Ceramic	Composite	UPC	2		X	X	X	X				
SC Duplex														
91	62.5 µm Multimode	Metal	Composite		2		X	X						
G7	50 µm Multimode	Ceramic	Composite		2		X	X						
E7	LOMMF	Ceramic	Composite		2		X	X						
59	Single-mode	Ceramic	Composite	UPC	2		X	X						
MT-RJ														
97	62.5 µm Multimode	N/A	Composite		2		X	X	X	X				
G1	50 µm Multimode	N/A	Composite		2		X	X	X	X				
E1	LOMMF	N/A	Composite		2		X	X	X	X				
98	Single-mode	N/A	Composite	UPC	2		X	X	X	X				
SC														
56	62.5 µm Multimode	Metal	Composite		1	X	X	X						
G6	50 µm Multimode	Ceramic	Composite		1	X	X	X						
E6	LOMMF	Ceramic	Composite		1	X	X	X						
3C	Single-mode	Ceramic	Composite	UPC	1	X	X	X						
6C	Single-mode	Ceramic	Composite	APC	1	X	X	X						
ST® Compatible Connector														
25T	62.5 µm Multimode	Metal	Metal		1	X	X	X						
15T	62.5 µm Multimode	Ceramic	Metal		1	X	X	X						
G5	50 MU	Ceramic	Metal		1	X	X	X						
E5	LOMMF	Ceramic	Metal		1	X	X	X						
19T	Single-mode	Ceramic	Metal	UPC	1	X	X	X						
FC														
11	Single-mode	Metal	Metal	UPC	1	X	X	X						
21	Single-mode	Metal	Metal	APC	1	X	X	X						
MTP® Connector														
69	62.5 µm Multimode	N/A	Composite		12						X	X	X	X
G3	50 µm Multimode	N/A	Composite		12						X	X	X	X
E3	LOMMF	N/A	Composite		12						X	X	X	X
89	Single-mode	N/A	Composite	UPC	12						X	X	X	X
90	Single-mode	N/A	Composite	APC	12						X	X	X	X

Fiber Type	**Housing Color**
62.5 µm Multimode	Beige
50 µm Multimode	Black
50 µm LOMMF	Aqua
Single-mode	Blue
Single-mode APC	Green

**LOMMF = Laser-Optimized Multimode Fiber*

Closet Connector Housing Panels (CCH-CP)

A LANscape® Solutions Product

Ordering Information *(continued)*

Closet Connector Panels

CCH - CP ☐☐ - ☐☐
1 **2**

Use the following options to construct the part number:

1 Select fiber count.

06 = 6 fibers
08 = 8 fibers
12 = 12 fibers
16 = 16 fibers
24 = 24 fibers
36 = 36 fibers
72 = 72 fibers
96 = 96 fibers
E4 = 144 fibers

Confirm fiber count for desired adapter is available in preceding chart.

2 Select adapter code from chart on previous page.

Pigtailed Closet Connector Panels (pigtail is 3 m long)

CCH - CP ☐☐ - ☐☐ - **P03** ☐☐
1 **2** **3**

Use the following options to construct the part number:

1 Select fiber count.

06 = 6 fibers
08 = 8 fibers
12 = 12 fibers
16 = 16 fibers
24 = 24 fibers

Confirm fiber count for desired adapter is available in preceeding chart

2 Select adapter code from chart on previous page.

3 Select fiber type.

MIC® Subunit Cable (Standard Fiber Cable Option)

KH = Multimode (62.5/125 µm)
CH = Standard 50 µm multimode (50/125 µm)
SH = Laser-optimized multimode (50/125 µm)
RH = Single-mode

Ribbon Fiber

KJ = Multimode (62.5/125 µm)
CJ = Standard 50 µm multimode (50/125 µm)
SJ = Laser-optimized multimode (50/125 µm)
RJ = Single-mode

Ordering Information *(continued)*

Colored Icons

Pack of 50 Colored Icons

ICN - □ □ □
1

Use the following options to construct the part number:

1 Select icons.

Blank Icons



YLB = Blank (Yellow)
RDB = Blank (Red)
GRB = Blank (Green)
BLB = Blank (Blue)
WTB = Blank (White)

Etched Icons



BLP = Phone (Blue)



RDC = Computer (Red)



GRT = Cable TV (Green)

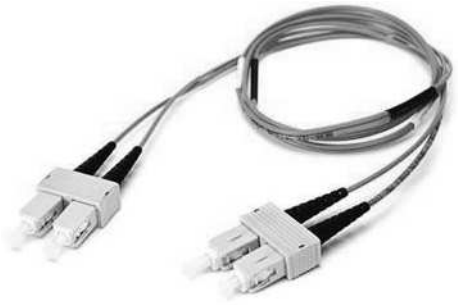
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Cable Assembly Information

Duplex, Ceramic Ferruled (eg. - MTRJ), EIA/TIA Compliant Patch Cords



SC Duplex Cable Assembly

END CONNECTORS	1 METER 3 FEET CSC PART NO.	2 METERS 7 FEET CSC PART NO.	3 METERS 10 FEET CSC PART NO.	5 METERS 16.5 FEET CSC PART NO.	10 METERS 33 FEET CSC PART NO.
62.5/125 µm					
SC to SC	807835	807837	807843	807846	807848
ST to ST	807850	807851	807853	807855	807857
ST to SC	807859	807860	807862	807863	807864
MTRJ to MTRJ	807865	807866	807869	807871	807875
MTRJ to ST	807877	807879	807880	807881	807882
MTRJ to SC	807883	807884	807891	807893	807894
LC to LC	807899	807900	807901	807902	807903
LC to SC	807905	807906	807907	807910	807915
LC to ST	807923	807924	807925	807926	807928
50/125 µm					
SC to SC	807967	807968	807969	807970	807971
LC to LC	808004	808005	808008	808009	808010
LC to SC	808011	808013	808014	808015	808016
LC to ST	808017	808018	808019	808020	808021
50/125 µm 10 Gig					
SC to SC	807929	807930	807931	807932	807933
LC to LC	807949	807950	807951	807952	807954
LC to SC	807955	807956	807957	807958	807959
LC to ST	807961	807963	807964	807965	807966
Singlemode					
SC to SC	808048	808052	808053	808054	808056
ST to ST	808058	808063	808064	808065	808066
ST to SC	808069	808070	808071	808072	808073
LC to LC	808075	808076	808077	808079	808080
LC to SC	808081	808082	808086	808088	808089
LC to ST	808090	808092	808093	808094	808095

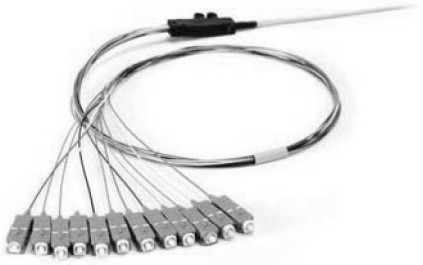
Cable Assembly Information

Fibertron offers a wide range of high performance singlemode and multimode cable assemblies (including hybrids) from their in-depth stock of cable, connectors, and termination products. Their production and assembly facilities have received ISO 9002 Certification and are qualified to MIL-I-45208A for the manufacturing of jumper and pigtail assemblies.
Skilled technicians, using state-of-the-art assembly equipment, microscopically and optically test every cable, connector, and assembly using EIA/TIA fiber optic testing procedures to ensure the highest level of quality and performance.
Each Fibertron cable assembly is guaranteed to conform to published connector/cable specifications and performance standards. High accuracy polishing techniques, applied to every Fibertron cable assembly, translates into assemblies that meet or exceed industry standards for optical performance and repeatability.
Fibertron can assist you in the selection of the correct jumper, pigtail, and multi-fiber assembly, as well as design and build an assembly to meet your applications requirements

Cable Selection
Fibertron offers a wide assortment of quality fiber optic cable from leading manufacturers. Their applications specialists can help you in the selection of the right cable for your specific requirements and the appropriate termination components for multimode and singlemode cable with 1–288 fibers.

Connector Selection
Fibertron offers a wide assortment of quality fiber optic connectors from leading manufacturers.

Optional Finishes
Fibertron cable assemblies come standard with a PC polish, Ultra-PC and Angled-PC polishes are available on some connectors.



Multi-Fiber Cable Assembly



Multi-Fiber Cable Assembly on Spool

See page 2-68 for ordering information

SDU Series, DIN Rail AC UPS

The SDU DIN Rail UPS combines an industry leading compact design with a wide operation temperature range and unique installation options. The SDU series provides economical protection from damaging impulses and power interruptions. These units include easy to wire screw terminations for critical devices needing battery back up such as computer based control systems.



UL 1778
Ind. Application
E179213

Features

- Lightweight, compact industrial design
- Wide operation temperature range (0-50°C)
- Cold start capability
- Phone/dataline surge protection
- Software and cable included for easy installation
- Simulated sinewave output
- RS232 Communication Port
- USB Communication Port (optional)
- Form C Dry Contact Relay (optional)
- Panel/Wall mounting brackets (optional)
- Remote turn-on and shut-off capabilities NEW
- Limited two-year warranty

Approvals

- 120V models are UL1778 recognized for industrial applications without derating.
  - No derating required in UL508 applications.
- 230V models are CE marked.

Applications

- Programmable Logic Controllers
- Factory Automation
- Robotics
- Conveying Equipment
- Computer-based Control Systems

Related Products

- Portable MCR Power Conditioners
- STV Surge Protective Devices
- SDN DIN Rail Power Supplies
- STFV Plus Active Tracking® Filters

Selection Table

Capacity (VA/W)	Catalog Number	Volts, Frequency In/Out	Typical Back–up Time (minutes)*	Input/Output Connections	Approx. Ship Weight – lbs (kg)
500/300	SDU 500	120 Vac, 50/60 Hz	4	IP20 touch proof, screw terminals. Wire range: 10 ~ 24 AWG.	10.7 (4.7)
850/510	SDU 850		2		11.4 (5.0)
500/300	SDU 500-5	230 Vac, 50/60 Hz	4		11.5 (5.2)
850/510	SDU 850-5		2		11.9 (5.4)

* At full load.

SDU Accessories

Catalog Number	Description	Approx. Ship Weight – lbs (kg)
RELAYCARD-SDU	Dry contact I/O relay box, IP20 touch proof screw terminals, wire size range 12~22 AWG (IEC 2.5mm); N.O./N.C. form "C" contact. Relay contact signal for "On Battery", "Low Battery" and "UPS Shutdown".	1.0 (0.45)
UPSMON-USB	RS232 to USB adapter cable	1.0 (0.45)
SDU-PMBRK	Mounting brackets to secure UPS to wall, back of panel or enclosure.	1.0 (0.45)

Visit our website at www.solaheviduty.com or
contact **Technical Services** at **(800) 377-4384** with any questions.

Specifications

Catalog Number	SDU 500	SDU 850	SDU 500-5	SDU 850-5
Capacity (VA/Watts)	500/300	850/510	500/300	850/510
Load Power Factor	0.6			
Dimensions – inches (mm)				
Unit (H x W x D)	4.88 x 11.1 x 4.55 (124 x 281 x 116)			
Weight – lbs (kg)	10.7 (4.7)	11.4 (5.0)	11.5 (5.2)	11.9 (5.4)
Input Parameters				
Voltage	120 V (+10%, -20%)		230 V (+/- 20%)	
Frequency	50 +/- 5 Hz or 60 Hz +/- 6 Hz (auto sensing)			
Output AC Parameters				
Voltage (Battery Mode)	Step sinewave			
	+/- 5%			
Frequency (On Battery)	50 or 60 Hz			
	+/- 0.3 Hz			
Overload Protection	UPS automatic shutdown if overload exceeds 105% of nominal at 20 seconds, 120% at 10 seconds, 130% at 3 seconds			
Short Circuit	UPS output cut off immediately			
Battery Parameters				
Battery Type	Sealed, non-spillable, maintenance-free lead acid batteries			
Transfer Time	4 - 6 ms typical			
Back–up Time* (minutes)	4.5/18	2.5/10	4.5/18	2.5/10
Recharge Time	8 hours to 90% capacity after full discharge			
Environmental				
Operating Temperature	32°F to 122°F (0°C to 50°C)			
Storage Temperature	5°F to 140°F (-15°C to 60°C)			
Relative Humidity	1% to 95%, non-condensing			
Ambient Operation	1-95% humidity non-condensing, 0-50°C up to 5,000 ft. (1500m)			
Audible Noise	< 40dBA (1 meter from surface)			
Standards				
Safety	UL 1778 Recognized components for industrial applications in accordance with UL508 without derating. CAN/CSA C22.2 No 107.1-01. Overvoltage Category 3, pollution degree 3. FCC Part 15, Subpart B, Class A		CE Marked; LVD: EN62040-1-1; EMC: EN50091-2, EN61000-3-2, EN61000-3-3, IEC60801-2, IEC60801-3, IEC60801-4, IEC61000-2-2.	
Elevation	5000 ft. without derating			
Shock & Vibration	According to the International Safe Transit Association standard ISTA 2A.			
Mounting	To be mounted on DIN TS35/7.5 or TS35/15 rail system. Chassis mounting permissible via optional brackets. Unit handles normal shock and vibration of industrial use and transportation without coming off rail.			

* At full load/half load.

Harmony™ 9001K/SK/KX
30 mm push buttons
9001SK – Push buttons and mushroom operators

Note: When ordering, add prefix "9001" to the reference.

Non-Illuminated Momentary Push Button Operators—UL Types 4, 4X, 13/NEMA 4, 4X, 13
For use in hazardous locations, see page 53.
Contact blocks and legend plate not included unless otherwise noted.

Description	Color	Operator with 1 N.O. and 1 N.C. Contact (KA1)	Operator with 1 N.O. Contact (KA2)	Operator with 1 N.C. Contact (KA3)	Operator Only No Contacts *(5)*
 *9001SKR1B Full Guard*	Black	**SKR1BH13**	**SKR1BH5**	**SKR1BH6**	**SKR1B**
	Red	**SKR1RH13**	**SKR1RH5**	**SKR1RH6**	**SKR1R**
	Green	**SKR1GH13**	**SKR1GH5**	**SKR1GH6**	**SKR1G**
	Universal *(1)*	**SKR1UH13**	**SKR1UH5**	**SKR1UH6**	**SKR1U**
	Other *(2)*	**SKR1■H13**	**SKR1■H5**	**SKR1■H6**	**SKR1■**
 *9001SKR3B No Guard*	Black	**SKR3BH13**	**SKR3BH5**	**SKR3BH6**	**SKR3B**
	Red	**SKR3RH13**	**SKR3RH5**	**SKR3RH6**	**SKR3R**
	Green	**SKR3GH13**	**SKR3GH5**	**SKR3GH6**	**SKR3G**
	Universal *(1)*	**SKR3UH13**	**SKR3UH5**	**SKR3UH6**	**SKR3U**
	Other *(2)*	**SKR3■H13**	**SKR3■H5**	**SKR3■H6**	**SKR3■**
 *9001SKR2B Extended Guard*	Black	**SKR2BH13**	**SKR2BH5**	**SKR2BH6**	**SKR2B**
	Red	**SKR2RH13**	**SKR2RH5**	**SKR2RH6**	**SKR2R**
	Green	**SKR2GH13**	**SKR2GH5**	**SKR2GH6**	**SKR2G**
	Universal *(1)*	**SKR2UH13**	**SKR2UH5**	**SKR2UH6**	**SKR2U**
	Other *(2)*	**SKR2■**	**SKR2■H5**	**SKR2■H6**	**SKR2■**
 *9001SKR4B 1-3/8 in (35 mm) Mushroom Button*	**Snap-In Mushroom Button**				
	Black	**SKR4BH13**	**SKR4BH5**	**SKR4BH6**	**SKR4B**
	Red	**SKR4RH13**	**SKR4RH5**	**SKR4RH6**	**SKR4R**
	Red *(3)*	**SKR4R05H13**	**SKR4R05H5**	**SKR4R05H6**	**SKR4R05**
	Green	**SKR4GH13**	**SKR4GH5**	**SKR4GH6**	**SKR4G**
	Other *(4)*	**SKR4★H13**	**SKR4★H5**	**SKR4★H6**	**SKR4★**
	Screw-On Mushroom Button with Set Screw Security				
	Black	**SKR24BH13**	**SKR24BH5**	**SKR24BH6**	**SKR24B**
	Red	**SKR24RH13**	**SKR24RH5**	**SKR24RH6**	**SKR24R**
	Green	**SKR24GH13**	**SKR24GH5**	**SKR24GH6**	**SKR24G**
	Other *(4)*	**SKR24★H13**	**SKR24★H5**	**SKR24★H6**	**SKR24★**
 *9001SKR5 2-1/4 in (57 mm) Mushroom Button*	**Snap-In Mushroom Button**				
	Black	**SKR5BH13**	**SKR5BH5**	**SKR5BH6**	**SKR5B**
	Red	**SKR5RH13**	**SKR5RH5**	**SKR5RH6**	**SKR5R**
	Red *(3)*	**SKR5R05H13**	**SKR5R05H5**	**SKR5R05H6**	**SKR5R05**
	Green	**SKR5GH13**	**SKR5GH5**	**SKR5GH6**	**SKR5G**
	Other *(4)*	**SKR5★H13**	**SKR5★H5**	**SKR5★H6**	**SKR5★**
	Screw-On Mushroom Button with Set Screw Security				
	Black	**SKR25BH13**	**SKR25BH5**	**SKR25BH6**	**SKR25B**
	Red	**SKR25RH13**	**SKR25RH5**	**SKR25RH6**	**SKR25R**
	Green	**SKR25GH13**	**SKR25GH5**	**SKR25GH6**	**SKR25G**
	Other *(4)*	**SKR25★H13**	**SKR25★H5**	**SKR25★H6**	**SKR25★**

Color Codes

Color	■ SKR1, 2, 3 Place Color Code in Reference	★ SKR4, 5, 24, 25 Place Color Code in Reference
Blue	L	L
Yellow	Y	Y
White	W	—
Orange	S	S
Gray	E	—

(1) The universal push button operators contain one each of the following color inserts: black, red, green, yellow, orange, blue and white.
(2) Replace ■ with the color code as chosen from the color code table above.
(3) Knob has the words "Emergency Stop" in raised letters highlighted in white for readability.
(4) Replace ★ with the color code as chosen from the color code table above
(5) These operators can be ordered complete with contact blocks. For maximum block usage, see page 51. Add the "H" number chosen from page 51 to the end of the operator reference number and add the cost of the "H" number to the operator cost.

To select and order Contact Blocks, Light Modules, Knobs, and Accessories, see pages 50 to 59.

Harmony™ 9001K/SK/KX
30 mm push buttons
9001SK

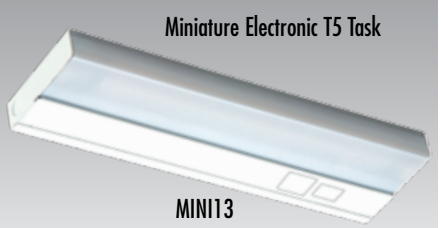
Environmental specifications

Conforming to standards	CE Marked		EN/IEC 60947-1, EN/IEC 60947-5-1, EN/IEC 60947-5-4, JIS C 4520 and 852, UL 508, CSA C22-2 n° 14, CE marked, RoHS compliant
Product certifications	UL File E78403 CCN NKCR; CSA File LR25490 Class 3211-03		UL File E78403, CCN NKCR and CSA File LR25490, Class 3211-03
Protective treatment standard version			"TC"
Ambient air temperature around the device	Storage	**°F (°C)**	-40 to +158 (-40 to +70)
	Operation	**°F (°C)**	-13 to +158 (-25 to +70)
Vibration resistance	Conforming to IEC 60068-2-6		Frequency: 2 to 500 Hz: 7gn Ford Standard EA-1
Shock resistance	Conforming to IEC 60068-2-27		Half sine wave: 50 gn
Electric shock protection	Conforming to IEC 61140		Class II
Degree of protection	Conforming to EN/IEC 60529		IP 66
	Conforming to NEMA		Types 1, 2, 3, 3R, 4, 12 and 13
Mechanical life (in millions of operating cycles)	Push buttons, spring return		5
	Illuminated push buttons		5
	Selector switches and key switches		0.5
Mounting position			All positions

Electrical characteristics of contact blocks

Rated operational characteristics	~ AC-15		3 A, 240 V			
	⎓ DC-13		0.55 A, 125 V			
Rated insulation voltage	Conforming to EN/IEC 60947-1	**V**	Ui = 250 degree of pollution 3 (except pilot lights with incandescent bulb: degree of pollution 2)			
Rated impulse withstand voltage	Conforming to EN/IEC 60947-1	**kV**	Uimp = 2.5			
Contact material	Normal environment and usage		Silver alloy			
Contact operation	"N/C" ou "N/O"		Slow break			
Positive operation	Conforming to EN/IEC 60947-5-1	**N**	N/C contact(s) with positive opening operation			
Short-circuit protection	Conforming to EN/IEC 60947-5-1	**A**	Cartridge fuse mounted upstream: 10			
Cabling capacity (9001KA contact blocks and 9001KM light modules)	Conforming to EN/IEC 60947-1	**mm²** **mm²**	Screw clamp terminals (cross headedslotted screw) Mini: 1 x 0.22 Maxi: 2 x 1.5 Recommended tightening torque: 0.8 N.m (10 in-lbs)			
Thermal current	Ith	**A**	10			
Maximum operation current	a.c. supply: utilization category AC-15 NEMA A600		Contact making capacity			
		V	120	240	480	600
		A	60	30	15	12
		VA	7200	7200	7200	7200
			Breaking capacity			
		V	120	240	480	600
		A	6	3	1.5	1.2
		VA	720	720	720	720
	d.c.supply: utilization category DC-13 NEMA Q600		Contact making capacity and breaking capacity			
		V	125	250	600	
		A	0.55	0.27	0.1	

Product range: page 36 | References: page 41 | Dimensions: page 60 | Mounting: page 61



The ultra-compact, **MINI series,** with an integral micro-electronic T5 ballast provides maximum design flexibility for demanding home and office projects where excellent color rendering, long lamp life and superior lamp efficacy are essential. The MINI's tiny, trim profile mounts neatly out of view.

- The MINI's shadow-free illumination is ideal for intricate tasks like cutting.
- Designed to meet stringent energy codes like TITLE 24, the MINI's T5 lighting system produces more light using less energy.
- The MINI's high CRI lamps create color correct illumination.
- 4100K T5 lamps included

MINI Features & Benefits

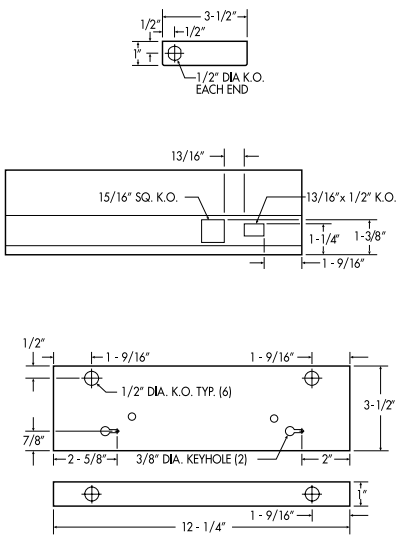
- Miniature profile 1" H x 3.5" W is ideal for use in confined areas.
- High performance electronic ballast and T5 lamp(s) produce instant-on, quiet, flicker-free light.
- Stay white, snap fit, damage resistant white ribbed acrylic lens provides even illumination.
- Fastener-free housing is post-painted after fabrication to ensure a high quality finish.
- Includes conduit connector and mounting hardware.
- Hingeable service tray for quick installation and maintenance.
- Rocker switch and grounded convenience available as field installed kit. Order part number (SWCO-KIT).
- U.L. listed.

Great For Tight Spaces



Miniature 1" x 3.5" profile is ideal for space restricted areas.

Dimensions



ADDITIONAL LENGTHS ARE 21-5/16", 24-1/2", 33-1/2" AND 42-1/2"

T5 Fluorescent MINI Series Ordering Information 4100K T5 lamps included (standard)

Series	Lamps	Ballast	H	L	W	Input Wattage
MINI	**8L1** = (1)-8WT5	Electronic, Instant Start NPF 120V	1"	12-1/4"	3-1/2"	6.5
	13L1 = (1)-13WT5	Electronic, Instant Start NPF 120V	1"	21-5/16"	3-1/2"	11.8
	28L1= (2)-8WT5	Electronic, Instant Start NPF 120V	1"	24-1/2"	3-1/2"	17.1
	813L1 = (1)-8WT5 & (1)13WT5	Electronic, Instant Start NPF 120V	1"	33-1/2"	3-1/2"	21.2
	213L1 = (2)-13WT5	Electronic, Instant Start NPF 120V	1"	42-1/2"	3-1/2"	25.2

Accessories
SWCO-KIT = Rocker switch and outlet (field install)

Lighting Packages

PANELITE™ Remote Door Switches



- Remote door switch activates the light when the enclosure door is opened
- Mounts on enclosure frame and includes mounting hardware
- Mounting plate is 14 gauge steel with a plated finish
- Can be hard-wired to the PANELITE™LED or Fluorescent light or connected via the PANELITE Door Switch Cable

Bulletin: A80LT, P20

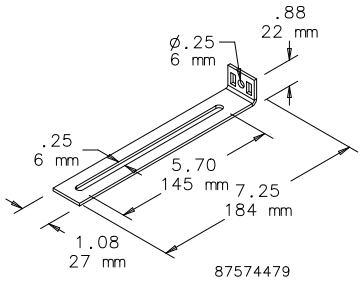
Catalog Number	Description
ALFSWD	Door switch assembly (order connection cable separately)
PLFSWD	Door switch assembly for PROLINE® (order connection cable separately)

Mounting Bracket Kit for Light Package

Kit simplifies mounting light package in Hoffman PROLINE® disconnect enclosures. Includes brackets, all mounting hardware and complete instructions.

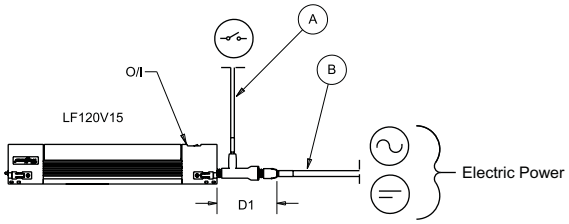
Bulletin: A80LT

Catalog Number	Description
PDLFBRKT	Mounting Bracket Kit



PANELITE™ Wiring Options

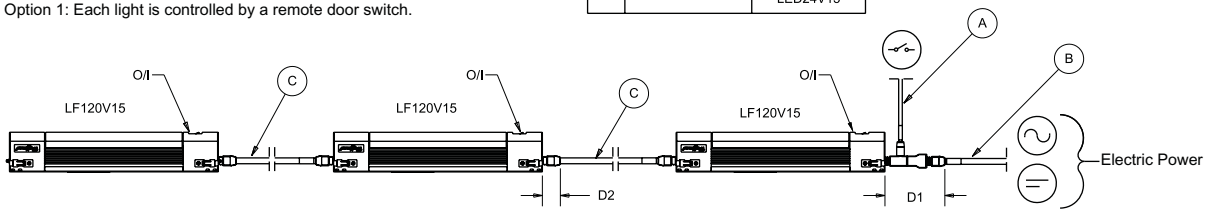
See the table on the drawing for cable clearance dimensions.



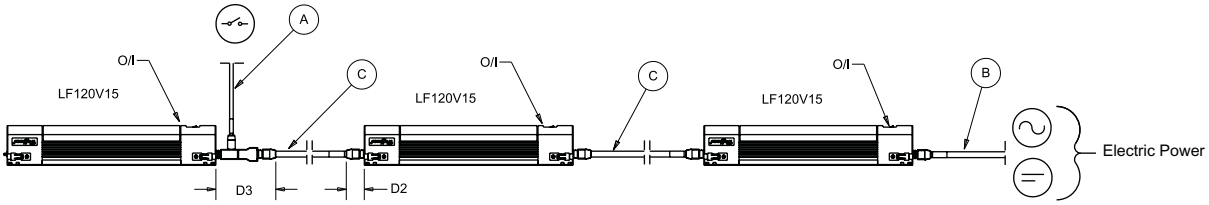
ITEM	CONNECTOR TYPE	LIGHT FIXTURE
A	LDSWITCH18 LDSWITCH72	LF120V15 LF120V18 LF120V28 LED24V15
B	LF120VCORD LPC72	LF120V15 LF120V18 LF120V28
	LED24VCORD	LED24V15
C	LGCABLE24 LGCABLE48 LGCABLE72	LF120V15 LF120V18 LF120V28 LED24V15

PLUG	DIMENSION	'D' MIN
A + B	D1	127 MM 5.00 IN
C	D2	51 MM 2.00 IN
A + C	D3	127 MM 5.00 IN

Option 1: Each light is controlled by a remote door switch.



Option 2: All lights are controlled by a single remote door switch.



Option 3: The last light is controlled by a remote door switch. The first two lights are manually operated.

89046495

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FEDERAL SIGNAL CORPORATION



Vibratone® Horns

Model 350WB

DESIGNED FOR ROUTINE SIGNALING USES

- Available in 120VAC and 240VAC
- Effective range 200 feet
- Coded or sustained tones
- Wall mount
- Produces 100dBa @ 10' (110dBa @ 1m)
- Type 4X, IP65 enclosure
- UL and cUL Listed, CSA Certified and FM Approved

The Model 350WB (AC current) Vibratone® horn produces sound by the electro-mechanical vibration of a stainless steel diaphragm. The horn mechanism with diaphragm is attached to the grille. Indoor or outdoor use is made possible by the water- and dust-tight backbox.

The 350WB is available in 120 or 240VAC for 50/60Hz. The sound output level is 100dBa nominal at ten feet (110dBa @ 1m).

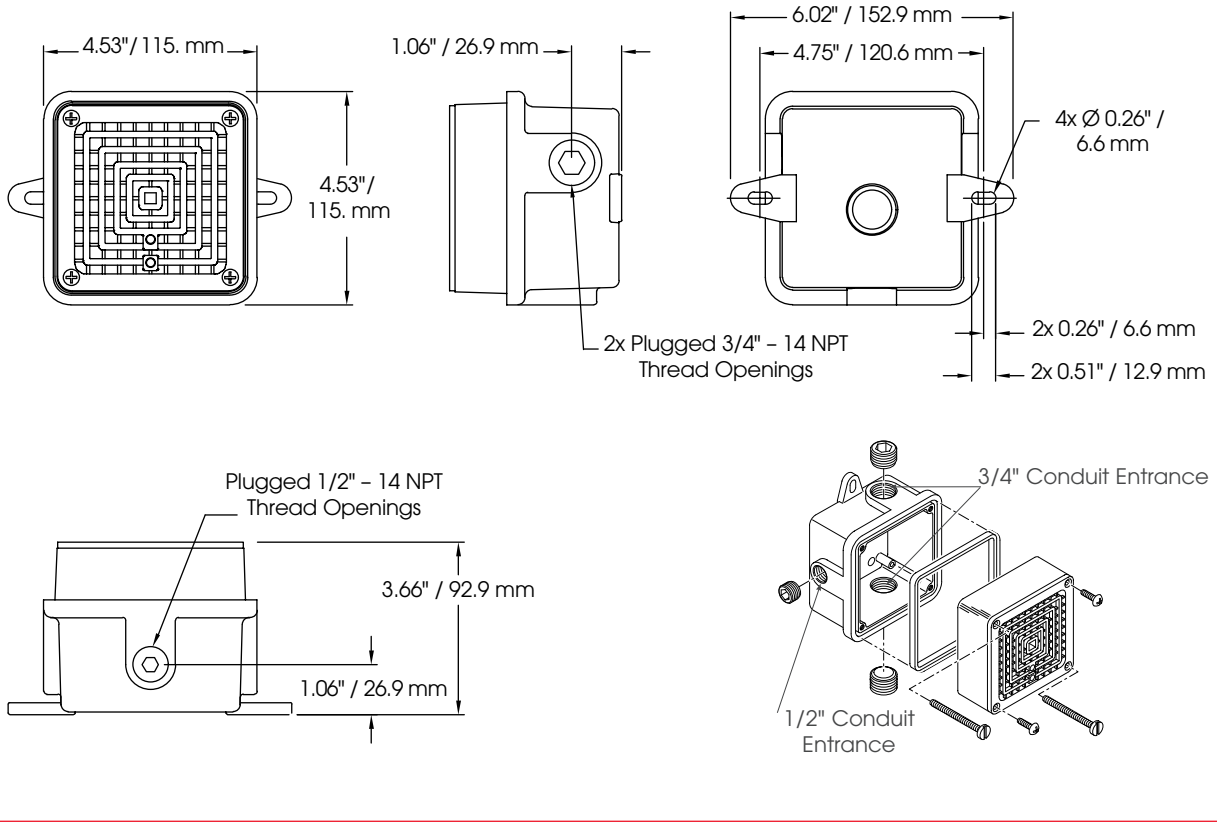
Model 350WB features a die-cast aluminum rear housing sealed with a gray enamel finish. The rugged outer housing resists vandalism without reducing sound output. Model 350WB is fused and utilizes a terminal block connection. The horn and backbox combination is UL and cUL Listed, CSA Certified and FM Approved.

Capable of reproducing coded blasts or sustained tones, Federal Signal's Vibratone horns are excellent for general alarm, start/dismissal, coded paging and process control signaling in areas where their sound output exceeds ambient noise levels. Compact size and various installation options make them ideal for institutional use.

Model	Voltage	Operating Current	Decibels @ 10'	Decibels @ 1m
350WB-120	120VAC 50/60Hz	0.18 amps	100	110
350WB-240	240VAC 50/60Hz	0.09 amps	100	110

5 yr FEDERAL SIGNAL WARRANTY

VIBRATONE® HORN (350WB)



SPECIFICATIONS

Operating Temperature:	-65°F to 150°F	-54°C to 66°C
Net Weight:	2.7 lbs.	1.2 kg
Shipping Weight:	2.8 lbs.	1.2 kg
Height:	5.3"	134.6 mm
Width:	5.3"	134.6 mm
Depth:	3.66"	92.9 mm

REPLACEMENT PARTS

Description	***Part Number***
Coil (120VAC only)	KFC1516C
Volume Control Kit	K8435663B

HOW TO ORDER

- Specify model and voltage
- Please refer to Model Number Index 350WB beginning on page 374

KRÜGER

SECTION 4.3

PANEL DRAWINGS

VEOLIA WATER Solutions & Technologies

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
1	ADDED ANALOG INPUT CARD	MRO		8/27/15

IFAS CONTROL PANEL

DRAWING	TITLE
G-001	DRAWING LIST
P-001	FRONT PANEL LAYOUT
P-002	BACK PANEL LAYOUT
P-003	PLC CHASSIS LAYOUT
P-004-1	POWER DISTRIBUTION
P-004-2	POWER DISTRIBUTION
I-000	CONTROLLOGIX PROCESSOR - CHASSIS 1/SLOT 0
I-001	ETHERNET MODULE - CHASSIS 1/SLOT 1
I-002-1	ANALOG INPUT WIRING - CHASSIS 1/SLOT 2
I-002-2	ANALOG INPUT WIRING - CHASSIS 1/SLOT 2
I-003-1	ANALOG INPUT WIRING - CHASSIS 1/SLOT 3
I-003-2	ANALOG INPUT WIRING - CHASSIS 1/SLOT 3
I-004-1	ANALOG INPUT WIRING - CHASSIS 1/SLOT 4
I-004-2	ANALOG INPUT WIRING - CHASSIS 1/SLOT 4
I-005	ANALOG OUTPUT WIRING - CHASSIS 1/SLOT 5
I-006	SPARE - CHASSIS 1/SLOT 6
I-007	DIGITAL INPUT WIRING - CHASSIS 1/SLOT 7
I-008	DIGITAL INPUT WIRING - CHASSIS 1/SLOT 8
I-009	DIGITAL INPUT WIRING - CHASSIS 1/SLOT 9
I-010	DIGITAL INPUT WIRING - CHASSIS 1/SLOT 10
I-011	DIGITAL INPUT WIRING - CHASSIS 1/SLOT 11
I-012	DIGITAL INPUT WIRING - CHASSIS 1/SLOT 12
I-013	SPARE - CHASSIS 1/SLOT 13
I-014	DIGITAL OUTPUT WIRING - CHASSIS 1/SLOT 14
I-015	DIGITAL OUTPUT WIRING - CHASSIS 1/SLOT 15
I-016	SPARE - CHASSIS 1/SLOT 16
C-001	COMMUNICATIONS LAYOUT

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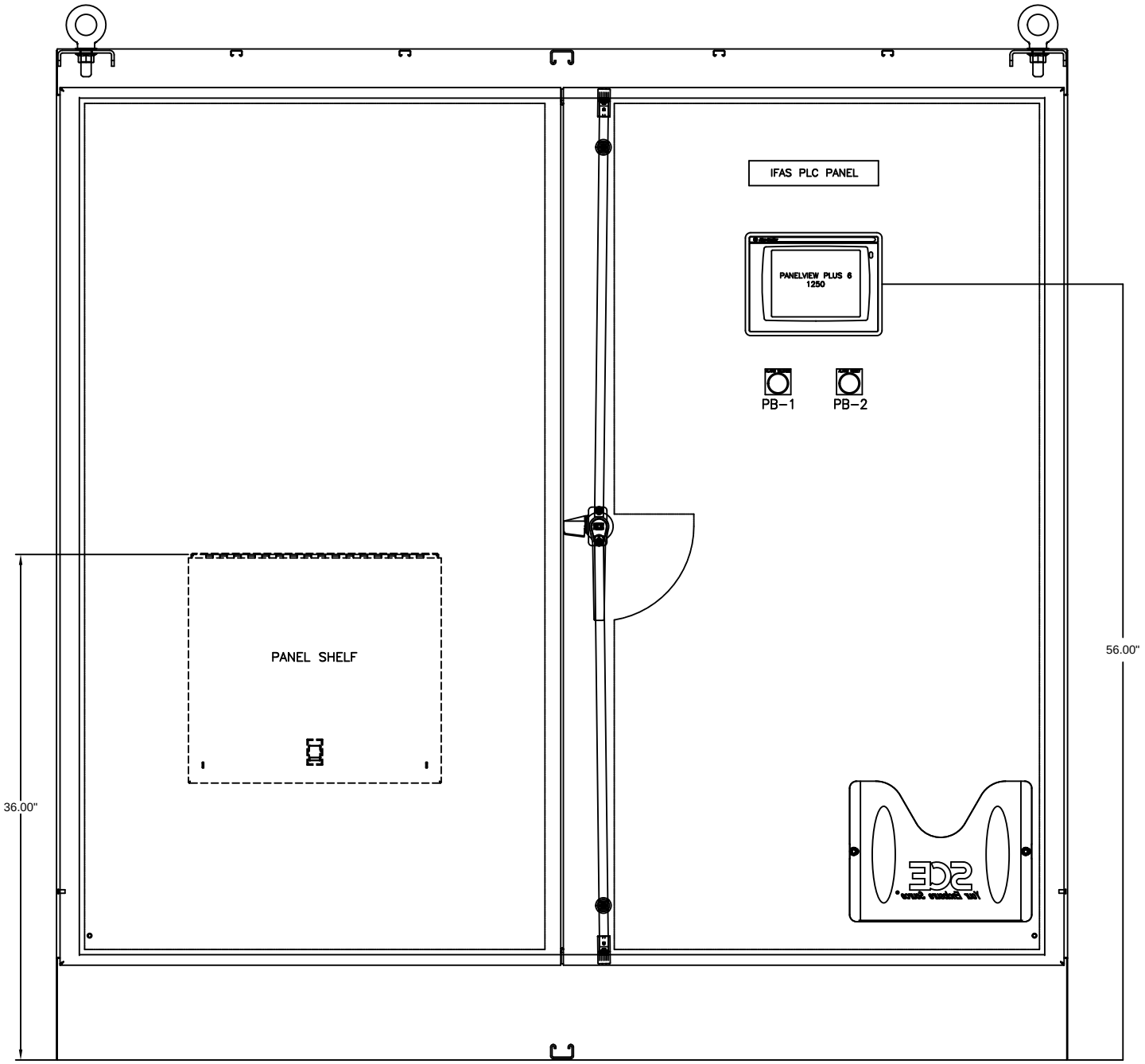
VEOLIA
I. KRUGER, INC.
4001 WESTON PARKWAY
CARY, NC 27513
(919) 677-8310

5700235402
MASSILLON, OH

IFAS
PLC CONTROL PANEL
DRAWING LIST

DRAWN	CHECKED		SCALE	DRAWING NO	SHEET	REV
MRO				G-001	1 of 27	1

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
1	CHANGED HMI TO 12"	MRO		5/18/15



NEMA 12 FREE STANDING ENCLOSURE
72"H x 72"W x 24"D
P/N: SCE–727224FSD

"PB–1" – ALARM SILENCE
"PB–2" – ALARM RESET

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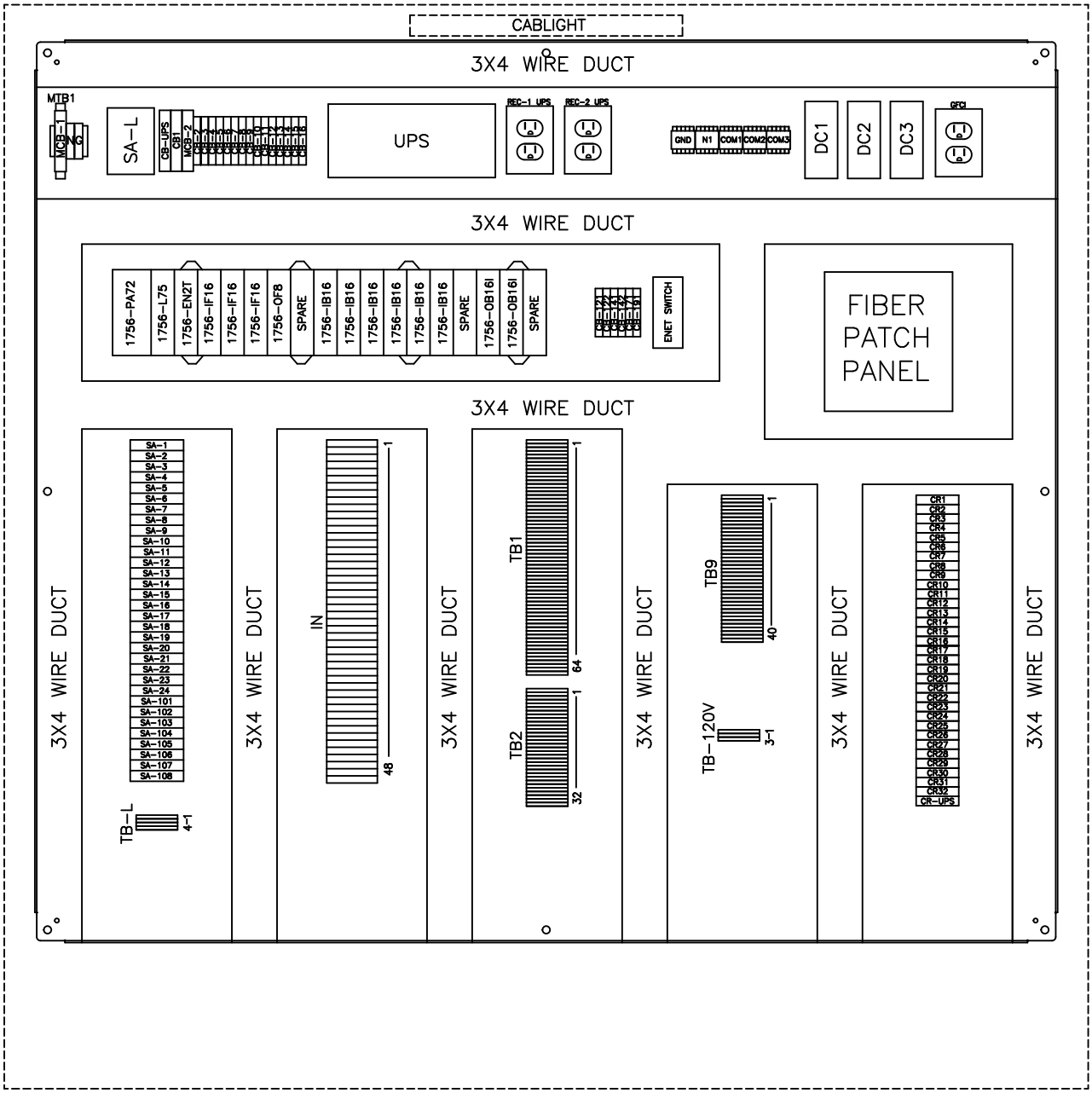
I. KRUGER, INC.
4001 WESTON PARKWAY
CARY, NC 27513
(919) 677-8310

5700235402
MASSILLON, OH

IFAS
PLC CONTROL PANEL
FRONT PANEL LAYOUT

DRAWN	CHECKED		SCALE	DRAWING NO	SHEET	REV
MRO				P-001	2 of 27	1

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
1	BREAKERS 14,15, AND 16 ADDED	NDB	.	5/26/15
2	ADDED ANALOG INPUT CARD	MRO		8/27/15



BACK PANEL
60"H x 68"W
P/N: SCE-72P72F1

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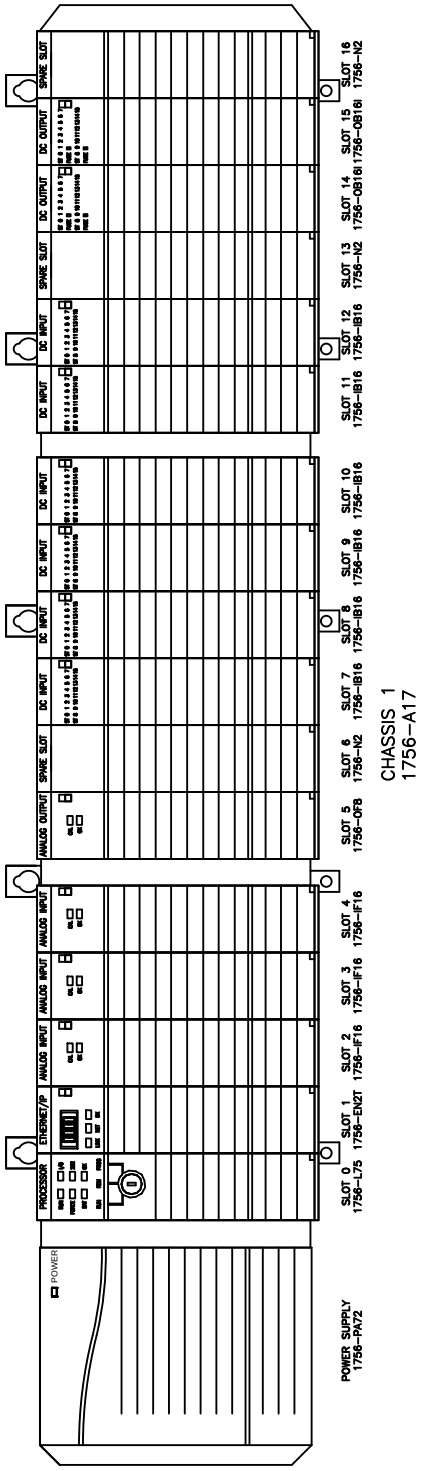
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IFAS
PLC CONTROL PANEL
BACK PANEL LAYOUT

DRAWN	CHECKED		SCALE	DRAWING NO	SHEET	REV
MRO				P-002	3 of 27	2

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
1	ADDED ANALOG INPUT CARD	MRO		8/27/15



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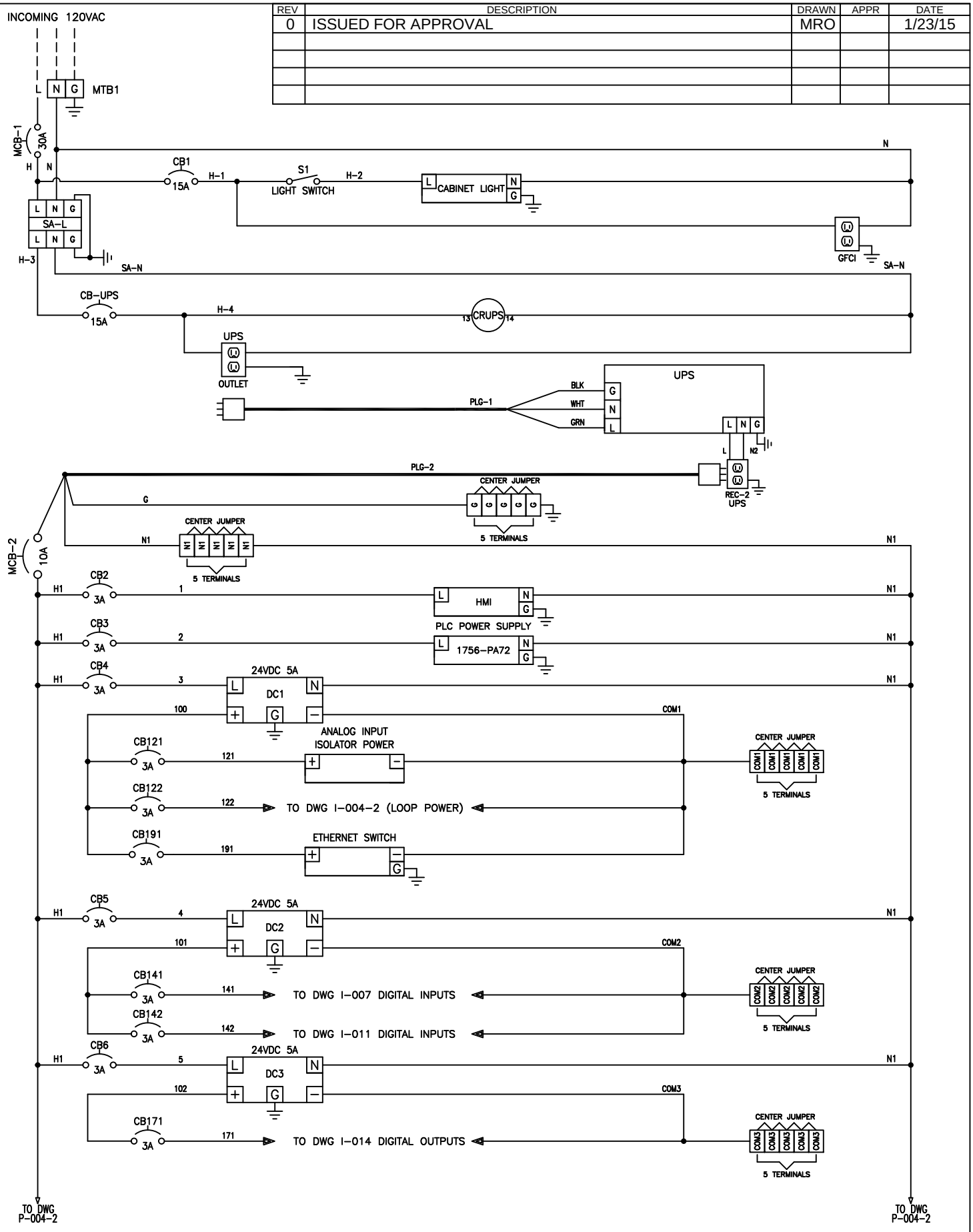
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IFAS
PLC CONTROL PANEL
PLC CHASSIS LAYOUT

DRAWN	CHECKED		SCALE	DRAWING NO	SHEET	REV
MRO				P-003	4 of 27	1

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15



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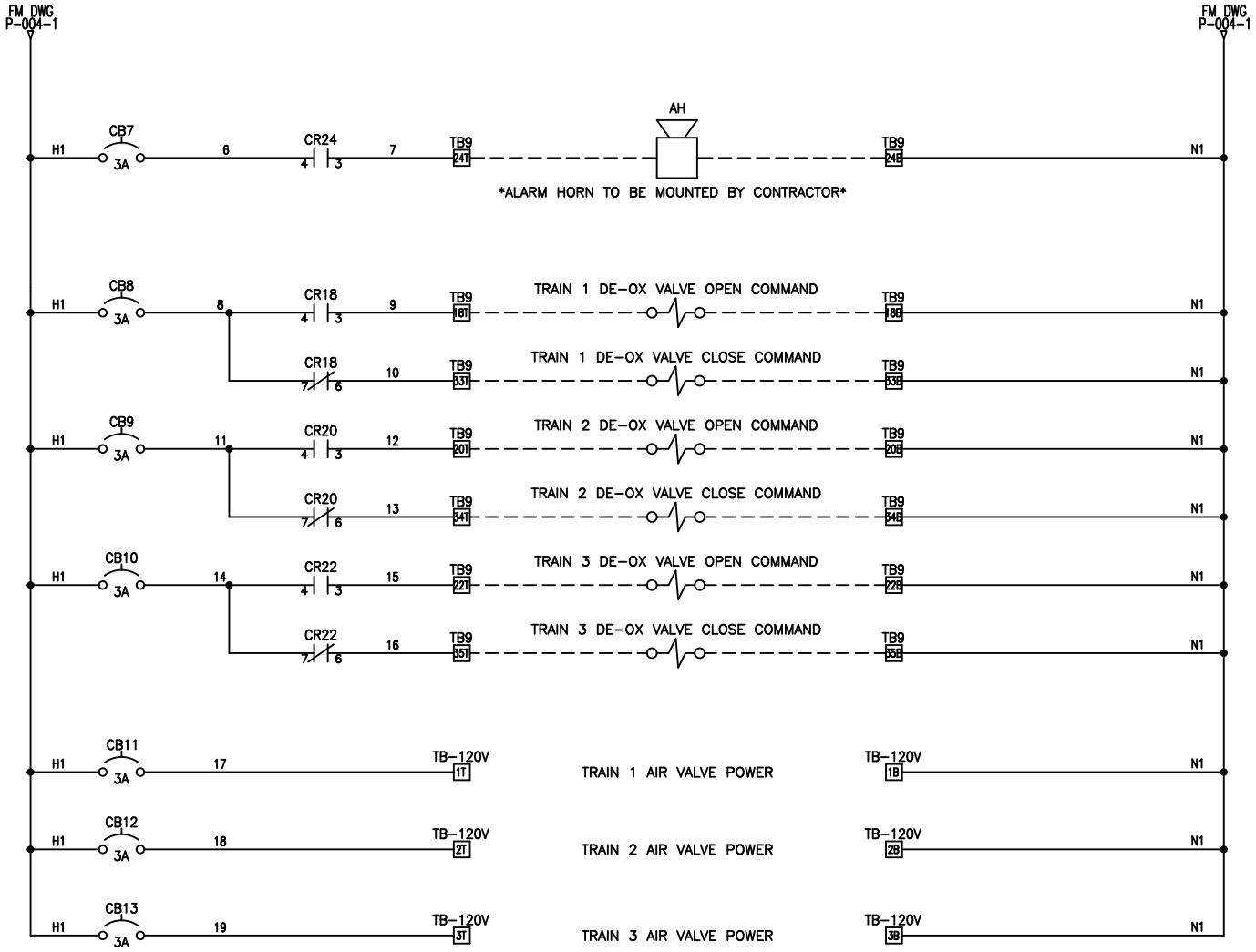
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IFAS
PLC CONTROL PANEL
POWER DISTRIBUTION

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRO			P-004-1	5 of 27	0

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
1	UPDATED VALVE WIRING	MRO		3/9/15
2	POWER ADDED FOR AIR VALVES	NDB		5/26/15



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DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRO			P-004-2	6 of 27	2

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15

CONTROLLOGIX PROCESSOR – CHASSIS 1/SLOT 0

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IFAS
PLC CONTROL PANEL
CONTROLLOGIX PROCESSOR - CHASSIS 1/SLOT 0

DRAWN	CHECKED		SCALE	DRAWING NO	SHEET	REV
MRO				I-000	7 of 27	0

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15

ETHERNET MODULE – CHASSIS 1/SLOT 1

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PLC CONTROL PANEL
ETHERNET MODULE - CHASSIS 1/SLOT 1

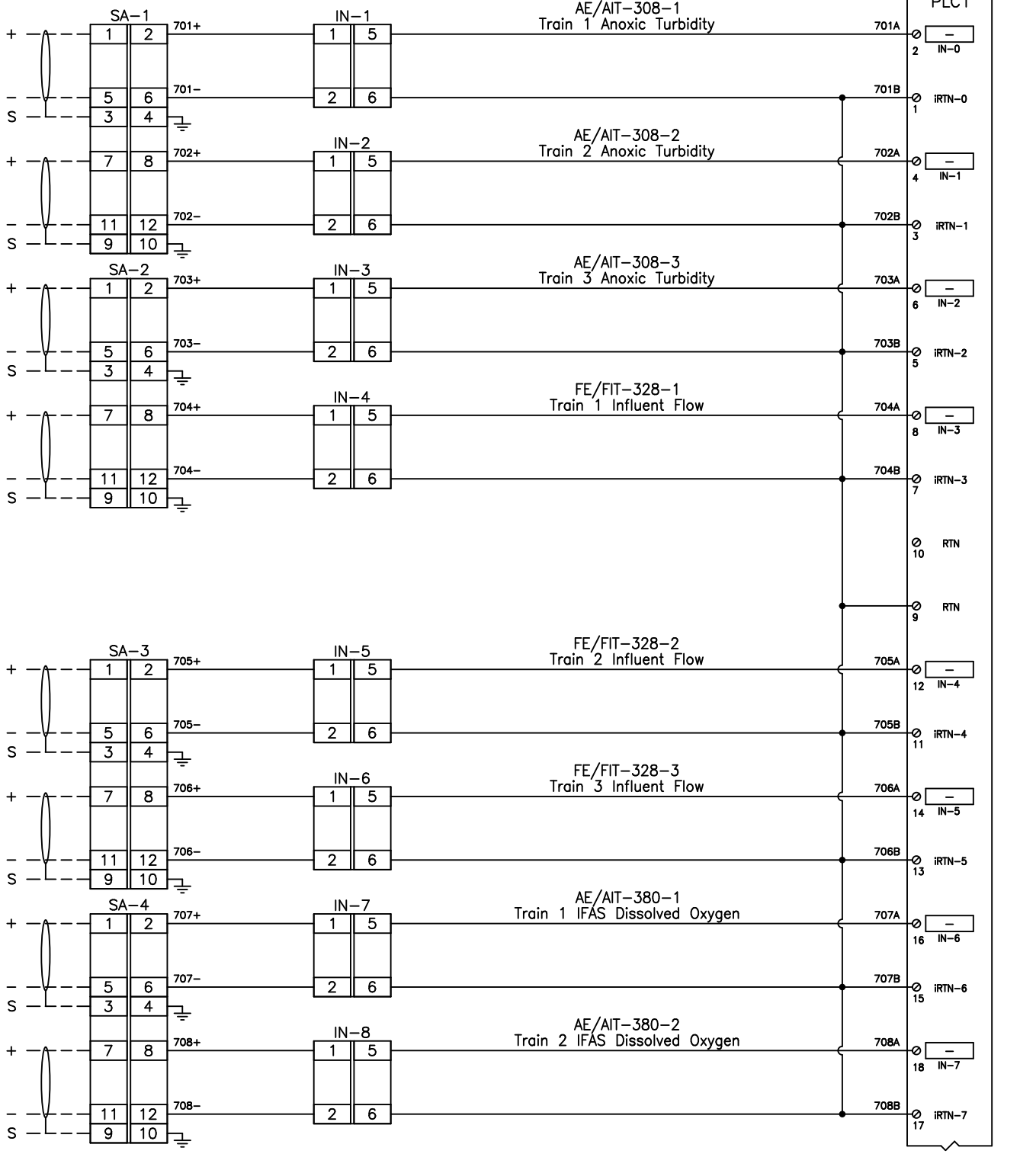
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MRO				I-001	8 of 27	0

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
1	UPDATED PER COMMENTS	MRO		8/27/15

FIELD WIRING BY OTHERS

ISOLATORS POWERED FROM DIN RAIL BUS CONNECTOR

AB 1756-IF16 CHASSIS 1 SLOT 2 16-CH ANA CUR/VOLT IN PLC1



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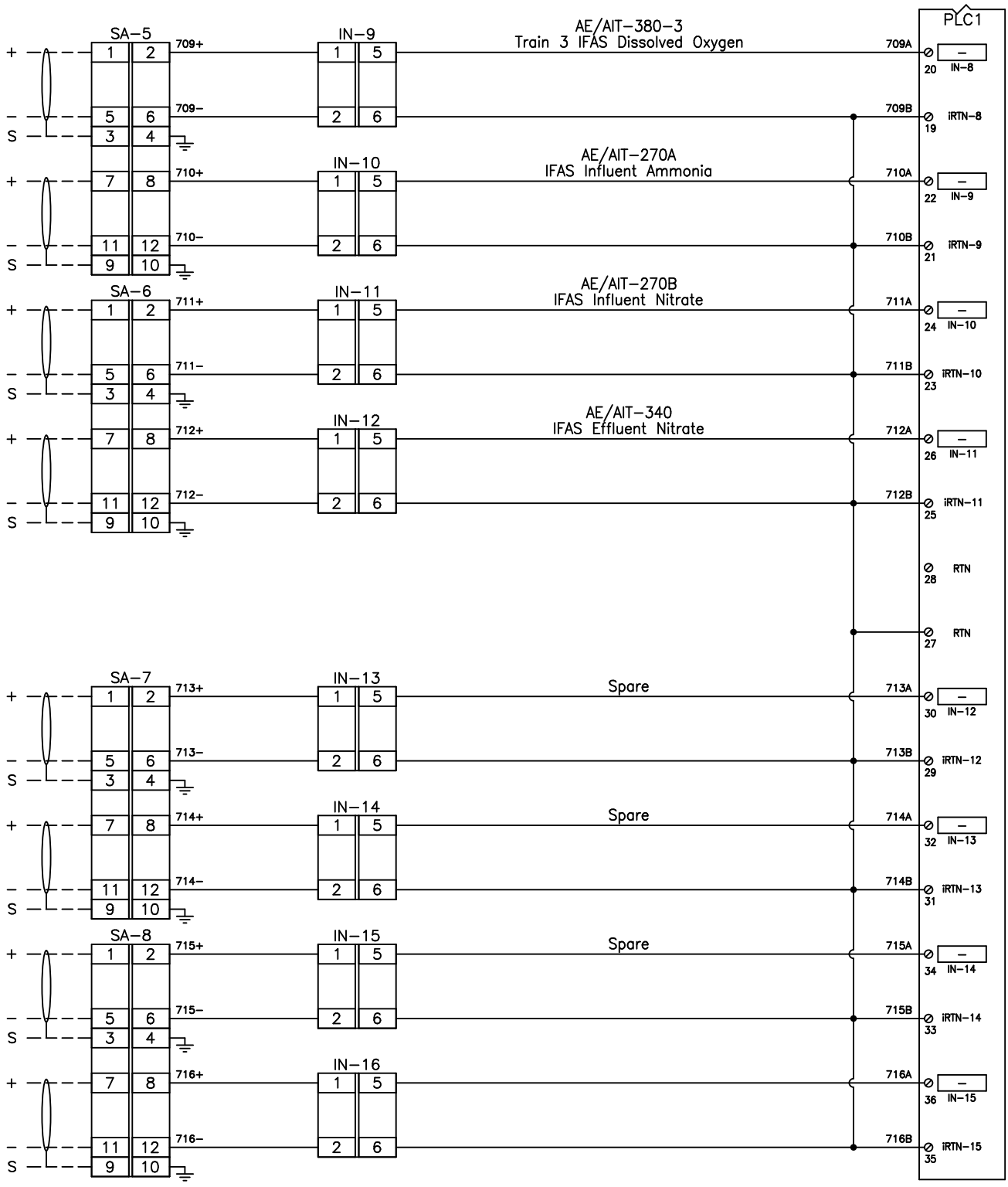
IFAS
PLC CONTROL PANEL
ANALOG INPUT WIRING - CHASSIS 1/SLOT 2

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRO			I-002-1	9 of 27	1

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
1	ADDED EFFLUENT NITRATE PER COMMENTS	MRO		3/13/15
2	ADDED ANOXIC TURBIDITY PER COMMENTS	MRO		5/15/15
3	UPDATED PER COMMENTS	MRO		8/27/15

FIELD WIRING BY OTHERS

ISOLATORS POWERED FROM DIN RAIL BUS CONNECTOR



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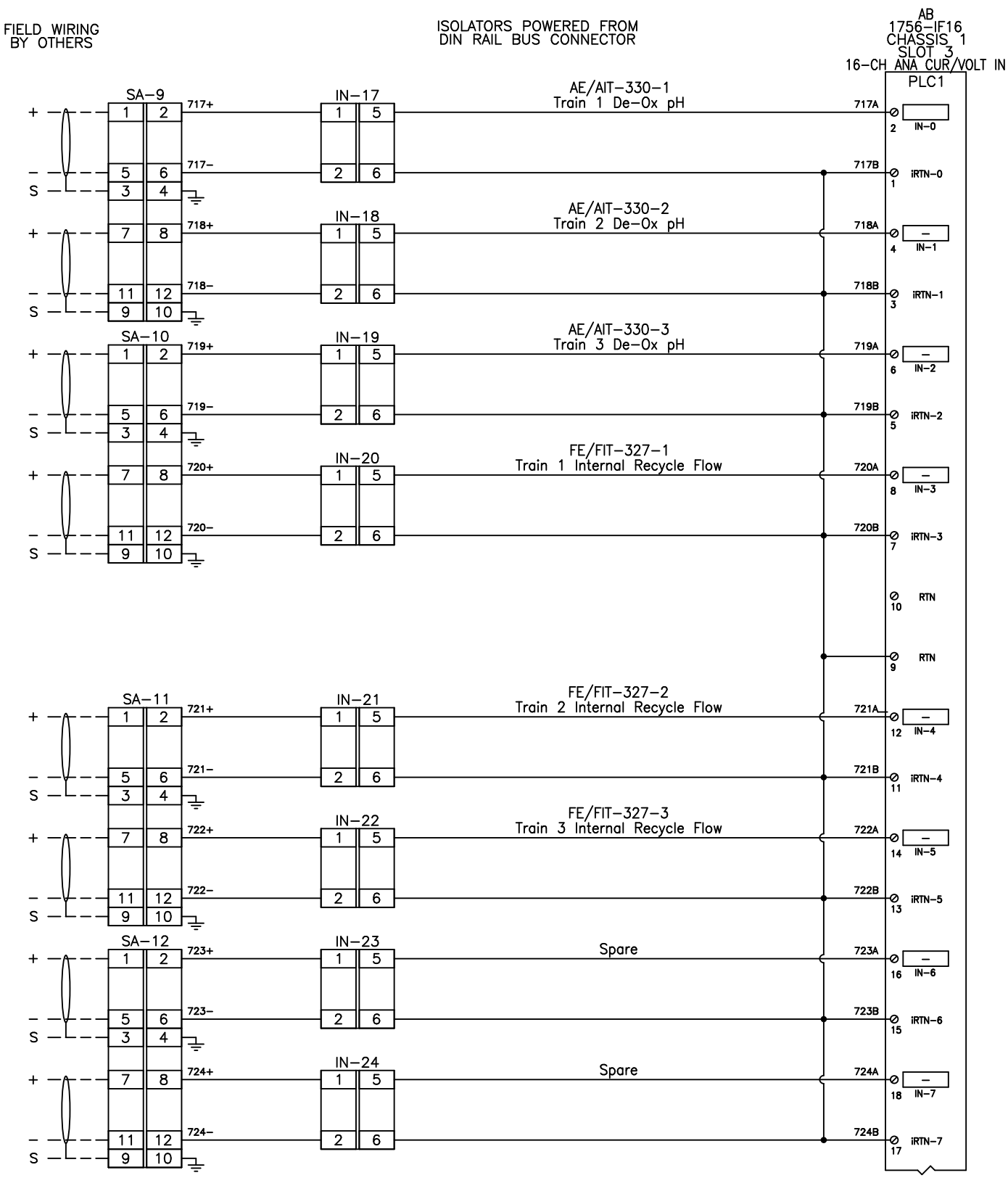
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MASSILLON, OH

IFAS
PLC CONTROL PANEL
ANALOG INPUT WIRING - CHASSIS 1/SLOT 2

DRAWN	CHECKED		SCALE	DRAWING NO	SHEET	REV
MRO				I-002-2	10 of 27	3

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
1	UPDATED PER COMMENTS	MRO		8/27/15



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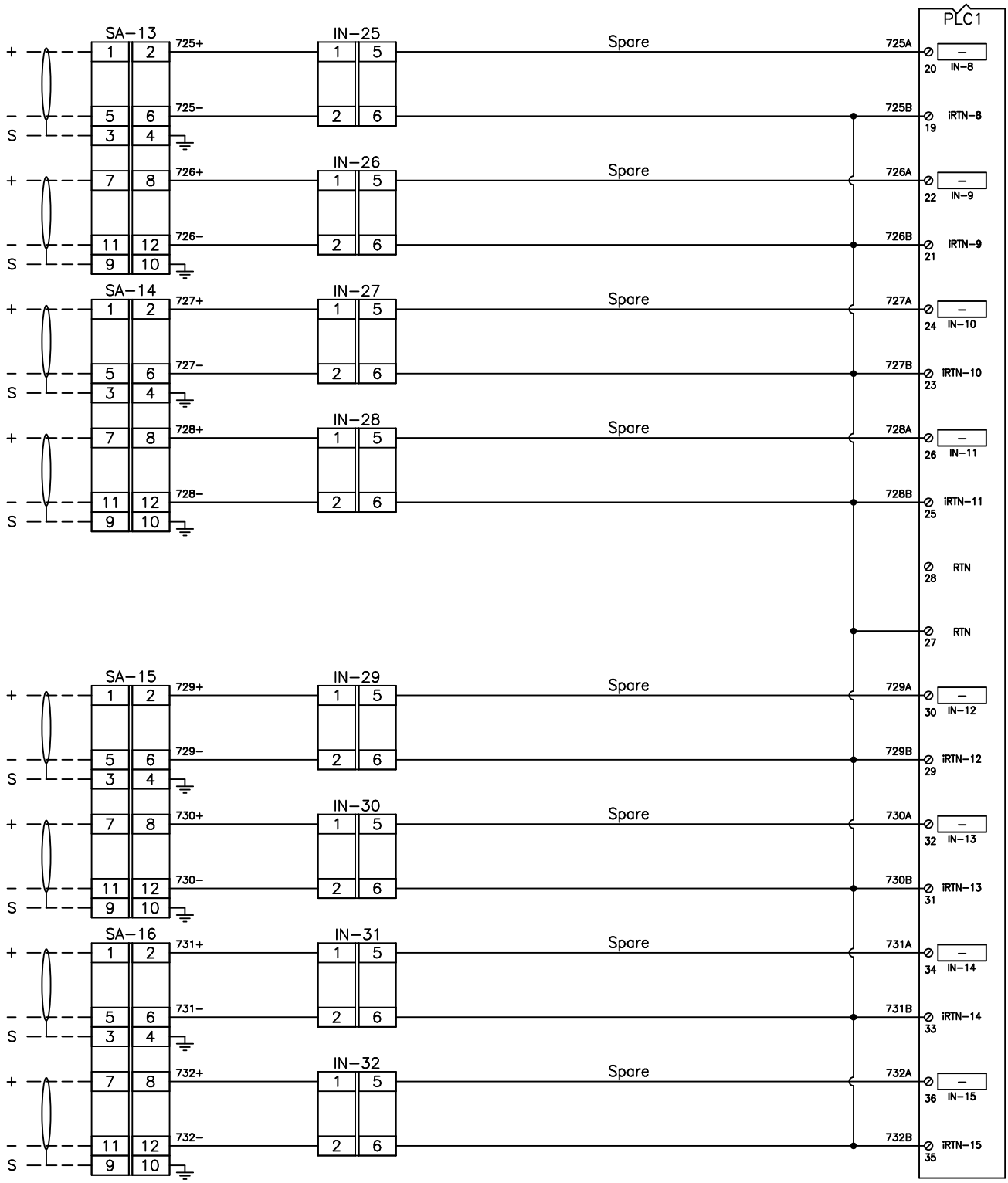
IFAS
PLC CONTROL PANEL
ANALOG INPUT WIRING - CHASSIS 1/SLOT 3

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRO			I-003-1	11 of 27	1

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
1	UPDATED PER COMMENTS	MRO		8/27/15

FIELD WIRING
BY OTHERS

ISOLATORS POWERED FROM
DIN RAIL BUS CONNECTOR



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PLC CONTROL PANEL
ANALOG INPUT WIRING - CHASSIS 1/SLOT 3

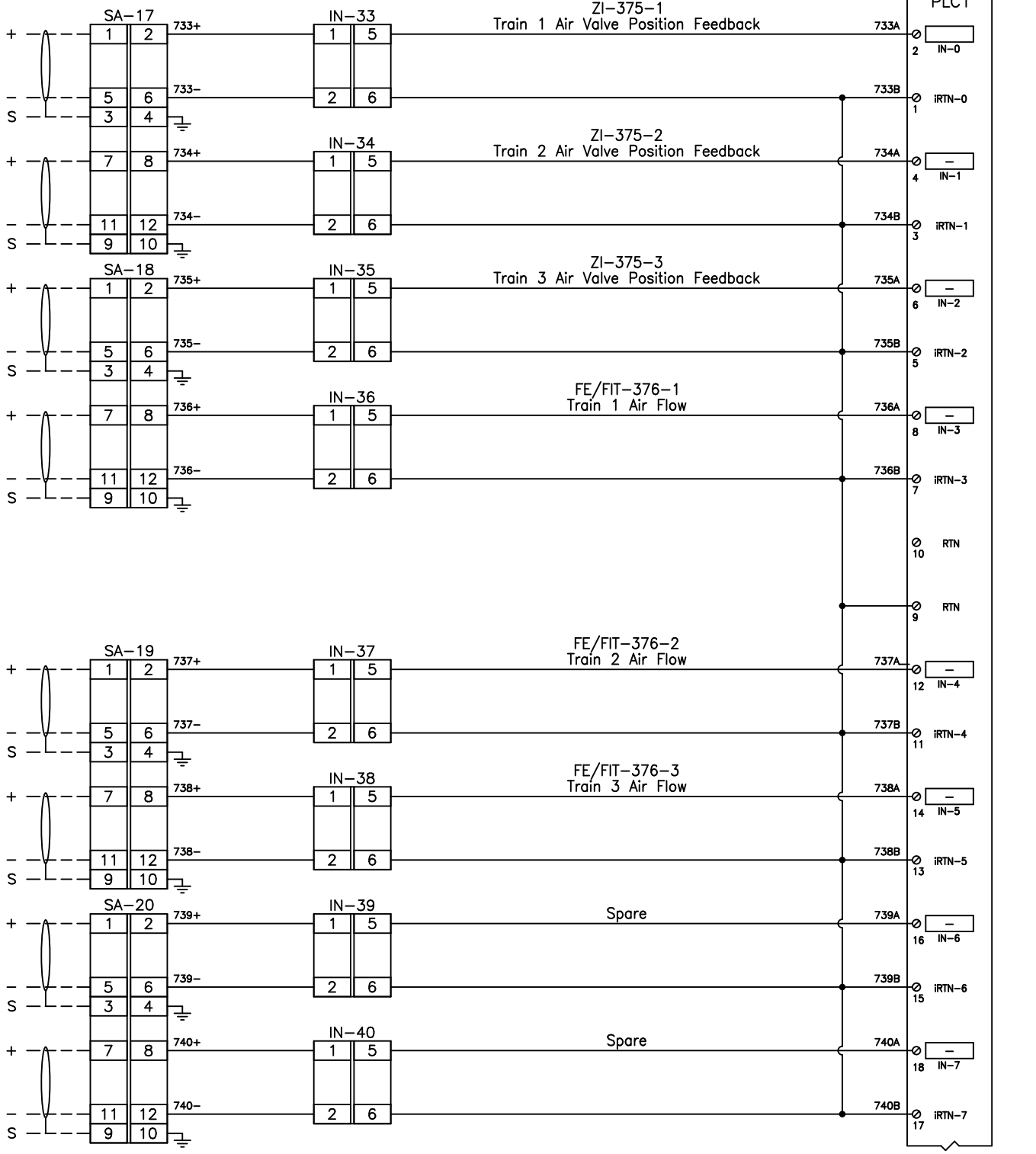
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MRO			I-003-2	12 of 27	1

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
1	UPDATED PER COMMENTS	MRO		8/27/15

FIELD WIRING BY OTHERS

ISOLATORS POWERED FROM DIN RAIL BUS CONNECTOR

AB 1756-IF16 CHASSIS X SLOT X 16-CH ANA CUR/VOLT IN PLC1



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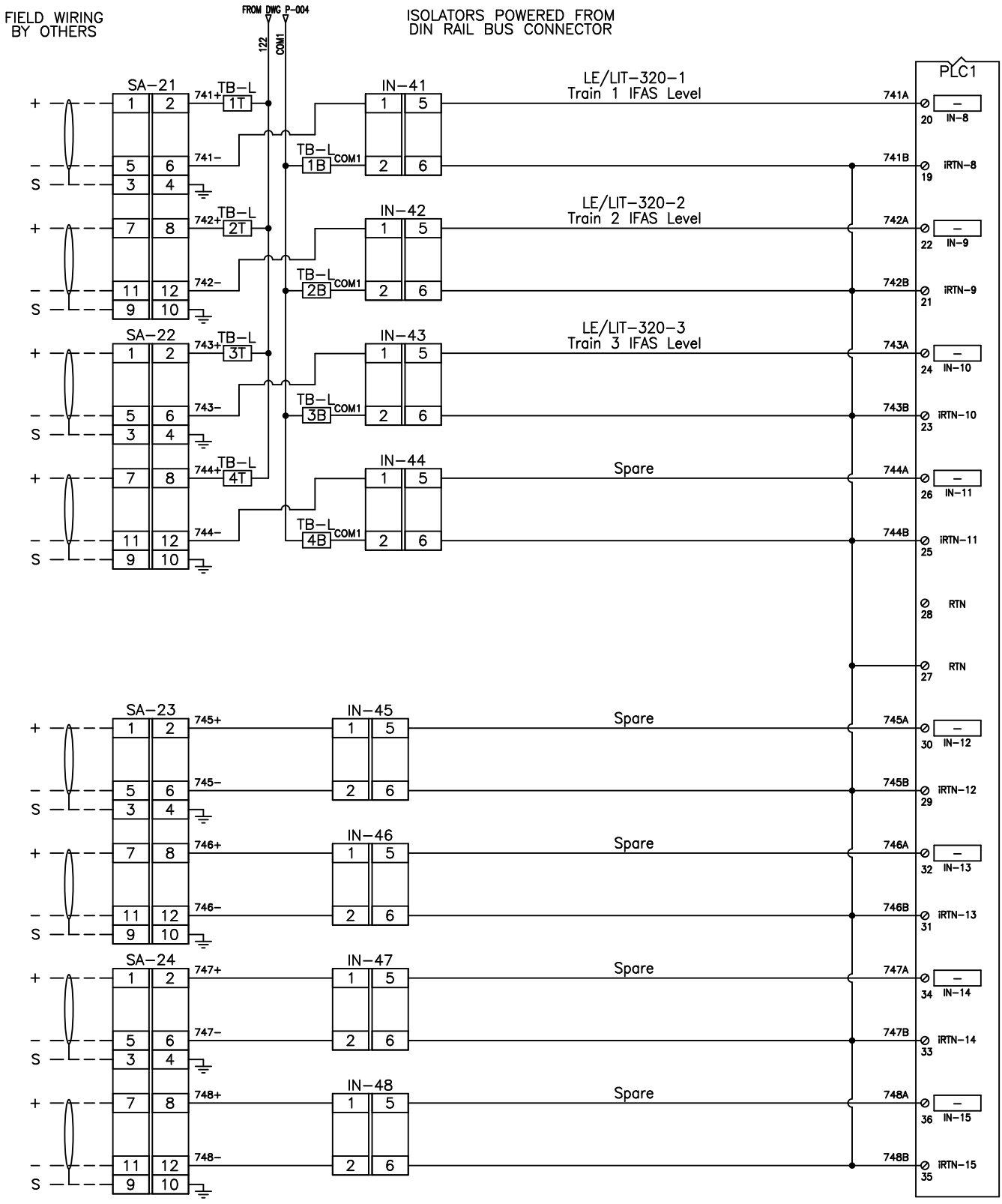
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IFAS
PLC CONTROL PANEL
ANALOG INPUT WIRING - CHASSIS 1/SLOT 4

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRO			I-004-1	13 of 27	1

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
1	UPDATED PER COMMENTS	MRO		8/27/15



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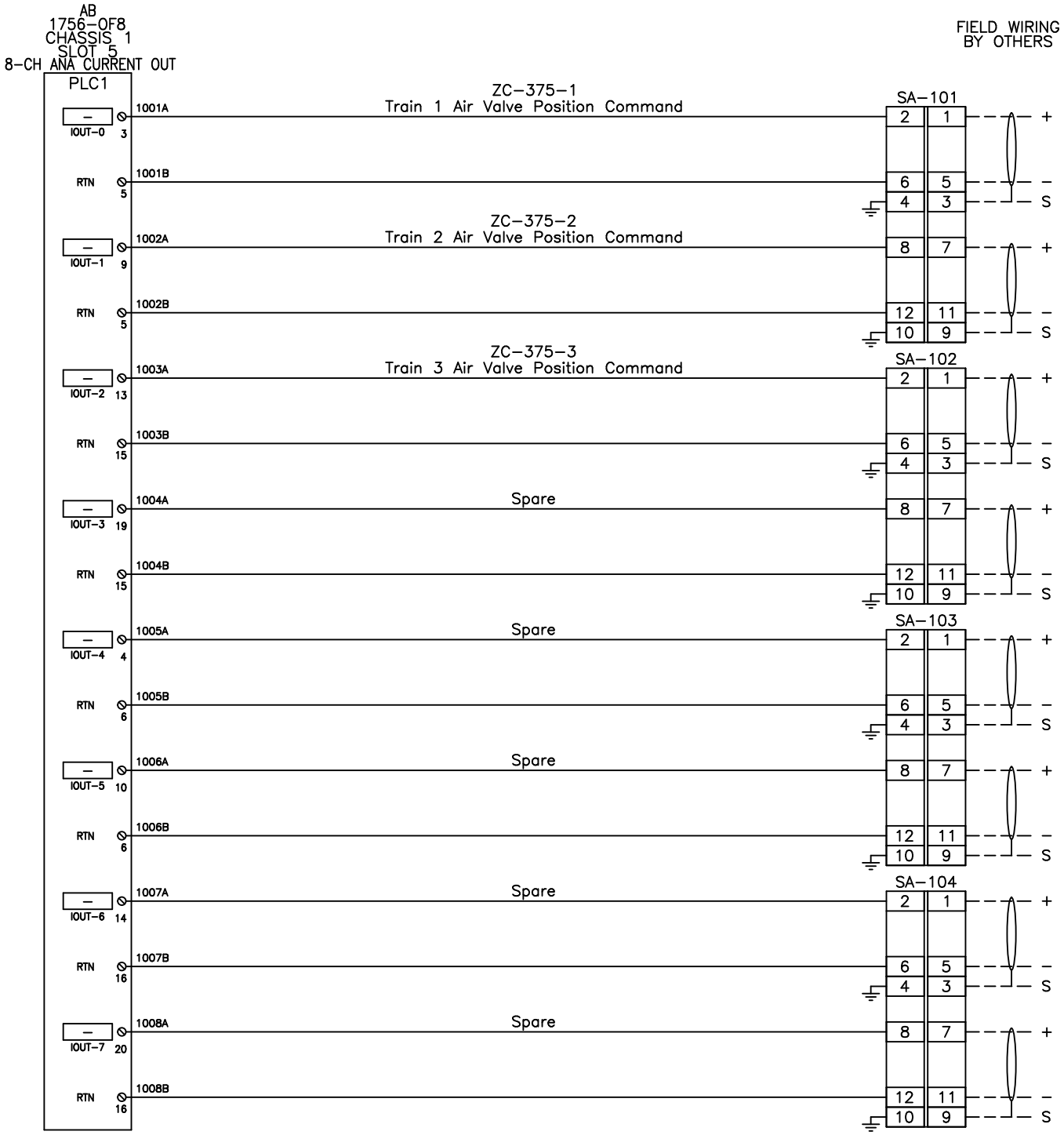
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ANALOG INPUT WIRING - CHASSIS 1/SLOT 4

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRO			I-004-2	14 of 27	1

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
1	UPDATED PER COMMENTS	MRO		8/27/15



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IFAS
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ANALOG OUTPUT WIRING - CHASSIS 1/SLOT 5

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRO			I-005	15 of 27	1

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15

SPARE – CHASSIS 1/SLOT 6

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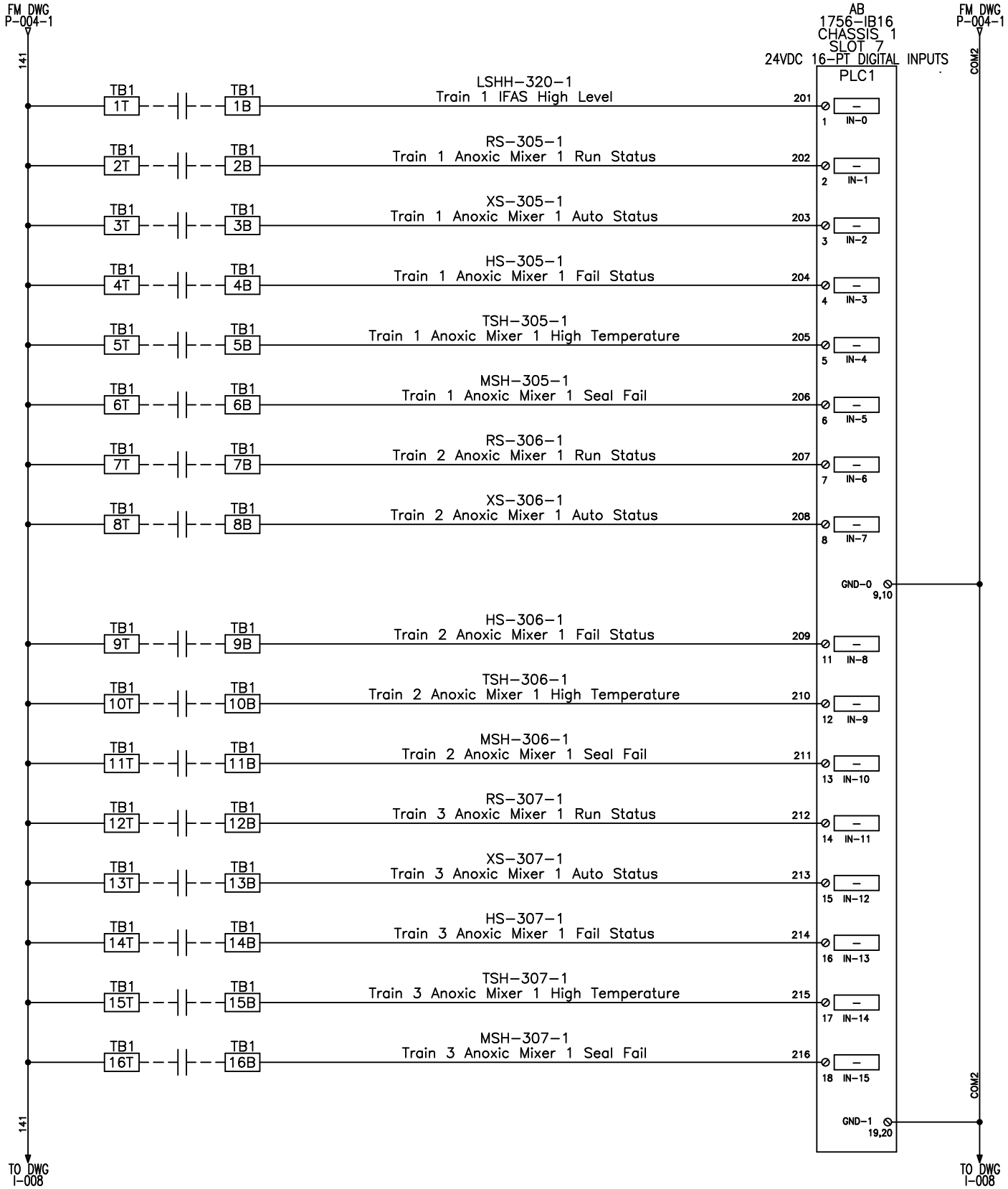
VEOLIA
I. KRUGER, INC.
4001 WESTON PARKWAY
CARY, NC 27513
(919) 677-8310

5700235402
MASSILLON, OH

IFAS
PLC CONTROL PANEL
SPARE - CHASSIS 1/SLOT 6

DRAWN	CHECKED		SCALE	DRAWING NO	SHEET	REV
MRO				I-006	16 of 27	0

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
1	REARRANGED I/O PER COMMENTS	MRO		5/19/15
2	UPDATED PER COMMENTS	MRO		8/27/15



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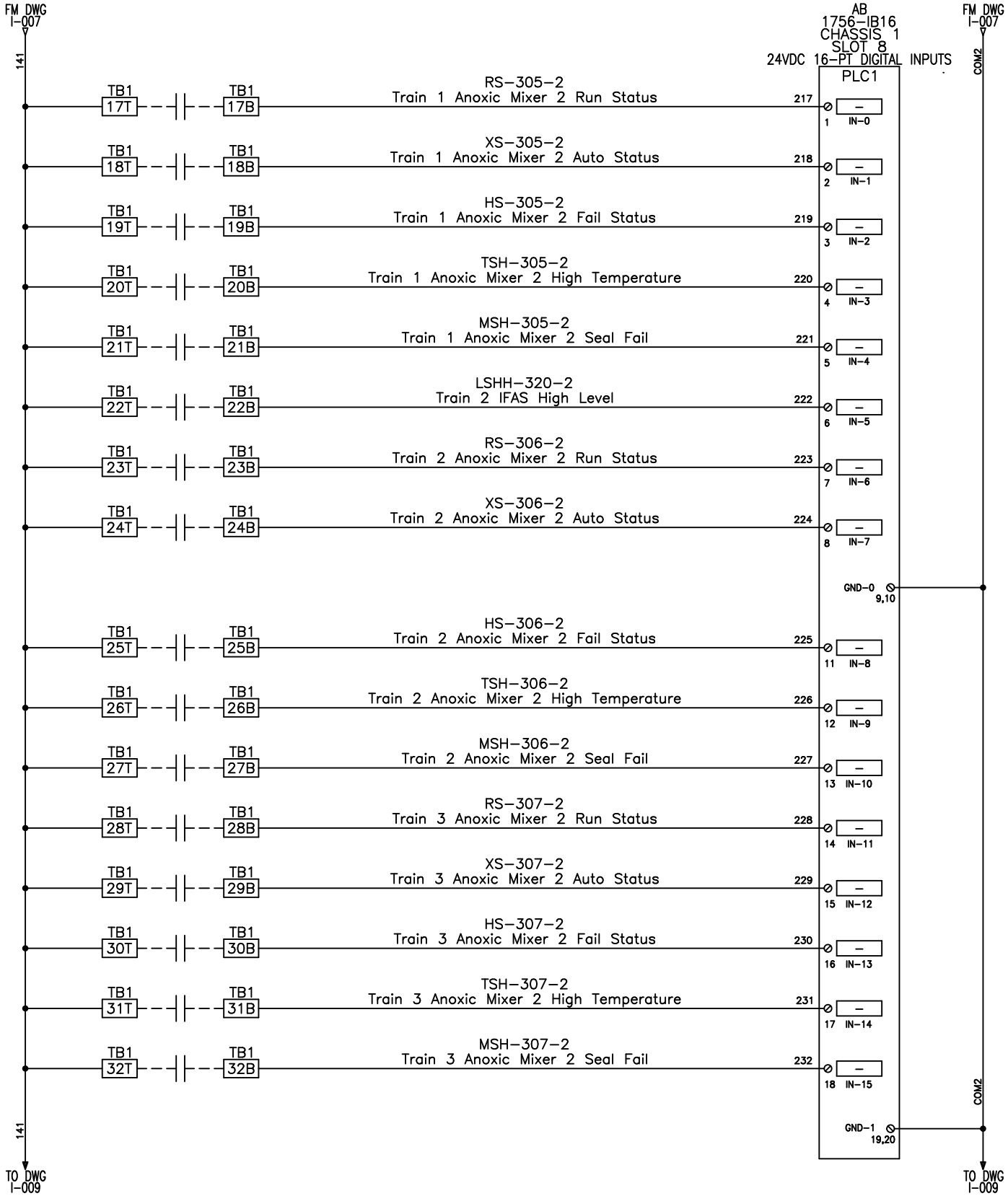
I. KRUGER, INC.
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5700235402
MASSILLON, OH

IFAS
PLC CONTROL PANEL
DIGITAL INPUT WIRING - CHASSIS 1/SLOT 7

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRO			I-007	17 of 27	2

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
1	REMOVED AIR VALVE AUTO STATUS	MRO		3/12/15
2	REARRANGED I/O PER COMMENTS	MRO		5/19/15
3	UPDATED PER COMMENTS	MRO		8/27/15



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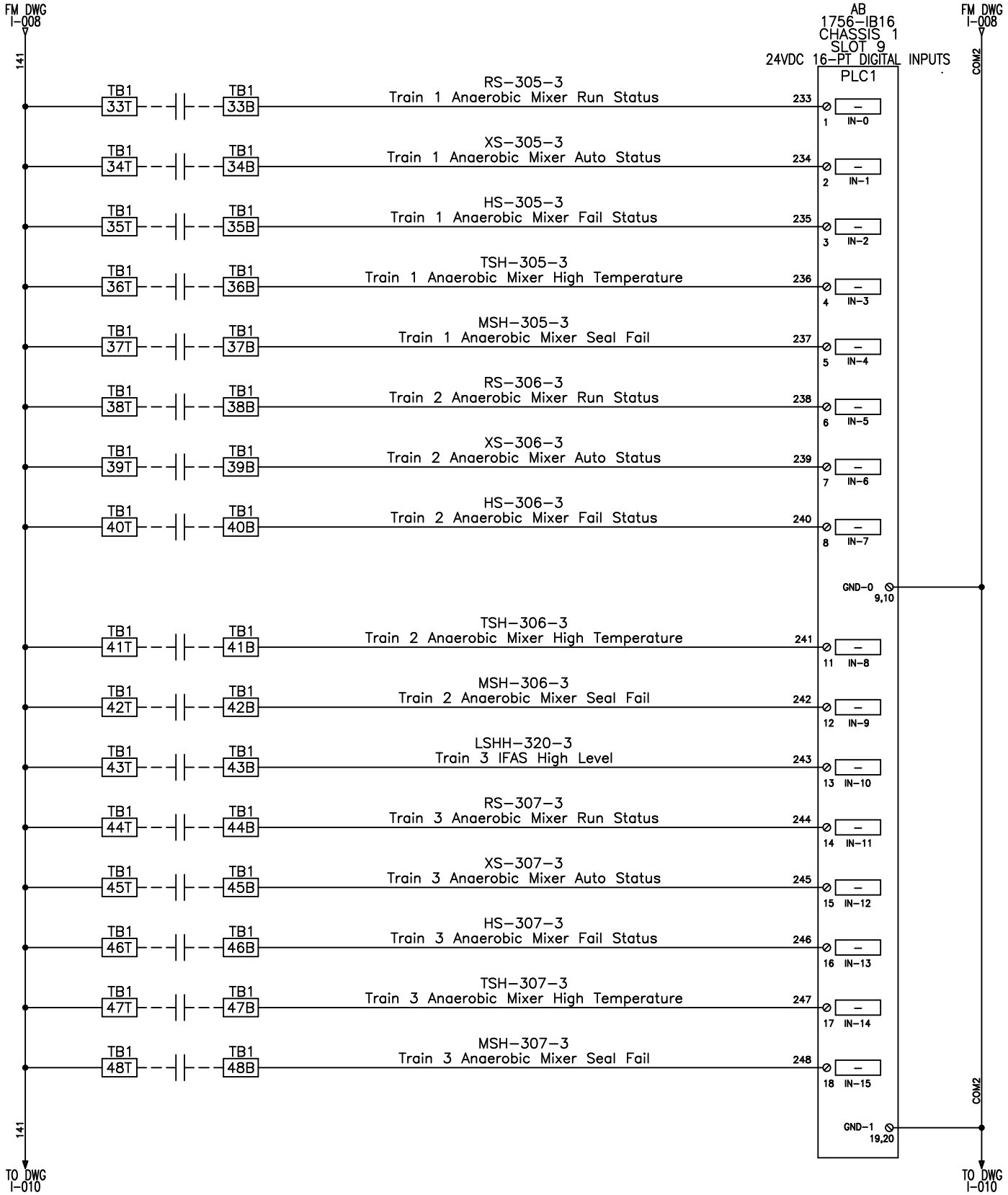
I. KRUGER, INC.
4001 WESTON PARKWAY
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MASSILLON, OH

IFAS
PLC CONTROL PANEL
DIGITAL INPUT WIRING - CHASSIS 1/SLOT 8

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRO			I-008	18 of 27	3

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
1	REMOVED AIR VALVE AUTO STATUS	MRO		3/12/15
2	REARRANGED I/O PER COMMENTS	MRO		5/19/15
3	UPDATED PER COMMENTS	MRO		8/27/15



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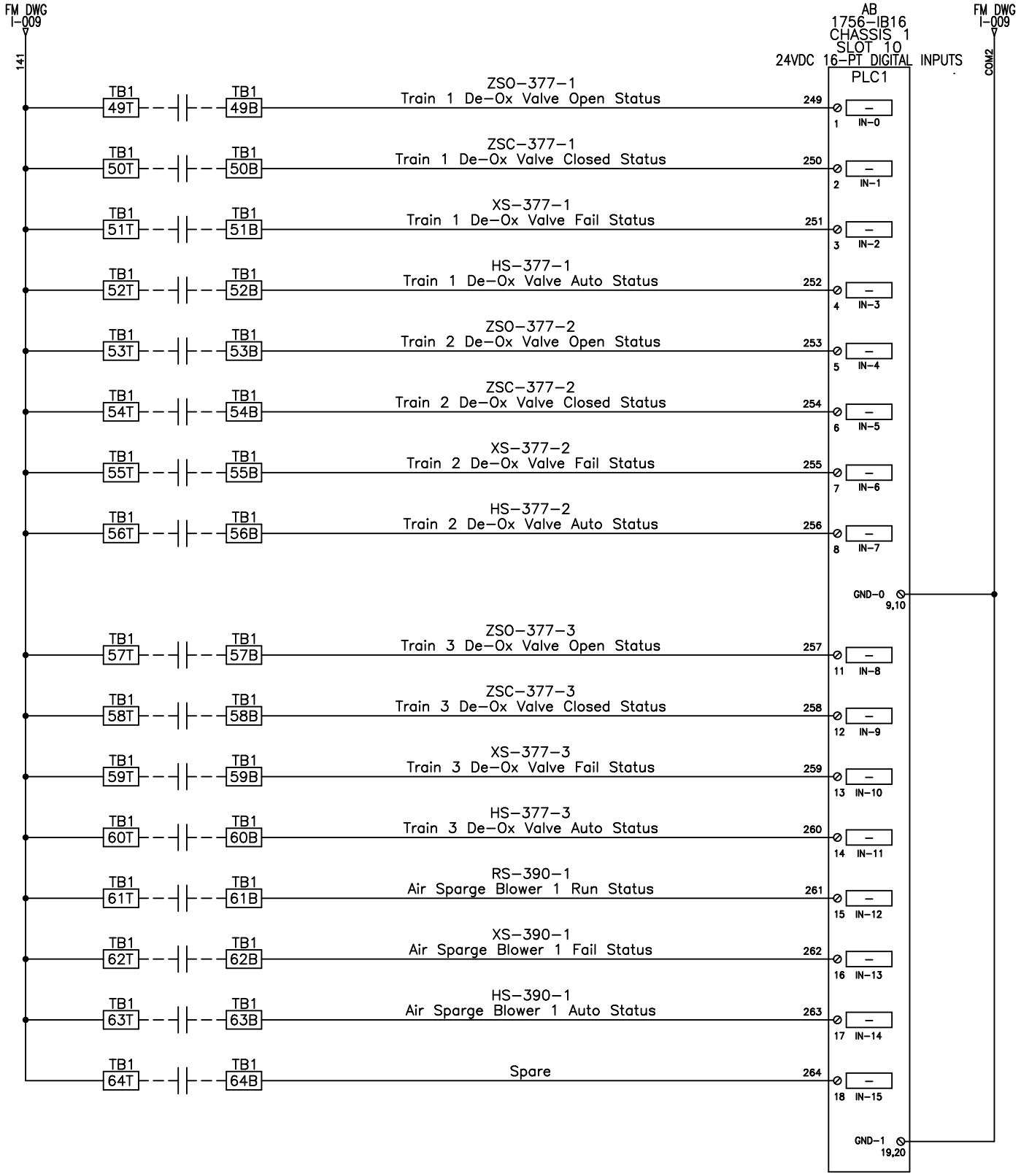
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CARY, NC 27513
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MASSILLON, OH

IFAS
PLC CONTROL PANEL
DIGITAL INPUT WIRING - CHASSIS 1/SLOT 9

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRO			I-009	19 of 27	3

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
1	REMOVED AIR VALVE AUTO STATUS	MRO		3/12/15
2	REARRANGED I/O PER COMMENTS	MRO		5/19/15
3	UPDATED PER COMMENTS	MRO		8/27/15



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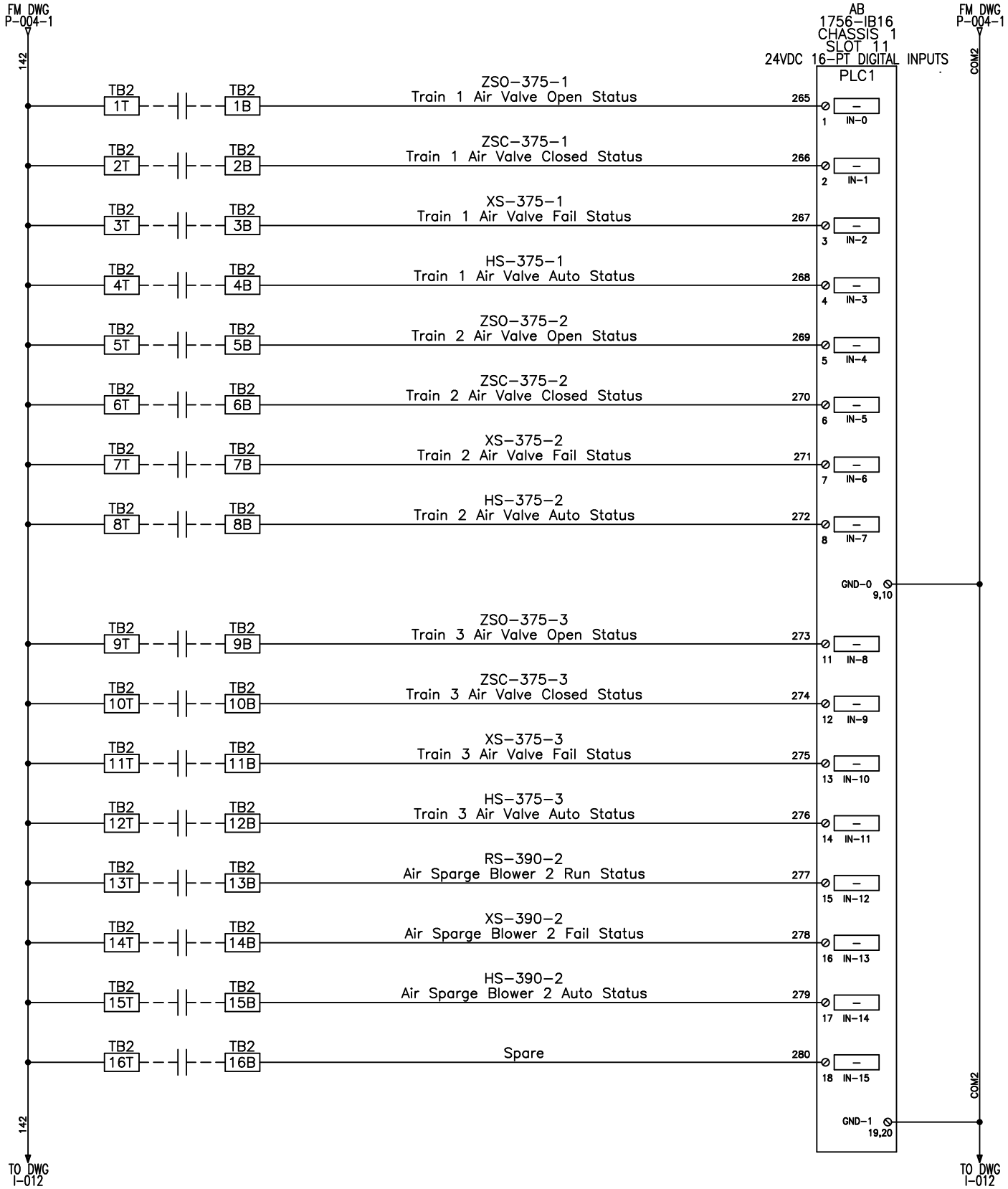
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IFAS
PLC CONTROL PANEL
DIGITAL INPUT WIRING - CHASSIS 1/SLOT 10

DRAWN	CHECKED		SCALE	DRAWING NO	SHEET	REV
MRO				I-010	20 of 27	3

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
1	ADDED VALVE OPEN/CLOSED STATUSES, EFFLUENT NITRATE	MRO		3/9/15
2	REARRANGED I/O PER COMMENTS	MRO		5/19/15
3	UPDATED PER COMMENTS	MRO		8/27/15



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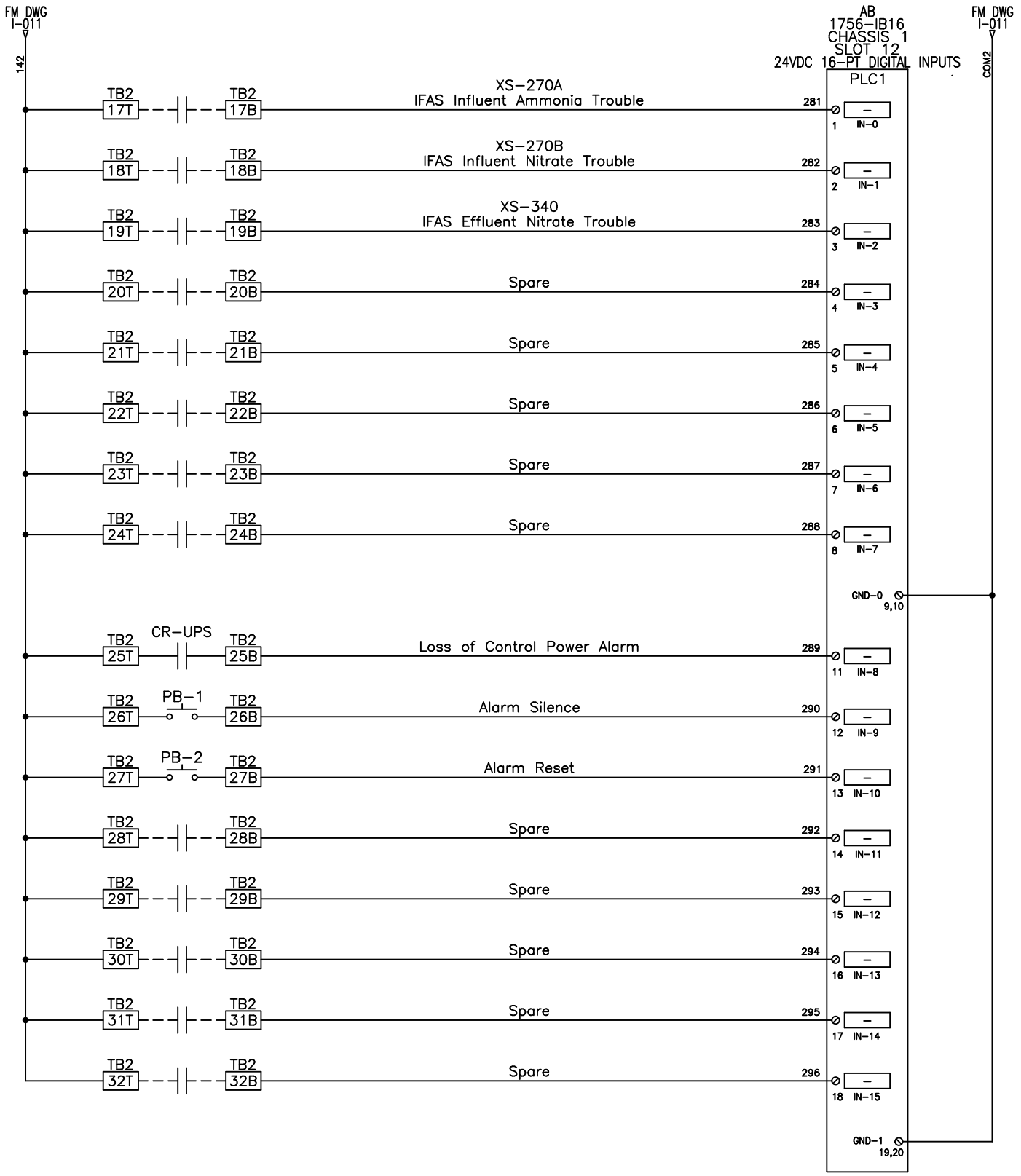
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5700235402
MASSILLON, OH

IFAS
PLC CONTROL PANEL
DIGITAL INPUT WIRING - CHASSIS 1/SLOT 11

DRAWN	CHECKED		SCALE	DRAWING NO	SHEET	REV
MRO				I-011	21 of 27	3

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
1	REARRANGED I/O PER COMMENTS	MRO		5/19/15
2	UPDATED PER COMMENTS	MRO		8/27/15



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MASSILLON, OH

IFAS
PLC CONTROL PANEL
DIGITAL INPUT WIRING - CHASSIS 1/SLOT 12

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRO			I-012	22 of 27	2

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15

SPARE – CHASSIS 1/SLOT 13

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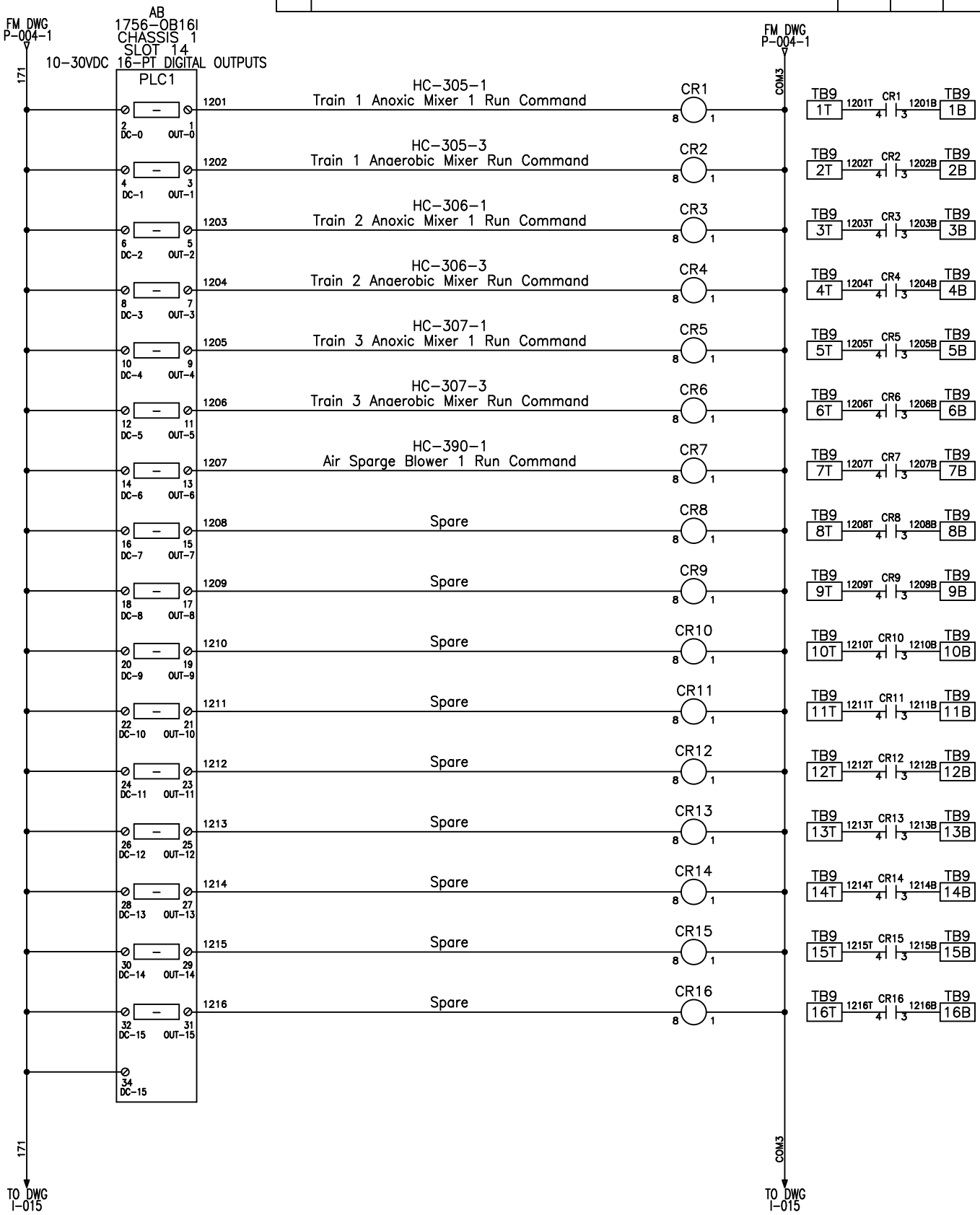
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MASSILLON, OH

IFAS
PLC CONTROL PANEL
SPARE - CHASSIS 1/SLOT 13

DRAWN	CHECKED		SCALE	DRAWING NO	SHEET	REV
MRO				I-013	23 of 27	0

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
1	UPDATED PER COMMENTS	MRO		8/27/15



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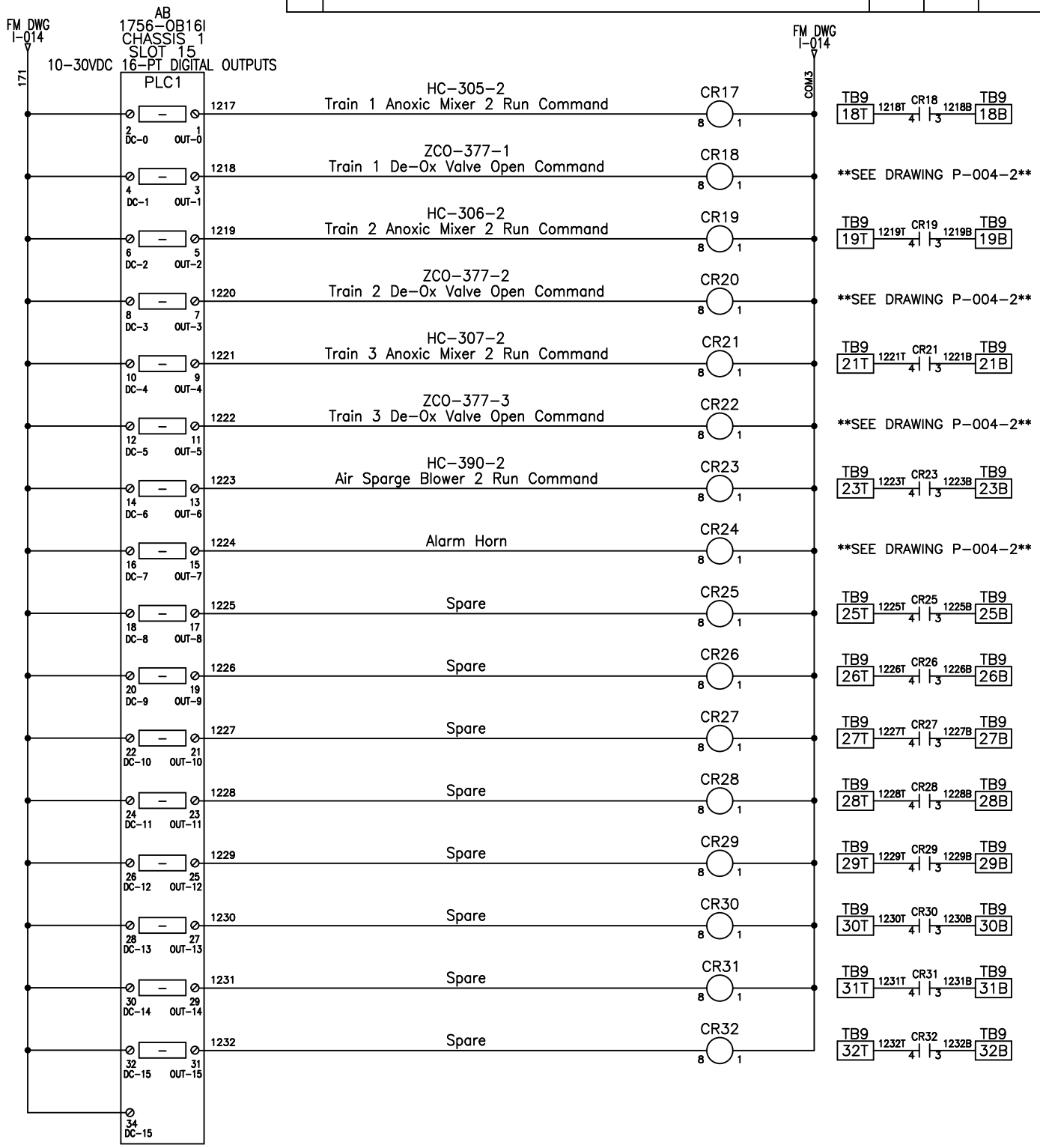
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IFAS
PLC CONTROL PANEL
DIGITAL OUTPUT WIRING - CHASSIS 1/SLOT 14

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRO			I-014	24 of 27	1

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
1	UPDATED PER COMMENTS	MRO		8/27/15



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IFAS
PLC CONTROL PANEL
DIGITAL OUTPUT WIRING - CHASSIS 1/SLOT 15

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRO			I-015	25 of 27	1

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15

SPARE – CHASSIS 1/SLOT 16

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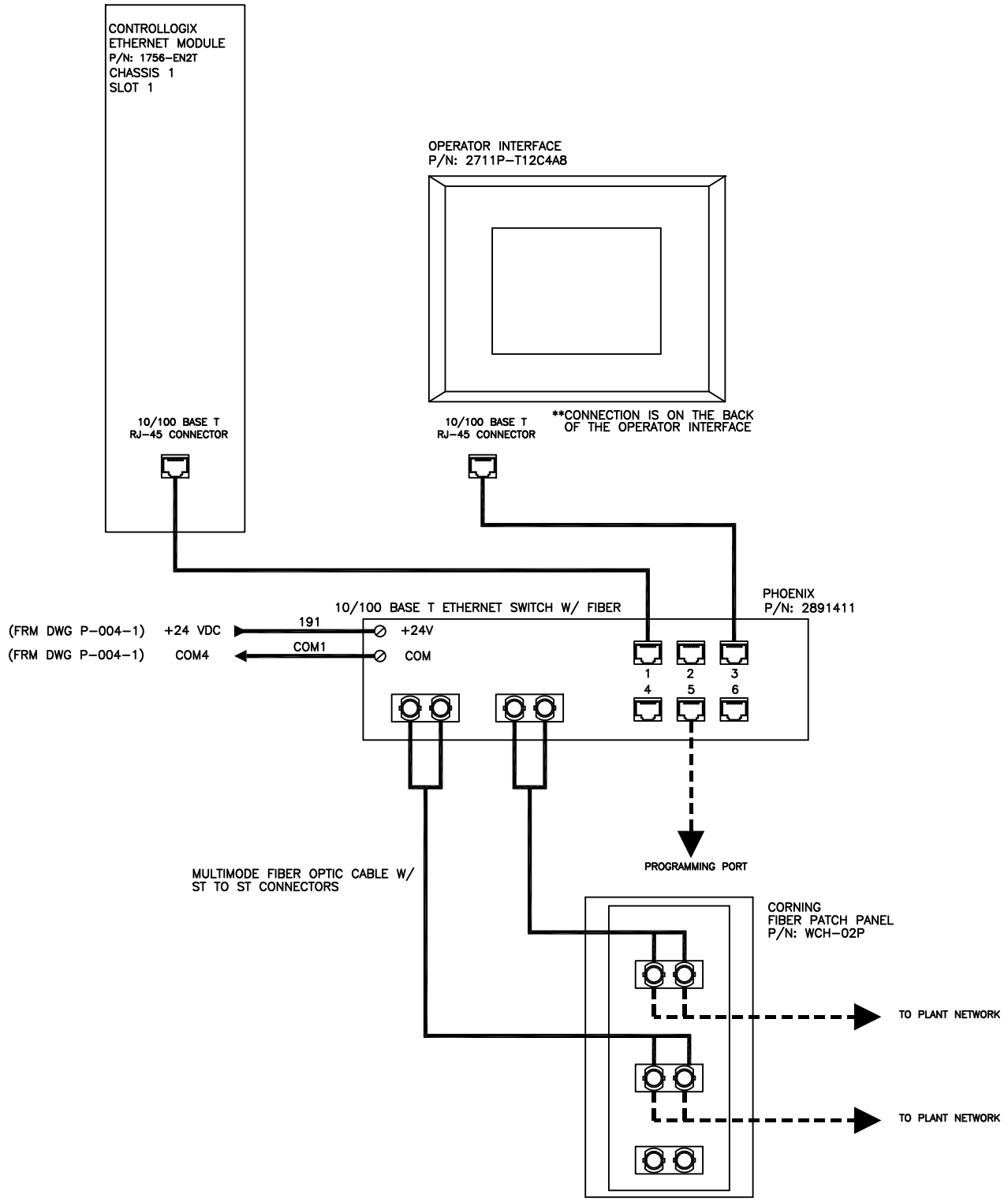
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MASSILLON, OH

IFAS
PLC CONTROL PANEL
SPARE - CHASSIS 1/SLOT 16

DRAWN	CHECKED		SCALE	DRAWING NO	SHEET	REV
MRO				I-016	26 of 27	0

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
1	CHANGED HMI TO 12"	MRO		5/18/15



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(919) 677-8310

5700235402
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IFAS
PLC CONTROL PANEL
COMMUNICATIONS LAYOUT

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRO			C-001	27 of 27	0

KRÜGER

SECTION 4.4

LOOP DRAWINGS

VEOLIA WATER
Solutions & Technologies

-

DRAWING LIST

DRAWING	TITLE
G-001	DRAWING LIST
L-001	FIELD INSTRUMENTS
L-002	FIELD INSTRUMENTS
L-003	FIELD INSTRUMENTS
L-004	FIELD INSTRUMENTS
L-005	TRAIN 1 IFAS HIGH LEVEL
L-006	TRAIN 1 ANOXIC MIXER 1
L-007	TRAIN 1 ANOXIC MIXER 2
L-008	TRAIN 1 ANAEROBIC MIXER
L-009	TRAIN 1 AIR VALVE
L-010	TRAIN 1 DE-OX VALVE
L-011	TRAIN 2 IFAS HIGH LEVEL
L-012	TRAIN 2 ANOXIC MIXER 1
L-013	TRAIN 2 ANOXIC MIXER 2
L-014	TRAIN 2 ANAEROBIC MIXER
L-015	TRAIN 2 AIR VALVE
L-016	TRAIN 2 DE-OX VALVE
L-017	TRAIN 3 IFAS HIGH LEVEL
L-018	TRAIN 3 ANOXIC MIXER 1
L-019	TRAIN 3 ANOXIC MIXER 2
L-020	TRAIN 3 ANAEROBIC MIXER
L-021	TRAIN 3 AIR VALVE
L-022	TRAIN 3 DE-OX VALVE
L-023	AIR SPARGE BLOWER 1
L-024	AIR SPARGE BLOWER 2
L-025	FIELD INSTRUMENTS
L-026	FIELD INSTRUMENTS
L-027	FIELD INSTRUMENTS
L-028	FIELD INSTRUMENTS

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRD		1/23/15
1	ADDED DRAWING L-028	MRD		5/18/15
2	UPDATED PER COMMENTS	MRD		9/18/15

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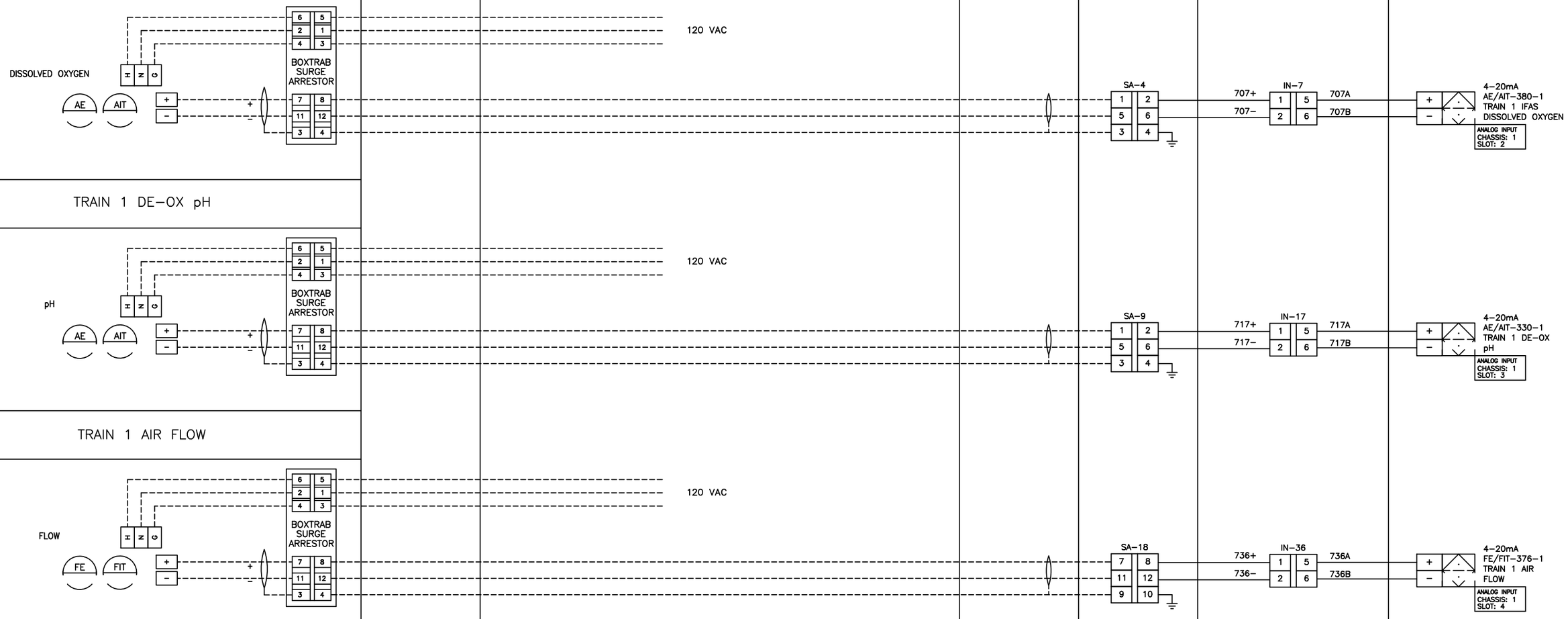
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CARY, NC 27513
(919) 677-8310

5700235402
MASSILLON, OH

IFAS
LOOP WIRING DIAGRAM
DRAWING LIST

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRD	MRD		G-001	1 of 29	2

FIELD DEVICE	MCC (BY OTHERS)			CONTROL PANEL (BY KRUGER, INC.)		
TRAIN 1 IFAS DISSOLVED OXYGEN	TERMINAL BLOCK	PANEL	TERMINAL BLOCK	TERMINAL BLOCK	PANEL	PLC
TRAIN 1 DE–OX pH						
TRAIN 1 AIR FLOW						



THIS FIELD WIRING DIAGRAM IS FOR GRAPHICAL REPRESENTATION ONLY AND MAY INCLUDE MORE WIRING AND EQUIPMENT THAN SHOWN

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
1	ADDED SURGE PROTECTOR WIRING	MRO		3/10/15
2	UPDATED PER COMMENTS	MRO		9/18/15

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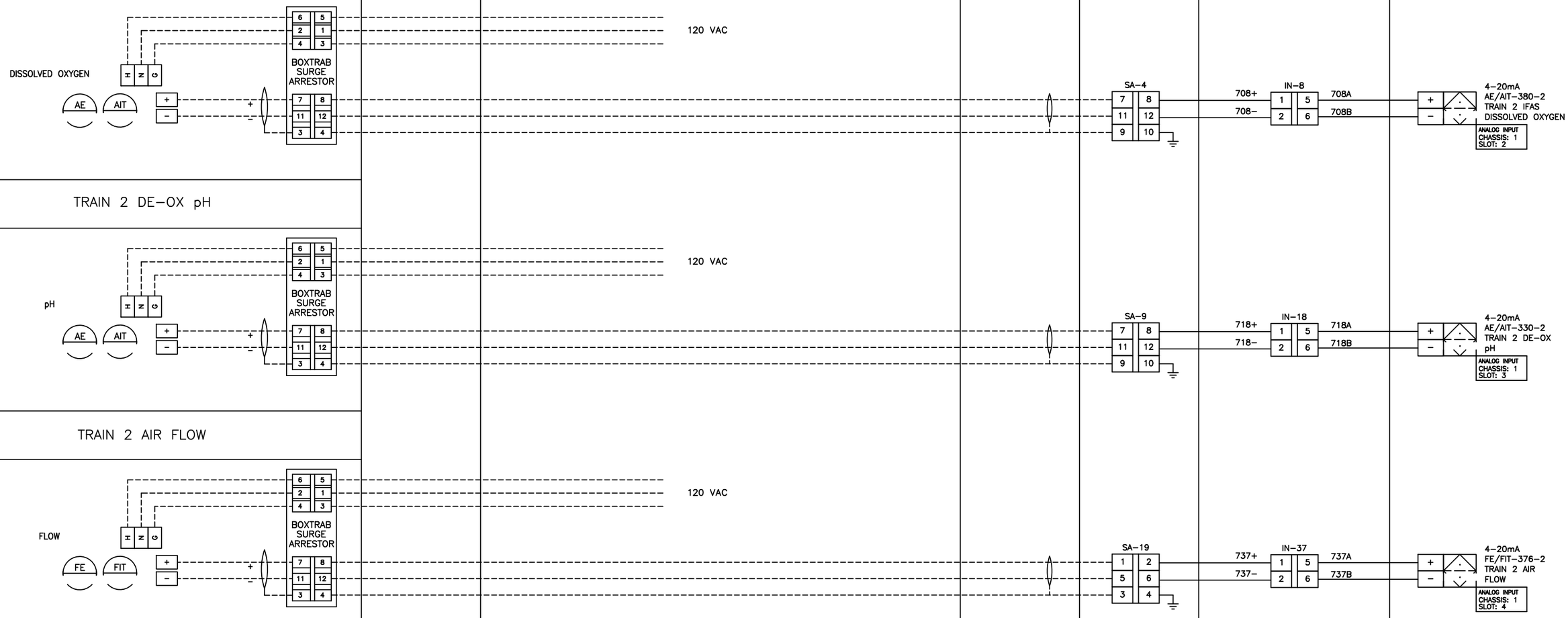
5700235402
MASSILLON, OH

IFAS LOOP WIRING DIAGRAM FIELD INSTRUMENTS

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRO	MRO		L–001	2 of 29	2

-

FIELD DEVICE	MCC (BY OTHERS)			CONTROL PANEL (BY KRUGER, INC.)		
TRAIN 2 IFAS DISSOLVED OXYGEN	TERMINAL BLOCK	PANEL	TERMINAL BLOCK	TERMINAL BLOCK	PANEL	PLC
TRAIN 2 DE–OX pH						
TRAIN 2 AIR FLOW						



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REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRD		1/23/15
1	ADDED SURGE PROTECTOR WIRING	MRD		3/10/15
2	UPDATED PER COMMENTS	MRD		9/18/15

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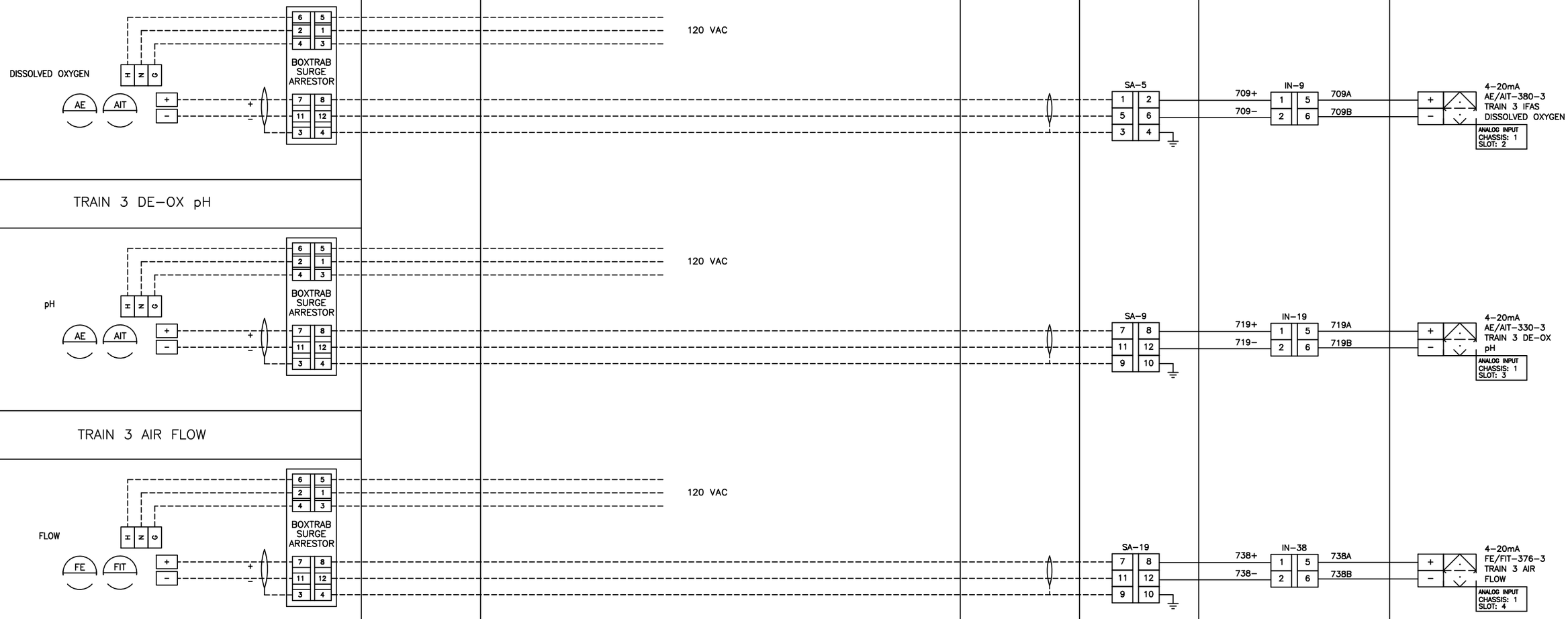
5700235402
MASSILLON, OH

IFAS LOOP WIRING DIAGRAM FIELD INSTRUMENTS

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRD	MRD		L–002	3 of 29	2

-

FIELD DEVICE	MCC (BY OTHERS)			CONTROL PANEL (BY KRUGER, INC.)		
TRAIN 3 IFAS DISSOLVED OXYGEN	TERMINAL BLOCK	PANEL	TERMINAL BLOCK	TERMINAL BLOCK	PANEL	PLC
TRAIN 3 DE–OX pH						
TRAIN 3 AIR FLOW						



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REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
1	ADDED SURGE PROTECTOR WIRING	MRO		3/10/15
2	UPDATED PER COMMENTS	MRO		9/18/15

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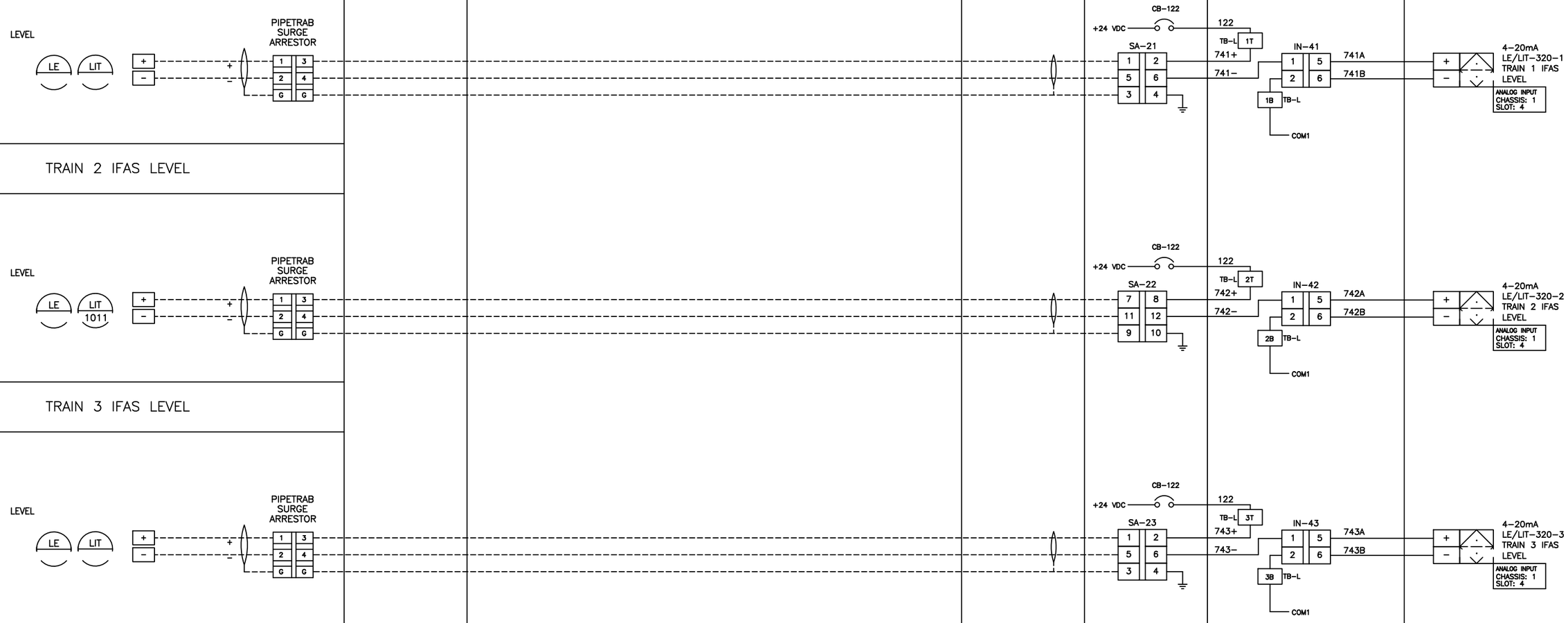
5700235402
MASSILLON, OH

IFAS LOOP WIRING DIAGRAM FIELD INSTRUMENTS

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRO	MRO		L–003	4 of 29	2

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FIELD DEVICE	MCC (BY OTHERS)			CONTROL PANEL (BY KRUGER, INC.)		
	TERMINAL BLOCK	PANEL	TERMINAL BLOCK	TERMINAL BLOCK	PANEL	PLC
TRAIN 1 IFAS LEVEL						
TRAIN 2 IFAS LEVEL						
TRAIN 3 IFAS LEVEL						



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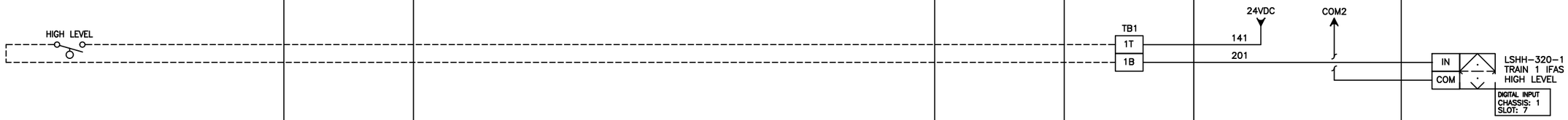
5700235402
MASSILLON, OH

IFAS LOOP WIRING DIAGRAM FIELD INSTRUMENTS

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRD	MRD		L-004	5 of 29	2

-

FIELD DEVICE	MCC (BY OTHERS)			CONTROL PANEL (BY KRUGER, INC.)		
	TERMINAL BLOCK	PANEL	TERMINAL BLOCK	TERMINAL BLOCK	PANEL	PLC



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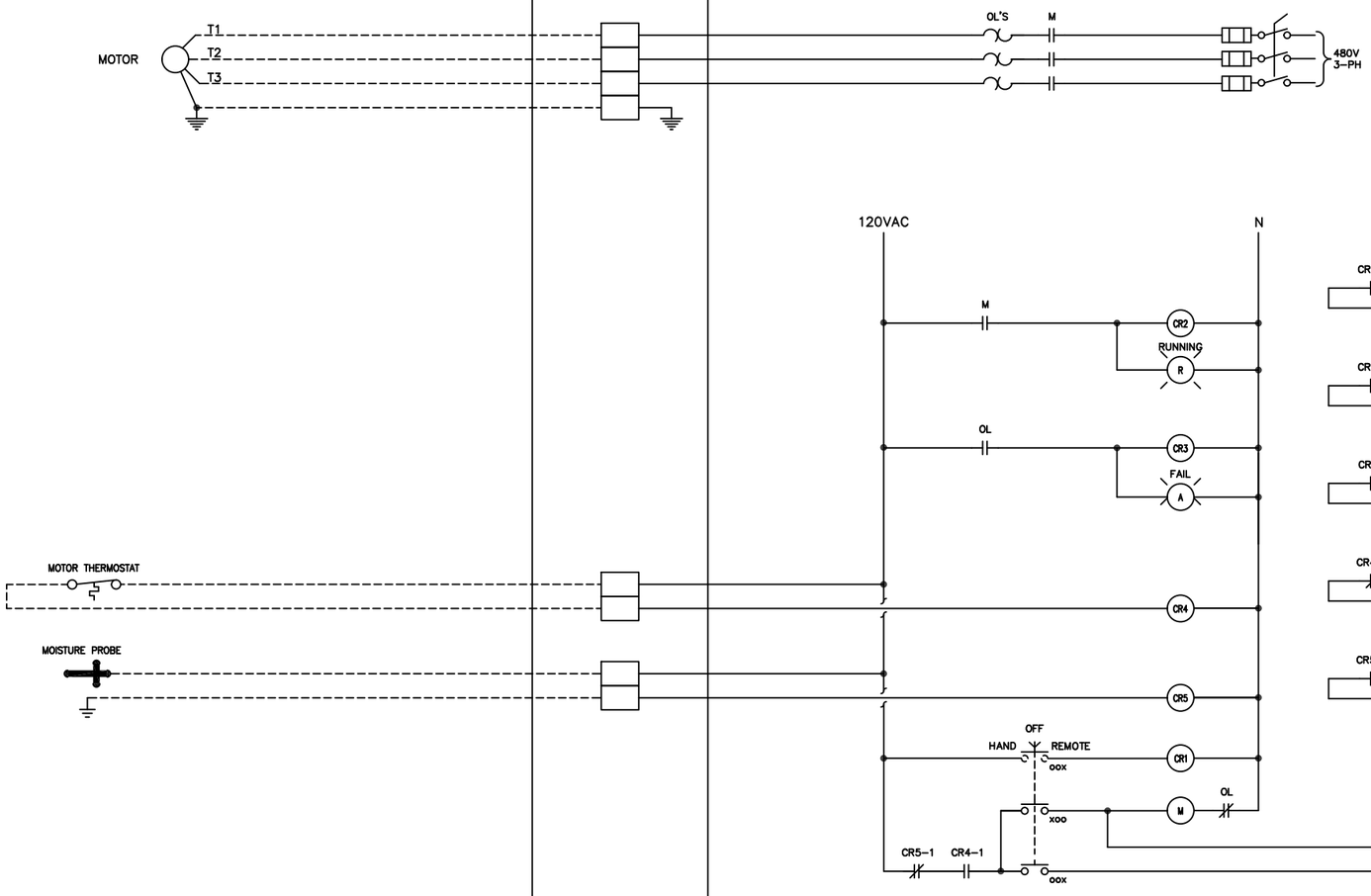
5700235402
MASSILLON, OH

IFAS
LOOP WIRING DIAGRAM
TRAIN 1 IFAS HIGH LEVEL

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRO	MRO		L-005	6 of 29	1

-

FIELD DEVICE	MCC (BY OTHERS)			CONTROL PANEL (BY KRUGER, INC.)		
	TERMINAL BLOCK	PANEL	TERMINAL BLOCK	TERMINAL BLOCK	PANEL	PLC



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0	ISSUED FOR APPROVAL	MRD		1/23/15
1	UPDATED PER COMMENTS	MRD		8/26/15

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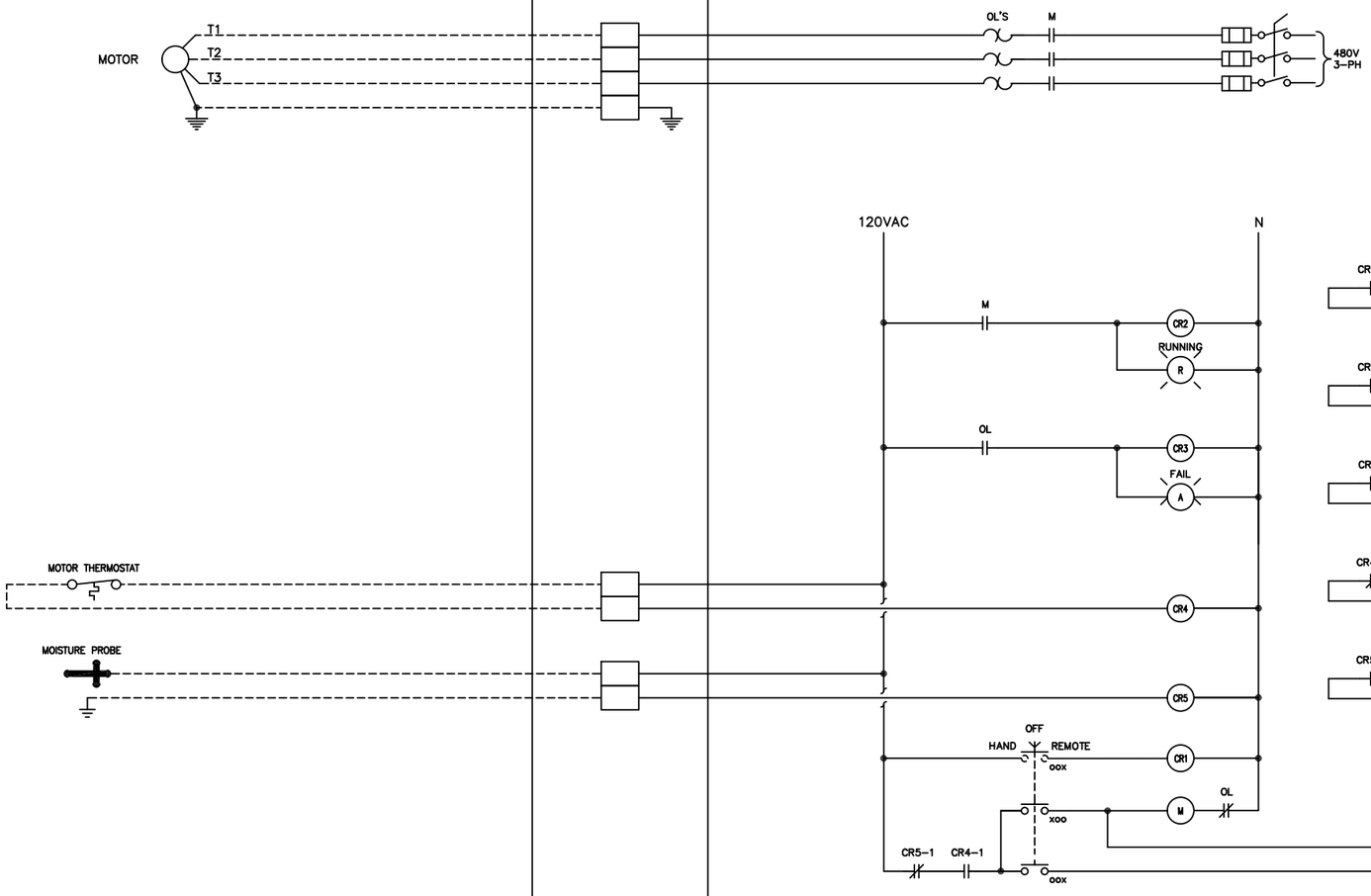
5700235402
MASSILLON, OH

IFAS
LOOP WIRING DIAGRAM
TRAIN 1 ANOXIC MIXER 1

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRD	MRD		L-006	7 of 29	1

-

FIELD DEVICE	MCC (BY OTHERS)			CONTROL PANEL (BY KRUGER, INC.)		
	TERMINAL BLOCK	PANEL	TERMINAL BLOCK	TERMINAL BLOCK	PANEL	PLC



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REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRD		1/23/15
1	REARRANGED I/O PER COMMENTS	MRD		5/19/15
2	UPDATED PER COMMENTS	MRD		8/26/15

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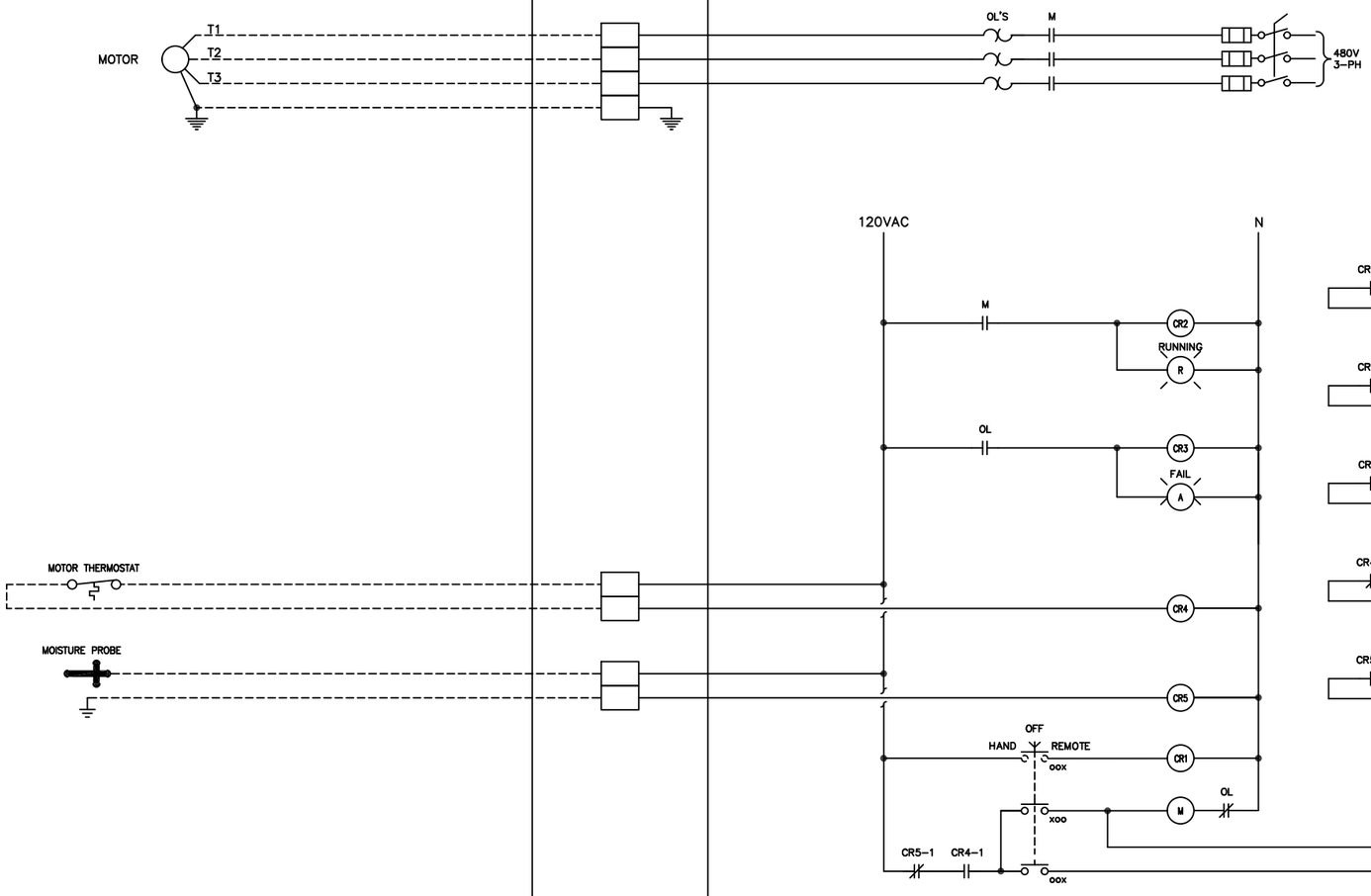
5700235402
MASSILLON, OH

IFAS
LOOP WIRING DIAGRAM
TRAIN 1 ANOXIC MIXER 2

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRD	MRD		L-007	8 of 29	2

-

FIELD DEVICE	MCC (BY OTHERS)			CONTROL PANEL (BY KRUGER, INC.)		
	TERMINAL BLOCK	PANEL	TERMINAL BLOCK	TERMINAL BLOCK	PANEL	PLC



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REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
1	REARRANGED I/O PER COMMENTS	MRO		5/19/15
2	UPDATED PER COMMENTS	MRO		8/26/15

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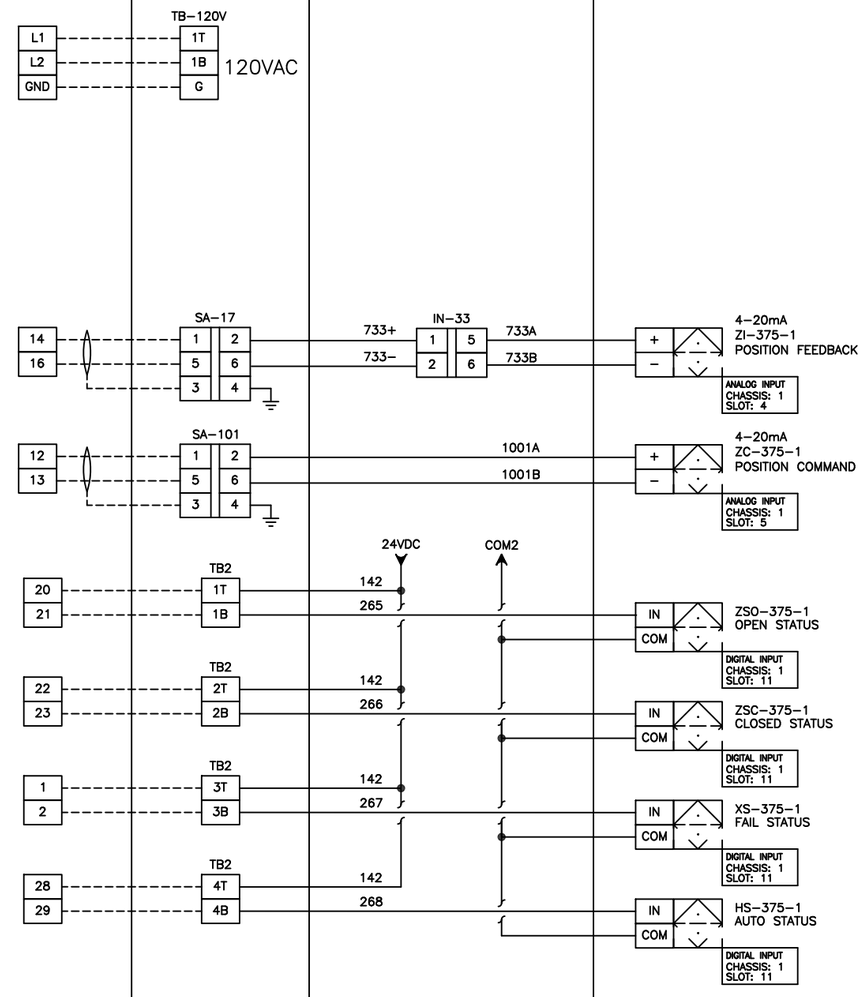
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MASSILLON, OH

IFAS
LOOP WIRING DIAGRAM
TRAIN 1 ANAEROBIC MIXER

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRO	MRO		L-008	9 of 29	2

-

MCC (BY OTHERS)	VALVE ACTUATOR			CONTROL PANEL (BY KRUGER, INC.)		
	TERMINAL BLOCK	PANEL	TERMINAL BLOCK	TERMINAL BLOCK	PANEL	PLC



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REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRD		1/23/15
1	ADDED FIELD TERMINAL NUMBERS	MRD		3/10/15
2	CORRECTED TYPO/REARRANGED I/O	MRD		5/15/15
3	VALVE POWER MOVED FROM MCC TO PLC	NDB		6/26/15
4	UPDATED PER COMMENTS	MRD		9/18/15

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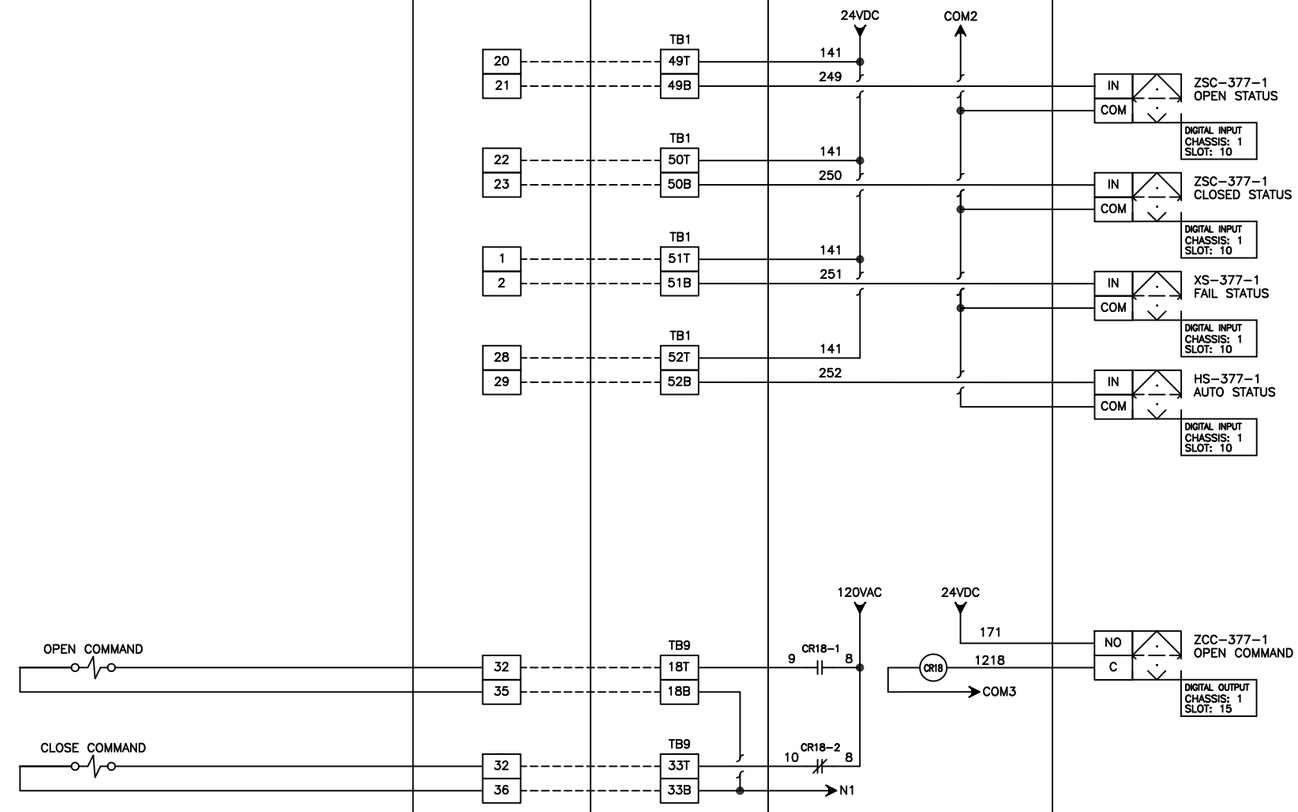
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IFAS
LOOP WIRING DIAGRAM
TRAIN 1 AIR VALVE

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRD	MRD		L-009	10of29	4

-

FIELD DEVICE	VALVE ACTUATOR			CONTROL PANEL (BY KRUGER, INC.)		
	TERMINAL BLOCK	PANEL	TERMINAL BLOCK	TERMINAL BLOCK	PANEL	PLC



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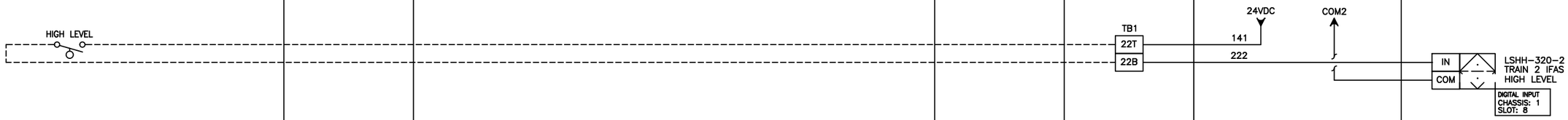
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IFAS
LOOP WIRING DIAGRAM
TRAIN 1 DE-OX VALVE

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRO	MRO		L-010	11of29	3

-

FIELD DEVICE	MCC (BY OTHERS)			CONTROL PANEL (BY KRUGER, INC.)		
	TERMINAL BLOCK	PANEL	TERMINAL BLOCK	TERMINAL BLOCK	PANEL	PLC



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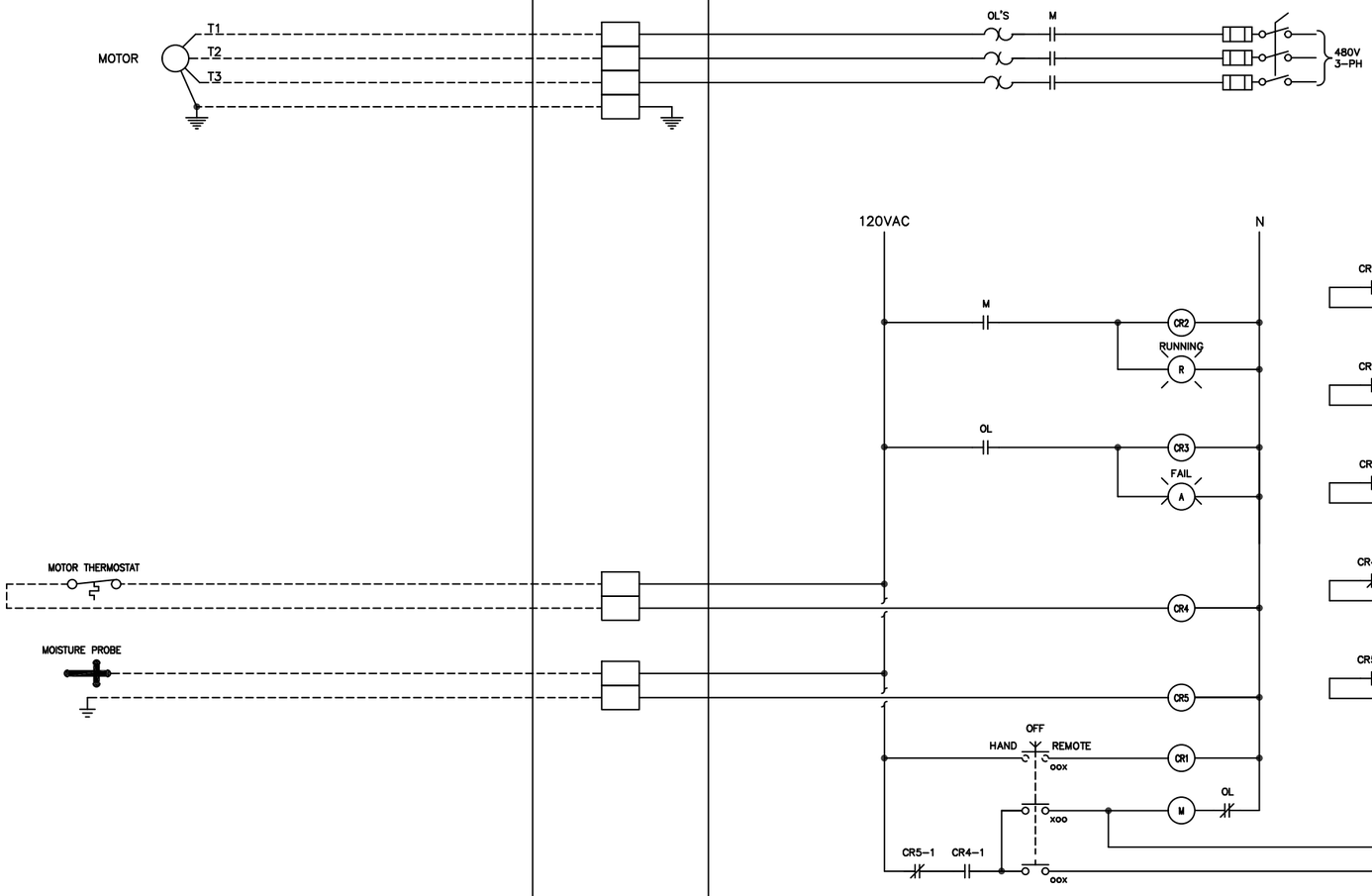
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IFAS
LOOP WIRING DIAGRAM
TRAIN 2 IFAS HIGH LEVEL

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRO	MRO		L-011	12of29	2

-

FIELD DEVICE	MCC (BY OTHERS)			CONTROL PANEL (BY KRUGER, INC.)		
	TERMINAL BLOCK	PANEL	TERMINAL BLOCK	TERMINAL BLOCK	PANEL	PLC



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1	REARRANGED I/O PER COMMENTS	MRD		5/19/15
2	UPDATED PER COMMENTS	MRD		8/26/15

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CARY, NC 27513
(919) 677-8310

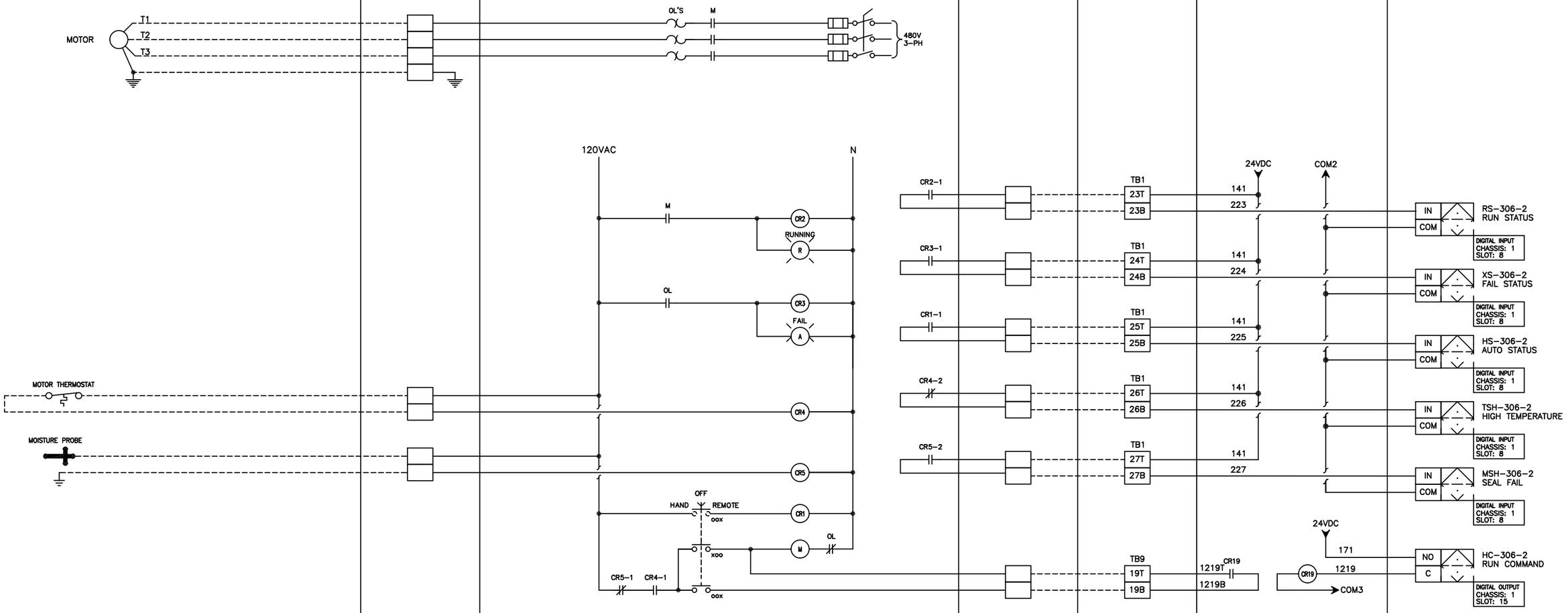
5700235402
MASSILLON, OH

IFAS
LOOP WIRING DIAGRAM
TRAIN 2 ANOXIC MIXER 1

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRD	MRD		L-012	13of29	2

-

FIELD DEVICE	MCC (BY OTHERS)			CONTROL PANEL (BY KRUGER, INC.)		
	TERMINAL BLOCK	PANEL	TERMINAL BLOCK	TERMINAL BLOCK	PANEL	PLC



THIS FIELD WIRING DIAGRAM IS FOR GRAPHICAL REPRESENTATION ONLY AND MAY INCLUDE MORE WIRING AND EQUIPMENT THAN SHOWN

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRD		1/23/15
1	REARRANGED I/O PER COMMENTS	MRD		5/19/15
2	UPDATED PER COMMENTS	MRD		8/26/15

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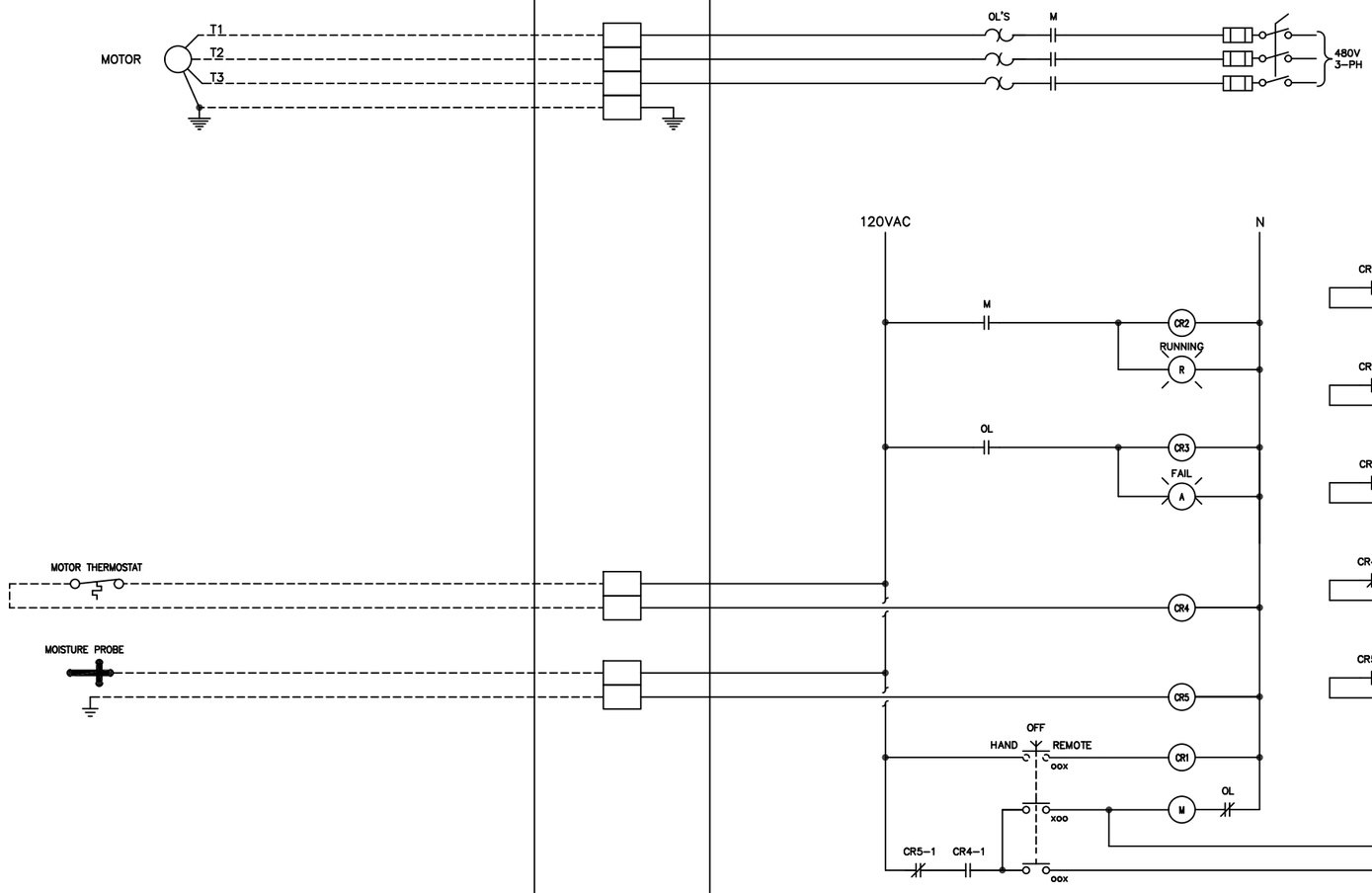
5700235402
MASSILLON, OH

IFAS
LOOP WIRING DIAGRAM
TRAIN 2 ANOXIC MIXER 2

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRD	MRD		L-013	14of29	2

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FIELD DEVICE	MCC (BY OTHERS)			CONTROL PANEL (BY KRUGER, INC.)		
	TERMINAL BLOCK	PANEL	TERMINAL BLOCK	TERMINAL BLOCK	PANEL	PLC



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REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
1	REARRANGED I/O PER COMMENTS	MRO		5/19/15
2	UPDATED PER COMMENTS	MRO		8/26/14

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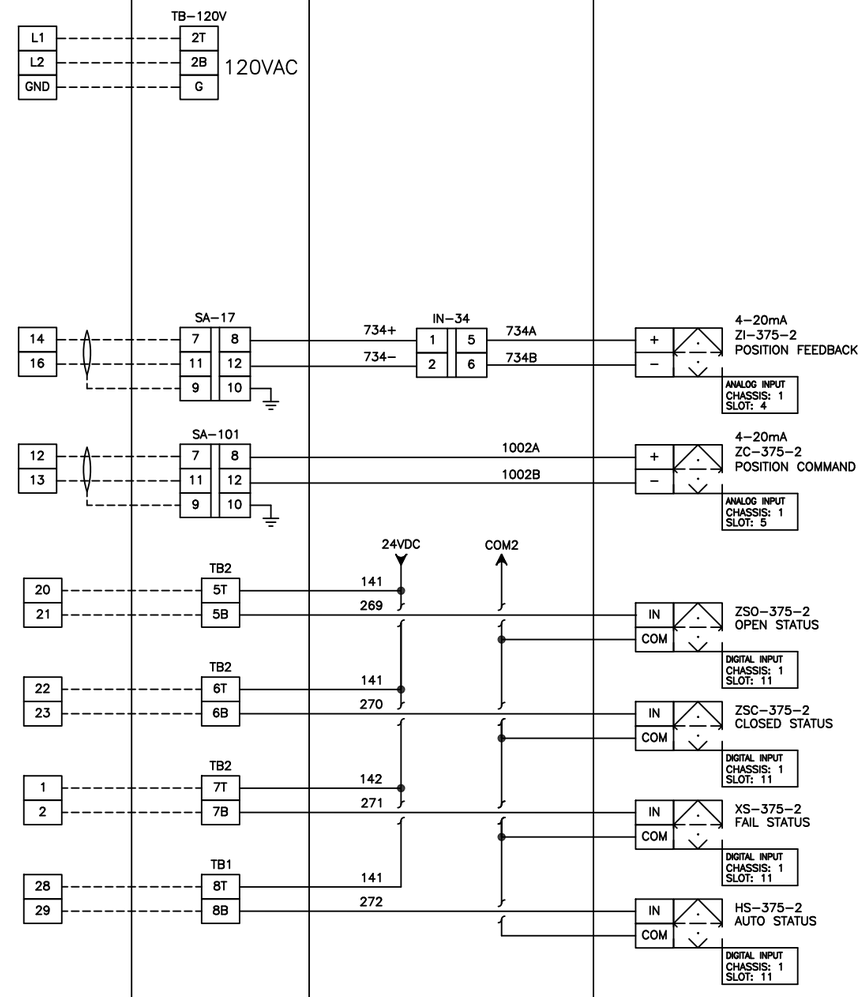
5700235402
MASSILLON, OH

IFAS
LOOP WIRING DIAGRAM
TRAIN 2 ANAEROBIC MIXER

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRO	MRO		L-014	15of29	2

-

MCC (BY OTHERS)	VALVE ACTUATOR			CONTROL PANEL (BY KRUGER, INC.)		
	TERMINAL BLOCK	PANEL	TERMINAL BLOCK	TERMINAL BLOCK	PANEL	PLC



THIS FIELD WIRING DIAGRAM IS FOR GRAPHICAL REPRESENTATION ONLY AND MAY INCLUDE MORE WIRING AND EQUIPMENT THAN SHOWN

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
1	ADDED FIELD TERMINAL NUMBERS	MRO		3/10/15
2	CORRECTED TYPO/REARRANGED I/O	MRO		5/15/15
3	VALVE POWER MOVED FROM MCC TO PLC	NDB		6/26/15
4	UPDATED PER COMMENTS	MRO		9/18/15

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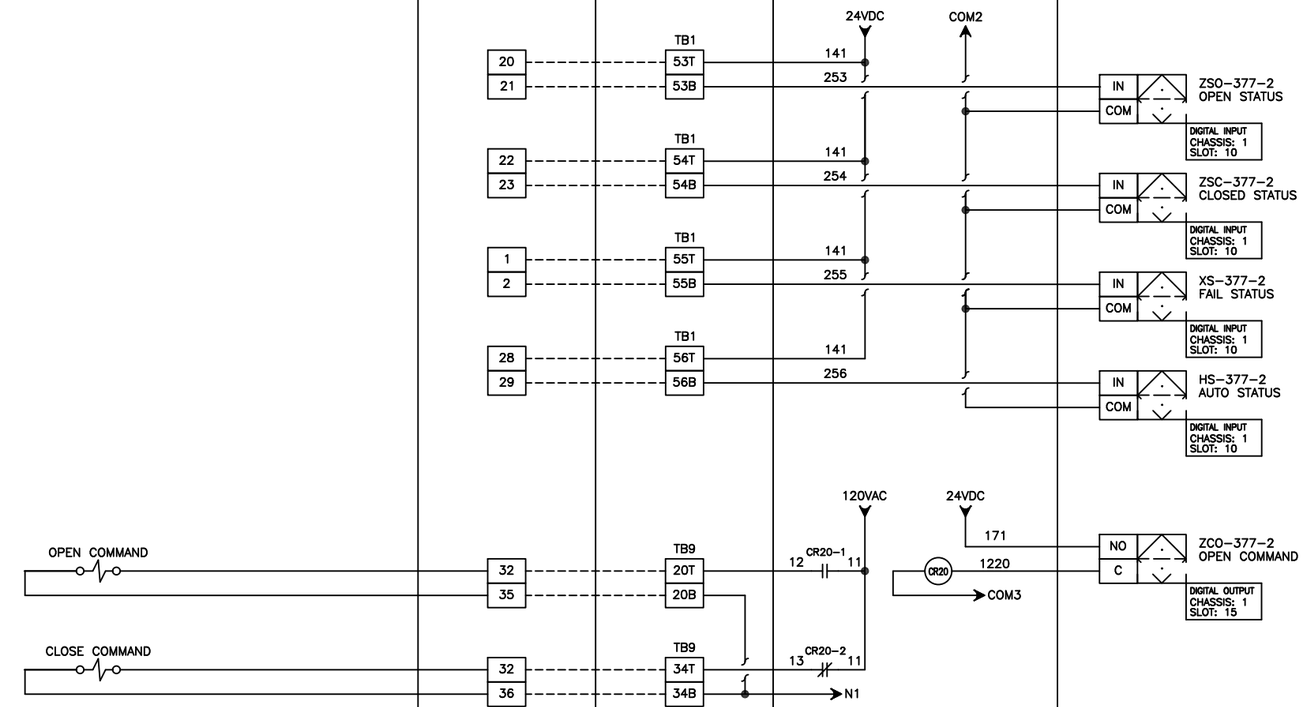
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CARY, NC 27513
(919) 677-8310

5700235402
MASSILLON, OH

IFAS
LOOP WIRING DIAGRAM
TRAIN 2 AIR VALVE

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRO	MRO		L-015	16of29	4

FIELD DEVICE	VALVE ACTUATOR			CONTROL PANEL (BY KRUGER, INC.)		
	TERMINAL BLOCK	PANEL	TERMINAL BLOCK	TERMINAL BLOCK	PANEL	PLC



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REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRD		1/23/15
1	CORRECTED VALVE WIRING	MRD		3/10/15
2	REARRANGED I/O PER COMMENTS	MRD		5/19/15
3	UPDATED PER COMMENTS	MRD		9/18/15

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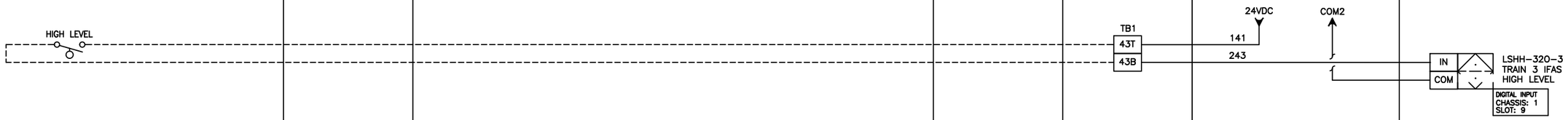
5700235402
MASSILLON, OH

IFAS
LOOP WIRING DIAGRAM
TRAIN 2 DE-OX VALVE

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRD	MRD		L-016	17of29	3

-

FIELD DEVICE	MCC (BY OTHERS)			CONTROL PANEL (BY KRUGER, INC.)		
	TERMINAL BLOCK	PANEL	TERMINAL BLOCK	TERMINAL BLOCK	PANEL	PLC



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REV	DESCRIPTION	DRAWN	APPR	DATE
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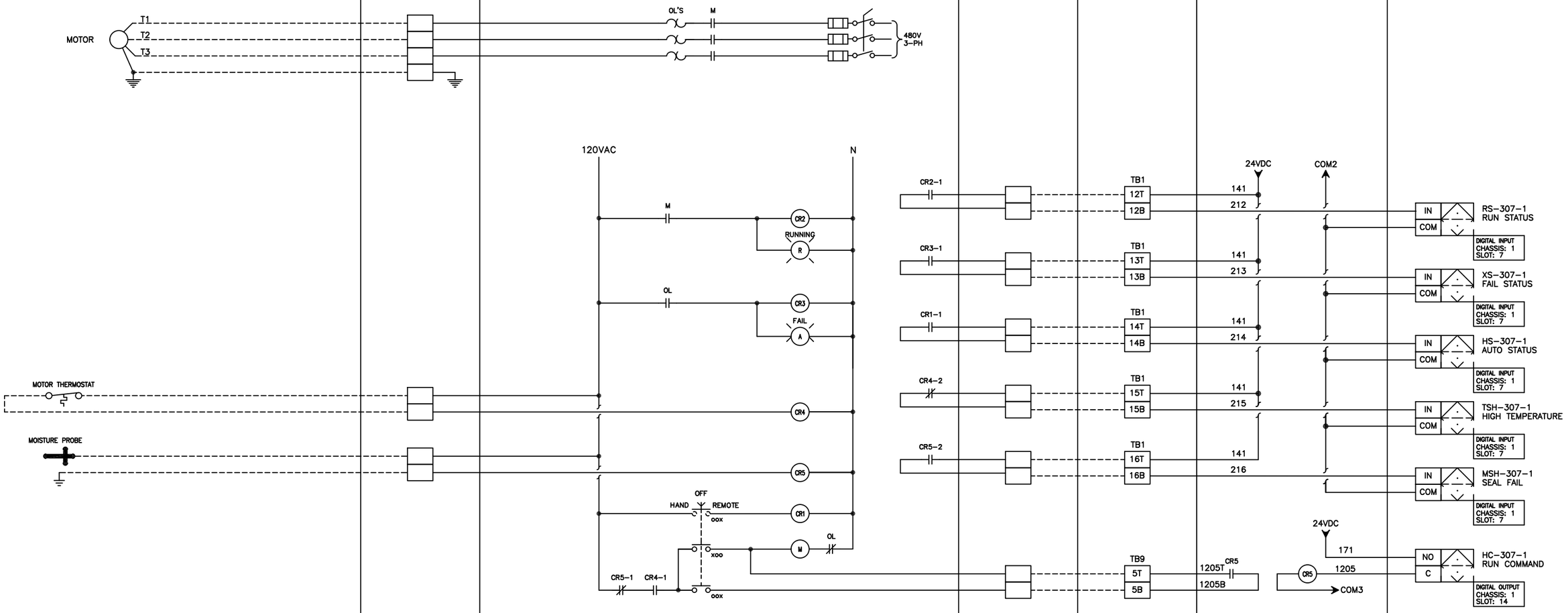
5700235402
MASSILLON, OH

IFAS
LOOP WIRING DIAGRAM
TRAIN 3 IFAS HIGH LEVEL

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRO	MRO		L-017	18of29	2

-

FIELD DEVICE	MCC (BY OTHERS)			CONTROL PANEL (BY KRUGER, INC.)		
	TERMINAL BLOCK	PANEL	TERMINAL BLOCK	TERMINAL BLOCK	PANEL	PLC



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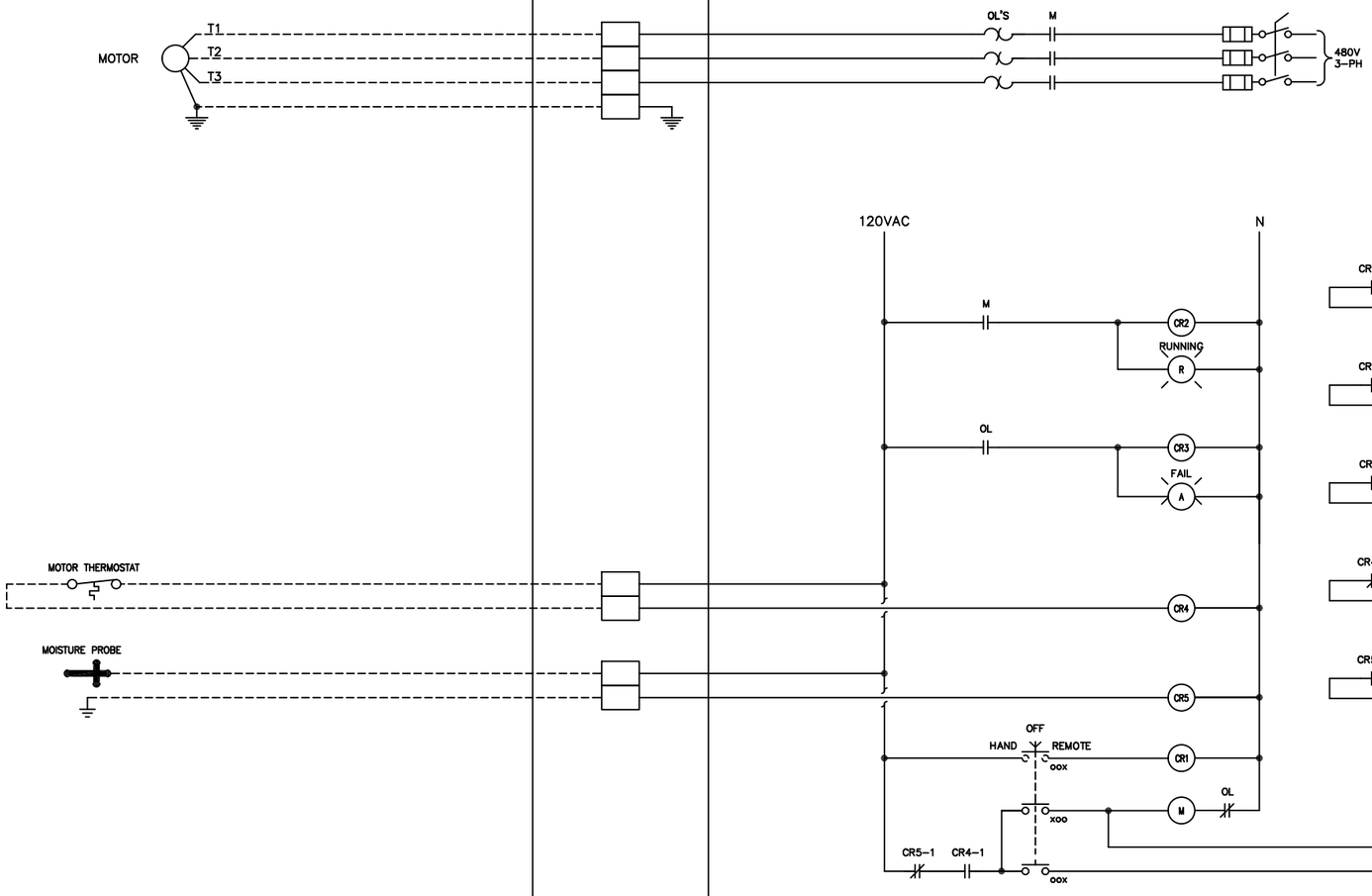
5700235402
MASSILLON, OH

IFAS
LOOP WIRING DIAGRAM
TRAIN 3 ANOXIC MIXER 1

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRO	MRO		L-018	19of29	2

-

FIELD DEVICE	MCC (BY OTHERS)			CONTROL PANEL (BY KRUGER, INC.)		
	TERMINAL BLOCK	PANEL	TERMINAL BLOCK	TERMINAL BLOCK	PANEL	PLC



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REV	DESCRIPTION	DRAWN	APPR	DATE
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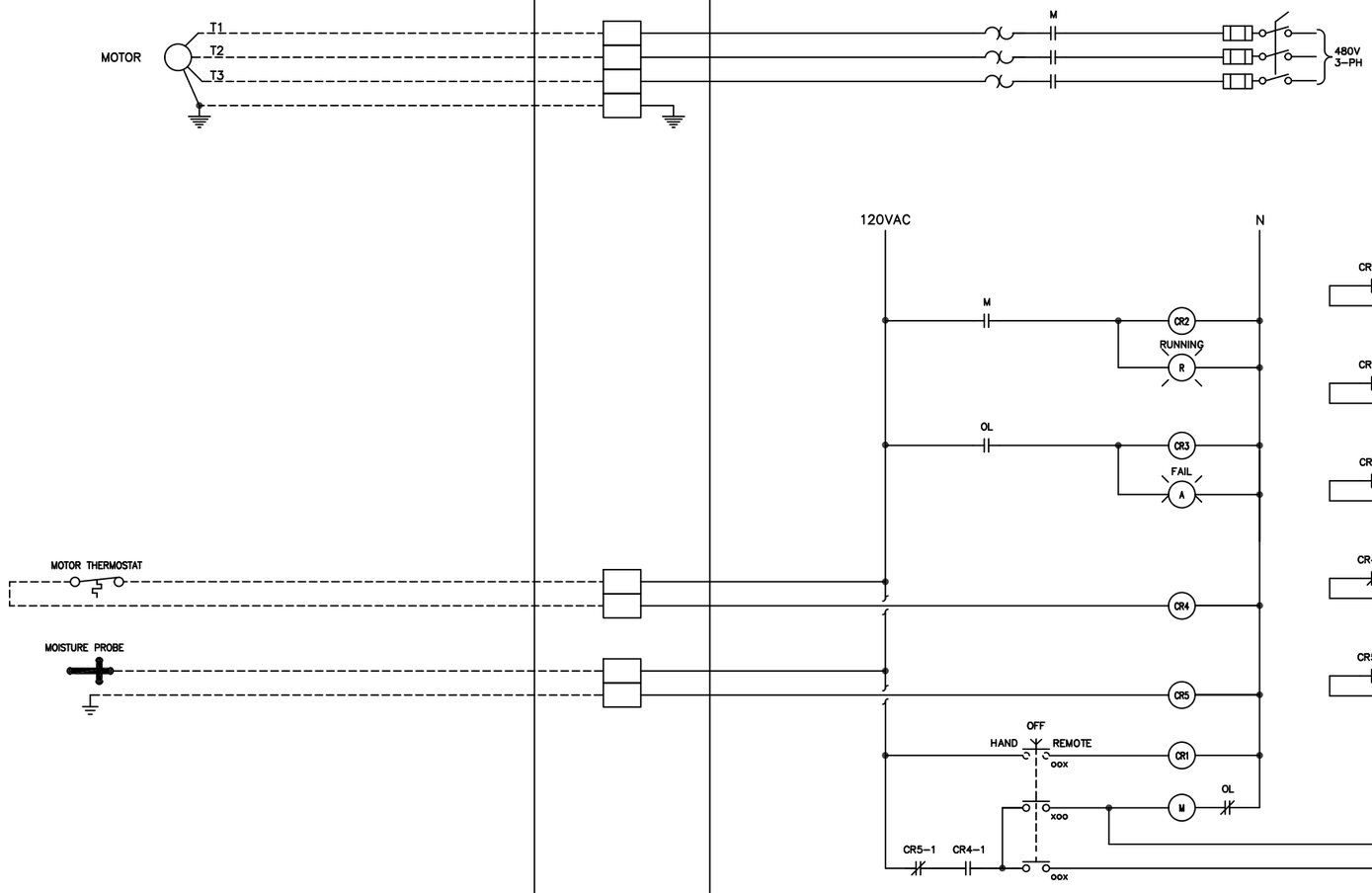
5700235402
MASSILLON, OH

IFAS
LOOP WIRING DIAGRAM
TRAIN 3 ANOXIC MIXER 2

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRO	MRO		L-019	20of29	2

-

FIELD DEVICE	MCC (BY OTHERS)			CONTROL PANEL (BY KRUGER, INC.)		
	TERMINAL BLOCK	PANEL	TERMINAL BLOCK	TERMINAL BLOCK	PANEL	PLC



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REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
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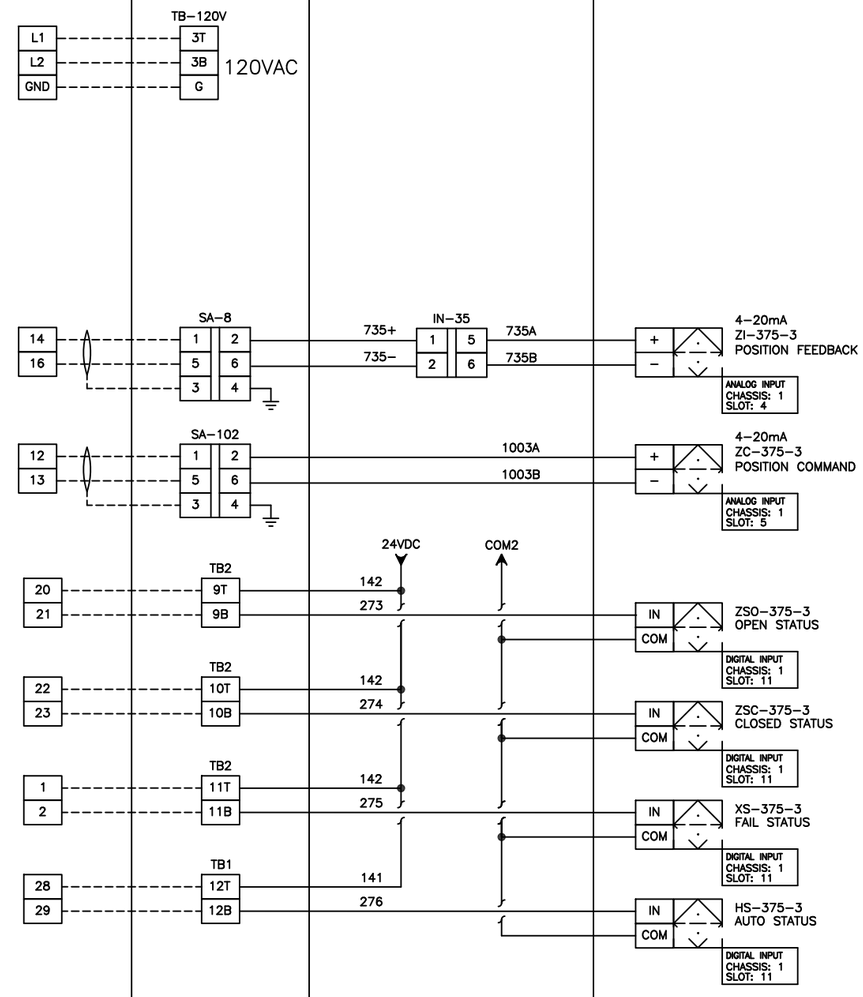
5700235402
MASSILLON, OH

IFAS
LOOP WIRING DIAGRAM
TRAIN 3 ANAEROBIC MIXER

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRO	MRO		L-020	21of29	2

-

MCC (BY OTHERS)	VALVE ACTUATOR			CONTROL PANEL (BY KRUGER, INC.)		
	TERMINAL BLOCK	PANEL	TERMINAL BLOCK	TERMINAL BLOCK	PANEL	PLC



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REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
1	ADDED FIELD TERMINAL NUMBERS	MRO		3/10/15
2	CORRECTED TYPO/REARRANGED I/O	MRO		5/15/15
3	VALVE POWER MOVED FROM MCC TO PLC	NDB		6/26/15
4	UPDATED PER COMMENTS	MRO		9/18/15

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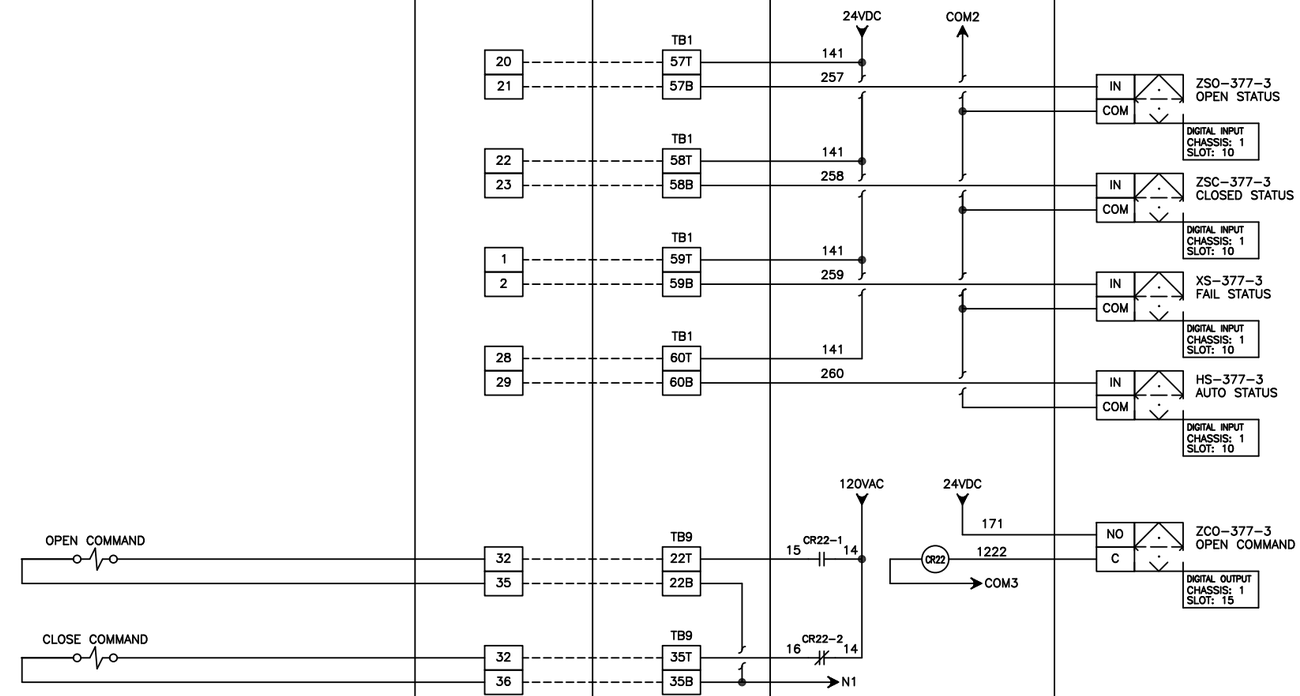
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MASSILLON, OH

IFAS
LOOP WIRING DIAGRAM
TRAIN 3 AIR VALVE

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRO	MRO		L-021	22of29	4

-

FIELD DEVICE	VALVE ACTUATOR			CONTROL PANEL (BY KRUGER, INC.)		
	TERMINAL BLOCK	PANEL	TERMINAL BLOCK	TERMINAL BLOCK	PANEL	PLC



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REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRD		1/23/15
1	CORRECTED VALVE WIRING	MRD		3/10/15
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3	UPDATED PER COMMENTS	MRD		9/18/15

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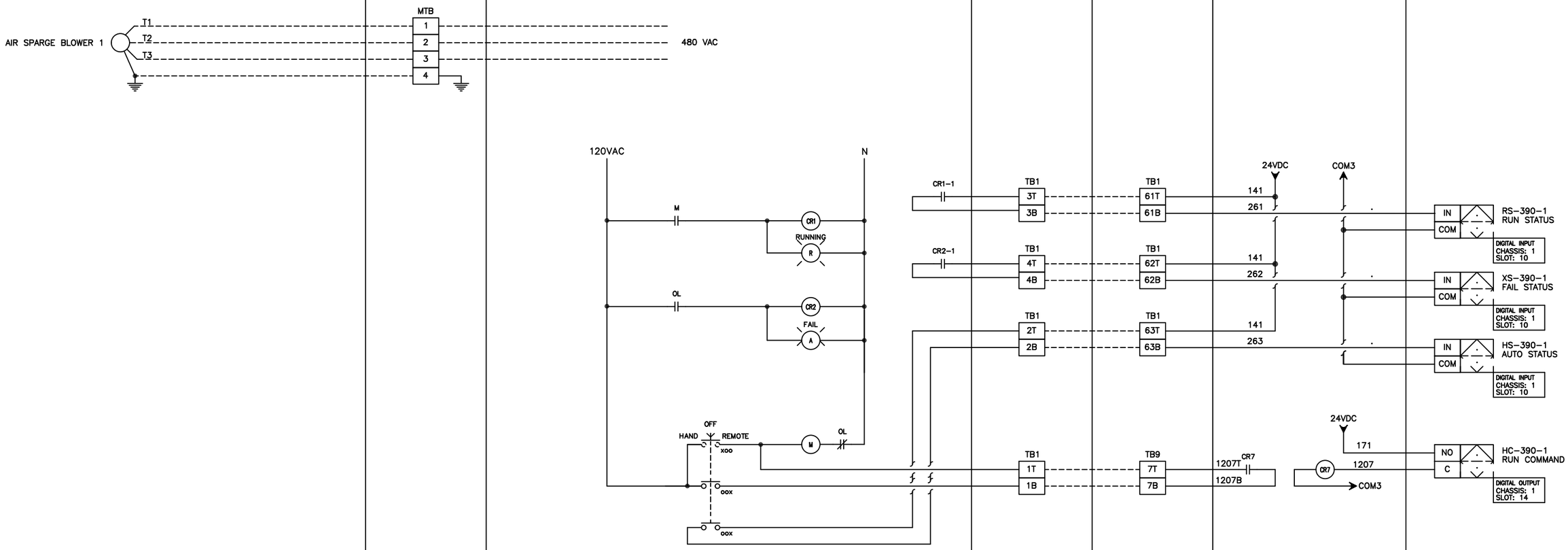
5700235402
MASSILLON, OH

IFAS
LOOP WIRING DIAGRAM
TRAIN 3 DE-OX VALVE

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRD	MRD		L-022	23 of 29	3

-

FIELD DEVICE	BLOWER LOCAL CONTROL PANEL			CONTROL PANEL (BY KRUGER, INC.)		
	TERMINAL BLOCK	PANEL	TERMINAL BLOCK	TERMINAL BLOCK	PANEL	PLC



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REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
1	ADDED FIELD TERMINAL NUMBERS	MRO		3/12/15
2	REARRANGED I/O PER COMMENTS	MRO		5/19/15
3	UPDATED PER COMMENTS	MRO		8/26/15

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CARY, NC 27513
(919) 677-8310

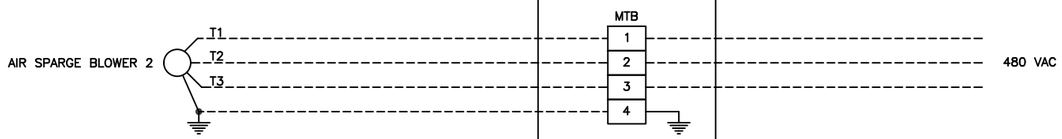
5700235402
MASSILLON, OH

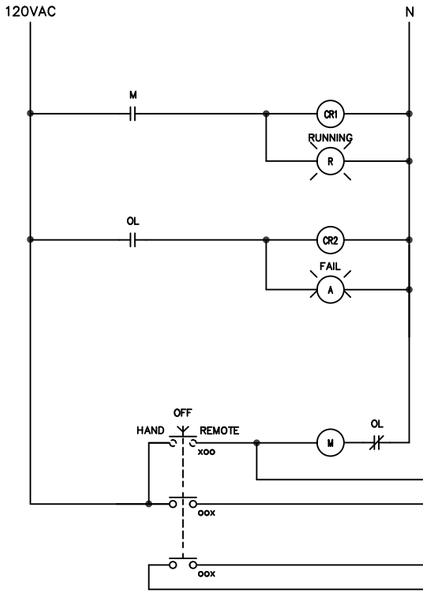
IFAS
LOOP WIRING DIAGRAM
AIR SPARGE BLOWER 1

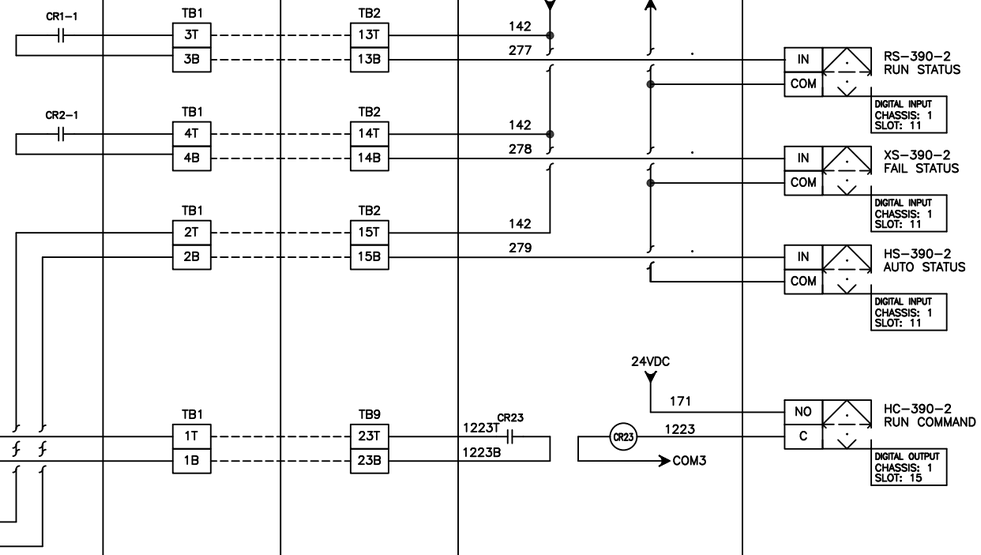
DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRO	MRO		L-023	24of29	3

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FIELD DEVICE	BLOWER LOCAL CONTROL PANEL			CONTROL PANEL (BY KRUGER, INC.)		
	TERMINAL BLOCK	PANEL	TERMINAL BLOCK	TERMINAL BLOCK	PANEL	PLC







THIS FIELD WIRING DIAGRAM IS FOR GRAPHICAL REPRESENTATION ONLY AND MAY INCLUDE MORE WIRING AND EQUIPMENT THAN SHOWN

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
1	ADDED FIELD TERMINAL NUMBERS	MRO		3/12/15
2	CORRECTED TYPO/REARRANGED I/O	MRO		5/15/15
3	UPDATED PER COMMENTS	MRO		8/26/15

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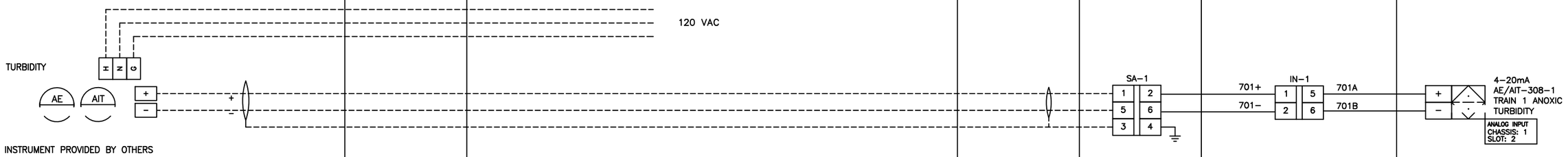
5700235402
MASSILLON, OH

IFAS
LOOP WIRING DIAGRAM
AIR SPARGE BLOWER 2

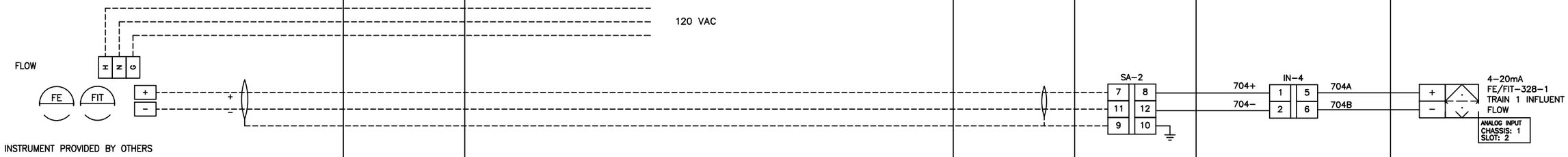
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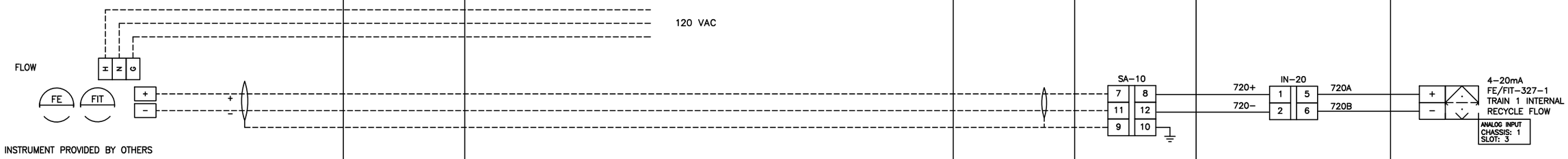
FIELD DEVICE	MCC (BY OTHERS)			CONTROL PANEL (BY KRUGER, INC.)		
TRAIN 1 ANOXIC TURBIDITY	TERMINAL BLOCK	PANEL	TERMINAL BLOCK	TERMINAL BLOCK	PANEL	PLC



TRAIN 1 INFLUENT FLOW



TRAIN 1 INTERNAL RECYCLE FLOW



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REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
1	UPDATED PER COMMENTS	MRO		9/18/15

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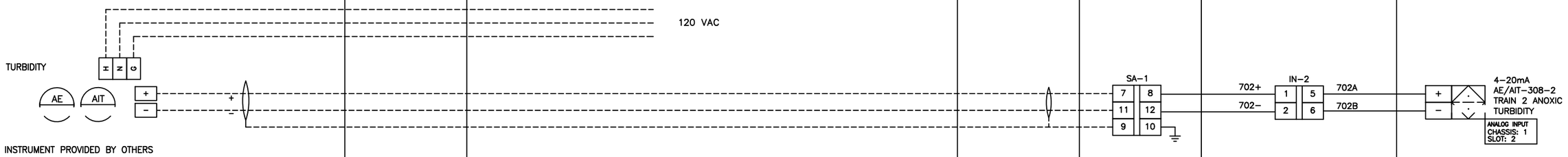
5700235402
MASSILLON, OH

IFAS
LOOP WIRING DIAGRAM
FIELD INSTRUMENTS

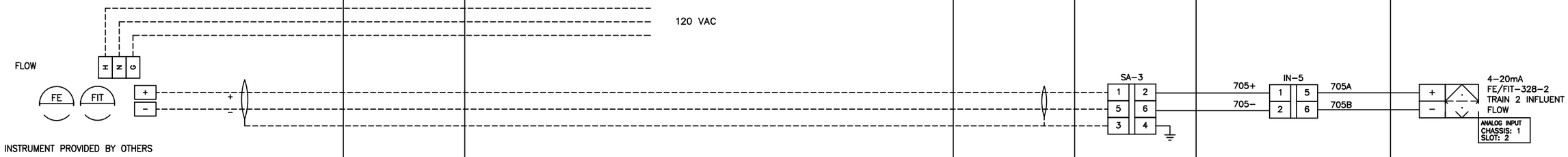
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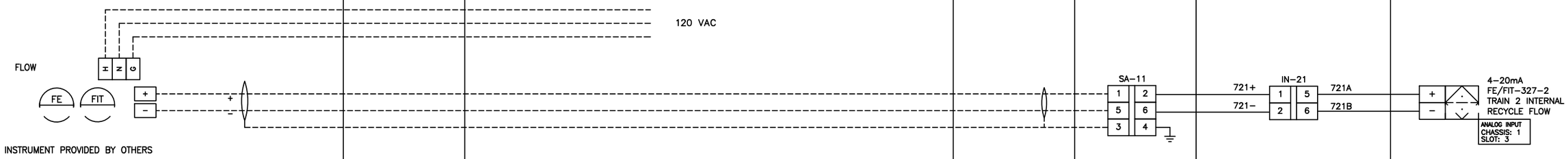
FIELD DEVICE	MCC (BY OTHERS)			CONTROL PANEL (BY KRUGER, INC.)		
TRAIN 2 ANOXIC TURBIDITY	TERMINAL BLOCK	PANEL	TERMINAL BLOCK	TERMINAL BLOCK	PANEL	PLC



TRAIN 2 INFLUENT FLOW



TRAIN 2 INTERNAL RECYCLE FLOW



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REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
1	UPDATED PER COMMENTS	MRO		9/18/15

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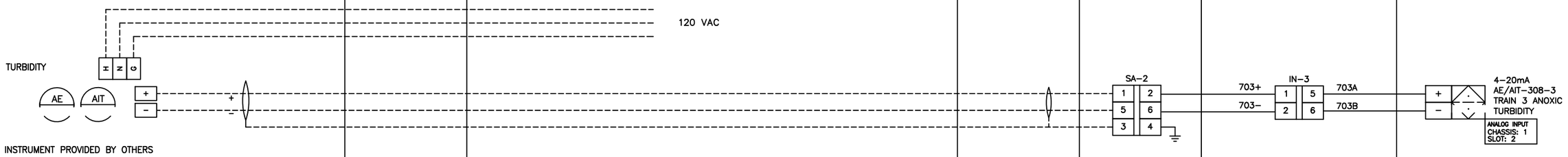
5700235402
MASSILLON, OH

IFAS
LOOP WIRING DIAGRAM
FIELD INSTRUMENTS

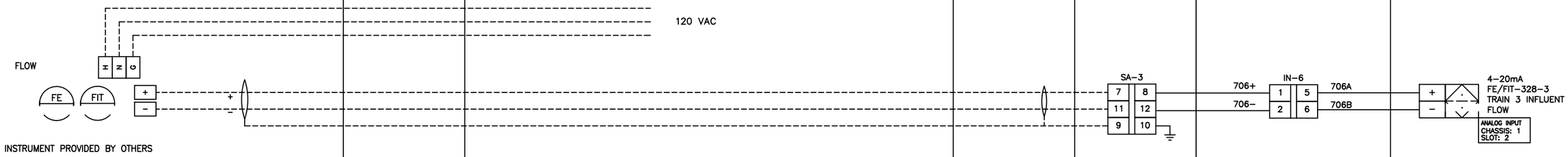
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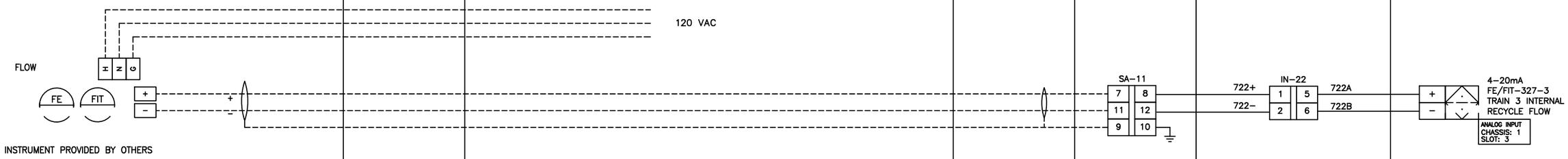
FIELD DEVICE	MCC (BY OTHERS)			CONTROL PANEL (BY KRUGER, INC.)		
TRAIN 3 ANOXIC TURBIDITY	TERMINAL BLOCK	PANEL	TERMINAL BLOCK	TERMINAL BLOCK	PANEL	PLC



TRAIN 3 INFLUENT FLOW



TRAIN 3 INTERNAL RECYCLE FLOW



THIS FIELD WIRING DIAGRAM IS FOR GRAPHICAL REPRESENTATION ONLY AND MAY INCLUDE MORE WIRING AND EQUIPMENT THAN SHOWN

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		1/23/15
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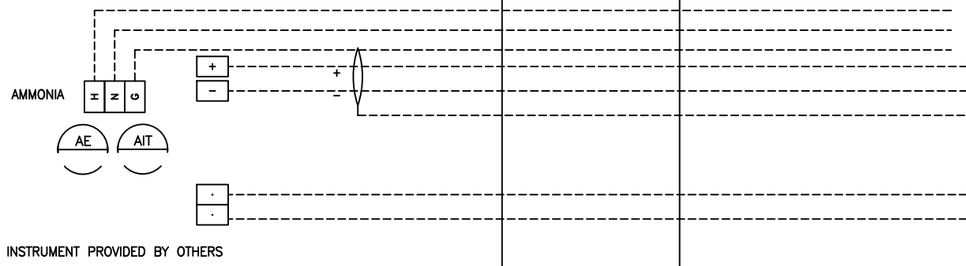
5700235402
MASSILLON, OH

IFAS
LOOP WIRING DIAGRAM
FIELD INSTRUMENTS

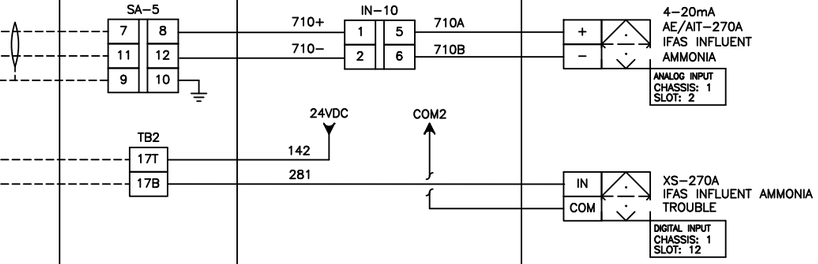
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MRO	MRO		L-027	28 of 29	1

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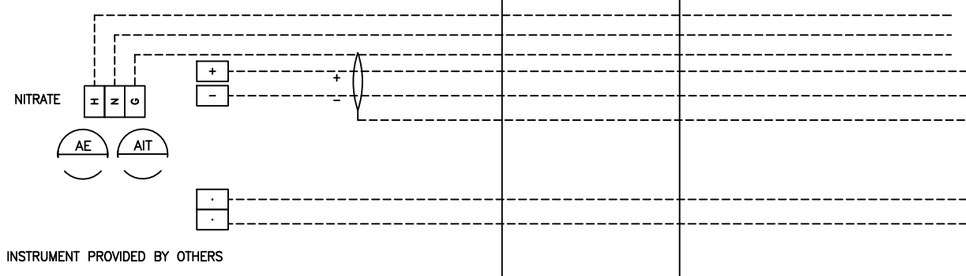
FIELD DEVICE	MCC (BY OTHERS)			CONTROL PANEL (BY KRUGER, INC.)		
IFAS INFLUENT AMMONIA	TERMINAL BLOCK	PANEL	TERMINAL BLOCK	TERMINAL BLOCK	PANEL	PLC



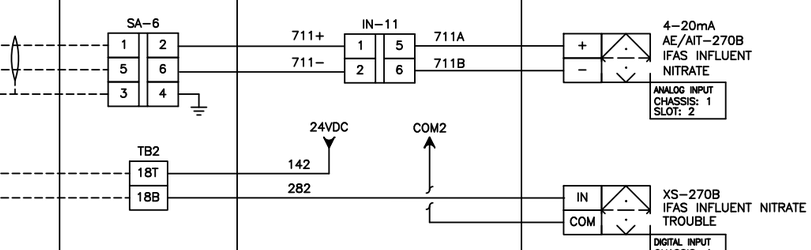
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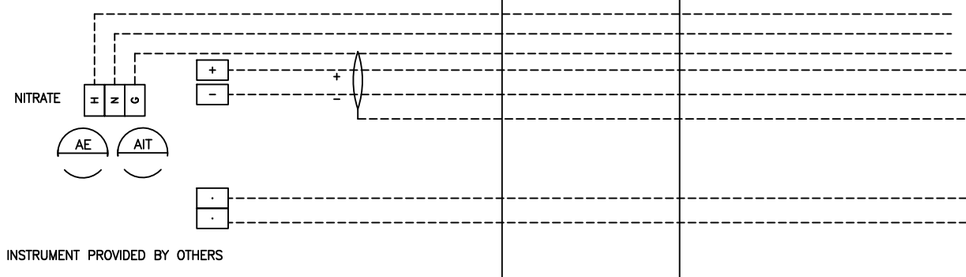
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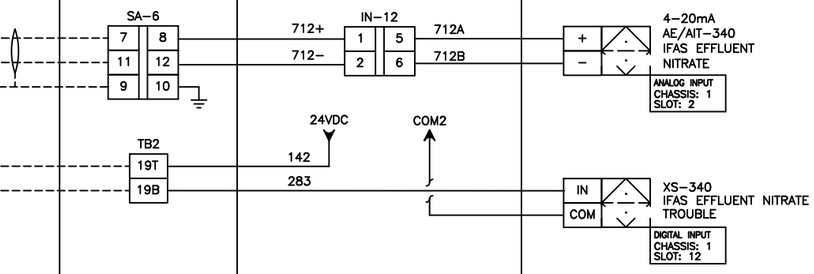
120 VAC



IFAS EFFLUENT NITRATE						



120 VAC



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REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRD		1/23/15
1	UPDATED PER COMMENTS	MRD		9/18/15

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4001 WESTON PARKWAY
CARY, NC 27513
(919) 677-8310

5700235402
MASSILLON, OH

IFAS LOOP WIRING DIAGRAM FIELD INSTRUMENTS

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRD	MRD		L-028	29of29	1

KRÜGER

SECTION 4.5

DISSOLVED OXYGEN ANALYZER

VEOLIA WATER
Solutions & Technologies

INSTRUMENT DATASHEET

PROJECT NAME: Massillon, OH

PROJECT NO.: 5700235402

Dissolved Oxygen		Train 1 IFAS Reactor

Sensor		Transmitter	
Model No.:	LDO	Model No.:	SC200
Range:	0-20.0 mg/L	Range:	0-20.0 mg/L
Power Supply:	Transmitter Supplied	Power Supply:	100 to 240 VAC
Power Requirements:		Power Requirements:	100 VA
Output Signal:	Digital	Output Signal:	(2) 4-20mA
Enclosure Rating:	NEMA 6P	Enclosure Rating:	NEMA 4X
Operating Temp:	32 to 122°F	Operating Temp:	-4 to 140°F
Process Connection:		Accuracy:	±0.02 mg/L
Cable Length:	33 ft.	Integral/Remote Mount:	Remote
Cable Connection:	Integral w/ Quick Connect	Local Display:	Yes
Sensor Type:	Immersion	Input Signal:	(1) Digital

Comments:

Function	Signal	Units	Input		Output	
			LRV	URV	LRV	URV
Dissolved Oxygen	Analog Output 1	mg/L				

Description	Manufacturer	Part Number	Qty
Sensor	Hach	9020000	1
Transmitter	Hach	LXV404.99.00552	1
Handrail Mounting Kit	Hach	9253000	1
Guard Head Assembly	Hach	9253900	1

Rev	Date	By	Approval	Remarks
0	1/23/2015	MRO		Issued for Approval

Kruger Inc.
4001 Weston Parkway
Cary, NC 27513 USA
Tel: 919-677-8310 ● Fax: 919-677-0082
Web site: www.krugerusa.com

VEOLIA WATER
Solutions & Technologies

INSTRUMENT DATASHEET

PROJECT NAME: Massillon, OH

PROJECT NO.: 5700235402

Dissolved Oxygen		Train 2 IFAS Reactor

Sensor		Transmitter	
Model No.:	LDO	Model No.:	SC200
Range:	0-20.0 mg/L	Range:	0-20.0 mg/L
Power Supply:	Transmitter Supplied	Power Supply:	100 to 240 VAC
Power Requirements:		Power Requirements:	100 VA
Output Signal:	Digital	Output Signal:	(2) 4-20mA
Enclosure Rating:	NEMA 6P	Enclosure Rating:	NEMA 4X
Operating Temp:	32 to 122°F	Operating Temp:	-4 to 140°F
Process Connection:		Accuracy:	±0.02 mg/L
Cable Length:	33 ft.	Integral/Remote Mount:	Remote
Cable Connection:	Integral w/ Quick Connect	Local Display:	Yes
Sensor Type:	Immersion	Input Signal:	(1) Digital

Comments:

Function	Signal	Units	Input		Output	
			LRV	URV	LRV	URV
Dissolved Oxygen	Analog Output 1	mg/L				

Description	Manufacturer	Part Number	Qty
Sensor	Hach	9020000	1
Transmitter	Hach	LXV404.99.00552	1
Handrail Mounting Kit	Hach	9253000	1
Guard Head Assembly	Hach	9253900	1

Rev	Date	By	Approval	Remarks
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VEOLIA WATER
Solutions & Technologies

INSTRUMENT DATASHEET

PROJECT NAME: Massillon, OH

PROJECT NO.: 5700235402

Dissolved Oxygen		Train 3 IFAS Reactor

Sensor		Transmitter	
Model No.:	LDO	Model No.:	SC200
Range:	0-20.0 mg/L	Range:	0-20.0 mg/L
Power Supply:	Transmitter Supplied	Power Supply:	100 to 240 VAC
Power Requirements:		Power Requirements:	100 VA
Output Signal:	Digital	Output Signal:	(2) 4-20mA
Enclosure Rating:	NEMA 6P	Enclosure Rating:	NEMA 4X
Operating Temp:	32 to 122°F	Operating Temp:	-4 to 140°F
Process Connection:		Accuracy:	±0.02 mg/L
Cable Length:	33 ft.	Integral/Remote Mount:	Remote
Cable Connection:	Integral w/ Quick Connect	Local Display:	Yes
Sensor Type:	Immersion	Input Signal:	(1) Digital

Comments:

Function	Signal	Units	Input		Output	
			LRV	URV	LRV	URV
Dissolved Oxygen	Analog Output 1	mg/L				

Description	Manufacturer	Part Number	Qty
Sensor	Hach	9020000	1
Transmitter	Hach	LXV404.99.00552	1
Handrail Mounting Kit	Hach	9253000	1
Guard Head Assembly	Hach	9253900	1

Rev	Date	By	Approval	Remarks
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Tel: 919-677-8310 ● Fax: 919-677-0082
Web site: www.krugerusa.com

VEOLIA WATER
Solutions & Technologies

Dissolved Oxygen: Hach LDO® Probe, Model 2

Applications

- Wastewater
- Industrial Water
- Drinking Water



Take "No" for an answer when measuring dissolved oxygen with the next generation Hach LDO probe.

No Calibration Required

The Hach LDO probe is ready to work in your process right out of the box with no calibration required for the entire 2 year life of the sensor cap.

No Membranes to Replace

There is virtually no maintenance with Hach's breakthrough luminescent technology, as there are no membranes to replace, no electrolyte solution to replenish, and no anode or cathode to clean.

No Missed Cleaning Cycles

Customizable service indicators trigger a service message so that a cleaning cycle is never missed.

No Drift

A cutting-edge 3D calibration procedure at the factory makes oxygen measurement with the Hach LDO probe more accurate than ever before.

No Complications

A robust new design gives the Hach LDO enhanced durability and reduced size for easier handling.

*Specifications**

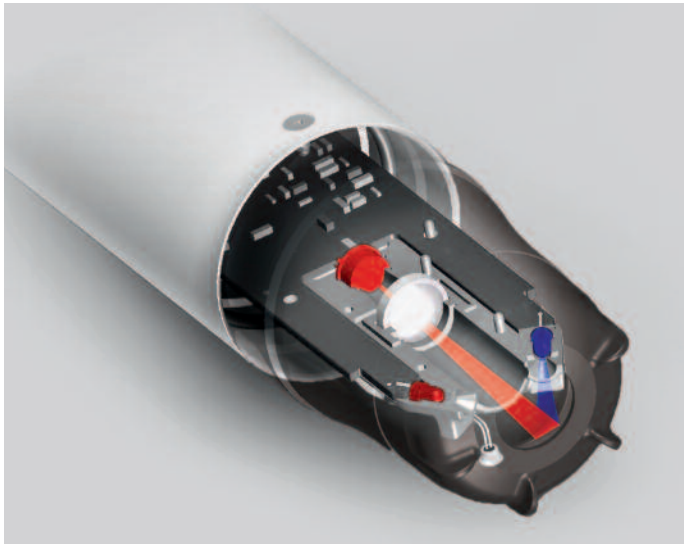
Measuring Range	0 - 20.00 ppm 0 - 20.0 mg/L 0 - 200% saturation
Accuracy	±0.1 ppm Below 5 ppm ±0.2 ppm Above 5 ppm Temperature: ±0.2°C
Response Time	at 20ºC: To 95% in less than 60 seconds To 90% in less than 40 seconds
Resolution	0.01 ppm (mg/L) / 0.1% saturation
Repeatability	±0.1 ppm (mg/L)
Operating Temperature	0 to 50°C (32 to 122°F)
Flow Rate	None required
Sensor Immersion Depth	Pressure Limits at 34 m 345 kPa (112 ft.), 345 kPa (50 psi), maximum; accuracy may not be maintained at this depth
Transmission Distance	1000 m (3280 ft.) maximum when used with a termination box
Cable Length	10 m
Wetted Materials	Sensor Cap: Acrylic; Probe Body: CPVC, Polyurethane, Viton, Noryl, 316 Stainless Steel
Dimensions (D x L)	1.95 in x 10.05 in (49.53 mm x 255.27 mm)
Weight	2.2 lbs. (1 kg)

**Subject to change without notice.*

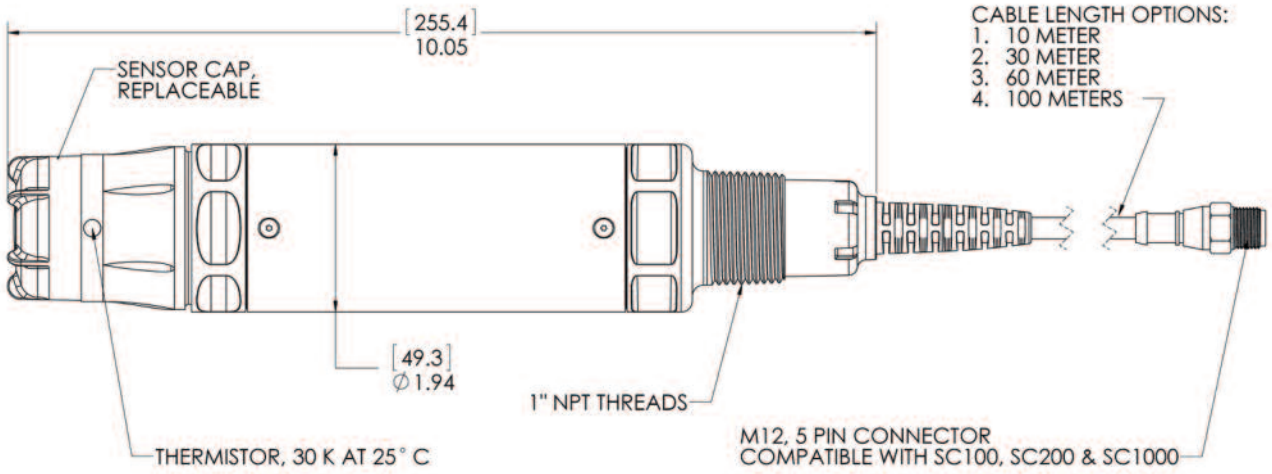
Principal of Operation

The HACH LDO sensor is coated with a luminescent material. Blue light from an LED is transmitted to the sensor surface. The blue light excites the luminescent material. As the material relaxes it emits red light. The time for the red light to be emitted is measured. Between the flashes of blue light, a red LED is flashed on the sensor and used as an internal reference.

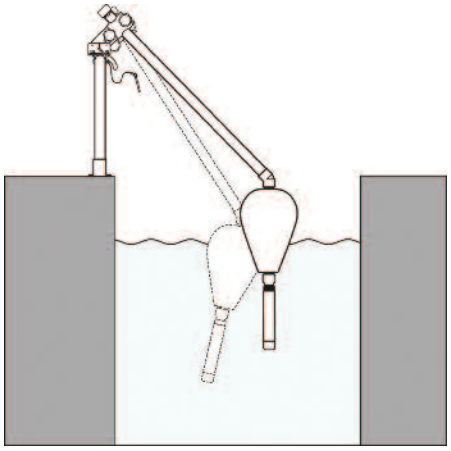
Increased oxygen in the sample decreases the time it takes for the red light to be emitted. The time measurements correlate to the oxygen concentration.



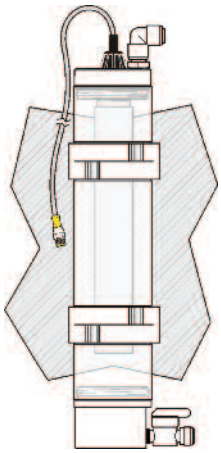
Dimensions



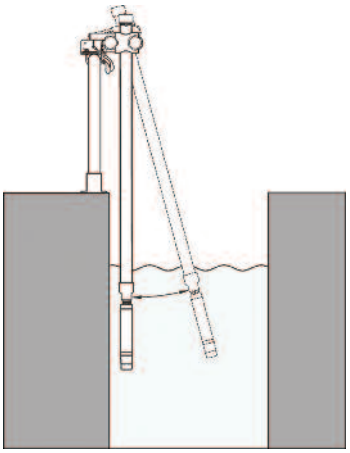
Installation / Mounting



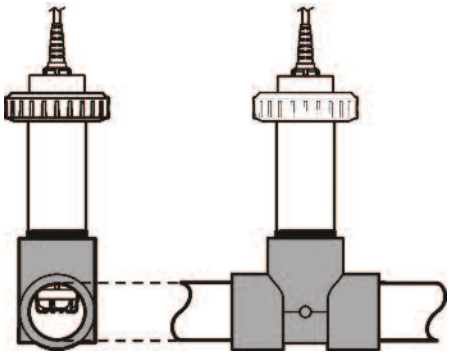
Float Mount Kit



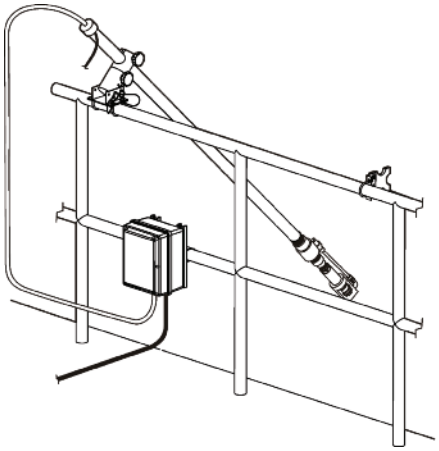
Flow Cell



Pole Mount Kit



Union Mount Kit



Air Blast Cleaning System

Ordering Information

9020000	Dissolved Oxygen: Hach LDO® Probe
9020000-UPGRADE	LDO Probe, Mounting Conversion Adapter
9020000-SC200	LDO Probe, Mounting Conversion Adapter, sc200 controller with 2 channels

Accessories

5867000	Digital Termination Box
5796000	Digital Extension Cable, 7.7 m (25 ft.)
5796100	Digital Extension Cable, 15 m (50 ft.)
5796200	Digital Extension Cable, 31 m (100 ft.)
6860000	High Output Air Blast Cleaning System, 115 Vac
6860100	High Output Air Blast Cleaning System, 230 Vac
9253500	Air Blast Hardware Components

Replacement Parts

9021100	LDO Model 2 Sensor Cap Replacement Kit

Mounting Kits

9253000	Pole Mount Kit, PVC
9253100	Ball Float Mount Kit, PVC
9257000	Union Mount Kit, PVC
9253400	Mounting Conversion Adapter, LDO Model 1 to LDO Model 2
7300800	1 NPT sc Sensors Flow Cell

Controllers

sc200 Digital Controllers

LXV404.99.00552	sc200 controllers, 2 channels, digital
LXV404.99.00542	sc200 controller, 2 channel, digital & mA input
LXV404.99.00502	sc200 controller, 1 channel, digital
LXV404.99.00512	sc200 controller, 2 channel, digital & pH/DO
LXV404.99.00522	sc200 controller, 2 channel, digital & Conductivity
LXV404.99.00532	sc200 controller, 2 channel, digital & Flow

sc1000 Digital Controllers

LXV402.99.00002	sc1000 Display Module
LXV400.99.1R572	sc1000 Probe Module, 4 sensors, 4 mA Out, 4 mA In, 4 Relays, 110-230V
LXV400.99.1B572	sc1000 Probe Module, 4 sensors, 4 mA Out, 4 mA In, 4 Relays, RS-485 (MODBUS), 110-230V
LXV400.99.1F572	sc1000 Probe Module, 4 sensors, 4 mA Out, 4 mA In, 4 Relays, PROFIBUS DP, 110-230V
LXV400.99.1R582	sc1000 Probe Module, 6 sensors, 4 mA Out, 4 mA In, 4 Relays, 110-230V







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www.hach.com

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In the interest of improving and updating its equipment, Hach Company reserves the right to alter specifications to equipment at any time.

HACH® Be Right™

Hach sc200™ Universal Controller



Choose from up to 29 digital or analog sensors for up to 15 different parameters.

Product Overview

One Controller for the Broadest Range of Sensors

The sc200 Universal Controller is the most versatile controller on the market. The sc200 controller allows the use of digital and analog sensors, either alone or in combination, to provide compatibility with the broadest range of sensors. It replaces the Hach sc100 digital and GLI53 analog controllers with advanced features for easier operator use.

The sc200 controller platform can be configured to operate either 2 Digital Sensor Inputs, or 1 or 2 Analog Sensor Inputs, or a combination of Digital and Analog Sensor Inputs. Customers may choose their communication options from a variety of offerings including MODBUS RTU, Profibus DPV1, and HART.

Features and Benefits

Maximum Versatility

- *Standardized controller eliminates the need for a variety of dedicated controllers*
- *Multi-channel controller operates either 1 or 2 sensors reducing inventory holding costs and providing an inexpensive option to add a second sensor at a later time*
- *"Plug and Play" operation with all Hach digital sensors*
- *True dual sensor controller provides 4-20 mA outputs to transmit primary and secondary measurement values*

Ease of Use and Confidence in Results

- *New display and guided calibration procedures reduce operator error*
- *Password protected SD card reader offers a simple solution for data download and transfer, and sc200 and digital sensor configuration file duplication and backup*
- *Visual warning system provides critical alerts*



Communication Options

- *MODBUS RS232/RS485, Profibus DPV1, or HART*

Controller Configuration	Functionality
2 Channel Digital Controller	Maximum versatility and flexibility: • Plug and play with all Hach digital sensors • Mix and match with Hach digital and GLI analog sensors
2 Channel Controller with 1 Analog and 1 Digital Sensor Input	• Plug and play with any one Hach digital sensor • Mix and match with any one GLI analog sensor
1 or 2 Channel Analog Controller	• Mix and match up to two GLI analog sensors

DW = drinking water *WW = wastewater municipal* ***PW = pure water / power***
IW = industrial water ***E = environmental*** *C = collections* ***FB = food and beverage***

DW WW PW IW

HACH®
Be Right™

Controller Comparison







Features	Previous Models sc100™ Controller	Previous Models GLI53 Controller	sc200™ Controller	Benefits
Display	64 x 128 pixels 33 x 66 mm (1.3 x 2.6 in.)	64 x 128 pixels 33 x 66 mm (1.3 x 2.6 in.)	160 x 240 pixels 48 x 68 mm (1.89 x 2.67 in.) Transreflective	• Improved user interface—50% bigger • Easier to read in daylight and sunlight
Data Management	irDA Port/PDA Service Cable	N/A	SD Card Service Cable	• Simplifies data transfer • Standardized accessories/ max compatibility
Sensor Inputs	2 Max Direct Digital Analog via External Gateway	2 Max Analog Depending on Parameter	2 Max Digital and/or Analog with Sensor Card	• Simplifies analog sensor connections • Works with GLI and Hach's digital sensors
Analog Inputs	N/A	N/A	1 Analog Input Signal Analog 4-20mA Card	• Enables non-sc analyzer monitoring • Accepts mA signals from other analyzers for local display • Consolidates analog mA signals to a digital output
4-20 mA Outputs	2 Standard	2 Standard	2 Standard Optional 3 Additional	• Total of five (5) 4-20 mA outputs allows multiple mA outputs per sensor input
Digital Communication	MODBUS RS232/RS485 Profibus DP V1.0	HART	MODBUS RS232/RS485 Profibus DP V1.0 HART 7.2	• Unprecedented combination of sensor breadth and digital communication options

To complete your measurement system, choose from Hach's portfolio of controller and sensor products...



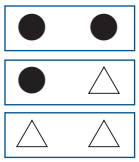
Choose from Hach's Broad Range of Digital and Analog Sensors

Parameter	Sensor	Digital or Analog
Ammonia	AMTAX™ sc, NH4D sc	●
Chlorine	CLF10 sc, CLT10 sc, 9184 sc	●
Chlorine Dioxide	9185 sc	●
Conductivity	3400, 3700	△
Dissolved Oxygen	LDO™, 5740 sc	●
Dissolved Oxygen	5500	△
Flow	U53, F53 Sensors	△
Nitrate	NITRATAX™ sc, NO3D sc	●
Oil in Water	FP360 sc	●
Organics	UVAS sc	●
Ozone	9187 sc	●
pH/ORP	pHD	●
pH/ORP	pHD, pH Combination, LCP	△
Phosphate	PHOSPHAX™ sc	●
Sludge Level	SONATAX™ sc	●
Suspended Solids	SOLITAX™ sc, TSS sc	●
Turbidity	1720E, FT660 sc, SS7 sc, ULTRATURB sc, SOLITAX sc	●

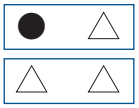
● = Digital △ = Analog

The diagrams below demonstrate the versatility and flexibility for the base controller units. Connect any of the appropriate sensors listed above to meet your measurement needs. Operation of analog sensors require the controller to be equipped with the appropriate sensor card.

2 Channel Digital Controller Configurations



2 Channel Controller with 1 Analog and 1 Digital Sensor Input Configurations



2 Channel Analog Controller Configurations



Engineering Specifications

1. The controller shall be a microprocessor based instrument.
2. The enclosure shall be 1/2 DIN format, NEMA4X rated for wall, pole and panel mounting.
3. The controller shall be available in either 100–240 Vac 50/60 Hz or 24 Vdc power supply versions.
4. The controller shall offer two analog 0/4-20 mA output signals with independent PID control functions and optional additional 4-20 mA outputs.
5. The controller shall accept either Digital Sensors or Sensor Modules for analog pH, Conductivity, DO, Paddle Wheel Flow, and Ultra Sonic Flow sensors.
6. The controller shall have single channel and dual channel options.
7. The controller shall have options for MODBUS RS232, MODBUS RS485, Profibus DPV1, and HART 7.2 communication.
8. The display contrast shall be adjustable.
9. The Menu shall be available in at least 19 different languages.
10. The controller shall have 2 Data logs, 128 kb each. The logged data shall be downloadable on a SD card in XML format.
11. The controller shall be Hach Company sc200 Universal Controller.

Specifications*

sc200 General Specifications

Display
Graphic dot matrix LCD with LED backlighting
Transreflective

Display Size
48 x 68 mm (1.89 x 2.67 in.)

Display Resolution
240 x 160 pixels

Height x Width x Depth
144 x 144 x 181 mm (5.7 x 5.7 x 7.1 in.)

Weight
1.70 kg (3.75 lb)

Power Requirements
100 – 240 Vac ±10%, 50/60 Hz
24 Vdc -15% + 20%

Operating Temperature
-20 to 60°C (-4 to 140°F), 0 to 95% RH non-condensing

Storage Temperature
-20 to 70°C (-4 to 158°F), 0 to 95% RH non-condensing

Analog Output Signal
Two 0/4-20 mA isolated current outputs, max 500Ω

Operational Mode
Primary or secondary measurement or calculated value (dual channel only)

Functional Mode
Linear, Logarithmic, Bi-linear, PID

Optional 3 additional 4-20 mA isolated current outputs, max 500Ω @ 18-24 Vdc loop-powered or max 350Ω @ 15 Vdc (self-powered)

Security Levels
Two password protected levels

Enclosure Materials
Polycarbonate, Aluminum (powder coated), Stainless Steel

Mounting Configurations
Wall, pole and panel mounting

Enclosure Rating
NEMA4X / IP66

Conduit Openings
1/2" NPT Conduit

Relays
Four electromechanical SPDT (Form C) contacts, 1200W, 5 A, 250 Vac

Operational Mode
Primary or secondary measurement, calculated value (dual channel only) or timer

Functional Mode
Alarm, Timer, Feeder Control, PWM or FM Control, System Alarm

Digital Communication
MODBUS RS232/RS485, Profibus DPV1, or HART 7.2 optional

Memory Backup
Flash memory

Electrical Certifications
EMC
CE compliant for conducted and radiated emissions:
- CISPR 11 (Class A limits)
- EMC Immunity EN 61326-1 (Industrial limits)

Safety
cETLus safety mark for:
- General Locations per ANSI/UL 61010-1 & CAN/CSA C22.2. No. 61010-1
- Hazardous Location Class I, Division 2, Groups A,B,C & D (Zone 2, Group IIC) per FM 3600 / FM 3611 & CSA C22.2 No. 213 M1987 with approved options and appropriately rated Class I, Division 2 or Zone 2 sensors

OR
cULus safety mark (for Indoor Use Only)
- General Locations per UL 61010-1 & CAN/CSA C22.2. No. 61010-1

Warranty
2 years

sc200 for Hach Analog pH/ORP Sensors

Measuring Range
-2.0 to 14.0 pH or -2.00 to 14.00 pH
-2,100 to 2,100 mV

Repeatability
±0.1% of range

Response Time
0.5 s

Temperature Range
PT100/PT1000: -20 to 200°C (-4 to 392°F)
NTC300: -20 to 110°C (-4 to 230°F)
Manual: -25 to 400°C (-13 to 752°F)

Temperature Accuracy
±0.5°C (0.9°F)

Temperature Drift
±0.03% of reading /°C

Temperature Compensation
Automatic from -20 to 110°C (-4 to 230°F) or manual

Temperature Sensors
PT100/PT1000/NTC300

Temperature Compensation Curves
Nernst, for Pure Water: Ammonia, Morpholine, User Defined (linear)

Sensor-to-Controller Distance (maximum)
pHD or LCP sensor: 914 m (3000 ft.)
pH Combination electrode w/ preamplifier: 300 m (958 ft.)
pH Combination electrode w/o preamplifier: 30 m (100 ft.), depending on environment this distance is shorter

Calibration Methods
2-point buffer (pH only)
1-point buffer (pH only)
2-point sample (pH only)
1-point sample (pH or ORP)

Specifications *continued*

sc200 for Hach Analog Contacting Conductivity Sensors

Measuring Range

Conductivity
µS/cm: 0-2.000, 0-20.00, 0-200.0 or 0-2,000
mS/cm: 0-2.000, 0-20.00 or 0-200.0

Resistivity
0-19.99 MΩ•cm or 0-999.9 kΩ•cm

TDS
0-9999 ppm or 0-9999 ppb

Repeatability, Precision (0-20 µS/cm, K=1)
±0.02 mS/cm

Repeatability (20-200,000 µS/cm, K=1)
±0.1% of reading

Response Time
0.5 s

Temperature Range
-20 to 200°C (-4 to 392°F)

Temperature Accuracy
±0.5°C (0.9°F)

Temperature Drift
> 20 µS/cm: ±0.02% of reading / °C
< 20 µS/cm: ±0.004 µS/cm

Temperature Compensation
Automatic from -20 to 200°C (-4 to 392°F) or manual

Temperature Sensor
PT100/PT1000

Temperature Compensation Curves
Linear, Ammonia, Natural water, User Defined, none

Sensor-to-Controller Distance (max)
91m (300 ft.)

Calibration Methods
Zero
GLI DRY-CAL
1-point sample

sc200 for Hach Analog Inductive Conductivity Sensors

Measuring Range

Conductivity
µS/cm: 0-200.0 or 0-2,000
mS/cm: 0-2.000, 0-20.00, 0-200.0 or 0-2,000
S/cm: 0-2.000

% Concentration
0-99.99% or 0-200.0%

TDS
0-9999 ppm repeatability

Repeatability > 500 µS/cm
±0.5% of reading

Repeatability < 500 µS/cm
±2.5 µS/cm

Response Time
1 s

Temperature Range
-20 to 200°C (-4 to 392°F)

Temperature Accuracy
±0.5°C (0.9°F)

Temperature Drift
> 500 µS/cm: ±0.02% of reading / °C
< 500 µS/cm: ±0.1 µS/cm

Temperature Compensation
Automatic from -20 to 200°C (-4 to 392°F) or manual

Temperature Sensors
PT1000

Temperature Compensation Curves
Linear, Natural water, User Defined, none**

Concentration Curves
H_3PO_4: 0-40%; HCl: 0-18%; HCl: 22-36%; NaOH: 0-16%; $CaCl_2$: 0-22%; HNO_3: 0-28%; HNO_3: 36-96%; H_2SO_4: 0-30%; H_2SO_4: 40-80%

Sensor-to-Controller Distance

Full-scale value	*Maximum length*
200 to 2,000 µS/cm	61m (200 ft.)
2,000–2,000,000 µS/cm	91m (300 ft.)

Calibration Methods
1-point Cond (or Concentration or TDS)
Zero

***Available curves depend on the selected type of measurement (Conductivity, Concentration or TDS).*

Continued on next page.

Specifications *continued*

Linearity 3700 Inductive Conductivity Sensors

1.5 mS/cm – 2 S/cm
1% or reading

< 1.5 mS/cm
±15 µS/cm

Linearity 3700 Inductive Conductivity Sensors with Multiple Point Calibration

1.5 mS/cm – 2 S/cm
0.5% or reading

< 1.5 mS/cm
±5 µS/cm

sc200 for Hach Analog Dissolved Oxygen Sensors

Measuring Range
0 to 40 ppm
200% saturation

Repeatability
±0.05% of range

Response Time
0.5 s

Temperature Range
0 to 50°C (32 to 122°F)

Temperature Accuracy
±0.5°C (0.9°F)

Temperature Drift
±0.02% of reading / °C

Temperature Compensation
Automatic from 0 to 40 ppm or manual

Temperature Sensor
NTC30K / Manual

Sensor-to-Controller Distance (max)
305 m (1000 ft.)

Calibration Methods
Sample
Air
Saturation

sc200 for Hach UltraSonic Flow Sensor

Flow Rate
0-9999, 0-999.9, 0-99.99 with selectable flow rate units and multiplier

Volume
0-9,999,999 with selectable volume units

Depth
0-1200.0 inches, 0-100.0 feet, 0-30,000 mm, or 0-30.00 meters

Input Filter
999 sec

Totalizers
8-digit resettable LCD software totalizer

Totalized Flow
Gal., $ft.^3$, acre-ft., lit., m^3

Repeatability
±0.1% of span

Sensor-to-Controller Distance (max)
100 m (328 ft.)

Calibration Methods
Cal Depth 1 point
Cal Depth 2 point

sc200 for Hach Paddle Wheel Flow Sensor

Flow Rate
Function of Structure Type: 0-9999, 0-999.9, 0-99.99 with selectable flow rate units and multiplier

Volume
0-9,999,999 with selectable volume units

Input Filter
999 sec

Totalizers
8-digit resettable LCD software totalizer

Totalized Flow
Gal., $ft.^3$, acre-ft., lit., m^3

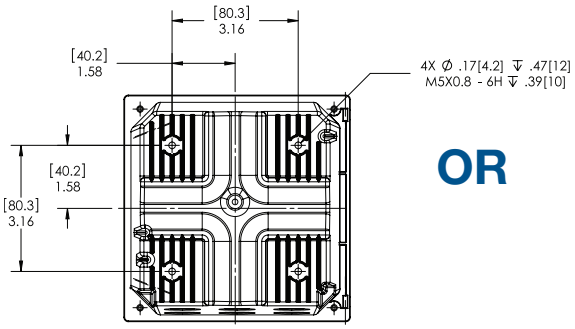
Sensor-to-Controller Distance (max)
GLI impeller Sensors: 610m (2000 ft.)
Non-GLI Sensors: 91m (300 ft.)

**Specifications subject to change without notice.*

Dimensions

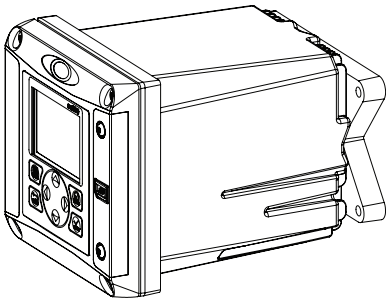
The sc200 controller unit can be installed on a surface, panel, or horizontal or vertical pipe. Pipe Mount hardware is included.
NOTE: Dimensions are in inches [millimeters].

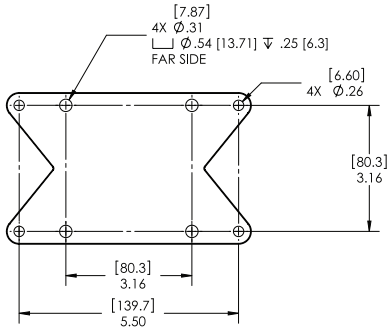
Surface Mounting Dimensions



Mounting Dimensions
(Rear View)

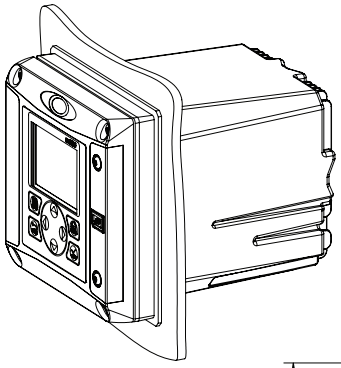
OR

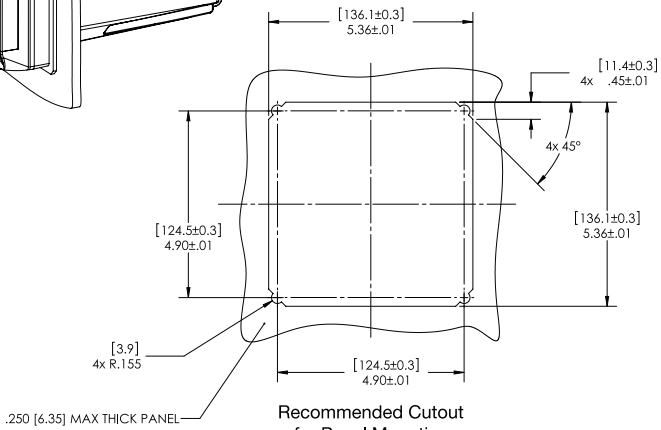




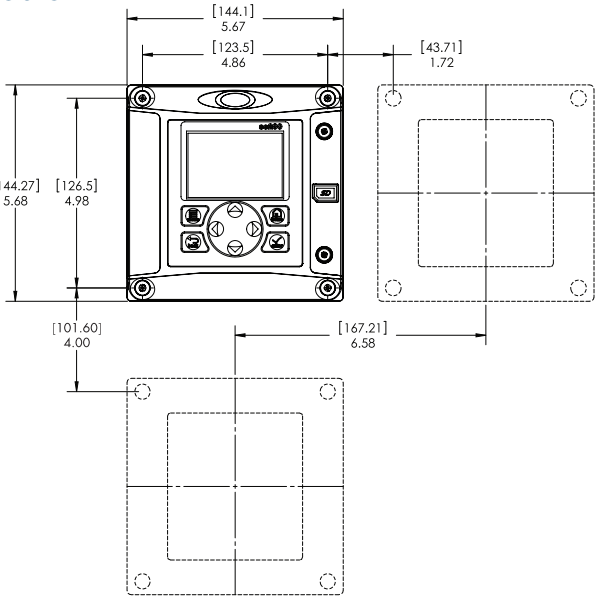
Bracket (supplied) for Surface Mounting
(Not compatible with Weather and Sun Shield p/n 9220600 when surface mounting.)

Panel Mounting Dimensions



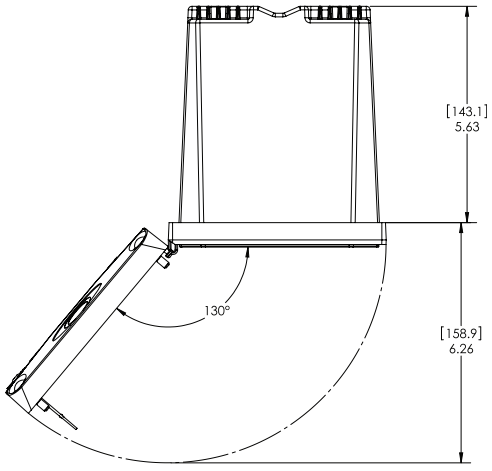


Recommended Cutout
for Panel Mounting

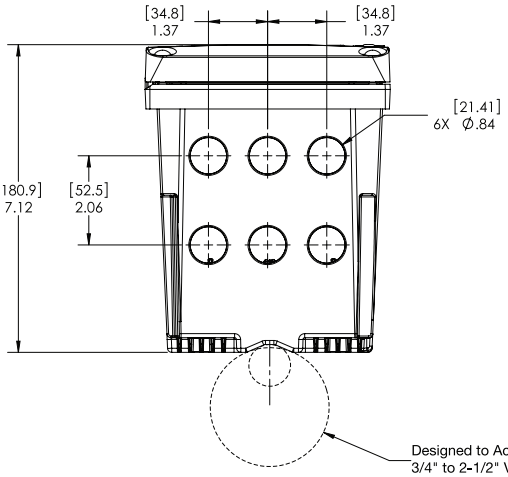


Minimum Spacing Dimensions
for Group Mounting

Top and Bottom Views



Door Opening Details



Ordering Information

sc200 for Hach Digital Sensors

LXV404.99.00552	sc200 controller, 2 channel, digital
LXV404.99.00502	sc200 controller, 1 channel, digital
LXV404.99.00542	sc200 controller, 2 channel, digital & mA input
LXV404.99.00512	sc200 controller, 2 channel, digital & analog pH/DO
LXV404.99.00522	sc200 controller, 2 channel, digital & analog Conductivity
LXV404.99.00532	sc200 controller, 2 channel, digital & analog Flow

sc200 for Hach Analog Sensors

LXV404.99.00102	sc200 controller, 1 channel, pH/DO
LXV404.99.00112	sc200 controller, 2 channel, pH/DO
LXV404.99.00202	sc200 controller, 1 channel, Conductivity
LXV404.99.00222	sc200 controller, 2 channel, Conductivity
LXV404.99.00212	sc200 controller, 2 channel, pH/DO & Conductivity
LXV404.99.00302	sc200 controller, 1 channel, Flow
LXV404.99.00332	sc200 controller, 2 channel, Flow
LXV404.99.00312	sc200 controller, 2 channel, Flow & pH/DO
LXV404.99.00322	sc200 controller, 2 channel, Flow & Conductivity

Note: Other Sensor combinations are available. Please contact Hach Technical Support or your Hach representative.

Note: Communication options (MODBUS, Profibus DPV1, and HART) are available. Please contact Hach Technical Support or your Hach representative.

Power Cords

9202900	sc200 power cord with strain relief, 125 Vac
9203000	sc200 power cord with strain relief, 230 Vac, European-style plug

Accessories

9220600	sc200 Weather and Sun Shield with UV Protection Screen
8809200	sc200 UV Protection Screen
9218200	SD card reader (USB) for connection to PC
9218100	4 GB SD card

Sensor and Communication Modules

9012900	pH and DO module
9013000	Conductivity module
9012700	Flow module
9012800	4-20 mA input module
9013200	MODBUS network module
9173900	Profibus network module
9328100	HART network module
9334600	4-20 mA output module

At Hach, it's about learning from our customers and providing the right answers. It's more than ensuring the quality of water—it's about ensuring the quality of life. When it comes to the things that touch our lives...

Keep it pure.

Make it simple.

Be right.

For current price information, technical support, and ordering assistance, contact the Hach office or distributor serving your area.

In the United States, contact:

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SECTION 4.6

pH ANALYZER

VEOLIA WATER
Solutions & Technologies

INSTRUMENT DATASHEET

PROJECT NAME: Massillon, OH

PROJECT NO.: 5700235402

pH Analyzer		Train 1 Anoxic 2 pH

Sensor		Transmitter	
Model No.:	pHD	Model No.:	SC200
Range:	-2 to 14 pH	Range:	-2 to 14 pH
Power Supply:	Transmitter Supplied	Power Supply:	100 to 240 VAC
Power Requirements:	1.5 watts	Power Requirements:	100 VA
Output Signal:	Digital	Output Signal:	(2) 4-20mA
Enclosure Rating:	NEMA 6P	Enclosure Rating:	NEMA 4X
Operating Temp:	23 to 158°F	Operating Temp:	-4 to 140°F
Process Connection:	1" NPT	Accuracy:	±0.02 pH
Cable Length:	33 ft.	Integral/Remote Mount:	Remote
Cable Connection:	Integral w/ Quick Connect	Local Display:	Yes
Sensor Type:	Convertible (Immersion)	Input Signal:	(1) Digital

Comments:

Function	Signal	Units	Input		Output	
			LRV	URV	LRV	URV
pH	Analog Output 1	pH				

Description	Manufacturer	Part Number	Qty
Sensor	Hach	DPD1P1	1
Transmitter	Hach	LXV404.99.00552	1
Hand Rail Mount	Hach	MH236B00Z	1
pH 7 Buffer	Hach	2283549	1
pH 4 Buffer	Hach	2283449	1

Rev	Date	By	Approval	Remarks
0	1/23/2015	MRO		ISSUED FOR APPROVAL

Kruger Inc.
4001 Weston Parkway
Cary, NC 27513 USA
Tel: 919-677-8310 ● Fax: 919-677-0082
Web site: www.krugerusa.com

VEOLIA WATER
Solutions & Technologies

INSTRUMENT DATASHEET

PROJECT NAME: Massillon, OH

PROJECT NO.: 5700235402

pH Analyzer		Train 2 Anoxic 2 pH

Sensor		Transmitter	
Model No.:	pHD	Model No.:	SC200
Range:	-2 to 14 pH	Range:	-2 to 14 pH
Power Supply:	Transmitter Supplied	Power Supply:	100 to 240 VAC
Power Requirements:	1.5 watts	Power Requirements:	100 VA
Output Signal:	Digital	Output Signal:	(2) 4-20mA
Enclosure Rating:	NEMA 6P	Enclosure Rating:	NEMA 4X
Operating Temp:	23 to 158°F	Operating Temp:	-4 to 140°F
Process Connection:	1" NPT	Accuracy:	±0.02 pH
Cable Length:	33 ft.	Integral/Remote Mount:	Remote
Cable Connection:	Integral w/ Quick Connect	Local Display:	Yes
Sensor Type:	Convertible (Immersion)	Input Signal:	(1) Digital

Comments:

Function	Signal	Units	Input		Output	
			LRV	URV	LRV	URV
pH	Analog Output 1	pH				

Description	Manufacturer	Part Number	Qty
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VEOLIA WATER
Solutions & Technologies

INSTRUMENT DATASHEET

PROJECT NAME: Massillon, OH

PROJECT NO.: 5700235402

pH Analyzer		Train 3 Anoxic 2 pH

Sensor		Transmitter	
Model No.:	pHD	Model No.:	SC200
Range:	-2 to 14 pH	Range:	-2 to 14 pH
Power Supply:	Transmitter Supplied	Power Supply:	100 to 240 VAC
Power Requirements:	1.5 watts	Power Requirements:	100 VA
Output Signal:	Digital	Output Signal:	(2) 4-20mA
Enclosure Rating:	NEMA 6P	Enclosure Rating:	NEMA 4X
Operating Temp:	23 to 158°F	Operating Temp:	-4 to 140°F
Process Connection:	1" NPT	Accuracy:	±0.02 pH
Cable Length:	33 ft.	Integral/Remote Mount:	Remote
Cable Connection:	Integral w/ Quick Connect	Local Display:	Yes
Sensor Type:	Convertible (Immersion)	Input Signal:	(1) Digital

Comments:

Function	Signal	Units	Input		Output	
			LRV	URV	LRV	URV
pH	Analog Output 1	pH				

Description	Manufacturer	Part Number	Qty
Sensor	Hach	DPD1P1	1
Transmitter	Hach	LXV404.99.00552	1
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Rev	Date	By	Approval	Remarks
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VEOLIA WATER
Solutions & Technologies

DIFFERENTIAL pH AND ORP SENSORS

Applications

- Drinking Water
- Wastewater
- Industrial Water
- Power



Wide range pH glass
(HF resistant glass also available)



The smart choice for accurate, reliable, and dependable pH/ORP measurement.

Hach Digital pHD sc sensors are available in convertible (PEEK® or Ryton®), insertion, and sanitary body styles. Three electrodes are used in these sensors to increase measurement accuracy and eliminate sensor ground loops.

Differential Electrode Measurement Technique

This field-proven technique uses three electrodes instead of the two normally used in conventional pH sensors. Process and reference electrodes measure the pH differentially with respect to a third ground electrode. The end result is unsurpassed measurement accuracy, reduced reference junction potential, and elimination of sensor ground loops. These sensors provide greater reliability, resulting in less downtime and maintenance.

Patented Technology

The former GLI, now a Hach Company brand, invented the Differential Electrode Technique for pH measurement in 1970. The pHD™ sensor series (U.S. Patent Number 6395158B1, May 28, 2002) takes this field-proven technology to a new level.

Replaceable Salt Bridge/Protector

The unique, replaceable salt bridge holds an extraordinary volume of buffer to extend the working life of the sensor by protecting the reference electrode from harsh process conditions.

Built-in Encapsulated Preamp

Encapsulated construction protects the sensor's built-in preamp from moisture and humidity, ensuring reliable sensor operation. The preamp in the pHD analog sensor produces a strong signal, enabling the sensor to be located up to 1000 m (3280 ft.) from the analyzer.

Durable Body Materials

Both the digital and analog pH and ORP differential sensors feature a durable PEEK® body for chemical compatibility with most process solutions. For less aggressive solutions, Hach offers a Ryton® sensor in a convertible style for pH and ORP measurement. A sensor with a stainless steel body is available for immersion applications.

Versatile Mounting Styles

Sensors are available in four mounting styles—convertible, insertion, immersion, and sanitary.

Differential Sensor Warranty

Hach Company offers an outstanding warranty on its differential sensors. We will replace any differential sensor that fails due to defects in materials or workmanship within one year from the date of shipment, and up to 30 months on a prorated basis for any failure.

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Specifications*

pH Sensors

Some industrial applications require accurate measurement and control below 2 or above 12 pH. In these special cases, please contact Hach Technical Support for further details.

Measuring Range	-2 to 14 pH
Sensitivity	±0.01 pH
Stability	0.03 pH per 24 hours, non-cumulative
Operating Temperature	Digital Sensor: -5 to 70ºC (23 to 158ºF) Analog Sensor with Digital Gateway: 5 to 105ºC (23 to 221ºF) Immersion Sensor: 0 to 50ºC (32 to 122ºF)
Flow Rate	3 m (10 ft.) per second, maximum
Sensor Pressure/ Temperature Limits	Digital: 6.9 bar at 70ºC (100 psi at 158ºF) Analog: 6.9 bar at 105ºC (100 psi at 221ºF)
Built-in Temperature Element	NTC 300 ohm thermistor for automatic temperature compensation and analyzer temperature readout
Transmission Distance	100 m (328 ft.), maximum 1000 m (3280 ft.), maximum when used with a termination box
Sensor Cable (integral)	4 conductor cable with one shield and polyurethane jacket; rated to 105ºC (221ºF); 10 m (33 ft.) standard length
Wetted Materials	PEEK® or Ryton® (PVDF), salt bridge of matching material with Kynar® junction, glass process electrode, titanium ground electrode, and Viton® O-ring seals (Please contact Hach Technical Support for available wetted O-ring materials.)

ORP (Redox) Sensors

For best ORP measuring results in solutions containing zinc, cyanide, cadmium or nickel, Hach recommends using the pHD sc ORP sensor equipped with an optional gold electrode.

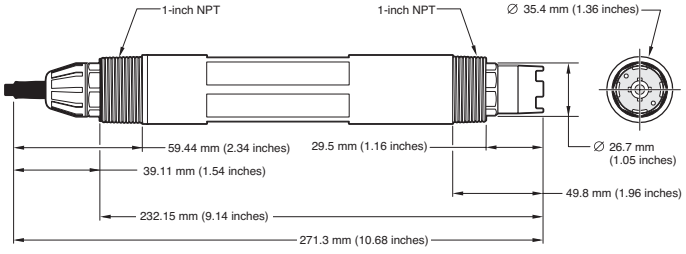
Measuring Range	-1500 to +1500 mV
Sensitivity	±0.5 mV
Stability	2 mV per 24 hours, non-cumulative
Operating Temperature	Digital Sensor: -5 to 70ºC (23 to 158ºF) Analog Sensor with Digital Gateway: -5 to 105ºC (23 to 221ºF) Immersion Sensor: 0 to 50ºC (32 to 122ºF)
Flow Rate	3 m (10 ft.) per second, maximum
Sensor Pressure/ Temperature Limits	Digital: 6.9 bar at 70ºC (100 psi at 158ºF) Analog: 6.9 bar at 105ºC (100 psi at 221ºF)
Built-in Temperature Element	NTC 300 ohm thermistor for analyzer temperature readout only—no automatic temperature compensation necessary for ORP measurement
Transmission Distance	100 m (328 ft.), maximum 1000 m (3280 ft.), maximum when used with a termination box
Sensor Cable (integral)	4 conductor cable with one shield and polyurethane jacket; rated to 105ºC (221ºF); 10 m (33 ft.) standard length
Wetted Materials	PEEK® or Ryton® (PVDF), salt bridge of matching material with Kynar® junction, glass and platinum (or plastic and gold) process electrode, titanium ground electrode, and Viton® O-ring seals

**Subject to change without notice.*

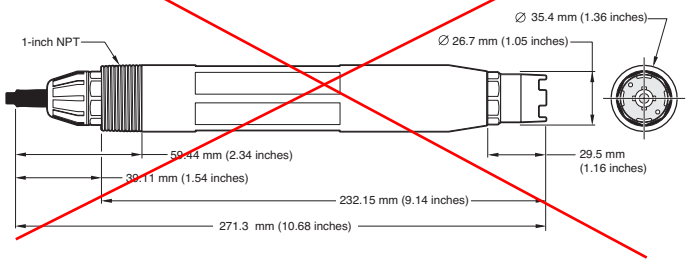
PEEK® is a registered trademark of ICI Americas, Inc.; Ryton® is a registered trademark of Phillips 66 Co.; Kynar® is a registered trademark of Pennwalt Corp.; Viton® is a registered trademark of E.I. DuPont de Nemours + Co.

Dimensions

Convertible Style



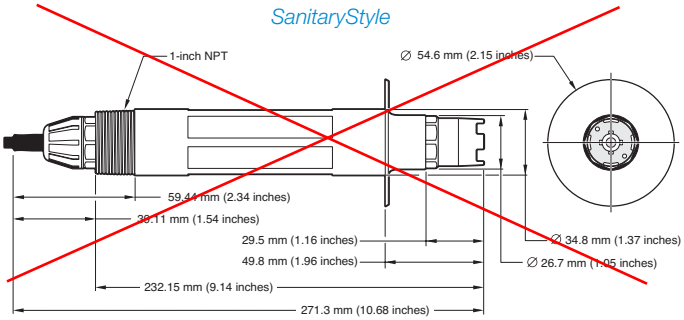
Insertion Style



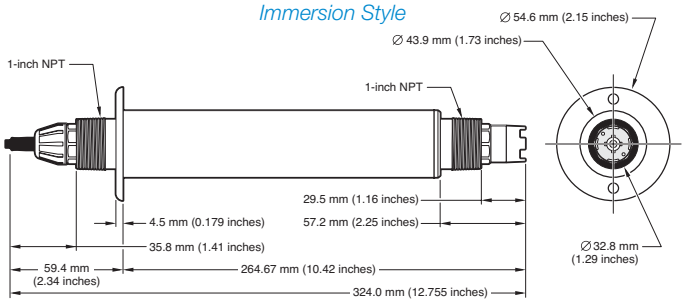
Continued on next page.

Dimensions *continued*

SanitaryStyle



Immersion Style



Ordering Information

pHD sc Digital Differential pH/ORP Sensors

All digital sensors include built-in digital electronics and integral 10 m (33 ft.) cable terminated with connector for the Hach sc Digital Controllers.

pH Sensors

Prod. No.	Body Material	Body Style*	Electrode Material	Max Temp
DPD1P1	PEEK[1]	Convertible	Glass, General Purpose	70ºC (158ºF)
DPD1P3	PEEK[1]	Convertible	Glass, HF-resistant	70ºC (158ºF)
DPD2P1	PEEK[1]	Insertion	Glass, General Purpose	70ºC (158ºF)
DPD3P1	PEEK[1]	Sanitary	Glass, General Purpose	70ºC (158ºF)
DPD1R1	Ryton[2]	Convertible	Glass, General Purpose	70ºC (158ºF)
DPD1R3	Ryton[2]	Convertible	Glass, HF-resistant	70ºC (158ºF)
DPS1	Stainless Steel	Immersion	Glass, General Purpose	50ºC (122ºF)

[1]Polyetheretherketone [2]Polyphenelene Sulfide

ORP Sensors

Prod. No.	Body Material	Body Style*	Electrode Material	Max Temp
DRD1P5	PEEK[1]	Convertible	Platinum	70ºC (158ºF)
DRD1P6	PEEK[1]	Convertible	Gold	70ºC (158ºF)
DRD2P5	PEEK[1]	Insertion	Platinum	70ºC (158ºF)
DRD1R5	Ryton[2]	Convertible	Platinum	70ºC (158ºF)
DRD1R6	Ryton[2]	Convertible	Gold	70ºC (158ºF)
DRS5	Stainless Steel	Immersion	Platinum	50ºC (122ºF)

[1]Polyetheretherketone [2]Polyphenelene Sulfide

Digitl Gateway

6120500 Digital Gateway, convert pHD analog sensors to digital output for connecting to sc1000 digital controller

pHD Analog Sensors

All analog sensors include built-in preamplifier and integral 4.5 m (15 ft.) cable terminated with stripped and tinned wires.

pH Sensors

Prod. No.	Body Material	Body Style*	Electrode Material	Max Temp
PD1P1	PEEK[1]	Convertible	Glass, General Purpose	95ºC (203ºF)
PD1P3	PEEK[1]	Convertible	Glass, HF-resistant	95ºC (203ºF)
PD2P1	PEEK[1]	Insertion	Glass, General Purpose	95ºC (203ºF)
PD3P1	PEEK[1]	Sanitary	Glass, General Purpose	95ºC (203ºF)
PD1R1	Ryton[2]	Convertible	Glass, General Purpose	95ºC (203ºF)
PD1R3	Ryton[2]	Convertible	Glass, HF-resistant	95ºC (203ºF)

[1]Polyetheretherketone [2]Polyphenelene Sulfide

ORP Sensors

Prod. No.	Body Material	Body Style*	Electrode Material	Max Temp
RD1P5	PEEK[1]	Convertible	Platinum	95ºC (203ºF)
RD1P6	PEEK[1]	Convertible	Gold	95ºC (203ºF)
RD2P5	PEEK[1]	Insertion	Platinum	95ºC (203ºF)
RD1R5	Ryton[2]	Convertible	Platinum	95ºC (203ºF)
RD1R6	Ryton[2]	Convertible	Gold	95ºC (203ºF)

[1]Polyetheretherketone [2]Polyphenelene Sulfide

**Definitions of body styles:*

- *Convertible – 1-inch NPT threads at both ends, designed for tee-mounting or other flow through mountings, and pipe mounting for immersion*
- *Insertion – no threads on the electrode end, designed for use with insertion valve assembly*
- *Sanitary – 2-inch flange for a tri-clover style fitting*
- *Immersion – used with chain mounting or pipe mounting*

Continued on next page.

Ordering Information *continued*

pHD sc Digital and pHD Analog Sensor Accessories

Cables

Extension cables are used only with digital sensors or digital gateways when connecting to an sc Digital Controller.

6122400	Digital Extension Cable, 1 m (3.2 ft.)
5796000	Digital Extension Cable, 7.7 m (25 ft.)
5796100	Digital Extension Cable, 15 m (50 ft.)
5796200	Digital Extension Cable, 31 m (100 ft.)

Interconnect cables are used only with analog sensors, junction box, and controller.

1W1100	Analog Interconnect Cable, order per foot

Digital Termination Box

Required when the cable between the sensor/gateway and sc Digital Controller is 100 m (328 ft.) to 1000 m (3280 ft.)

5867000	Digital Termination Box

Analog Junction Box

Required when the cable between the analog sensor and controller is greater than standard sensor cable. Includes terminal strip and gasket.

60A2053	Junction Box, Surface-mount, aluminum (includes mounting hardware)
60A9944	Junction Box, Pipe-mount, PVC (for 1/2-inch diameter pipe, includes mounting hardware)
60G2052	Junction Box, Pipe-mount, PVC (for 1-inch diameter pipe, includes mounting hardware)
76A4010-001	Junction Box, NEMA 4X (no mounting hardware included)

Salt Bridges

The double junction salt bridge on the standard cell of all Hach pHD sensors is field-replaceable.

SB-P1SV	PEEK Sensor and Salt Bridge Body, Kynar (PVDF) Outer Junction
SB-P2SV	PEEK Sensor and Salt Bridge Body, Ceramic Outer Junction
SB-P1SP[1]	PEEK Sensor and Salt Bridge Body, Kynar (PVDF) Outer Junction
SB-R1SV	RytonSensor and Salt Bridge Body Kynar (PVDF) Outer Junction

[1]*Special perfluoroelastomer O-ring in place of the Viton® O-ring*

pHD Sensor Reagents and Standards

25M1A1025-115	Standard Cell Solution, 500 mL
25M8A1002-101	Gel Powder, for high temperature applications, 2 g

pH Buffers

2283549	pH 7, 500 mL (1 pint)
2283449	pH 4, 500 mL (1 pint)
2283649	pH 10, 500 mL (1 pint)

ORP Reference Solutions (in resealable plastic bottles)

25M2A1001-115	200 mV	500 mL (1 pint)
25M2A1002-115	600 mV	500 mL (1 pint)

Mounting Hardware for pHD sc Differential Sensors

Sanitary Mount

MH018S8SZ 316 SS

Includes 2-inch sanitary tee and heavy-duty clamp. Cap and EPDM compound gasket supplied with sensor; can be ordered separately.

Union Mount

6131300	CPVC
6131400	316 SS

Includes standard 1-1/2 inch tee, union pipe with adapter, sealing hub, and lock ring and Viton® O-ring.

Flow-through Mount

MH334N4NZ	CPVC
MH314N4MZ	316 SS

Includes a standard 1-inch tee in respective material.

Insertion Mount

Digital		*Analog*	
5646300	CPVC	**5646400**	CPVC
5646350	316 SS	**5646450**	316 SS

Includes a 1-1/2 inch ball valve, 1-1/2 inch NPT close nipple, sensor adapter with two Viton® O-rings and wiper, extension pipe, pipe adapter, back tube, and lock ring.

Immersion Mount

Standard Hardware

Digital		*Analog*	
6136400	CPVC	**MH434A00B**	CPVC
6136500	316 SS	**MH414A00B**	316 SS

Includes 1-inch by 4 ft. pipe and 1-inch x 1-inch NPT coupling. (Pipe-mount junction box with terminal strip included in analog hardware.)

Handrail Hardware

MH236B00Z CPVC

Includes 1-1/2 inch by 7.5 ft. CPVC pipe, and swivel/pivot/ pipe clamp assembly.

Chain Mount Hardware

2881900 316 ss

Includes stainless steel bail, nuts, and washers. Does not include chain. To be used with stainless steel immersion sensor only.

Ball Float Hardware

6131000 CPVC

Includes 1-1/2 inch by 7.5 ft. CPVC pipe, ball float assembly, and swivel/pivot/ pipe clamp assembly.

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Hach Company reserves the right to alter specifications to equipment at any time.

HACH® Be Right™

Hach sc200™ Universal Controller



Choose from up to 29 digital or analog sensors for up to 15 different parameters.

Product Overview

One Controller for the Broadest Range of Sensors

The sc200 Universal Controller is the most versatile controller on the market. The sc200 controller allows the use of digital and analog sensors, either alone or in combination, to provide compatibility with the broadest range of sensors. It replaces the Hach sc100 digital and GLI53 analog controllers with advanced features for easier operator use.

The sc200 controller platform can be configured to operate either 2 Digital Sensor Inputs, or 1 or 2 Analog Sensor Inputs, or a combination of Digital and Analog Sensor Inputs. Customers may choose their communication options from a variety of offerings including MODBUS RTU, Profibus DPV1, and HART.

Features and Benefits

Maximum Versatility

- *Standardized controller eliminates the need for a variety of dedicated controllers*
- *Multi-channel controller operates either 1 or 2 sensors reducing inventory holding costs and providing an inexpensive option to add a second sensor at a later time*
- *"Plug and Play" operation with all Hach digital sensors*
- *True dual sensor controller provides 4-20 mA outputs to transmit primary and secondary measurement values*

Ease of Use and Confidence in Results

- *New display and guided calibration procedures reduce operator error*
- *Password protected SD card reader offers a simple solution for data download and transfer, and sc200 and digital sensor configuration file duplication and backup*
- *Visual warning system provides critical alerts*



Communication Options

- *MODBUS RS232/RS485, Profibus DPV1, or HART*

Controller Configuration	Functionality
2 Channel Digital Controller	Maximum versatility and flexibility: • Plug and play with all Hach digital sensors • Mix and match with Hach digital and GLI analog sensors
2 Channel Controller with 1 Analog and 1 Digital Sensor Input	• Plug and play with any one Hach digital sensor • Mix and match with any one GLI analog sensor
1 or 2 Channel Analog Controller	• Mix and match up to two GLI analog sensors

DW = drinking water *WW = wastewater municipal* ***PW = pure water / power***
IW = industrial water ***E = environmental*** *C = collections* ***FB = food and beverage***

DW WW PW IW

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Controller Comparison







Features	Previous Models sc100™ Controller	Previous Models GLI53 Controller	sc200™ Controller	Benefits
Display	64 x 128 pixels 33 x 66 mm (1.3 x 2.6 in.)	64 x 128 pixels 33 x 66 mm (1.3 x 2.6 in.)	160 x 240 pixels 48 x 68 mm (1.89 x 2.67 in.) Transreflective	• Improved user interface—50% bigger • Easier to read in daylight and sunlight
Data Management	irDA Port/PDA Service Cable	N/A	SD Card Service Cable	• Simplifies data transfer • Standardized accessories/ max compatibility
Sensor Inputs	2 Max Direct Digital Analog via External Gateway	2 Max Analog Depending on Parameter	2 Max Digital and/or Analog with Sensor Card	• Simplifies analog sensor connections • Works with GLI and Hach's digital sensors
Analog Inputs	N/A	N/A	1 Analog Input Signal Analog 4-20mA Card	• Enables non-sc analyzer monitoring • Accepts mA signals from other analyzers for local display • Consolidates analog mA signals to a digital output
4-20 mA Outputs	2 Standard	2 Standard	2 Standard Optional 3 Additional	• Total of five (5) 4-20 mA outputs allows multiple mA outputs per sensor input
Digital Communication	MODBUS RS232/RS485 Profibus DP V1.0	HART	MODBUS RS232/RS485 Profibus DP V1.0 HART 7.2	• Unprecedented combination of sensor breadth and digital communication options

To complete your measurement system, choose from Hach's portfolio of controller and sensor products...



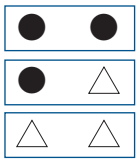
Choose from Hach's Broad Range of Digital and Analog Sensors

Parameter	Sensor	Digital or Analog
Ammonia	AMTAX™ sc, NH4D sc	●
Chlorine	CLF10 sc, CLT10 sc, 9184 sc	●
Chlorine Dioxide	9185 sc	●
Conductivity	3400, 3700	△
Dissolved Oxygen	LDO™, 5740 sc	●
Dissolved Oxygen	5500	△
Flow	U53, F53 Sensors	△
Nitrate	NITRATAX™ sc, NO3D sc	●
Oil in Water	FP360 sc	●
Organics	UVAS sc	●
Ozone	9187 sc	●
pH/ORP	pHD	●
pH/ORP	pHD, pH Combination, LCP	△
Phosphate	PHOSPHAX™ sc	●
Sludge Level	SONATAX™ sc	●
Suspended Solids	SOLITAX™ sc, TSS sc	●
Turbidity	1720E, FT660 sc, SS7 sc, ULTRATURB sc, SOLITAX sc	●

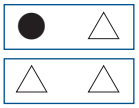
● = Digital △ = Analog

The diagrams below demonstrate the versatility and flexibility for the base controller units. Connect any of the appropriate sensors listed above to meet your measurement needs. Operation of analog sensors require the controller to be equipped with the appropriate sensor card.

2 Channel Digital Controller Configurations



2 Channel Controller with 1 Analog and 1 Digital Sensor Input Configurations



2 Channel Analog Controller Configurations



Engineering Specifications

1. The controller shall be a microprocessor based instrument.
2. The enclosure shall be 1/2 DIN format, NEMA4X rated for wall, pole and panel mounting.
3. The controller shall be available in either 100–240 Vac 50/60 Hz or 24 Vdc power supply versions.
4. The controller shall offer two analog 0/4-20 mA output signals with independent PID control functions and optional additional 4-20 mA outputs.
5. The controller shall accept either Digital Sensors or Sensor Modules for analog pH, Conductivity, DO, Paddle Wheel Flow, and Ultra Sonic Flow sensors.
6. The controller shall have single channel and dual channel options.
7. The controller shall have options for MODBUS RS232, MODBUS RS485, Profibus DPV1, and HART 7.2 communication.
8. The display contrast shall be adjustable.
9. The Menu shall be available in at least 19 different languages.
10. The controller shall have 2 Data logs, 128 kb each. The logged data shall be downloadable on a SD card in XML format.
11. The controller shall be Hach Company sc200 Universal Controller.

Specifications*

sc200 General Specifications

Display
Graphic dot matrix LCD with LED backlighting
Transreflective

Display Size
48 x 68 mm (1.89 x 2.67 in.)

Display Resolution
240 x 160 pixels

Height x Width x Depth
144 x 144 x 181 mm (5.7 x 5.7 x 7.1 in.)

Weight
1.70 kg (3.75 lb)

Power Requirements
100 – 240 Vac ±10%, 50/60 Hz
24 Vdc -15% + 20%

Operating Temperature
-20 to 60°C (-4 to 140°F), 0 to 95% RH non-condensing

Storage Temperature
-20 to 70°C (-4 to 158°F), 0 to 95% RH non-condensing

Analog Output Signal
Two 0/4-20 mA isolated current outputs, max 500Ω

Operational Mode
Primary or secondary measurement or calculated value (dual channel only)

Functional Mode
Linear, Logarithmic, Bi-linear, PID

Optional 3 additional 4-20 mA isolated current outputs, max 500Ω @ 18-24 Vdc loop-powered or max 350Ω @ 15 Vdc (self-powered)

Security Levels
Two password protected levels

Enclosure Materials
Polycarbonate, Aluminum (powder coated), Stainless Steel

Mounting Configurations
Wall, pole and panel mounting

Enclosure Rating
NEMA4X / IP66

Conduit Openings
1/2" NPT Conduit

Relays
Four electromechanical SPDT (Form C) contacts, 1200W, 5 A, 250 Vac

Operational Mode
Primary or secondary measurement, calculated value (dual channel only) or timer

Functional Mode
Alarm, Timer, Feeder Control, PWM or FM Control, System Alarm

Digital Communication
MODBUS RS232/RS485, Profibus DPV1, or HART 7.2 optional

Memory Backup
Flash memory

Electrical Certifications
EMC
CE compliant for conducted and radiated emissions:
- CISPR 11 (Class A limits)
- EMC Immunity EN 61326-1 (Industrial limits)

Safety
cETLus safety mark for:
- General Locations per ANSI/UL 61010-1 & CAN/CSA C22.2. No. 61010-1
- Hazardous Location Class I, Division 2, Groups A,B,C & D (Zone 2, Group IIC) per FM 3600 / FM 3611 & CSA C22.2 No. 213 M1987 with approved options and appropriately rated Class I, Division 2 or Zone 2 sensors

OR
cULus safety mark (for Indoor Use Only)
- General Locations per UL 61010-1 & CAN/CSA C22.2. No. 61010-1

Warranty
2 years

sc200 for Hach Analog pH/ORP Sensors

Measuring Range
-2.0 to 14.0 pH or -2.00 to 14.00 pH
-2,100 to 2,100 mV

Repeatability
±0.1% of range

Response Time
0.5 s

Temperature Range
PT100/PT1000: -20 to 200°C (-4 to 392°F)
NTC300: -20 to 110°C (-4 to 230°F)
Manual: -25 to 400°C (-13 to 752°F)

Temperature Accuracy
±0.5°C (0.9°F)

Temperature Drift
±0.03% of reading /°C

Temperature Compensation
Automatic from -20 to 110°C (-4 to 230°F) or manual

Temperature Sensors
PT100/PT1000/NTC300

Temperature Compensation Curves
Nernst, for Pure Water: Ammonia, Morpholine, User Defined (linear)

Sensor-to-Controller Distance (maximum)
pHD or LCP sensor: 914 m (3000 ft.)
pH Combination electrode w/ preamplifier: 300 m (958 ft.)
pH Combination electrode w/o preamplifier: 30 m (100 ft.), depending on environment this distance is shorter

Calibration Methods
2-point buffer (pH only)
1-point buffer (pH only)
2-point sample (pH only)
1-point sample (pH or ORP)

Specifications *continued*

sc200 for Hach Analog Contacting Conductivity Sensors

Measuring Range

Conductivity
µS/cm: 0-2.000, 0-20.00, 0-200.0 or 0-2,000
mS/cm: 0-2.000, 0-20.00 or 0-200.0

Resistivity
0-19.99 MΩ•cm or 0-999.9 kΩ•cm

TDS
0-9999 ppm or 0-9999 ppb

Repeatability, Precision (0-20 µS/cm, K=1)
±0.02 mS/cm

Repeatability (20-200,000 µS/cm, K=1)
±0.1% of reading

Response Time
0.5 s

Temperature Range
-20 to 200°C (-4 to 392°F)

Temperature Accuracy
±0.5°C (0.9°F)

Temperature Drift
> 20 µS/cm: ±0.02% of reading / °C
< 20 µS/cm: ±0.004 µS/cm

Temperature Compensation
Automatic from -20 to 200°C (-4 to 392°F) or manual

Temperature Sensor
PT100/PT1000

Temperature Compensation Curves
Linear, Ammonia, Natural water, User Defined, none

Sensor-to-Controller Distance (max)
91m (300 ft.)

Calibration Methods
Zero
GLI DRY-CAL
1-point sample

sc200 for Hach Analog Inductive Conductivity Sensors

Measuring Range

Conductivity
µS/cm: 0-200.0 or 0-2,000
mS/cm: 0-2.000, 0-20.00, 0-200.0 or 0-2,000
S/cm: 0-2.000

% Concentration
0-99.99% or 0-200.0%

TDS
0-9999 ppm repeatability

Repeatability > 500 µS/cm
±0.5% of reading

Repeatability < 500 µS/cm
±2.5 µS/cm

Response Time
1 s

Temperature Range
-20 to 200°C (-4 to 392°F)

Temperature Accuracy
±0.5°C (0.9°F)

Temperature Drift
> 500 µS/cm: ±0.02% of reading / °C
< 500 µS/cm: ±0.1 µS/cm

Temperature Compensation
Automatic from -20 to 200°C (-4 to 392°F) or manual

Temperature Sensors
PT1000

Temperature Compensation Curves
Linear, Natural water, User Defined, none**

Concentration Curves
H_3PO_4: 0-40%; HCl: 0-18%; HCl: 22-36%; NaOH: 0-16%; $CaCl_2$: 0-22%; HNO_3: 0-28%; HNO_3: 36-96%; H_2SO_4: 0-30%; H_2SO_4: 40-80%

Sensor-to-Controller Distance

Full-scale value	*Maximum length*
200 to 2,000 µS/cm	61m (200 ft.)
2,000–2,000,000 µS/cm	91m (300 ft.)

Calibration Methods
1-point Cond (or Concentration or TDS)
Zero

***Available curves depend on the selected type of measurement (Conductivity, Concentration or TDS).*

Continued on next page.

Specifications *continued*

Linearity 3700 Inductive Conductivity Sensors

1.5 mS/cm – 2 S/cm
1% or reading

< 1.5 mS/cm
±15 µS/cm

Linearity 3700 Inductive Conductivity Sensors with Multiple Point Calibration

1.5 mS/cm – 2 S/cm
0.5% or reading

< 1.5 mS/cm
±5 µS/cm

sc200 for Hach Analog Dissolved Oxygen Sensors

Measuring Range
0 to 40 ppm
200% saturation

Repeatability
±0.05% of range

Response Time
0.5 s

Temperature Range
0 to 50°C (32 to 122°F)

Temperature Accuracy
±0.5°C (0.9°F)

Temperature Drift
±0.02% of reading / °C

Temperature Compensation
Automatic from 0 to 40 ppm or manual

Temperature Sensor
NTC30K / Manual

Sensor-to-Controller Distance (max)
305 m (1000 ft.)

Calibration Methods
Sample
Air
Saturation

sc200 for Hach UltraSonic Flow Sensor

Flow Rate
0-9999, 0-999.9, 0-99.99 with selectable flow rate units and multiplier

Volume
0-9,999,999 with selectable volume units

Depth
0-1200.0 inches, 0-100.0 feet, 0-30,000 mm, or 0-30.00 meters

Input Filter
999 sec

Totalizers
8-digit resettable LCD software totalizer

Totalized Flow
Gal., $ft.^3$, acre-ft., lit., m^3

Repeatability
±0.1% of span

Sensor-to-Controller Distance (max)
100 m (328 ft.)

Calibration Methods
Cal Depth 1 point
Cal Depth 2 point

sc200 for Hach Paddle Wheel Flow Sensor

Flow Rate
Function of Structure Type: 0-9999, 0-999.9, 0-99.99 with selectable flow rate units and multiplier

Volume
0-9,999,999 with selectable volume units

Input Filter
999 sec

Totalizers
8-digit resettable LCD software totalizer

Totalized Flow
Gal., $ft.^3$, acre-ft., lit., m^3

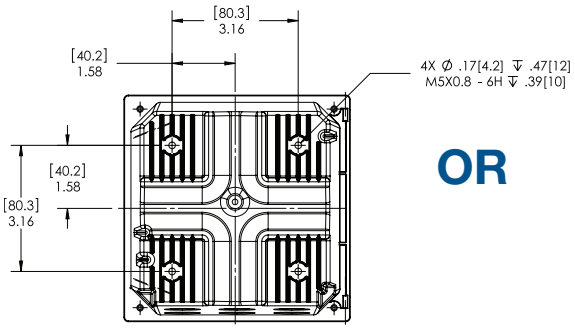
Sensor-to-Controller Distance (max)
GLI impeller Sensors: 610m (2000 ft.)
Non-GLI Sensors: 91m (300 ft.)

**Specifications subject to change without notice.*

Dimensions

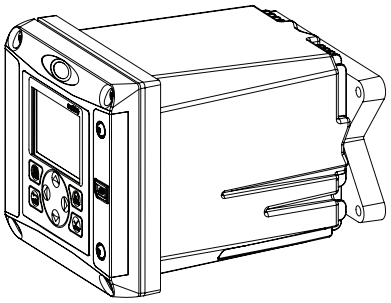
The sc200 controller unit can be installed on a surface, panel, or horizontal or vertical pipe. Pipe Mount hardware is included.
NOTE: Dimensions are in inches [millimeters].

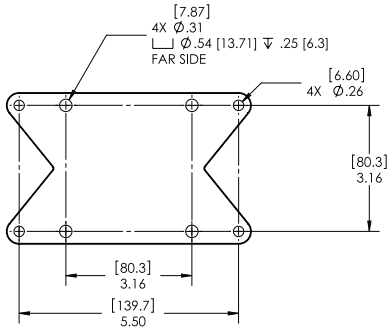
Surface Mounting Dimensions



Mounting Dimensions
(Rear View)

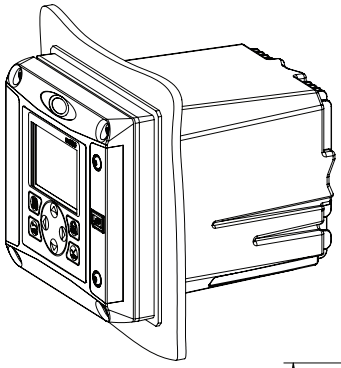
OR

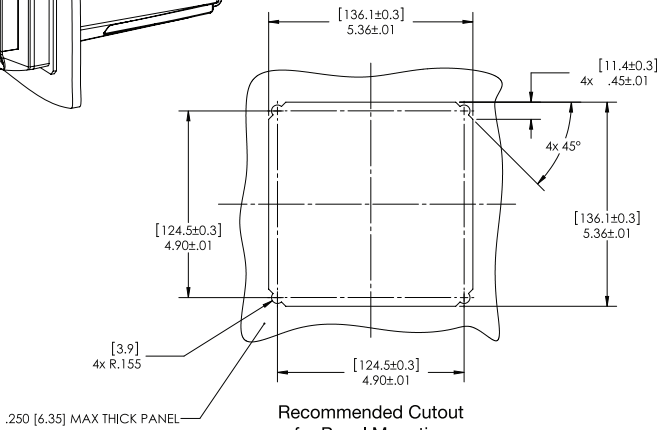




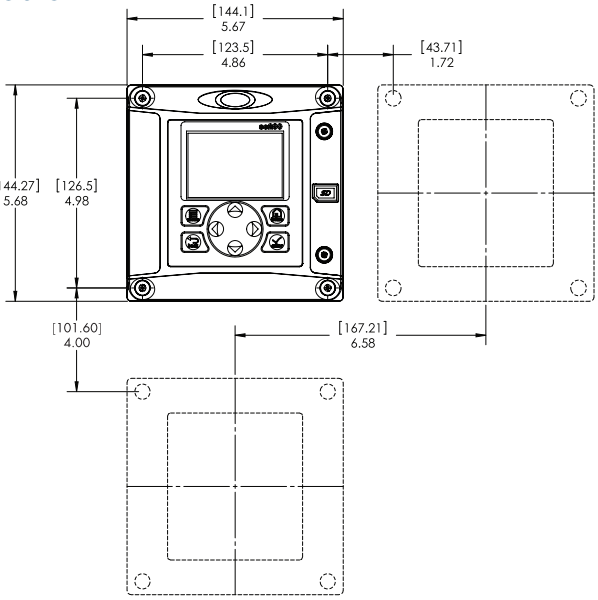
Bracket (supplied) for Surface Mounting
(Not compatible with Weather and Sun Shield p/n 9220600 when surface mounting.)

Panel Mounting Dimensions



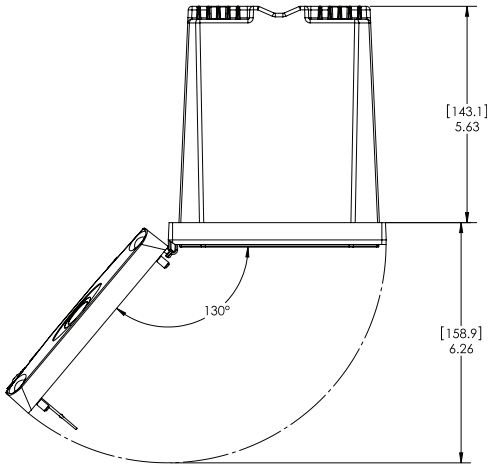


Recommended Cutout
for Panel Mounting

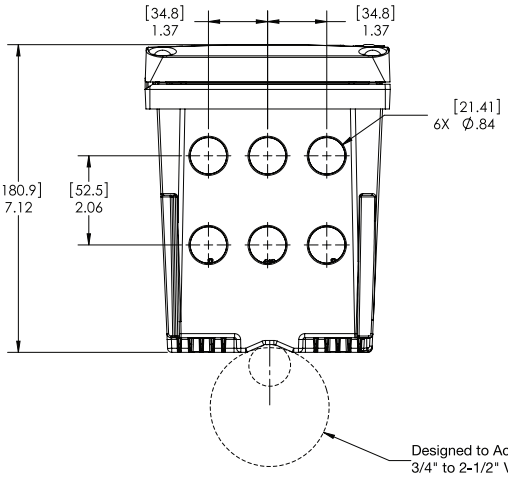


Minimum Spacing Dimensions
for Group Mounting

Top and Bottom Views



Door Opening Details



Ordering Information

sc200 for Hach Digital Sensors

LXV404.99.00552	sc200 controller, 2 channel, digital
LXV404.99.00502	sc200 controller, 1 channel, digital
LXV404.99.00542	sc200 controller, 2 channel, digital & mA input
LXV404.99.00512	sc200 controller, 2 channel, digital & analog pH/DO
LXV404.99.00522	sc200 controller, 2 channel, digital & analog Conductivity
LXV404.99.00532	sc200 controller, 2 channel, digital & analog Flow

sc200 for Hach Analog Sensors

LXV404.99.00102	sc200 controller, 1 channel, pH/DO
LXV404.99.00112	sc200 controller, 2 channel, pH/DO
LXV404.99.00202	sc200 controller, 1 channel, Conductivity
LXV404.99.00222	sc200 controller, 2 channel, Conductivity
LXV404.99.00212	sc200 controller, 2 channel, pH/DO & Conductivity
LXV404.99.00302	sc200 controller, 1 channel, Flow
LXV404.99.00332	sc200 controller, 2 channel, Flow
LXV404.99.00312	sc200 controller, 2 channel, Flow & pH/DO
LXV404.99.00322	sc200 controller, 2 channel, Flow & Conductivity

Note: Other Sensor combinations are available. Please contact Hach Technical Support or your Hach representative.

Note: Communication options (MODBUS, Profibus DPV1, and HART) are available. Please contact Hach Technical Support or your Hach representative.

Power Cords

9202900	sc200 power cord with strain relief, 125 Vac
9203000	sc200 power cord with strain relief, 230 Vac, European-style plug

Accessories

9220600	sc200 Weather and Sun Shield with UV Protection Screen
8809200	sc200 UV Protection Screen
9218200	SD card reader (USB) for connection to PC
9218100	4 GB SD card

Sensor and Communication Modules

9012900	pH and DO module
9013000	Conductivity module
9012700	Flow module
9012800	4-20 mA input module
9013200	MODBUS network module
9173900	Profibus network module
9328100	HART network module
9334600	4-20 mA output module

At Hach, it's about learning from our customers and providing the right answers. It's more than ensuring the quality of water—it's about ensuring the quality of life. When it comes to the things that touch our lives...

Keep it pure.

Make it simple.

Be right.

For current price information, technical support, and ordering assistance, contact the Hach office or distributor serving your area.

In the United States, contact:

HACH COMPANY World Headquarters
P.O. Box 389
Loveland, Colorado 80539-0389
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Fax: 970-669-2932
E-mail: orders@hach.com
www.hach.com

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Be Right™

KRÜGER

SECTION 4.7

THERMAL MASS FLOW METER

VEOLIA WATER
Solutions & Technologies

INSTRUMENT DATASHEET

PROJECT NAME: Massillon, OH

PROJECT NO.: 5700235402

Thermal Mass Flow Meter		Train 1 Air

Sensor		Transmitter	
Model No.:	ST50	Model No.:	ST50
Range:	0.75 to 400 SFPS	Range:	0.75 to 400 SFPS
Power Supply:	Transmitter Supplied	Power Supply:	85 to 265 VAC
Power Requirements:		Power Requirements:	
Output Signal:		Output Signal:	(2) 4-20mA
Enclosure Rating:		Enclosure Rating:	NEMA 4X
Operating Temp:	0 to 250°F	Operating Temp:	-4 to 140°F
Process Connection:	1/2" NPT	Accuracy:	2%
Cable Length:	3 meters	Integral/Remote Mount:	Remote
Cable Connection:	Quick Connect	Local Display:	Yes
Sensor Type:	Insertion 1 to 12"	Input Signal:	

Comments:

Please take installation recommendations into consideration. Instrument requires 20 pipe diameters upstream and 10 pipe diameters downstream.

A straightening vein will be provided to reduce the pipe diameters required.

Function	Signal	Units	Input		Output	
			LRV	URV	LRV	URV
Flow	Analog Output 1	SCFM				

Description	Manufacturer	Part Number	Qty
Sensor/Transmitter	FCI	ST50-8F12A00A	1
Straightening Vein	FCI	Custom	1

Rev	Date	By	Approval	Remarks
0	1/23/2015	MRO		Issued for Approval
1	3/13/2015	MRO		Added straightening vein per request
2	5/18/2015	MRO		Changed transmitter to remote

Kruger Inc.
4001 Weston Parkway
Cary, NC 27513 USA
Tel: 919-677-8310 ● Fax: 919-677-0082
Web site: www.krugerusa.com

INSTRUMENT DATASHEET

PROJECT NAME: Massillon, OH

PROJECT NO.: 5700235402

Thermal Mass Flow Meter		Train 2 Air

Sensor		Transmitter	
Model No.:	ST50	Model No.:	ST50
Range:	0.75 to 400 SFPS	Range:	0.75 to 400 SFPS
Power Supply:	Transmitter Supplied	Power Supply:	85 to 265 VAC
Power Requirements:		Power Requirements:	
Output Signal:		Output Signal:	(2) 4-20mA
Enclosure Rating:		Enclosure Rating:	NEMA 4X
Operating Temp:	0 to 250°F	Operating Temp:	-4 to 140°F
Process Connection:	1/2" NPT	Accuracy:	2%
Cable Length:	3 meters	Integral/Remote Mount:	Remote
Cable Connection:	Quick Connect	Local Display:	Yes
Sensor Type:	Insertion 1 to 12"	Input Signal:	

Comments:

Please take installation recommendations into consideration. Instrument requires 20 pipe diameters upstream and 10 pipe diameters downstream.

A straightening vein will be provided to reduce the pipe diameters required.

Function	Signal	Units	Input		Output	
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Flow	Analog Output 1	SCFM				

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VEOLIA WATER
Solutions & Technologies

INSTRUMENT DATASHEET

PROJECT NAME: Massillon, OH

PROJECT NO.: 5700235402

Thermal Mass Flow Meter		Train 3 Air

Sensor		Transmitter	
Model No.:	ST50	Model No.:	ST50
Range:	0.75 to 400 SFPS	Range:	0.75 to 400 SFPS
Power Supply:	Transmitter Supplied	Power Supply:	85 to 265 VAC
Power Requirements:		Power Requirements:	
Output Signal:		Output Signal:	(2) 4-20mA
Enclosure Rating:		Enclosure Rating:	NEMA 4X
Operating Temp:	0 to 250°F	Operating Temp:	-4 to 140°F
Process Connection:	1/2" NPT	Accuracy:	2%
Cable Length:	3 meters	Integral/Remote Mount:	Remote
Cable Connection:	Quick Connect	Local Display:	Yes
Sensor Type:	Insertion 1 to 12"	Input Signal:	

Comments:

Please take installation recommendations into consideration. Instrument requires 20 pipe diameters upstream and 10 pipe diameters downstream.

A straightening vein will be provided to reduce the pipe diameters required.

Function	Signal	Units	Input		Output	
			LRV	URV	LRV	URV
Flow	Analog Output 1	SCFM				

Description	Manufacturer	Part Number	Qty
Sensor/Transmitter	FCI	ST50-8F12A00A	1
Straightening Vein	FCI	Custom	1

Rev	Date	By	Approval	Remarks
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FCI ST50 Series Flowmeters

Low Cost, Low Maintenance
Air, Compressed Air and Nitrogen Flow Measurement
for Process and Plant Applications



Wastewater Treatment Aeration Control
Blower and Dryer Air Flow Control
Burner and Furnace Air Flow Control
Lake, Pond and Aquaculture Aeration
HVAC Duct/Damper Control
Compressed Air Distribution Measurements

FCI® FLUID COMPONENTS INTERNATIONAL LLC

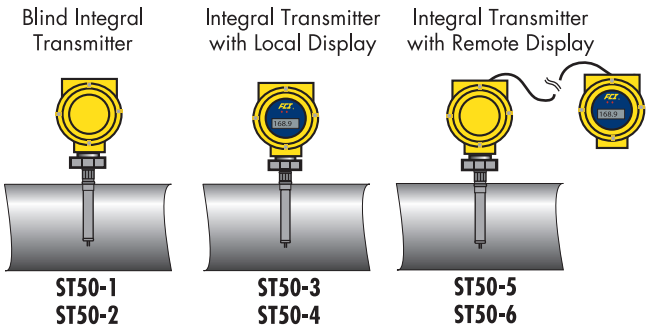
FCI ST50 Series Flowmeters

Easy to Install, Easy to Use

The ST50 Flowmeter is an accurate, easy to install, no moving parts solution for measuring and controlling air, compressed air or nitrogen flow. ST50 utilizes FCI proven thermal dispersion technology to provide direct mass flow measurement resulting in higher performance at a lower cost than orifice plates, DP, Vortex shedding and other thermal devices. The meter installs in line sizes ranging from 2 to 24 inches [51 to 610 mm] with 1/2" or 3/4" NPT.

ST50 uses precision, lithography structured platinum RTD sensors embedded in FCI's equal mass small diameter, all metal thermowells. Combined with microprocessor electronics and precision calibration, the ST50 achieves excellent accuracy, fast response and virtually maintenance free operation.

To serve a variety of application and installation requirements the ST50 is available in three standard configurations as shown below. (Other display options are described in Accessory Remote Digital Display section)



The ST50 is available with four calibration and final set-up selections. Two are standard calibrations suitable for final ranging and set-up in the field and two are for factory custom calibration with factory performed final ranging and set-up. All final set-up and flow ranges are subject to 100:1 maximum and 10:1 minimum turndowns.

Two standard calibrations include one for air or nitrogen flow rates between 1.25 to 125 SFPS [0.4 to 38 NMPS] in service pressures between 10 to 50 psia [0.7 to 3.5 Bara] and one for compressed air, air or nitrogen flows between 4 to 400 SFPS [1.2 to 122 NMPS] in service pressures between 50 to 165 psia [3.5 to 11.4 Bara]. All final user configurations for flow range, specific line size, standard volumetric or mass flow and engineering units are easily set-up in the field with a PC, PDA or FC88 programmer.

Alternatively, custom factory calibration and set-up is available for air or nitrogen with flow between 0.8 to 150 SFPS [0.2 to 46 NMPS] at service pressure between 10 to 50 psia [0.7 to 3.5 Bara] or compressed air, air or nitrogen flow between 2.5 to 400 SFPS [0.8 to 122 NMPS] with service pressure between 50 to 165 psia [3.5 to 11.4 Bara]. Custom calibration applications are subject to validation by FCI's AVAL flowmeter optimizer program and a submittal of a completed FCI Application Data Sheet.

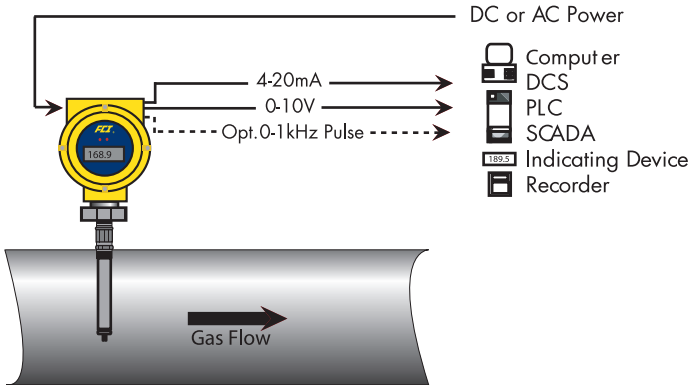
Features

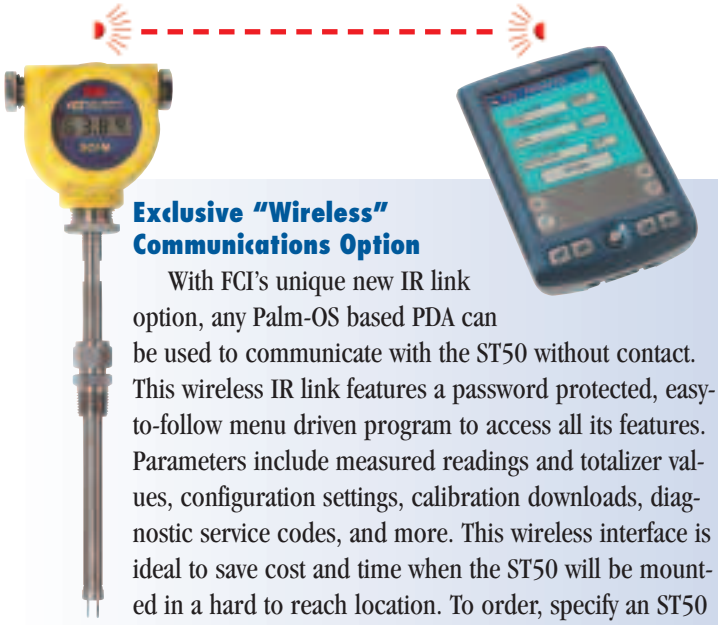
- Direct mass, volumetric or velocity flow measurement
- Dual analog outputs
- Line/pipe sizes from 2 to 24 inches [51 to 610 mm]
- Non-clogging, no moving parts sensor
- Wireless IR communications option
- 4-digit digital display option
- Small, compact design
- Easy installation

Extensive Outputs Ensure Application Compatibility

The ST50 includes dual analog outputs, 4-20 mA and 0-10 Vdc, which are field assignable as flow rate or temperature. Flow rate is selectable for reading in standard volumetric or mass flow engineering units. Optionally available as a third output, is a 0-1000Hz pulse output of total flow.

In all models a standard RS232C serial I/O link is provided for instrument configuration, service/troubleshooting data, and measured readings. Also included in all models with the digital display is a wireless IR sensor to enable wireless connectivity to PDA devices.





Exclusive "Wireless" Communications Option

With FCI's unique new IR link option, any Palm-OS based PDA can be used to communicate with the ST50 without contact. This wireless IR link features a password protected, easy-to-follow menu driven program to access all its features. Parameters include measured readings and totalizer values, configuration settings, calibration downloads, diagnostic service codes, and more. This wireless interface is ideal to save cost and time when the ST50 will be mounted in a hard to reach location. To order, specify an ST50 with a digital display (ST50-3, ST50-4, ST50-5, or ST50-6) and order software accessory kit p/n 019819-01.

Designed and Built to Last

The all stainless steel element with Hast-C tips, provides protection from invasive conditions within the pipe and ensures long service life. The electronics are housed in an all metal NEMA 4X (IP66) rated enclosure for ruggedness and dust/weather proof service in industrial plant installations.

Whether adding flow measurement to improve the process or replacing high-maintenance flowmeters, the ST50 provides the accurate, fast response and no-maintenance solution for air, compressed air and nitrogen flow measurement.



Precision Calibration in FCI Flow Laboratory

To ensure optimum accuracy, performance and quality, FCI owns and operates a best-in-class test and NIST traceable calibration laboratory. FCI product developments are subject to rigorous testing and calibration integrity validation using high-speed data acquisition systems and precision flow calibration equipment. Every FCI Flowmeter is also extensively tested and then calibrated using actual gases under customer conditions to assure their quality and performance.

- NIST traceability
- Automated data acquisition
- ISO 9001 certified
- Flow, pressure and temperature calibrations

Accessory Remote Digital Displays

For remote mounted digital readouts of flow, temperature and /or total flow, three types of accessory displays are available.



Model DM10 is a LCD readout meter which can be inserted and located anywhere in the 4-20 mA output loop from the ST50. It requires no separate power as it derives its power directly from the 4-20 mA loop. The DM10 is user scalable to ±1999 digits and features oversized, 1 inch H [25 mm] characters for an easy-to-read display. NEMA 4X rated. FM and CSA certified models optional

Size: 3.15" H x 5.51" W x 2.56" D [80 mm H x 140 mm W x 65 mm D]
Mounting: Wall. Panel mount or pipe mount kit optional
Wire-Up: Screw terminals via 1/2" conduit hole at bottom of case



Model DM15 is a high accuracy, 1/8 DIN panel mount, AC line powered meter with a bright red LED readout. It features a user scalable, ±9999 digit display and will accept both the 4-20 mA or 0-10 Vdc signals from the ST50. Optionally available with DM15 is a user programmable alarm setpoint with a Form C relay output.

Size: 1.89" H x 3.78" W x 5.35" D [48 mm H x 96 mm W x 136 mm D]
Mounting: Panel. Standard 1/8 DIN, 45 mm H x 92 mm W cutout
Wire-Up: Screw terminals at rear of instrument



Model DM20 is a miniature sized, totalizer counter that accepts the pulse output from the ST50. It features an 8-digit (0 to 99999999 counts) LCD that can be reset via its front-panel push-button. It is a panel-mount style that can be located in the field, in a separate enclosure or in the control room. It is self-powered by a lithium battery (included, 10 year life).

Size: 0.944" H x 1.89" W x 1.20" D [24 mm H x 48 mm W x 30.5 mm D]
Mounting: Panel. 22.5 mm H x 45 mm W cutout
Wire-Up: Screw-terminals at rear of instrument

ST50 Specifications

Instrument

Media Compatibility: Air, compressed air, and nitrogen
Pipe/Line Size Compatibility: 2 to 24 inches [51 to 610 mm]
Range: Air, compressed air, or nitrogen: 0.75 to 400 SFPS [0.23 to 122 MPS]
Accuracy: ± 2% of reading, ± 0.5% of full scale
Repeatability: ±0.5% of reading
Temperature Compensation:
Standard: 40° to 100°F [4° to 38°C];
Optional: 0° to 250°F [-18° to 121°C]
Turndown Ratio: 10:1 to 100:1
Agency Approvals: FM/CSA: Class I, Div. 2, Groups A, B, C and D; T4. CE Marked. (ATEX approvals pending)
Warranty: One year

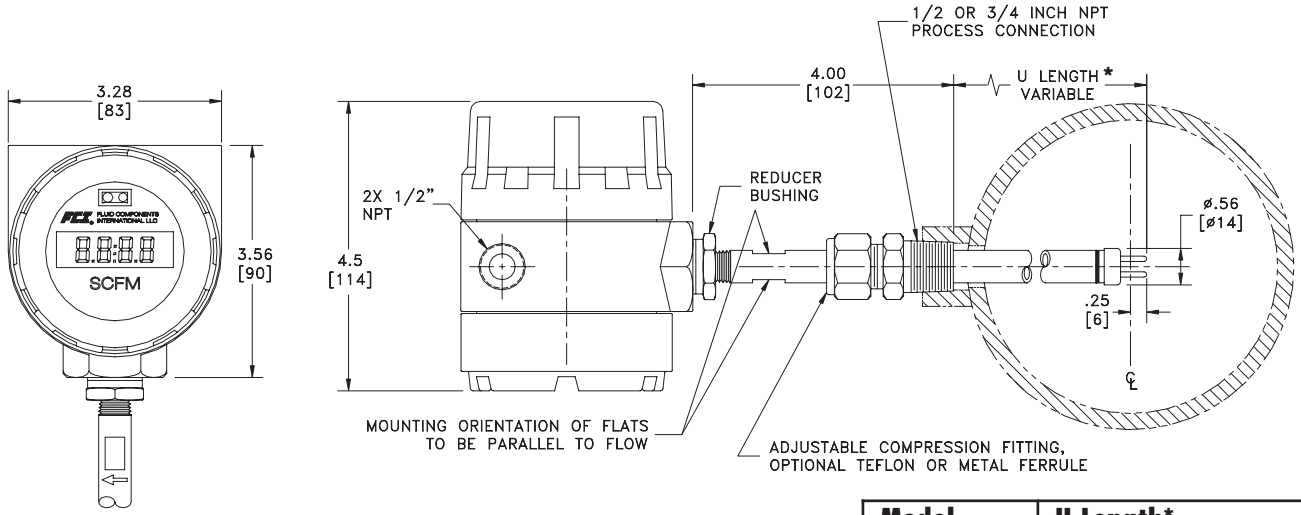
Flow Element

Installation: Insertion
Type: Thermal dispersion
Material of Construction: 316 stainless steel body with Hastelloy C thermowell sensors, 316 stainless steel compression fitting with teflon or stainless steel ferrule
Pressure (Maximum Operating without Damage):
Stainless steel ferrule: 500 psig [34 bar(g)]
Teflon ferrule: 150 psig [10 bar(g)]
Temperature (Maximum Operation):
Stainless steel ferrule: 0° to 250°F [-18° to 121°C]
Teflon ferrule: 0° to 200°F [-18° to 93°C]
Process Connection: 1/2" MNPT or 3/4" MNPT with stainless steel or teflon ferrule
Insertion Length: Field adjustable lengths: 1 to 6 inches [25 to 152 mm]; 1 to 12 inches [25 to 305 mm]; or 1 to 18 inches

Transmitter

Enclosure: NEMA 4X (IP66) aluminum, Epoxy coated
Output Signal:
Standard: 4-20 mA and 0-10 Vdc, user assignable to flow rate and/or temperature
Optional: 0 to 1000Hz pulse of total flow
Communication Port: RS232C. Wireless IR to PDA with optional digital display models
Input Power:
DC: 18 to 36 Vdc (Max. current draw 125 mA)
AC: 85 to 265 Vac (Max. current draw 60 mA)
(CE Mark Approval from 100 to 240 Vac)
Operating Temperature: 0° to 140°F [-18° to 60°C]
Digital Display: ±9999 Counts LCD, 0.45" H [11.4 mm] characters, user scalable to flow rate units or as 0-100%.

ST50 Dimension Drawing



Model	U Length*
ST50-xxx1	6.0 inches [152.4 mm]
ST50-xxx2	12.0 inches [304.8 mm]
ST50-xxx3	18.0 inches [457.2 mm]

ST50 Flowmeter

Single Insertion Point, Mass Flow Measurement

With premium components and attention to detail FCI's ST50 series provides long-lasting flowmeter quality and value. It's features and functions ensure application compatibility, maximum installation convenience, superior industrial durability and lowest maintenance.



Analog and digital outputs

Dual conduit ports facilitate power and signal wire run isolation and access

Easy access to all wiring terminations with removable front and rear covers

Compact, rugged, NEMA 4X (IP66), all metal enclosure and agency approvals for hazardous location installations

316 stainless steel probe element

Small mass sensor for fast response

Premium Hastelloy C tips

DC or AC powered

Wireless IR link to PDA

Large, easy-to-read, user scalable LC display

- ±9999 counts with programmable decimal point
- scale to engineering units SCFM, SFPS, SCFH, NCMM, NCMH, NMPS, LB M/Hr, kg/Hr, or %

Adjustable compression fitting to set insertion depth

Choice of 1/2″ or 3/4″ NPT stainless steel or teflon ferrule

Temperature compensated, precision calibration

FLUID COMPONENTS INTERNATIONAL LLC

1755 La Costa Meadows Drive
San Marcos, California 92078 USA
760-744-6950 / 800-854-1993 Fax: 760-736-6250
www.fluidcomponents.com

Order Information Sheet (OIS)

ST50

Air/Gas Flow Meter

INSTRUCTIONS: To order an **ST50**, please fill in each numbered block below with the appropriate code from the categories below. Once you have determined all the specifications, contact an *FCI* representative or *FCI* directly for price information or additional options not shown. Consult *FCI* on the cost of special data and documentation. Final acceptance of the part number is subject to *FCI*'s approval.

Model Number

Block No.	1	2	3	4	5	6	7	8
ST50-	☐	☐	☐	☐	☐	☐	☐	☐
	1	☐	1	1	A	0	0	0
	2		2	2	B	A	1	A
	3		3	3	D	M		B
	4		4		E	N		C
	7					Q		W
	8					T		
	A					R		
	B					U		
	C							
	D							
	E							
	F							

Description

Base Unit, Enclosure Style, Power Supply (Block 1) *Enclosures: all aluminum, NEMA4X/IP67 rated, epoxy coated*

1	Blind, Integral Transmitter with two 1/2" FNPT cable entries	18 Vdc to 36 Vdc powered
2	Blind, Integral Transmitter with two 1/2" FNPT cable entries	85 Vdc to 265 Vac powered
3	Integral Transmitter with local Digital Display, with two 1/2" FNPT cable entries	18 Vdc to 36 Vdc powered
4	Integral Transmitter with local Digital Display, with two 1/2" FNPT cable entries	85 Vdc to 265 Vac powered
7	Remote Transmitter with two 1/2" FNPT cable entries and with Digital Display (Specify cable length in Block 8)	18 Vdc to 36 Vdc powered
8	Remote Transmitter with two 1/2" FNPT cable entries and with Digital Display (Specify cable length in Block 8)	85 Vdc to 265 Vac powered
A	Blind, Integral Transmitter with two M20x1.5 cable entries	18 Vdc to 36 Vdc powered
B	Blind, Integral Transmitter with two M20x1.5 cable entries	85 Vdc to 265 Vac powered
C	Integral Transmitter, with local Digital Display, with two M20x1.5 cable entries	18 Vdc to 36 Vdc powered
D	Integral Transmitter, with local Digital Display, with two M20x1.5 cable entries	85 Vdc to 265 Vac powered
E	Remote Transmitter with two M20x1.5 cable entries and with Digital Display (Specify cable length in Block 8)	18 Vdc to 36 Vdc powered
F	Remote Transmitter with two M20x1.5 cable entries and with Digital Display (Specify cable length in Block 8)	85 Vdc to 265 Vac powered

Pipe Installation, Display/Transmitter Mounting Orientation and Flow Direction (Block 2)

Horizontal Pipe	Code
Top mount, display facing forward, flow left-to-right	F
Top mount, display facing forward, flow right-to-left	G
Side mount, display facing up, flow left-to-right	H
Side mount, display facing up, flow right-to-left	J
Side mount, display facing down, flow left-to-right	K
Side mount, display facing down, flow right-to-left	L

Vertical Pipe	Code
Side mount left, display facing forward, flow up	M
Side mount right, display facing forward, flow up	N
Side mount left, display facing forward, flow down	P
Side mount right, display facing forward, flow down	R

For visual representation, refer to FCI drawing number 021263

Process Connection/Ferrule Material (Block 3)

1	1/2" Male NPT/Teflon Ferrule
2	1/2" Male NPT/Metal Ferrule
3	3/4" Male NPT/Teflon Ferrule
4	3/4" Male NPT/Metal Ferrule

Insertion Length (Block 4)

1	6" [152 mm] maximum U length
2	12" [305 mm] maximum U length
3	18" [457 mm] maximum U length

Gas Medium, Calibration Range (Block 5)

A	Standard: Air/Nitrogen Calibration 1.25 SFPS to 125 SFPS; 10 psia to 50 psia [0,4 NMPS to 38 NMPS; 0,7 bar(a) to 3,5 bar(a)]
B	Customized: Air/Nitrogen Calibration 0.75 SFPS to 150 SFPS; 10 psia to 50 psia [0,2 NMPS to 46 NMPS; 0.7 bar(a) to 3,5 bar(a)]
D	Standard: Air/Nitrogen/Compressed Air Calibration 4 SFPS to 400 SFPS; 50 psia to 165 psia [1,2 NMPS to 122 NMPS; 3,5 bar(a) to 11,4 bar(a)]
E	Customized: Nitrogen/Compressed Air Calibration 2.5 SFPS to 400 SFPS; 50 psia to 165 psia [0,8 NMPS to 122 NMPS; 3,5 bar(a) to 11,4 bar(a)]

Calibration [4] and Calibration Conditions *Temperature, Vortab Flow Conditioner, Flat Flow Profile* **(Block 6)**

0	Standard 2% Accuracy Calibration and Conditions +40 °F to 100 °F [4 °C to 38 °C]
A	Standard 2% Accuracy Calibration and Extended Temperature Compensation: 0 °F to 250 °F [-18 °C to 121 °C]
M	High Accuracy 1% Calibration and Standard Conditions +40 °F to 100°F [4 °C to 38 °C]
N	High Accuracy 1% Calibration and Extended Temperature Compensation 0 °F to 250 °F [-18 °C to 121 °C]
Q	High Accuracy 1% Calibration with Vortab
T	High Accuracy 1% Calibration and Extended Temperature Compensation 0 °F to 250 °F [-18 °C to 121 °C] and Vortab
R	High Accuracy 1% Calibration, at Flat Flow Profile
U	High Accuracy 1% Calibration and Extended Temperature Compensation 0 °F to 250 °F [-18 °C to 121 °C] and Flat Flow Profile

Transmitter Options (Block 7) *All Standard*

0	None
1	Pulse Output

Interconnecting Cable Length for Remote Configurations [5] (Block 8)

0	Not required (specify with integral configurations)
A	10' [3 meters]
B	25' [7,6 meters]
C	50' [15 meters]
W	Custom length (cannot exceed 50' [15 meters])

Notes

2. User configures line size, scaled flow range and engineering units in the field with PC, PDA or FCI FC88 Calibrator
3. Must specify actual media (air, nitrogen, or compressed air), range, pipe size and engineering units when ordering Flow Range subject to maximum 100:1 and minimum 10:1 turndown. FCI application data sheet (ADS) must accompany order
4. Calibration accuracy is ±% of reading, ± 0.5% of full scale.
5. Fixed cable length with instrument calibrated together as matched set. Cable may be coiled but not cut.

Options and Accessories

Part Number	Description
019819-01	Software Interface Package for PDA/PalmOS
020802-01	PDA, Palm® model Tungsten™ E2
FC88	Portable Hand-held Communicator
014108-02	PC Interface Communications Kit, For RS232 serial port connection
DM10-N	Digital Display/Readout, LCD, 4-20 mA loop powered
DM10-FC	DM10 with FM and CSA approvals

Part Number	Description
DM10-KIT1	Panel Mount Kit for DM10
DM10-KIT2	2" (52 mm) Pipe Mount Kit for DM10 (Stainless steel)
DM15	Digital Display/Readout, LED 115/230 Vac powered
DM15-ALM	Same as DM-15 with user programmable alarm limit, relay output
DM20	Digital Display Readout, 8-digit LCD Pulse totalizer/counter

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Subject to change without notice. Order Information Sheet effective 6/2009

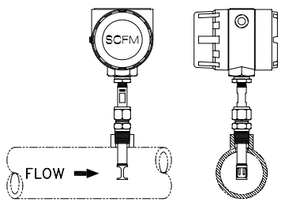
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REVISIONS			
REV	DESCRIPTION	DATE	APPROVED

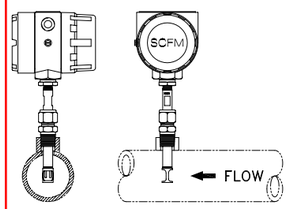
INTEGRAL HORIZONTAL MOUNTINGS

CODE F:



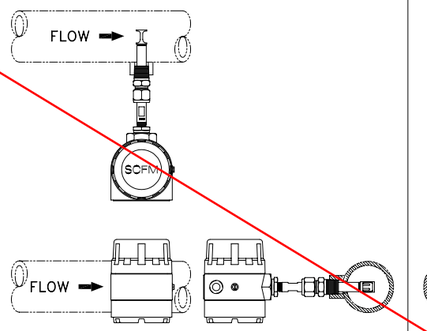
TOP MNT, DISPLAY FORWARD
FLOW LEFT TO RIGHT

CODE G:



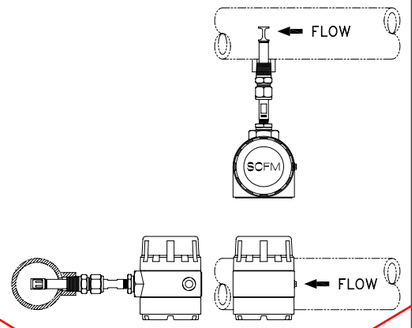
TOP MNT, DISPLAY FORWARD
FLOW RIGHT TO LEFT

CODE H:



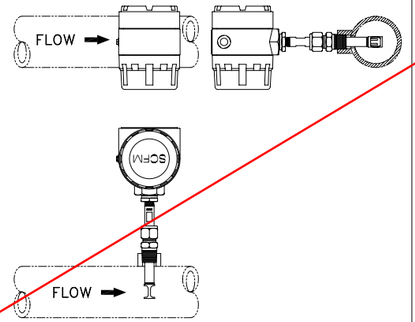
SIDE MOUNT, DISPLAY UP
FLOW LEFT TO RIGHT

CODE J:



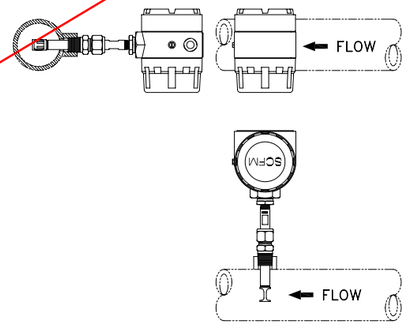
SIDE MOUNT, DISPLAY UP
FLOW RIGHT TO LEFT

CODE K:



SIDE MOUNT, DISPLAY DOWN
FLOW LEFT TO RIGHT

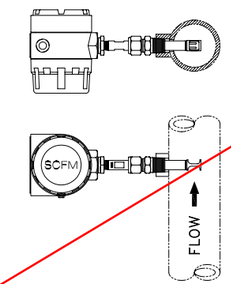
CODE L:



SIDE MOUNT, DISPLAY DOWN
FLOW RIGHT TO LEFT

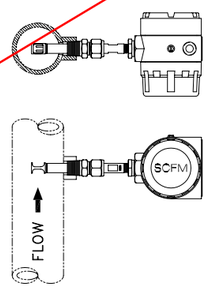
INTEGRAL VERTICAL MOUNTINGS

CODE M:



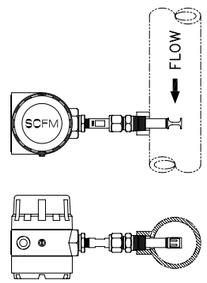
SIDE MOUNT LEFT
DISPLAY FORWARD
FLOW UP

CODE N:



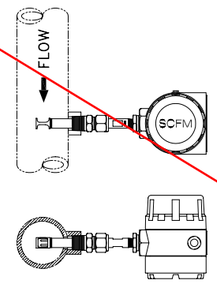
SIDE MOUNT RIGHT
DISPLAY FORWARD
FLOW UP

CODE P:



SIDE MOUNT LEFT
DISPLAY FORWARD
FLOW DOWN

CODE R:



SIDE MOUNT RIGHT
DISPLAY FORWARD
FLOW DOWN

3. THE LCD DISPLAY CAN BE USER ROTATED AND VIEWED AT ANY 90 DEGREE ORIENTATION.

2. IN REMOTE ELECTRONIC CONFIGURATIONS, THE LOCAL ENCLOSURE WILL BE ORIENTED AS SHOWN WITH SOLID COVER ON BOTH SIDES. INTERCONNECTING TERMINALS LOCATED INSIDE.

1. THIS DRAWING IS GENERIC IN NATURE, FOR SPECIFIC MODEL TYPE, ORIENTATION, CUSTOMER PROCESS CONNECTION, ETC, REFER TO IO&M MANUAL.

NOTES: UNLESS OTHERWISE SPECIFIED

NEXT ASSY	USED ON
APPLICATION	
THIRD ANGLE PROJECTION	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES
DECIMALS ANGULAR
MATERIAL
MACH SURFACE MACH RAD:
DO NOT SCALE DRAWING
PARTS TO BE FREE OF BURRS & SHARP EDGES

CONTRACT NO.

APPROVALS	APPROVALS
CONTRACT	DRAWN R. DUCAR 7/15/08
QUAL	CHECK
MFG	ENGR
QA	

FCI® FLUID COMPONENTS INTERNATIONAL LLC
SAN MARCOS, CA 92078

TITLE: ST50/ST51, ASSEMBLY ORIENTATION

SIZE	CAGE CODE	DWG NO.	REV
D	64818	021263	–

SCALE NONE SHEET 1 OF 1

KRÜGER

SECTION 4.8

GUIDED LEVEL RADAR TRANSMITTER

VEOLIA WATER
Solutions & Technologies

INSTRUMENT DATASHEET

PROJECT NAME: Massillon, OH

PROJECT NO.: 5700235402

Guided Level Radar Transmitter		Train 1 IFAS

Sensor		Transmitter	
Model No.:	Eclipse 706	Model No.:	Eclipse 706
Range:	0 to 4 feet	Range:	0 to 4 feet
Power Supply:	Transmitter Supplied	Power Supply:	24VDC Loop Powered
Power Requirements:		Power Requirements:	
Output Signal:	4-20mA	Output Signal:	4-20mA
Enclosure Rating:		Enclosure Rating:	IP67
Operating Temp:	-40 to 175°F	Operating Temp:	-40 to 175°F
Process Connection:	2" NPT Thread	Accuracy:	+/- 0.1%
Cable Length:	3 meters	Integral/Remote Mount:	Integral
Cable Connection:	Quick Connect	Local Display:	Yes
Sensor Type:	Immersion	Input Signal:	4-20mA

Comments:

Function	Signal	Units	Input		Output	
			LRV	URV	LRV	URV
Level	Analog Output 1	feet in H2O				

Description	Manufacturer	Part Number	Qty
Sensor	Magnetrol	7AF-4100-A00-01-048	1
Transmitter	Magnetrol	706-511B010	1

Rev	Date	By	Approval	Remarks
0	1/23/2015	MRO		Issued for Approval
1	5/15/2015	MRO		Changed the display to remote mount

Kruger Inc.
4001 Weston Parkway
Cary, NC 27513 USA
Tel: 919-677-8310 ● Fax: 919-677-0082
Web site: www.krugerusa.com

VEOLIA WATER
Solutions & Technologies

INSTRUMENT DATASHEET

PROJECT NAME: Massillon, OH

PROJECT NO.: 5700235402

Guided Level Radar Transmitter		Train 2 IFAS

Sensor		Transmitter	
Model No.:	Eclipse 706	Model No.:	Eclipse 706
Range:	0 to 4 feet	Range:	0 to 4 feet
Power Supply:	Transmitter Supplied	Power Supply:	24VDC Loop Powered
Power Requirements:		Power Requirements:	
Output Signal:	4-20mA	Output Signal:	4-20mA
Enclosure Rating:		Enclosure Rating:	IP67
Operating Temp:	-40 to 175°F	Operating Temp:	-40 to 175°F
Process Connection:	2" NPT Thread	Accuracy:	+/- 0.1%
Cable Length:	3 meters	Integral/Remote Mount:	Remote
Cable Connection:	Quick Connect	Local Display:	Yes
Sensor Type:	Immersion	Input Signal:	4-20mA

Comments:

Function	Signal	Units	Input		Output	
			LRV	URV	LRV	URV
Level	Analog Output 1	feet in H2O				

Description	Manufacturer	Part Number	Qty
Sensor	Magnetrol	7AF-4100-A00-01-048	1
Transmitter	Magnetrol	706-511B010	1

Rev	Date	By	Approval	Remarks
0	1/23/2015	MRO		Issued for Approval
1	5/15/2015	MRO		Changed the display to remote mount

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Tel: 919-677-8310 ● Fax: 919-677-0082
Web site: www.krugerusa.com

VEOLIA WATER
Solutions & Technologies

INSTRUMENT DATASHEET

PROJECT NAME: Massillon, OH

PROJECT NO.: 5700235402

Guided Level Radar Transmitter		**Train 3 IFAS**

Sensor		Transmitter	
Model No.:	Eclipse 706	Model No.:	Eclipse 706
Range:	0 to 4 feet	Range:	0 to 4 feet
Power Supply:	Transmitter Supplied	Power Supply:	24VDC Loop Powered
Power Requirements:		Power Requirements:	
Output Signal:	4-20mA	Output Signal:	4-20mA
Enclosure Rating:		Enclosure Rating:	IP67
Operating Temp:	-40 to 175°F	Operating Temp:	-40 to 175°F
Process Connection:	2" NPT Thread	Accuracy:	+/- 0.1%
Cable Length:	3 meters	Integral/Remote Mount:	Remote
Cable Connection:	Quick Connect	Local Display:	Yes
Sensor Type:	Immersion	Input Signal:	4-20mA

Comments:

Function	Signal	Units	Input		Output	
			LRV	URV	LRV	URV
Level	Analog Output 1	feet in H2O				

Description	Manufacturer	Part Number	Qty
Sensor	Magnetrol	7AF-4100-A00-01-048	1
Transmitter	Magnetrol	706-511B010	1

Rev	Date	By	Approval	Remarks
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1	5/15/2015	MRO		Changed the display to remote mount

Kruger Inc.
4001 Weston Parkway
Cary, NC 27513 USA
Tel: 919-677-8310 ● Fax: 919-677-0082
Web site: www.krugerusa.com

VEOLIA WATER
Solutions & Technologies

Eclipse® Model 706 High Performance Guided Wave Radar Level Transmitter

DESCRIPTION

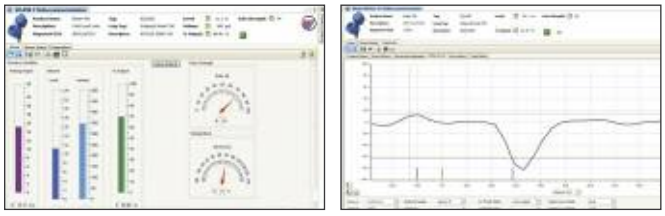
The new Eclipse® Model 706 High Performance Transmitter is a loop-powered, 24 VDC level transmitter that is based upon the proven and accepted technology of Guided Wave Radar (GWR). Encompassing a number of significant engineering accomplishments, this leading edge level transmitter is designed to provide measurement performance well beyond that of many of the more traditional technologies.

Utilizing "diode switching" technology, along with the most comprehensive probe offering on the market, this single transmitter can be used in a wide variety of applications ranging from very light hydrocarbons to water-based media.

The innovative angled, dual compartment enclosure is now a common sight in the industry. This enclosure, first brought to the industry by Magnetrol® in 1998, is angled to maximize ease of wiring, configuration, and viewing of the versatile graphic LCD display.

One universal Model 706 transmitter can be used and interchanged with all probe types, and offers enhanced reliability as it is suitable for use in critical SIL 2 hardware safety loops.

The ECLIPSE Model 706 supports both the FDT/DTM and Enhanced DD (EDDL) standards, which allow viewing of valuable configuration and diagnostic information such as the echo curve in tools such as PACT*ware*™, AMS Device Manager, and various HART® Field Communicators.



Eclipse® Model 706 DTM

Measures Level, Interface, Volume and Flow





APPLICATIONS

MEDIA: Liquids, solids, or slurries; hydrocarbons to water-based media (Dielectric Constant ε_r = 1.2–100)

VESSELS: Most process or storage vessels up to rated probe temperature and pressure.

CONDITIONS: All level measurement and control applications including process conditions exhibiting visible vapors, foam, surface agitation, bubbling or boiling, high fill/empty rates, low level and varying dielectric media or specific gravity.

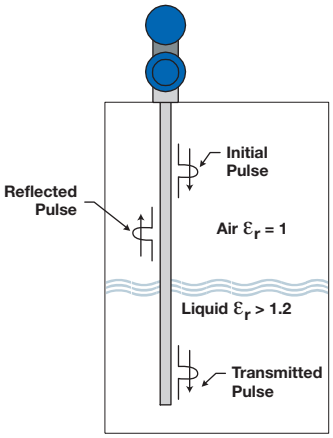
FEATURES

- Multivariable, two-wire, 24 VDC loop-powered transmitter for level, interface, volume, or flow.
- Diode switching technology offers best-in-class signal strength and signal-to-noise ratio (SNR) resulting in enhanced capability in difficult low dielectric applications.
- Level measurement not affected by changing media characteristics.
- No need to move levels for calibration.
- Overfill Capable probes allow for "true level" measurement all the way up to the process seal, without the need for special algorithms.
- 4-button keypad and graphic LCD display allow for convenient viewing of configuration parameters and echo curve.
- Proactive diagnostics advise not only what is wrong, but also offer troubleshooting tips.
- Nine common tank shapes for volumetric output.
- 30-point custom strapping table for uncommonly-shaped tanks.
- Two standard flumes and four standard weirs of various sizes for flow measurement.
- Generic flow equation for non-standard channels.
- 360° rotatable housing can be separated from probe without depressurizing the vessel.
- Probe designs up to +850° F/6250 psi (+450° C/431 bar).
- Saturated steam applications up to 1275 psi @ +572° F (88 bar @ +300° C).
- Cryogenic applications down to -320° F (-196° C).
- Transmitter can be remote-mounted up to 12 feet (3.6 m) away from the probe.
- FMEDA evaluation allows use in SIL 2 Loops (full FMEDA report available).
- No moving parts.

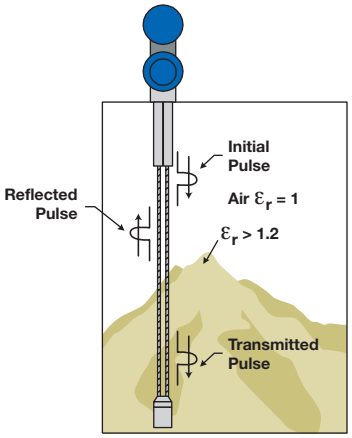
TECHNOLOGY

PRINCIPLE OF OPERATION

ECLIPSE Guided Wave Radar is based upon the technology of TDR (Time Domain Reflectometry). TDR utilizes pulses of electromagnetic energy transmitted down a wave guide (probe). When a pulse reaches a surface that has a higher dielectric constant than the air ($\varepsilon_r = 1$) in which it is traveling, a portion of the pulse is reflected. The transit time of the pulse is then measured via high speed timing circuitry that provides an accurate measure of the liquid (or solids) level. The amplitude of the reflection depends on the dielectric constant of the product. The higher the dielectric constant, the larger is the reflection.



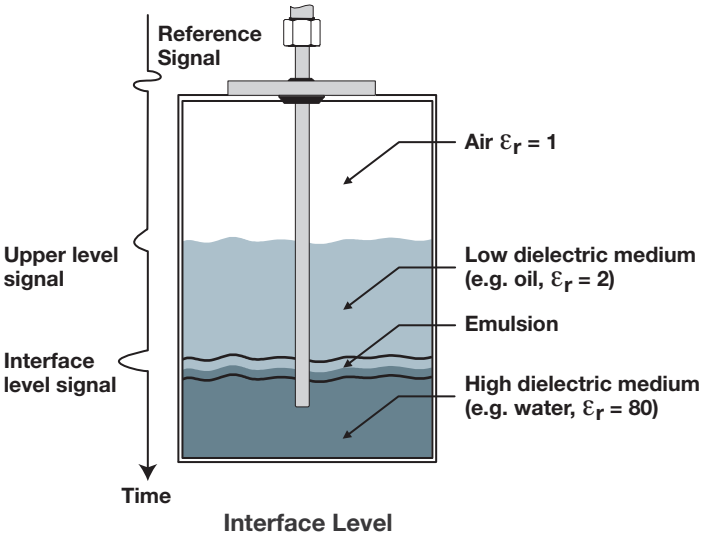
Overall Liquid Level



Bulk Solid Level

INTERFACE MEASUREMENT

The ECLIPSE Model 706 is capable of measuring both an upper liquid level and an interface liquid level. As only a portion of the pulse is reflected from a low dielectric upper surface, some of the transmitted energy continues down the GWR probe through the upper liquid. The remaining initial pulse is again reflected when it reaches the higher dielectric lower liquid. It is required that the upper liquid has a dielectric constant less than 10, and the lower liquid has a dielectric constant greater than 15. A typical interface application would be oil over water, with the upper layer of oil being non-conductive ($\varepsilon_r \approx 2.0$), and the lower layer of water being very conductive ($\varepsilon_r \approx 80$). The thickness of the upper layer could be as small as 2" (50 mm) while the maximum upper layer is limited to the length of the GWR probe.



Interface Level

EMULSION LAYERS

As emulsion layers, also called "rag layers," can decrease the strength of the reflected signal in an interface application, GWR transmitters are typically recommended for applications that have clean, distinct layers.

However, the ECLIPSE Model 706, with its powerful internal measurement algorithms, will tend to detect the top of an emulsion layer. Contact the factory for application assistance regarding emulsion layers in your specific application.

SATURATED STEAM APPLICATIONS (Boilers, Feedwater Heaters, etc.)

As the temperature of a saturated steam application increases, the dielectric constant of the steam vapor space also increases. This increase in vapor space dielectric causes a delay in the GWR signal propagation as it travels down the probe, causing the liquid level to appear lower than actual.

NOTE: The measurement error associated with this propagation delay does depend on temperature and is a function of the square root of the vapor space dielectric constant. For example, with no compensation, a +450° F (+230° C) application would show a level error of about 5.5%, while a +600° F (+315° C) application would show an error approaching 20%!

The ECLIPSE Model 706 transmitter and Model 7yS Coaxial Steam probe provide a unique solution to this application. The effects of the changing steam conditions can be compensated for by utilizing a mechanical steam target placed inside and near the top of the Model 7yS coaxial probe.

Knowing exactly where the target is located at room temperature, and then continuously monitoring its apparent location, the vapor space dielectric can be back-calculated. Knowing the vapor space dielectric, accurate compensation of the actual liquid level reading is accomplished.

This is a patented technique with two US Patents (US 6642801 and US 6867729) issued for both the mechanical target concept and the associated software algorithm.

Contact the factory for additional information relating to saturated steam applications.

OVERFILL CAPABILITY

Although agencies like WHG or VLAREM certify **Overfill proof** protection, defined as the tested, reliable operation when the transmitter is used as overfill alarm, it is assumed in their analysis that the installation is designed in such a way that the vessel or side mounted cage cannot physically overfill.

However, there are practical applications where a GWR probe can be completely flooded with level all the way up to the process connection (face of the flange). Although the affected areas are application dependent, typical GWR probes have a transition zone (or possibly dead zone) at the top of the probe where interacting signals can either affect the linearity of the measurement or, more dramatically, result in a complete loss of signal.

While some manufacturers of GWR transmitters may use special algorithms to "infer" level measurement when this undesirable signal interaction occurs and the actual level signal is lost, the ECLIPSE Model 706 offers a unique solution by utilizing a concept called **Overfill Safe Operation**.

An **Overfill safe probe** is defined by the fact that it has a predictable and uniform characteristic impedance all the way down the entire length of the waveguide (probe). These probes allow the ECLIPSE Model 706 to measure accurate levels up to the process flange without any non-measurable zone at the top of the GWR probe.

Overfill safe GWR probes are unique to ECLIPSE GWR, and coaxial probes can be installed at any location on the vessel. Overfill safe probes are offered in a variety of Coaxial and Caged designs.

PROBE OVERVIEW

THREE STYLES OF GWR PROBES

With one basic ECLIPSE Model 706 transmitter that operates with all probes, choosing the proper Guided Wave Radar (GWR) probe is the most important decision in the application process. The probe configuration establishes fundamental performance characteristics.

All ECLIPSE Model 706 probes can be described by three basic configurations:

- Coaxial
- Twin flexible cable
- Single element (rigid rod or flexible cable)

Each of these probe configurations has specific strengths and weaknesses. Although there can be overlap, and different probes can certainly be used in similar applications, it is important to understand their basic differences so that one can choose the probe type that will offer optimal performance.

The descriptions below are facts relating to the physics of GWR technology and are not specific to the ECLIPSE Model 706.

COAXIAL PROBES

The coaxial probe is the most efficient of all GWR probe configurations and should be the first consideration in all applications. Analogous to the efficiency of coaxial cable, a coaxial probe allows almost unimpeded movement of the high frequency pulses throughout its length.

The electromagnetic field that develops between the inner rod and outer tube is completely contained and uniform down the entire length of the probe. See Figure 1. This means that the coaxial probe is immune to any proximity affects from other objects in the vessel, and therefore, in essence, it can be used anywhere that it can mechanically fit.

The efficiency and overall sensitivity of a coaxial configuration yields robust signal strength, even in extremely low dielectric ($\varepsilon_r \geq 1.4$) applications. The sensitivity of this "closed" design, however, also makes it more susceptible to measurement error in applications that can have coating and buildup.

All ECLIPSE Model 706 coaxial probes are Overfill Safe as standard, by design.

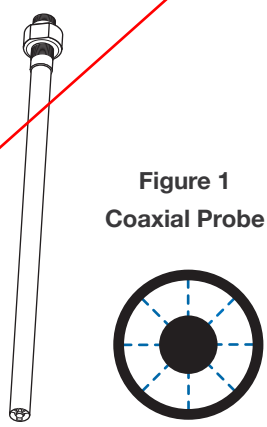


Figure 1
Coaxial Probe

BASIC–FOR CLEAN LIQUIDS

The basic 0.875" (22.5 mm) diameter coaxial GWR probe is only recommended for use in clean applications or special applications such as saturated steam. Teflon®, PEEK, or alumina spacers centering the inner rod within the outer tube are located at 24" (60 cm) intervals, resulting in a perfect characteristic impedance along the entire length of the probe.

This probe is recommended in applications with viscosities up to 500 cP (mPa.s) maximum.

ENLARGED–FOR DIFFICULT LIQUIDS

The standard Enlarged 1.75" (45 mm) or 1.93" (49mm) diameter coaxial GWR probes can be generally used for most applications. They can be installed directly into the tank as well as into bypass cages, stillwells or bridles.

The robust construction reduces the number of spacers required, allowing the probe to be used in applications where higher risk of buildup exists. To further reduce the possibility of media buildup, the use of a single bottom spacer is recommended up to probe lengths of 100 inches (2.54 meters). The overall sensitivity and performance of an enlarged coaxial GWR probe is identical to a standard coaxial GWR probe, but it offers the very important advantage that it can be used in applications with viscosities up to 2,000 cP (mPa.s).

OPTIONAL FLUSHING CONNECTION

The maintenance of coaxial GWR probes in applications suffering from buildup or crystallization can be significantly improved by using an optional flushing connection. This flushing connection is a metal extension with a port welded above the process connection. The port allows the user to purge the inside of the coaxial GWR probe during routine maintenance.

Note: The best approach to eliminate the effects of condensation or crystallization is to install adequate insulation or heat tracing (steam or electrical). A flushing connection is no substitute for proper maintenance, but will help to reduce the frequency of the intervention.





CAGED–FOR DIRTY LIQUIDS

Unique to MAGNETROL, the Caged GWR probe is a single rod probe which uses an existing or new cage, bridle, or stillwell as the second conductor to re-create the same signal propagation of a coaxial GWR probe. Caged GWR probes are designed for 2" (DN50), 3" (DN80) or 4" (DN100) diameter metal chambers, and utilize a specially designed impedance matching section that results in the same overall characteristic impedance of a coaxial style GWR probe.

Caged GWR probes offer the same sensitivity and performance as coaxial GWR probes, but the single conductor design allows it to be used in applications with viscosities up to 10,000 cP (mPa.s).

OPTIONAL ANNUNCIATOR FITTING

High Pressure and High Temperature High Pressure ECLIPSE Model 706 probes containing a glass ceramic alloy process seal (Models 7yD, P, J, L, M and N) are available with an optional annunciator fitting. The use of this fitting complies with the Dual Seal requirements of ANSI/ISA-12.27.01-2011, titled "Requirements for Process Sealing between Electrical Systems and Flammable or Combustible Process Fluids," which require the incorporation of a method that indicates or annunciates a primary seal failure (e.g., visible leakage, an audible whistle, or other means of monitoring).

THREE STYLES OF GWR PROBES

TWIN CABLE FLEXIBLE PROBES

The relationship of the Twin Cable probe design to a coaxial probe design is similar to that of older, twin-lead, antenna lead-in to modern, coaxial cable. 300-ohm twin-lead cable simply does not have the efficiency of 75-ohm coaxial cable, making the parallel conductor design less sensitive than the concentric coaxial. See Figure 2. This translates into Twin Cable GWR probes having the ability to measure dielectrics down to $\varepsilon_r \geq 1.7$.

Heavy bridging of material between the cables across the FEP coating can cause improper measurement and should be avoided.

Figure 2 also shows that, although most of the electromagnetic field develops between the two cables, there is also some peripheral energy that expands outward, making the Twin Cable probe more sensitive to proximity effects of objects located immediately around it. For that reason, it is recommended to keep the active element of the Twin Cable probe at least 1 inch (25 mm) away from metal objects.

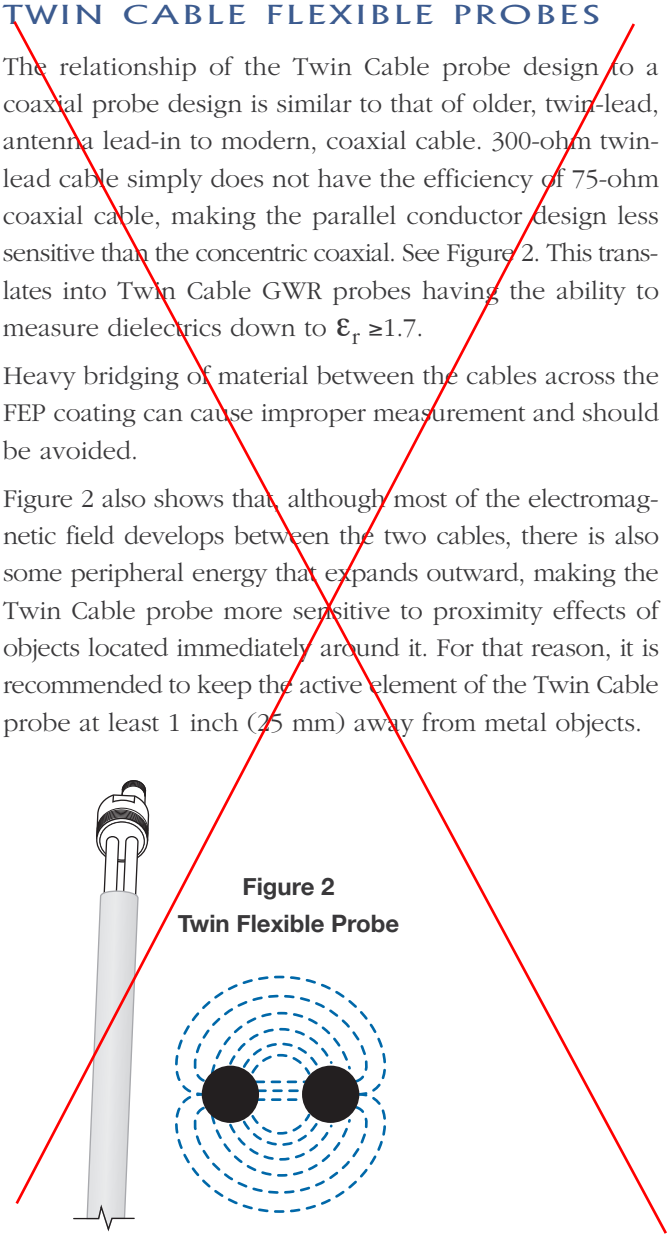


Figure 2
Twin Flexible Probe

SINGLE ROD PROBES

Single element GWR probes act quite differently than both coaxial and twin cable designs. With only one conductor to work with, the pulses of energy develop between the single rod probe and the mounting nut or flange. In other words, the pulse propagates down and around the rod as it references its ground at the top of the tank.

The energy and efficiency of the pulse are directly related to how much metallic surface exists around it at the top of the vessel. This metallic surface at the top of the probe is called the "launch plate." The larger the launch plate, the more efficient the signal propagation down the probe.

Figure 3 shows the single element design and how the electromagnetic pulse effectively expands into a teardrop shape as it propagates away from the top of the tank (the inherent ground reference). This single element configuration (rod or cable) is the least efficient of the three probe types, but can still operate with a with minimum dielectric detection of approximately $\varepsilon_r > 1.7$ in an open, non-metallic vessel.

However, this dielectric constant performance improves considerably ($\varepsilon_r > 1.4$) when the single rod probe is installed in a metal cage/bridle, or mounted 2–6" (50–150 mm) away from a metal tank wall. Because the design is "open," it exhibits two strong tendencies:

- It is the most forgiving of coating and buildup. (The PFA-insulated probe is the best choice for severe buildup and coating).
- It is most affected by proximity issues.

It is important to note that a parallel metal wall INCREASES the performance of a single rod probe while a singular, metal object protruding out near the probe may be improperly detected as a liquid level.

These tendencies are application/installation dependent. Therefore, by properly matching the single rod probe to a cage/chamber, the ECLIPSE Model 706 broad offering of caged probes combines the performance/sensitivity advantages of a coaxial probe and the viscosity immunity of a single rod probe. The Caged Probes are Overfill Safe by design, can be used in interface and other difficult, low dielectric applications, and are unique to MAGNETROL and the ECLIPSE Model 706.

Contact the factory for additional support and questions.

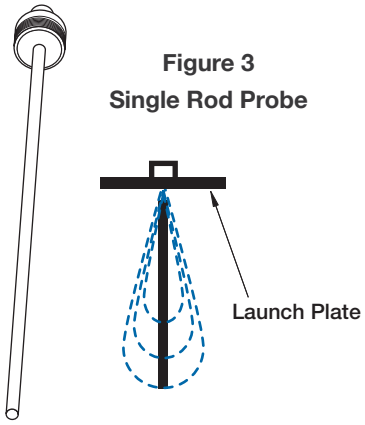
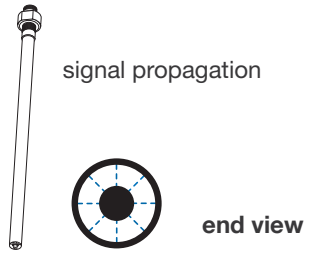


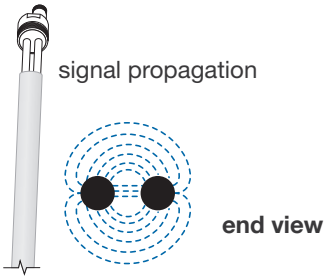
Figure 3
Single Rod Probe

PROBE SELECTION GUIDE

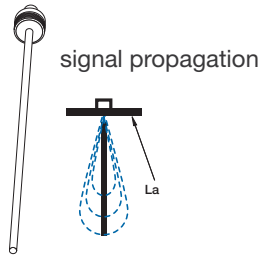
COAXIAL/CAGED GWR PROBE



TWIN CABLE GWR PROBE



SINGLE ROD/CABLE PROBE



GWR Probe①	Description	Application	Installation	Dielectric Range ②③	Temperature Range ④	Max. Pressure	Vacuum ⑤	Overfill Safe	Viscosity cP (mPa.s)
Coaxial GWR Probes—Liquids									
7yT	Standard Temperature	Level/Interface	Tank/Chamber	ε_r 1.4–100	-40° to +400° F (-40° to +200° C)	1000 psi (70 bar)	Yes	Yes	500/2000
7yP	High Pressure	Level/Interface	Tank/Chamber	ε_r 1.4–100	-320° to +400° F (-196° to +200° C)	6250 psi (431 bar)	Full	Yes	500/2000
7yD	High Temp./ High Press.	Level/Interface	Tank/Chamber	ε_r 1.4–100	-320° to +850° F (-196° to +450° C)	6250 psi (431 bar)	Full	Yes	500/2000
7yS	Steam Probe	Saturated Steam	Tank/Chamber	ε_r 10–100	-40° to +575° F (-40° to +300° C)	1275 psi (88 bar)	Full	No ⑥	500
Caged GWR Probes—Liquids									
7yG	Standard Temperature	Level/Interface	Chamber	ε_r 1.4–100	-40° to +400° F (-40° to +200° C)	1000 psi (70 bar)	Yes	Yes	10000
7yL	High Pressure	Level/Interface	Chamber	ε_r 1.4–100	-320° to +400° F (-196° to +200° C)	6250 psi (431 bar)	Full	Yes	10000
7yJ	High Temp./ High Press.	Level/Interface	Chamber	ε_r 1.4–100	-320° to +850° F (-196° to +450° C)	6250 psi (431 bar)	Full	Yes	10000
Single Rod Rigid GWR Probes—Liquids									
7yF	Standard Temperature	Level	Tank	ε_r 1.7–100	-40° to +400° F (-40° to +200° C)	1000 psi (70 bar)	Yes	No ⑦	10000
7yM	High Pressure	Level	Tank	ε_r 1.7–100	-320° to +400° F (-196° to +200° C)	6250 psi (431 bar)	Full	No ⑦	10000
7yN	High Temp./ High Press.	Level	Tank	ε_r 1.7–100	-320° to +850° F (-196° to +450° C)	6250 psi (431 bar)	Full	No ⑦	10000
Single Cable Flexible GWR Probes—Liquids									
7y1	Standard Temperature	Level	Tank	ε_r 1.7–100	-40° to +400° F (-40° to +200° C)	1000 psi (70 bar)	Yes	No ⑦	10000
7y3⑧	High Temp./ High Press.	Level	Tank	ε_r 1.7–100	-320° to +850° F (-196° to +450° C)	6250 psi (431 bar)	Full	No ⑦	10000
7y4⑧	Standard Temperature	Level/Interface	Chamber	ε_r 1.4–100	-40° to +400° F (-40° to +200° C)	1000 psi (70 bar)	Yes	No ⑦	10000
7y6⑧	High Temp./ High Press	Level/Interface	Chamber	ε_r 1.4–100	-320° to +850° F (-196° to +450° C)	6250 psi (431 bar)	Full	No ⑦	10000
Twin Cable Flexible GWR Probes—Liquids									
7y7	Standard Temperature	Level/Interface	Tank	ε_r 1.7–100	-40° to +400° F (-40° to +200° C)	1000 psi (70 bar)	Yes	No ⑦	1500
Single Cable Flexible GWR Probes—Solids									
7y2	Bulk Solids Probe	Level	Tank	ε_r 4–100	-40° to +150° F (-40° to +65° C)	Atmos.	No	No⑦	10000
Twin Cable Flexible GWR Probes—Solids									
7y5	Bulk Solids Probe	Level	Tank	ε_r 1.7–100	-40° to +150° F (-40° to +65° C)	Atmos.	No	No⑦	1500

① 2nd digit A=English, C=Metric
② Minimum ε_r 1.2 with end of probe analysis enabled.
③ Single rod probes mounted directly into the vessel must be within 3–6 inches of metal tank wall to obtain minimum dielectric of 1.4, otherwise ε_r min = 1.7.
④ Depends on the probe spacer material. Refer to Model Selection for spacer options.
⑤ ECLIPSE probes containing o-rings can be used for vacuum (negative pressure) service, but only those probes with glass seals are hermetically sealed to $<10^{-8}$ cc/sec @ 1 atmosphere helium.
⑥ Consult factory for overfill applications
⑦ Overfill capability can be achieved with software.
⑧ Scheduled for future release.

TRANSMITTER SPECIFICATIONS

FUNCTIONAL/PHYSICAL

System Design		
Measurement Principle		Guided Wave Radar based on Time Domain Reflectometry (TDR)
Input		
Measured Variable		Level, as determined by GWR time of flight
Span		6 inches to 100 feet (15 cm to 30 m); Model 7yS Probe 20 feet (610 cm) max.
Output		
Type		4 to 20 mA with HART: 3.8 mA to 20.5 mA useable (per NAMUR NE43)
		FOUNDATION™ fieldbus: H1 (ITK Ver. 6.1.1)
Resolution	Analog:	.003 mA
	Digital Display:	1 mm
Loop Resistance		591 ohms @ 24 VDC and 22 mA
Diagnostic Alarm		Selectable: 3.6 mA, 22 mA (meets requirements of NAMUR NE 43), or HOLD last output
Diagnostic Indication		Meets requirements of NAMUR NE107
Damping		Adjustable 0–10 seconds
User Interface		
Keypad		4-button menu-driven data entry
Display		Graphic liquid crystal display
Digital Communication/Systems		HART Version 7—with Field Communicator, FOUNDATION fieldbus, AMS, or FDT
		DTM (PACT*ware*™), EDDL
Menu Languages		Transmitter LCD: English, French, German, Spanish, Russian
		HART DD: English, French, German, Spanish, Russian, Chinese, Portuguese
		FOUNDATION fieldbus Host System: English
Power (at transmitter terminals)		HART: General Purpose (Weather proof)/Intrinsically Safe/Explosion-proof:
		16 to 36 VDC
		11 VDC minimum under certain conditions (refer to I&O Manual 57-606)
		FOUNDATION fieldbus: 9 to 17.5 VDC
		FISCO, FNICO, Explosion Proof, General Purpose and Weather Proof
Housing		
Material		IP67/die-cast aluminum A413 (<0.6% copper); optional stainless steel
Net/Gross Weight	Aluminum:	4.5 lbs. (2.0 kg)
	Stainless Steel:	10.0 lbs. (4.50 kg)
Overall Dimensions		H 8.34" (212 mm) x W 4.03" (102 mm) x D 7.56" (192 mm)
Cable Entry		½" NPT or M20
SIL 2 Hardware (Safety Integrity Level)		Safe Failure Fraction = 93% (HART only)
		Functional Safety to SIL 2 as 1oo1 in accordance with IEC 61508
		(Full FMEDA report available upon request)

TRANSMITTER SPECIFICATIONS CONTINUED

FUNCTIONAL/PHYSICAL

Environment	
Operating Temperature	-40° to +175° F (-40° to +80° C); LCD viewable -5° to +160° F (-20° to +70° C)
Storage Temperature	-50° to +185° F (-45° to +85° C)
Humidity	0 to 99%, non-condensing
Electromagnetic Compatibility	Meets CE requirement (EN 61326) and NAMUR NE 21
	NOTE: Single Rod and Twin Cable probes must be used in metallic vessel or stillwell to maintain CE noise immunity
Surge Protection	Meets CE EN 61326 (1000V)
Shock/Vibration	ANSI/ISA-S71.03 Class SA1 (Shock); ANSI/ISA-S71.03 Class VC2 (Vibration)
Performance	
Reference Conditions ①	Reflection from liquid, with dielectric constant in center of selected range, with a 72" (1.8 m) coaxial probe at +70° F (+20° C), in Auto Threshold Mode
Linearity ② Coaxial/Caged Probes:	<0.1% of probe length or 0.1 inch (2.5 mm), whichever is greater
Single Rod in Tanks/Twin Cable:	<0.3% of probe length or 0.3 inch (7.5 mm), whichever is greater
Accuracy Coaxial/Caged Probes:	±0.1% of probe length or ±0.1 inch (2.5 mm), whichever is greater
Single Rod in Tanks/Twin Cable:	±0.5% of probe length or ±0.5 inch (13 mm), whichever is greater
Interface Operation:	Coaxial/Caged probes: ±1 inch (25 mm) for an interface thickness greater than 2 inches (50 mm)
	Twin Flexible probes: ±2 inch (50 mm) for an interface thickness greater than 8 inches (200 mm)
Resolution	±0.1 inch or 1 mm
Repeatability	<0.1 inch (2.5 mm)
Hysteresis	<0.1 inch (2.5 mm)
Response Time	Approximately 1 second
Initialization Time	Less than 10 seconds
Ambient Temperature Effect	Approx. ±0.02% of probe length/degree C (for probes greater than 8 feet (2.5 m))
Process Dielectric ③	<0.3 inch (7.5 mm) within selected range
FOUNDATION™ fieldbus	
ITK Version	6.1.1
H1 Device Class	Link Master (LAS)—selectable ON/OFF
H1 Profile Class	31PS, 32L
Function Blocks	(8) AI, (3) Transducer, (1) Resource, (1) Arithmetic, (1) Input Selector, (1) Signal Characterizer, (2) PID, (1) Integrator
Quiescent Current	15 mA
Execution Time	15 ms (40 ms PID Block)
Device Revision	01
DD Version	0x01

① Specifications will degrade in Fixed Threshold mode.
② Linearity in top 18 inches (46 cm) of Twin Cable and Single Rod probes in tanks will be application dependent.
③ Accuracy may degrade when using manual or automatic compensation.

COAXIAL PROBE MATRIX

	7yT	7yP
Description	Standard Temperature	High Pressure
Application	Level/Interface	Level/Interface
Installation	Tank/Chamber	Tank/Chamber
Overfill Safe	Yes	Yes
Materials — Probe	316/316L (1.4401/1.4404) Hastelloy® C (2.4819) Monel® (2.4360)	316/316L (1.4401/1.4404) Hastelloy® C (2.4819) Monel® (2.4360)
Process Seal	Teflon® TFE with Viton® o-rings ①	Hermetic Glass Ceramic
Spacers	Teflon® TFE	Teflon® TFE
Probe Outside Diameter		
Enlarged	316 SS: 1.75" (45 mm) Hastelloy: 1.90" (49 mm) Monel: 1.90" (49 mm)	316 SS: 1.75" (45 mm) Hastelloy: 1.90" (49 mm) Monel: 1.90" (49 mm)
Basic	0.87" (22.5 mm)	0.87" (22.5 mm)
Process Connection		
Threaded	Enlarged 2" NPT (¾" NPT or 1" BSP)	Enlarged 2" NPT (¾" NPT or 1" BSP)
Flanged	Various ANSI, EN1092, and proprietary flanges	Various ANSI, EN1092, and proprietary flanges
Available Probe Length		
Standard	12 to 240 inches (30 to 610 cm)	12 to 240 inches (30 to 610 cm)
Enlarged	50 feet (15 m) max. segmented	50 feet (15 m) max. segmented
Transition Zones ②		
Top	0 inches (0 mm)	0 inches (0 mm)
Bottom	ε_r = 1.4: 6 inches (150 mm) ⑤, ε_r = 80: 2 inches (50 mm)	ε_r = 1.4: 6 inches (150 mm) ⑤, ε_r = 80: 2 inches (50 mm)
Process Temperature	-40° to +400° F (-40° to +200° C)	-320° to +400° F (-196° to +200° C)
Max. Process Pressure ③	1000 psi @ +70° F (70 bar @ +20° C)	6250 psi @ +70°F (431 bar @ +20°C)
Dielectric Range	1.4 to 100 ⑥	1.4 to 100 ⑥
Vacuum Service ④	Negative Pressure, but no hermetic seal	Full Vacuum
Viscosity		
Enlarged	2000cP (mPa.s)	2000cP (mPa.s)
Basic	500cP (mPa.s)	500cP (mPa.s)
Media Coating	Filming	Filming

① Other o-ring materials available upon request.
② Transition zones (areas with reduced accuracy) are dielectric dependent. It is recommended to set the 0-100% measuring range outside of the transition zones.
③ Refer to chart on page 16.
④ ECLIPSE probes containing o-rings can be used for vacuum (negative pressure) service, but only those probes with glass seal are hermetically sealed to $<10^{-8}$ cc/sec @ 1 atmosphere helium.
⑤ Can be reduced to 3" (75 mm) when lower accuracy is acceptable.
⑥ 1.2 minimum dielectric when end of probe analysis is enabled.

COAXIAL PROBE MATRIX CONTINUED

	7yD	7yS
Description	High Temp./High Pressure	Steam Probe
Application	Level/Interface	Saturated Steam
Installation	Tank/Chamber	Tank/Chamber
Overfill Safe	Yes	No ⑥
Materials — Probe	316/316L (1.4401/1.4404) Hastelloy® C (2.4819) Monel® (2.4360)	316/316L (1.4401/1.4404) Hastelloy® C (2.4819)
Process Seal	Hermetic Glass Ceramic	Hermetic Glass Ceramic, PEEK HT
Spacers	PEEK HT/Ceramic	PEEK HT/Ceramic
Probe Outside Diameter **Enlarged** **Basic**	 316 SS: 1.75" (45 mm) Hastelloy: 1.92" (49 mm) Monel: 1.92" (49 mm) 0.87" (22.5 mm)	 N/A 0.87" (22.5 mm)
Process Connection **Threaded** **Flanged**	 2" NPT or 2" BSP Various ANSI, EN1092, and proprietary flanges	 ¾" NPT or 1" BSP Various ANSI, EN1092, and proprietary flanges
Available Probe Length **Standard** **Enlarged**	 12 to 240 inches (30 to 610 cm) 50 feet (15 m) max. segmented	 24 to 240 inches (60 to 610 cm) N/A
Transition Zones ① **Top** **Bottom**	 0 inches (0 mm) ε_r = 1.4: 6 inches (150 mm) ④, ε_r = 80: 2 inches (50 mm)	 8 inches (200 mm) ε_r = 80: 2 inches (50 mm)
Process Temperature	-320° to +850° F (-196° to 450° C)	-58° to +575° F (-50° to +300° C)
Max. Process Pressure ②	6250 psi @ +70° F (431 bar @ +20°C)	1275 psi @ +575° F (87.9 bar @ +300°C)
Dielectric Range	1.4 to 100 ⑤	10 to 100
Vacuum Service ③	Full Vacuum	Full Vacuum
Viscosity **Enlarged** **Basic**	 2000cP (mPa.s) 500cP (mPa.s)	 N/A 500cP (mPa.s)
Media Coating	Filming	Filming

① Transition zones (areas with reduced accuracy) are dielectric dependent. It is recommended to set the 0-100% measuring range outside of the transition zones.
② Refer to chart on page 16.
③ ECLIPSE probes containing o-rings can be used for vacuum (negative pressure) service, but only those probes with glass seal are hermetically sealed to $<10^{-8}$ cc/sec @ 1 atmosphere helium.
④ Can be reduced to 3" (75 mm) when lower accuracy is acceptable.
⑤ 1.2 minimum dielectric when end of probe analysis is enabled.
⑥ Consult factory for overfill applications.

CAGED PROBE MATRIX

	7yG	7yL	7yJ
Description	Standard Temperature	High Pressure	High Temp./High Pressure
Application	Level/Interface	Level/Interface	Level/Interface
Installation	Chamber	Chamber	Chamber
Overfill Safe ⑦	Yes	Yes	Yes
Materials — Probe	316/316L (1.4401/1.4404) Hastelloy® C (2.4819) Monel® (2.4360)	316/316L (1.4401/1.4404) Hastelloy® C (2.4819) Monel® (2.4360)	316/316L (1.4401/1.4404) Hastelloy® C (2.4819) Monel® (2.4360)
Process Seal	Teflon® TFE with Viton® o-rings①	Hermetic Glass Ceramic	Hermetic Glass Ceramic
Spacers	PEEK	PEEK	PEEK HT/Celazole
Probe Outside Diameter			
2" Chamber	.5" (13 mm) to .75" (19 mm)	.5" (13 mm) to .75" (19 mm)	.5" (13 mm) to .75" (19 mm)
3" Chamber	.75" (19 mm) to 1.13" (29 mm)	.75" (19 mm) to 1.13" (29 mm)	.75" (19 mm) to 1.13" (29 mm)
4" Chamber	1.05" (27 mm) to 1.50" (38 mm)	1.05" (27 mm) to 1.50" (38 mm)	1.05" (27 mm) to 1.50" (38 mm)
Process Connection			
Flanged	Various ANSI, EN1092, and proprietary flanges	Various ANSI, EN1092, and proprietary flanges	Various ANSI, EN1092, and proprietary flanges
Available Probe Length	12 to 240 inches (30 to 610 cm)	12 to 240 inches (30 to 610 cm)	12 to 240 inches (30 to 610 cm)
Transition Zones ②			
Top	0 inches (0 mm)	0 inches (0 mm)	0 inches (0 mm)
Bottom	ε_r = 1.4: 6 inches (150 mm) ⑤, ε_r = 80: 2 inches (50 mm)	ε_r = 1.4: 6 inches (150 mm) ⑤, ε_r = 80: 2 inches (50 mm)	ε_r = 1.4: 6 inches (150 mm) ⑤, ε_r = 80: 2 inches (50 mm)
Process Temperature	-40° to +400° F (-40° to +200° C)	-320° to +400° F (-196° to +200° C)	-320° to +850° F (-196° to +450° C)
Max. Process Pressure ③	1000 psi @ +70° F (70 bar @ +20° C)	6250 psi @ +70° F (431 bar @ +20° C)	6250 psi @ +70° F (431 bar @ +20° C)
Dielectric Range ⑦	1.4 to 100 ⑥	1.4 to 100 ⑥	1.4 to 100 ⑥
Vacuum Service ④	Negative Pressure, but no hermetic seal	Full Vacuum	Full Vacuum
Viscosity	10,000cP (mPa.s)	10,000cP (mPa.s)	10,000cP (mPa.s)
Media Coating	Maximum Error 10% of coated length (% Error is dependent on dielectric and thickness)	Maximum Error 10% of coated length (% Error is dependent on dielectric and thickness)	Maximum Error 10% of coated length (% Error is dependent on dielectric and thickness)

① Other o-ring materials available upon request.
② Transition zones (areas with reduced accuracy) are dielectric dependent. It is recommended to set the 0-100% measuring range outside of the transition zones.
③ Refer to chart on page 16.
④ ECLIPSE probes containing o-rings can be used for vacuum (negative pressure) service, but only those probes with glass seal are hermetically sealed to $<10^{-8}$ cc/sec @ 1 atmosphere helium.
⑤ Can be reduced to 3" (75 mm) when lower accuracy is acceptable.
⑥ 1.2 minimum dielectric when end of probe analysis is enabled.
⑦ When installed in the proper chamber/cage/stilling well.

SINGLE ROD RIGID PROBE MATRIX

	7yF	7yM	7yN
Description	Standard Temperature	High Pressure	High Temp./High Pressure
Application	Level	Level	Level
Installation	Tank	Tank	Tank
Overfill Safe ⑦	No	No	No
Materials — Probe	316/316L (1.4401/1.4404) Hastelloy® C (2.4819) Monel® (2.4360) PFA Insulated 316/316L rod	316/316L (1.4401/1.4404) Hastelloy® C (2.4819) Monel® (2.4360)	316/316L (1.4401/1.4404) Hastelloy® C (2.4819) Monel® (2.4360)
Process Seal	Teflon® TFE with Viton® o-rings①	Hermetic Glass Ceramic	Hermetic Glass Ceramic
Spacers	None	None	PEEK HT/Celazole
Probe Outside Diameter	Bare: 0.38" (10 mm) rod Coated: 0.625" (16 mm) rod	Bare: 0.38" (10 mm) rod	Bare: 0.50" (13 mm) rod
Process Connection **Threaded** **Flanged**	1" or 2" (NPT or BSP) Various ANSI, EN1092, and proprietary flanges	1" or 2" (NPT or BSP) Various ANSI, EN1092, and proprietary flanges	2" (NPT or BSP) Various ANSI, EN1092, and proprietary flanges
Available Probe Length	24 to 240 inches (60 to 610 cm)	24 to 240 inches (60 to 610 cm)	24 to 240 inches (60 to 610 cm)
Transition Zones ② **Top** **Bottom**	Application Dependent ε_r = 1.4: 6 inches (150 mm) ⑤, ε_r = 80: 2 inches (50 mm)	Application Dependent ε_r = 1.4: 6 inches (150 mm) ⑤, ε_r = 80: 2 inches (50 mm)	Application Dependent ε_r = 1.4: 6 inches (150 mm) ⑤, ε_r = 80: 2 inches (50 mm)
Process Temperature	-40° to +400° F (-40° to +200° C)	-320° to +400° F (-196° to +200° C)	-320° to +850° F (-196° to +450° C)
Max. Process Pressure ③	1000 psi @ +70° F (70 bar @ +20° C)	6250 psi @ +70° F (431 bar @ +20° C)	6250 psi @ +70° F (431 bar @ +20° C)
Dielectric Range	1.7 to 100 ⑥	1.7 to 100 ⑥	1.7 to 100 ⑥
Vacuum Service ④	Negative Pressure, but no hermetic seal	Full Vacuum	Full Vacuum
Viscosity	10,000cP (mPa.s)	10,000cP (mPa.s)	10,000cP (mPa.s)
Media Coating	Maximum Error 10% of coated length (% Error is dependent on dielectric and thickness)	Maximum Error 10% of coated length (% Error is dependent on dielectric and thickness)	Maximum Error 10% of coated length (% Error is dependent on dielectric and thickness)

① Other o-ring materials available upon request.
② Transition zones (areas with reduced accuracy) are dielectric dependent. It is recommended to set the 0-100% measuring range outside of the transition zones.
③ Refer to chart on page 16.
④ ECLIPSE probes containing o-rings can be used for vacuum (negative pressure) service, but only those probes with glass seal are hermetically sealed to $<10^{-8}$ cc/sec @ 1 atmosphere helium.
⑤ Can be reduced to 3" (75 mm) when lower accuracy is acceptable.
⑥ 1.2 minimum dielectric when end of probe analysis is enabled.
⑦ Overfill capability can be achieved with software.

FLEXIBLE PROBES FOR LIQUIDS MATRIX

	7y1	7y3 (Future)
Description	Single Flexible Standard Temperature	Single Flexible HTHP
Application	Level	Level
Installation	Tank	Tank
Overfill Safe ⑥	No	No
Materials — Cable	316 (1.4401)	316 (1.4401)
Process Seal	Teflon® TFE with Viton® o-rings①	Hermetic Glass Ceramic
Probe Outside Diameter	0.19 inches (5 mm)	0.19 inches (5 mm)
Process Connection **Threaded** **Flanged**	2" NPT or 2" BSP Various ANSI, EN1092, and proprietary flanges	2" NPT or 2" BSP Various ANSI, EN1092, and proprietary flanges
Available Probe Length	3 to 100 feet (1 to 30 meters)	3 to 100 feet (1 to 30 meters)
Transition Zones ② **Top** **Bottom**	18 inches (45 cm) 12 inches (30 cm)	18 inches (45 cm) 12 inches (30 cm)
Process Temperature	-40° to +400° F (-40° to +200° C)	-320° to +850° F (-196° to +450° C)
Max. Process Pressure ③	1000 psi @ +70° F (70 bar @ +20°C)	6250 psi @ +70° F (431 bar @ +20° C)
Dielectric Range ⑤	1.7 to 100	1.7 to 100
Vacuum Service ④	Negative Pressure, but no hermetic seal	Full Vacuum
Viscosity	10,000 (mPa.s)	10,000 (mPa.s)
Media Coating	Maximum Error 10% of coated length (% Error is dependent on dielectric and thickness)	Maximum Error 10% of coated length (% Error is dependent on dielectric and thickness)

① Other o-ring materials available upon request.
② Transition zones (areas with reduced accuracy) are dielectric dependent. It is recommended to set the 0-100% measuring range outside of the transition zones.
③ Refer to chart on page 16.
④ ECLIPSE probes containing o-rings can be used for vacuum (negative pressure) service, but only those probes with glass seal are hermetically sealed to $<10^{-8}$ cc/sec @ 1 atmosphere helium.
⑤ 1.2 minimum dielectric when end of probe analysis is enabled.
⑥ Overfill capability can be achieved with software.

	7y4 (Future)	7y6 (Future)	7y7
Description	Single Flexible Standard Temperature	Single Flexible HTHP	Twin Flexible Standard Temperature
Application	Level	Level	Level/Interface
Installation	Chamber	Chamber	Tank/Chamber
Overfill Safe	No	No	No
Materials — Cable	316 (1.4401)	316 (1.4401)	316 SS (1.4401) Cables with FEP Webbing
Process Seal ①	Teflon® TFE with Viton® o-rings	Hermetic Glass Ceramic	Teflon® TFE with Viton® o-rings
Cable Outside Diameter	0.19 inches (5 mm)	0.19 inches (5 mm)	(2) 0.25 inches (6 mm)
Process Connection **Threaded** **Flanged**	2" NPT or 2" BSP Various ANSI, EN, and proprietary flanges	2" NPT or 2" BSP Various ANSI, EN, and proprietary flanges	2" NPT or 2" BSP Various ANSI, EN, and proprietary flanges
Available Probe Length	3 to 100 feet (1 to 30 meters)	3 to 100 feet (1 to 30 meters)	3 to 100 feet (1 to 30 meters)
Transition Zones ② **Top** **Bottom**	18 inches (45 cm) 12 inches (30 cm)	18 inches (45 cm) 12 inches (30 cm)	18 inches (45 cm) 12 inches (30 cm)
Process Temperature	-40° to +400° F (-40° to +200° C)	-320° to +850° F (-196° to +450° C)	-40° to +400° F (-40° to +200° C)
Max. Process Pressure ③	1000 psi @ +70° F (70 bar @ +20° C)	6250 psi @ +70° F (431 bar @ +20° C)	1000 psi @ +70° F (70 bar @ +20° C)
Dielectric Range ⑤	1.7 to 100	1.7 to 100	1.7 to 100
Vacuum Service ④	Negative Pressure, but no hermetic seal	Full Vacuum	Negative Pressure, but no hermetic seal
Viscosity	10,000 (mPa.s)	10,000 (mPa.s)	1500 (mPa.s)
Media Coating	Maximum Error 10% of coated length (% Error is dependent on dielectric and thickness)	Maximum Error 10% of coated length (% Error is dependent on dielectric and thickness)	Maximum Error 10% of coated length (% Error is dependent on dielectric and thickness)

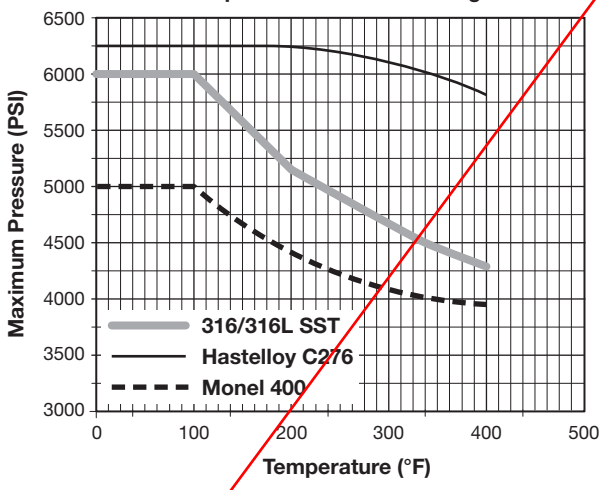
① Other o-ring materials available upon request.
② Transition zones (areas with reduced accuracy) are dielectric dependent. It is recommended to set the 0-100% measuring range outside of the transition zones.
③ Refer to chart on page 16.
④ ECLIPSE probes containing o-rings can be used for vacuum (negative pressure) service, but only those probes with glass seal are hermetically sealed to $<10^{-8}$ cc/sec @ 1 atmosphere helium.
⑤ 1.2 minimum dielectric when end of probe analysis is enabled.

FLEXIBLE PROBES FOR SOLIDS MATRIX

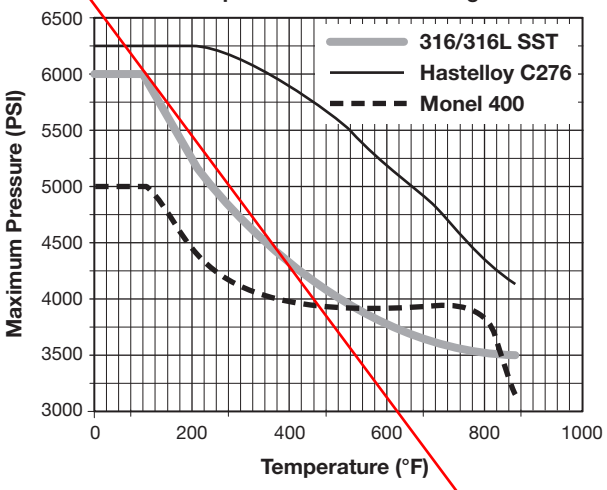
	7y2	7y5
Description	Single Flexible Standard Temp.	Twin Flexible Standard Temp.
Application	Level	Level
Installation	Tank	Tank
Overfill Safe	No	No
Pull Down Force	3000 lbs. (1360 Kg)	3000 lbs (1360 Kg)
Materials — Cable	316 (1.4401)	316 (1.4401)
Probe Outside Diameter	0.19 inches (5 mm)	(2) 0.25 inches (6 mm)
Process Connection		
Threaded	2" NPT or 2" BSP	2" NPT or 2" BSP
Flanged	Various ANSI, EN1092, and proprietary flanges	Various ANSI, EN1092, and proprietary flanges
Available Probe Length	3 to 100 feet (1 to 30 meters)	3 to 100 feet (1 to 30 meters)
Transition Zones ①		
Top	18 inches (45 cm)	18 inches (45 cm)
Bottom	12 inches (30 cm)	12 inches (30 cm)
Dielectric Range ②	4 to 100	1.7 to 100
Vacuum Service ③	Negative Pressure, but no hermetic seal	Negative Pressure, but no hermetic seal
Viscosity	10,000 (mPa.s)	10,000 (mPa.s)
Media Coating	Max. Error 10% of coated length (% Error is dependent on dielectric & thickness)	Max. Error 10% of coated length (% Error is dependent on dielectric & thickness)

① Transition zones (areas with reduced accuracy) are dielectric dependent. It is recommended to set the 0-100% measuring range outside of the transition zones.
② 1.2 minimum dielectric when end of probe analysis is enabled.
③ ECLIPSE probes containing o-rings can be used for vacuum (negative pressure) service, but only those probes with glass seal are hermetically sealed (helium leak $<10^{-8}$cc/sec @ 1 atmos.).

7yL, 7yM and 7yP
Temperature/Pressure Ratings



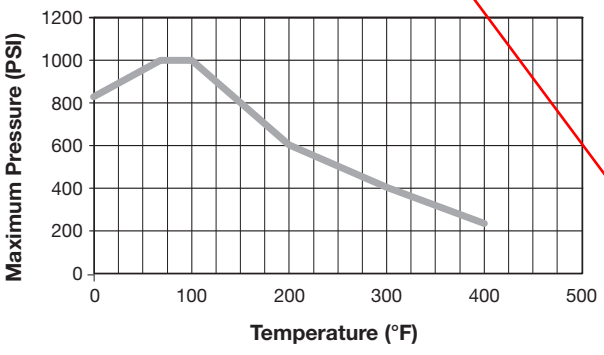
7yD, 7yJ, 7yN, 7y3 and 7y6
Temperature/Pressure Ratings



NOTES:

- 7yS steam probes are rated to 1275 psi (88 bar) up to +575° F (+300° C)
- 7y3, 7y6 HTHP flexible probes:
  Pressure is limited by the chamber
- 7y2, 7y5 bulk solids probes: 50 psi (3.45 bar) to +150° F (+65° C)
- High pressure probes with threaded fittings are rated as follows:
  7yD, 7yN, 7yP and 7y3 probes with threaded fittings have 3600 psi (248 bar) rating. 7yM probes with threaded fittings have 2016 psi (139 bar) rating.

7yF, 7yG, 7yT, 7y1, 7y4, 7y7



O-RING (SEAL) SELECTION CHART

O-RING/SEAL SPECIFICATIONS

Code	"O"-Ring Material	Max. Process Temperature	Min. Process Temperature	Max. Process Pressure	Not Recommended For Applications	Recommended for Applications
0	**Viton® GFLT**	400 °F @ 230 psi (200°C @ 16 bar)	-40° F (-40° C)	1000 psi 70° F (70 bar @ 20°C)	Ketones (MEK, acetone), skydrol fluids, amines, anhydrous ammonia, low molecular weight esters and ethers, hot hydrofluoric or chlorosulfuric acids, sour HCs	General purpose, ethylene
1	**EPDM**	250 °F @ 200 psi (125 °C @14 bar)	-60° F (-50° C)	1000 psi 70° F (70 bar @ 20°C)	Petroleum oils, di-ester base lubricant, steam	Acetone, MEK, skydrol fluids
2	**Kalrez® 4079**	400 °F @ 232 psi (200 °C @ 16 bar)	-40° F (-40° C)	1000 psi 70° F (70 bar @ 20°C)	Hot water/steam, hot aliphatic amines, ethylene oxide, propylene oxide	Inorganic and organic acids (including hydro fluids and nitric), aldehydes, ethylene, organic oils, glycols, silicone oils, vinegar, sour HCs
3	**HSN** (Highly Saturated Nitrile)	275 °F @ 320 psi (135 °C @ 22 bar)	-4° F (-20° C)	1000 psi 70° F (70 bar @ 20°C)	Halogenated HCs, nitro HCs, phosphate ester hydraulic fluids, ketones (MEK, acetone), strong acids, ozone, automotive brake fluid, steam	NACE applications
4	**Buna-N**	275 °F @ 320 psi (135 °C @ 22 bar)	-4° F (-20° C)	1000 psi 70° F (70 bar @ 20°C)	Halogenated HCs, nitro HCs, phosphate ester hydraulic fluids, ketones (MEK, acetone), strong acids, ozone, automotive brake fluid	General purpose sealing, petroleum oils and fluids, cold water, silicone greases and oils, di-ester base lubricants, ethylene glycol base fluids
5	**Neoprene®**	300 °F @ 290 psi (150 °C @ 20 bar)	-65° F (-55° C)	1000 psi 70° F (70 bar @ 20°C)	Phosphate ester fluids, ketones (MEK, acetone)	Refrigerants, high anline point petroleum oils, silicate ester lubricants
6	**Chemraz® 505**	400 °F @ 200 psi (200 °C @ 14 bar)	-20° F (-30° C)	1000 psi 70° F (70 bar @ 20°C)	Acetaldehyde, ammonia + lithium metal solution, butyraldehyde, di-water, freon, ethylene oxide, liquors, isobutyraldehyde	Inorganic and organic acids, alkalines, ketones, esters, aldehydes, fuels
7	**Polyurethane**	200 °F @ 420 psi (95 °C @29 bar)	-65° F (-55° C)	1000 psi 70° F (70 bar @ 20°C)	Acids, Ketones, chlorinated HCs,	Hydraulic systems, petroleum oils, HC fuel, oxygen, ozone
8	**Aegis PF128** ①	400 °F @ 232 psi (200 °C @ 16 bar)	-4° F (-20° C)	1000 psi 70° F (70 bar @ 20°C)	Black liquor, freon 43, freon 75, galden, KEL-F liquid, molten potassium, molten sodium	Inorganic and organic acids (including hydro fluids and nitric), aldehydes, ethylene, organic oils, glycols, silicone oils, vinegar, sour HCs, steam, amines, ethylene oxide, propylene oxide, NACE applications
A	**Kalrez® 6375**	400 °F @ 232 psi (200 °C @ 16 bar)	-40° F (-40° C)	1000 psi 70° F (70 bar @ 20°C)	Hot water/steam, hot aliphatic amines, ethylene oxide, propylene oxide	Inorganic and organic acids (including hydro fluids and nitric), aldehydes, ethylene, organic oils, glycols, silicone oils, vinegar, sour HCs
D or N	**Glass Ceramic Alloy**	850 °F @ 3600 psi (450 °C @ 248 bar)	-320° F (-195° C)	6250 psi 70° F (431 bar @ 20°C)	Hot alkaline solutions HF acid, media with ph>12, direct exposure to saturated steam	General high temperature/high pressure applications, hydrocarbons, full vacuum (hermetic), ammonia, chlorine

① Maximum +300° F (+150° C) for use on steam.

REPLACEMENT OF DISPLACER TRANSMITTERS

ECLIPSE has proven to be the ideal replacement for existing torque tube transmitters. In numerous applications worldwide, customers have found the performance of ECLIPSE Guided Wave Radar transmitters to be superior to that of antiquated torque tube transmitters.

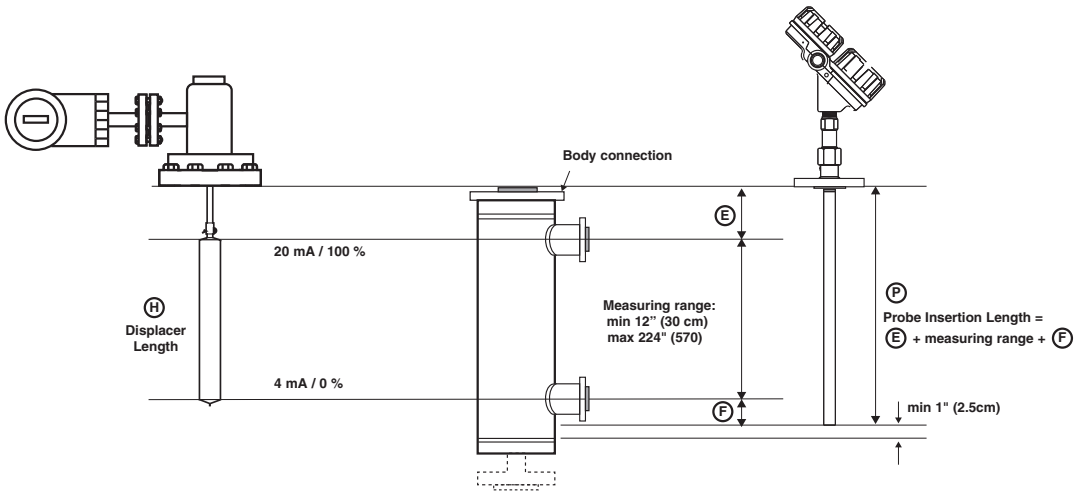
There are several benefits to using the ECLIPSE Model 706 as a replacement for torque tube transmitters:

- **Cost:**
  The cost of a new Model 706 transmitter cost is comparable to rebuilding an aging torque tube.
- **Installation:**
  No field calibration is necessary. The Model 706 transmitter can be configured in minutes with no level movement. (Complete factory pre-configuration is available, which can further decrease the installation effort).
- **Performance:**
  The ECLIPSE Model 706 is unaffected by changes in specific gravity and has no moving parts that can wear and lose tolerance.
- **Ease of replacement:**
  Proprietary and standard ANSI flanges are offered on all ECLIPSE Model 706 probes so existing chamber/cages can be used.

In order to match the proper ECLIPSE transmitter with the proper external cage, consider the following:

- **Type of application:**
  Use the proper GWR probe for the application, see pages 7 and 10 through 16.
- **Overfill proof:**
  For optimum performance, use an Overfill-safe probe in all chamber applications.

  Note: "Overfill" occurs when the level rises above the maximum range of operation. ***Some GWR probes may provide erroneous output in this zone unless an optimal, impedance-matched design is used.***
- **Minimum Cage Size:**
  - Coaxial or Caged Coaxial probes: 2" minimum
  - Enlarged Coaxial probes: 3" minimum
  - Twin Cable probes: 4" minimum







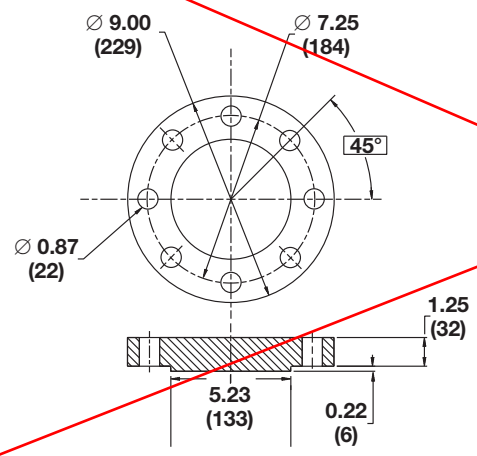
Recommended probe length for replacing displacer transmitters
The table below helps to define the GWR probe length for the most common displacer transmitters. Refer to the proprietary flange selection guide.

Manufacturer	Type	Process Connection	Displacer Length inches (mm)	Probe Length ① inches (mm)
MAGNETROL	EZ & PN Modulevel®	ANSI/EN flange	≥ 14" (356)	Displacer + 7 (178)
Masoneilan®	Series 1200	Proprietary flange	≥ 14" (356)	Displacer + 8 (203)
		ANSI/EN flange	≥ 16" (406)	Displacer + 8 (203)
Fisher® series 2300 & 2500	249B, 259B, 249C cages	Proprietary flange	≥ 14" (356)	Displacer + 10 (254)
	other cages	ANSI flange	≥ 14" (356)	consult factory
Eckardt®	Series 134, 144	ANSI/EN flange	≥ 14" (356)	consult factory
Tokyo Keiso®	FST-3000	ANSI/EN flange	H = 11.8" (300)	Displacer + 9 (229)
		ANSI/EN flange	≥ H = 19.7" (500)	Displacer + 9 (229)

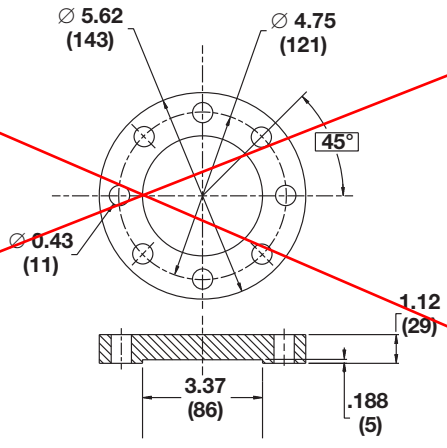
① Round down resulting calculation to the nearest inch.

PROPRIETARY FLANGES

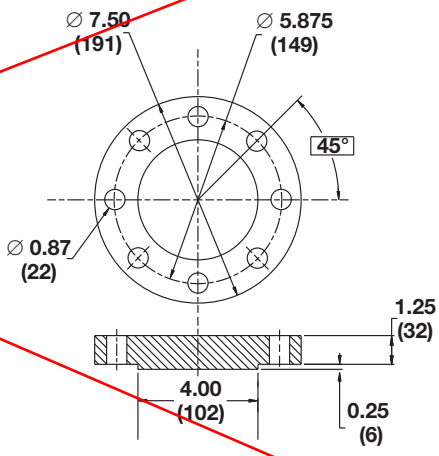
INCHES (mm)



Fisher 249B/259B (600 lb.), carbon steel



Fisher 249C (600 lb.), 316 stainless steel



Masoneilan (600 lb.), carbon steel

MAGNETROL CHAMBERS



A brief description of the MAGNETROL chamber offering follows. For more details, refer to MAGNETROL Sales Bulletin 41-140.

MAGNETROL has a long tradition in offering cost-effective chambers. The MAGNETROL external chamber is a self-contained cage designed for use with our top mounting level transmitters or switches. Quality construction and a wide selection of configurations make this cage an ideal means of utilizing the power of Guided Wave Radar without mounting directly into the process vessel.

MAGNETROL chambers are available with a wide variety of options, and can be manufactured to comply with various regulations such as:

- Commercial Design
- ASME B31.1 Design Code
- ASME B31.3 Design Code
- NACE Design Code
- PED

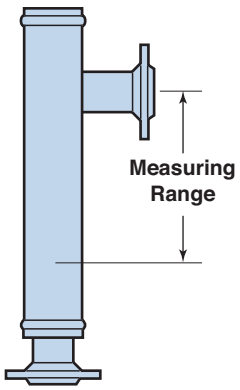
Some Model 706 probes can be installed into chambers as small as 2". When a new chamber is required, it can be ordered together with a factory pre-configured Model 706 for a true "plug and play" installation.

For example:

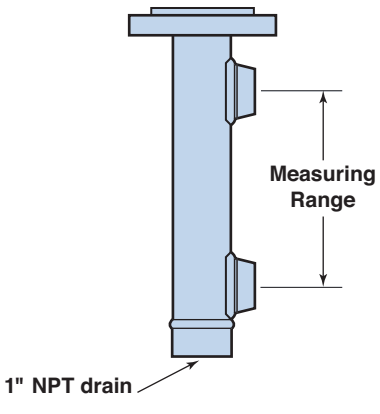
A standard Model 706-511A-310 explosion-proof transmitter with a Model 7AG-4300-A10-00-021 Caged probe can be used in a 2" chamber. A typical chamber Model Number would be:

F21-4A2D-014

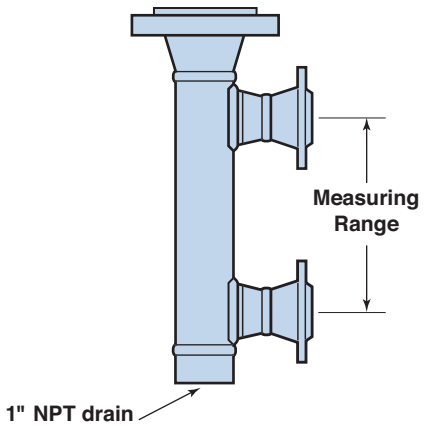
Refer to MAGNETROL Sales Bulletin 41-140 for details on chamber Model Numbers and additional options.



Sealed Chamber



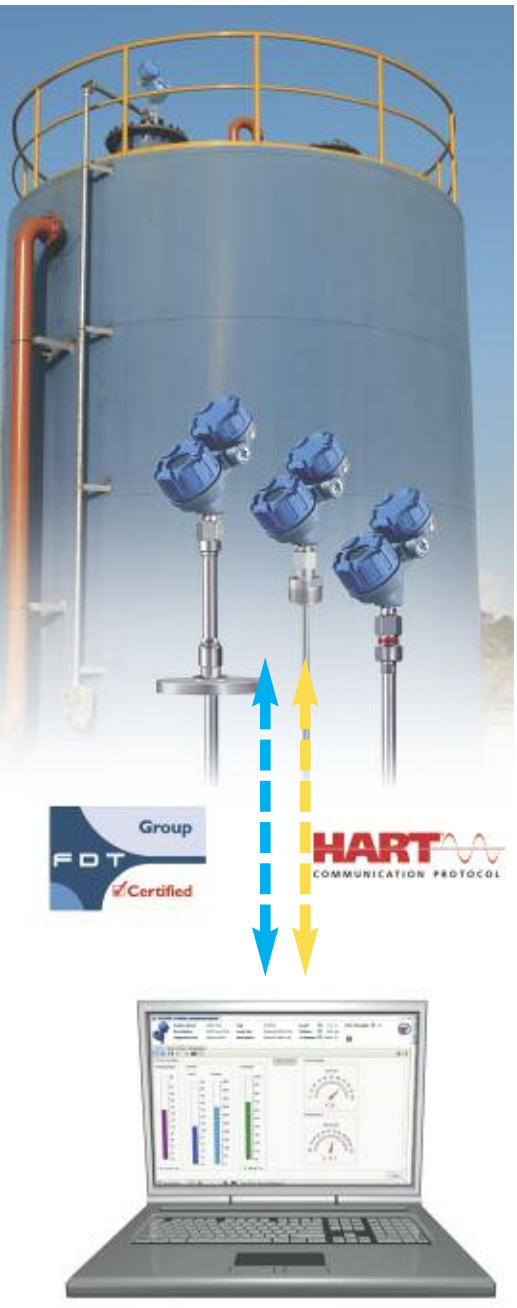
Slip-on head flange



Weld neck head flange

The Most Efficient PC Configuration Tool for Eclipse® Guided Wave Radar Transmitters

*PACT**ware**™ is the modern, user-friendly adjustment software that enables quick configuration and diagnosis of your HART® or FOUNDATION fieldbus™ Guided Wave Radar transmitters.*



GET CONNECTED Simply connect the HART/RS232 or HART/USB serial interface from the PC to the two-wire loop.

Level Monitoring Screen Continuously viewing the level in a tank is the starting point for PACT*ware*™. The position of liquid level can be viewed in a simple visual format on your PC. Level and Output values are shown numerically as well. The screen can be left open to show the relative position of the liquid level.



Level Monitoring Screen

Parameters Screen Every parameter in your radar transmitter can be monitored and modified remotely with a few clicks of the mouse. From units of measure to settings for dielectric, each parameter can be viewed or changed to suit application conditions. Parameters can be developed offline or transferred between transmitters.



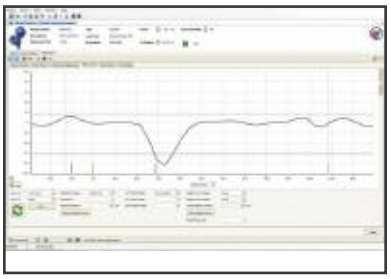
Parameters Screen

Trending Screen The ability to trend data over a period of time allows insight into overall operation of your GWR transmitter. Trending values are invaluable when attempting advanced configuration or troubleshooting. PACT*ware*™ PC software has the ability to track all parameters of your radar device and save them as a text or picture file.



Process Trend Screen

Echo Curve Screen This screen yields a wealth of useful information: Level; Echo Strength; Actual Echo Curve; Echo Rejection; and Threshold. Blue cursors show the location and echo strength of the reflection currently detected as liquid level.



Echo Curve Screen

AGENCY APPROVALS

AGENCY	MODEL APPROVED	APPROVAL CATEGORY	APPROVAL CLASSES
FM	706-5XXX-1XX	Intrinsically Safe	Class I, Div. 1; Groups A, B, C, & D Class II, Div. 1; Groups E, F, & G T4 Class III, Type 4X, IP67 Entity
	706-5XXX-3XX	Explosion-proof (with Intrinsically Safe probe) Dust Ignition-proof	Class I, Div. 1; Groups B, C & D Class II, Div. 1; Groups E, F, & G T4 Class III, Type 4X, IP67
	706-5XXX-3XX	Non-Incendive, Suitable for:	Class I, Div. 2; Groups A, B, C, & D Class II, Div. 2; Groups E, F & G T4 Class III, Type 4X, IP67
CSA	706-5XXX-1XX	Intrinsically Safe	Class I, Div. 1; Groups A, B, C, & D Class II, Div. 1; Group E, F & G T4 Class III, Type 4X, IP66/67 Entity
	706-5XXX-3XX	Explosion-proof (with Intrinsically Safe probe) Dust Ignition-proof	Class I, Div. 1; Groups B, C, & D Class II, Div. 1; Group E, F & G T4 Class III, Type 4X, IP66/67
	706-5XXX-3XX	Non-Incendive Suitable for:	Class I, Div. 2; Groups A, B, C, & D Class II, Div. 2; Group E, F & G T4 Class III, Type 4X, IP66/67
ATEX	706-5XXX-AXX	Intrinsically Safe	II 1G, Ex ia IIC T4 Ga
	706-5XXX-CXX	Non-sparking	II 1/3 G Ex nA [ia Ga] IIC T4 Ga/Gc
	706-5XXX-DXX	Dust Ex	II 1/2 D Ex tb [ia] IIIC T85°C .. T450°C Da/Db
	706-5XXX-BXX	Flame Proof	II 1/2 G Ex d [ia] IIC T6 .. T1 Ga/Gb
IEC	706-5XXX-AXX	Intrinsically Safe	Ex ia IIC T4 Ga
	706-5XXX-CXX	Non-sparking	Ex nA [ia Ga] IIC T4 Ga/Gc
	706-5XXX-BXX	Flame Proof	Ex d [ia] IIC T6 .. T1 Ga/Gb
	706-5XXX-DXX	Dust Proof	Ex tb [ia] IIIC T85°C .. T450°C Da/Db

These units are in conformity of:
1. The EMC Directive: 2004/108/EC. The units have been tested to EN 61326.

Note: Single and twin rod probes must be used in metallic vessel or stillwell to maintain CE compliance.

Dual seal approval per ANSI/ISA–12.27.01

Single seal approval per ANSI/ISA-12.27.01

MODEL NUMBER

TRANSMITTER

Models available for quick shipment, usually within one week after factory receipt of a complete purchase order, through the Expedite Ship Plan (ESP).

1 2 3 | BASIC MODEL NUMBER

7 0 6	ECLIPSE 4th Generation Guided Wave Radar (GWR) Level Transmitter

4 | POWER

5	24 VDC, Two-Wire

5 | SIGNAL OUTPUT

1	4–20 mA with HART
2	FOUNDATION fieldbus™ Communications

6 | SAFETY OPTIONS

0	None – FOUNDATION fieldbus only (5th digit = 2)
1	SIL 2 Hardware - HART only (5th digit = 1)

7 | ACCESSORIES/MOUNTING

0	No Digital Display or Keypad - Integral
1	No Digital Display or Keypad - 3-foot (1 meter) remote
2	No Digital Display or Keypad - 12-foot (3.6 meter) remote
A	Digital Display and Keypad - Integral
B	Digital Display and Keypad - 3-foot (1 meter) remote
C	Digital Display and Keypad - 12-foot (3.6 meter) remote

8 | CLASSIFICATION

0	General Purpose, Weatherproof (IP 67)
1	Intrinsically Safe (FM & CSA CL 1 Div 1, Grps A, B, C, D)
3	Explosion-proof (FM & CSA CL 1 Div 1, Grps B, C, D)
A	Intrinsically Safe (ATEX/IEC Ex ia IIC T4)
B	Flame-proof (ATEX/IEC Ex d ia IIC T6)
C	Non-sparking (ATEX Ex n IIC T6)
D	Dust Ex (ATEX II)

9 | HOUSING

1	Die-cast Aluminum, Dual-compartment, 45-degree
2	Investment Cast, Stainless Steal, Dual-compartment, 45-degree

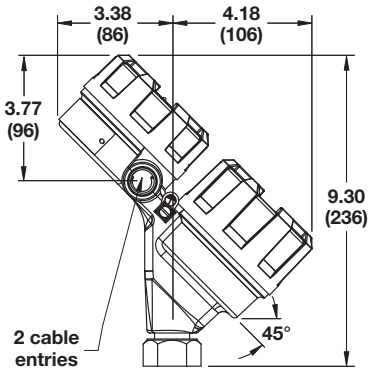
10 | CONDUIT CONNECTION

0	½" NPT
1	M20
2	½" NPT with sunshade
3	M20 with sunshade

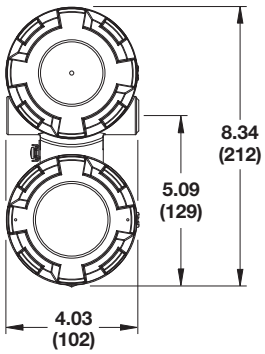
7	0	6	—	5				—			
1	2	3		4	5	6	7		8	9	10

DIMENSIONS

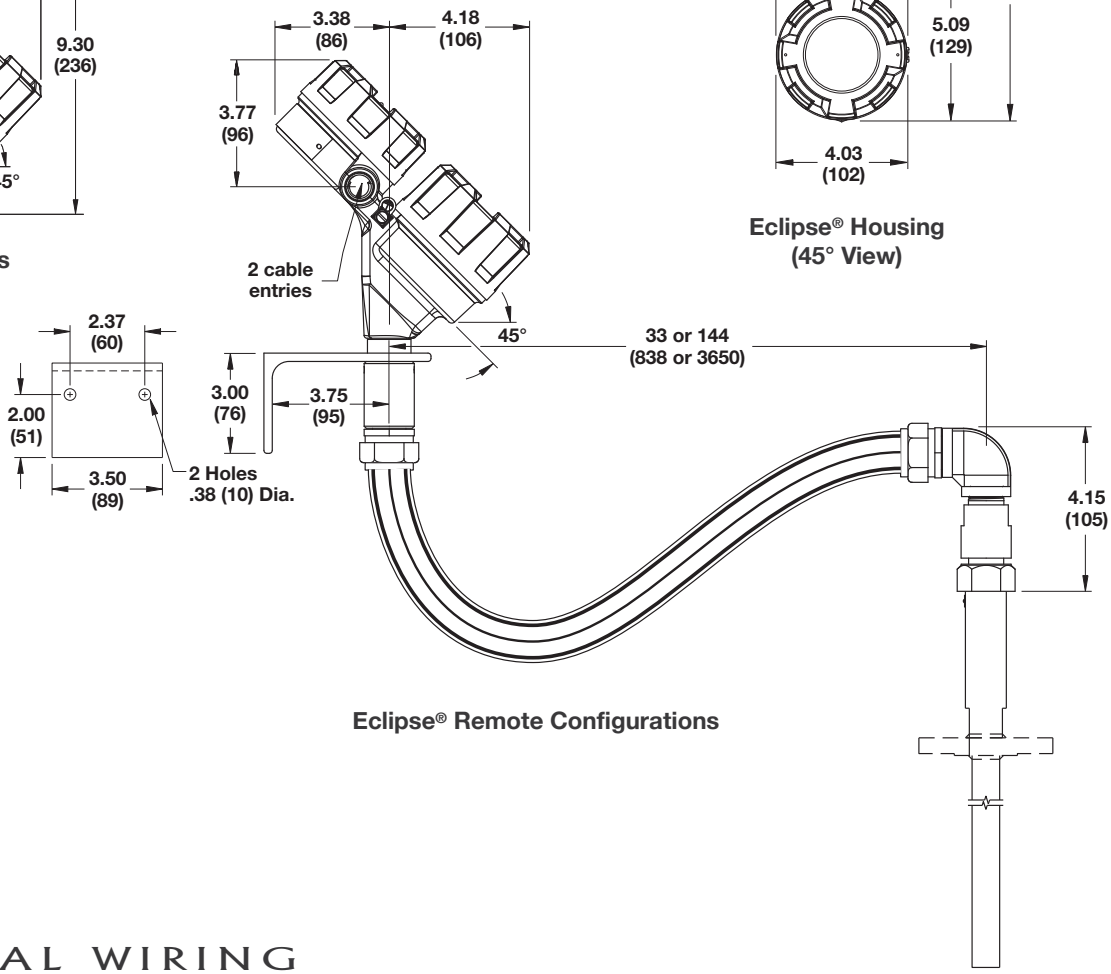
inches (mm)



Integral Electronics

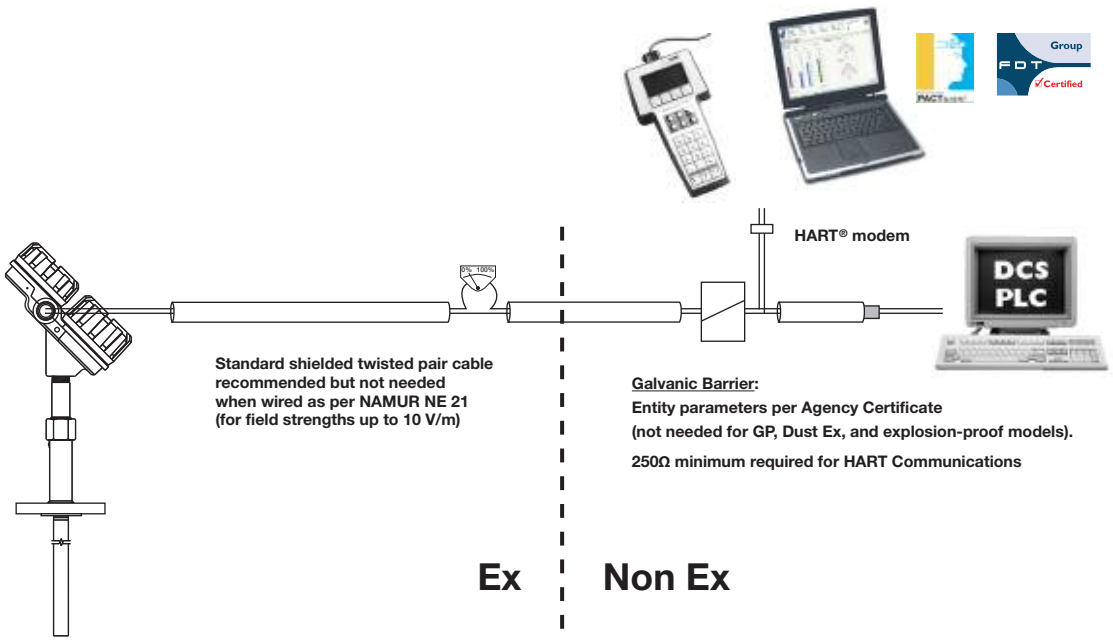


Eclipse® Housing
(45° View)



Eclipse® Remote Configurations

ELECTRICAL WIRING



MODEL NUMBER

ENLARGED COAXIAL PROBE

Models available for quick shipment, usually within one week after factory receipt of a complete purchase order, through the Expedite Ship Plan (ESP).

1 | TECHNOLOGY

7	ECLIPSE GWR Probes - Model 706

2 | MEASUREMENT SYSTEM

A	English
C	Metric

3 | CONFIGURATION/STYLE (RIGID)

D	Enlarged Coaxial, High Temp/High Pressure: Overfill w/Glass Seal (+850° F/+450° C) — Available only with 10th digit N or D
P	Enlarged Coaxial, High Pressure: Overfill w/Glass Seal (+400° F/+200° C) — Available only with 10th digit N or D
T	Enlarged Coaxial, Overfill Standard O-Ring Seal (+400° F/+200° C) — Not available with 10th digit N or D

4 5 | PROCESS CONNECTION – SIZE/TYPE (consult factory for other process connections)

Threaded

4 1	2" NPT Thread ①
4 2	2" BSP (G1) Thread ①

ANSI Flanges

4 3	2"	150# ANSI RF ①
4 4	2"	300# ANSI RF ①
4 5	2"	600# ANSI RF ①
4 K	2"	600# ANSI RTJ ①
5 3	3"	150# ANSI RF
5 4	3"	300# ANSI RF
5 5	3"	600# ANSI RF
56	3"	900# ANSI RF
57	3"	1500# ANSI RF
58	3"	2500# ANSI RF
5K	3"	600# ANSI RTJ
5L	3"	900# ANSI RTJ
5M	3"	1500# ANSI RTJ
5N	3"	2500# ANSI RTJ
6 3	4"	150# ANSI RF
6 4	4"	300# ANSI RF
6 5	4"	600# ANSI RF
6 6	4"	900# ANSI RF
6 7	4"	1500# ANSI RF
6 8	4"	2500# ANSI RF
6K	4"	600# ANSI RTJ
6L	4"	900# ANSI RTJ
6M	4"	1500# ANSI RTJ
6N	4"	2500# ANSI RTJ

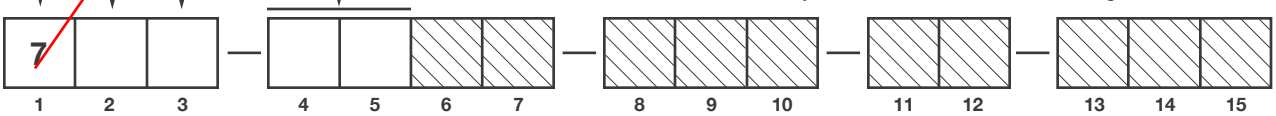
EN Flanges

D A	DN 50, PN 16	EN 1092-1 TYPE A ①
D B	DN 50, PN 25/40	EN 1092-1 TYPE A ①
D D	DN 50, PN 63	EN 1092-1 TYPE B2 ①
D E	DN 50, PN 100	EN 1092-1 TYPE B2 ①
E A	DN 80, PN 16	EN 1092-1 TYPE A
E B	DN 80, PN 25/40	EN 1092-1 TYPE A
E D	DN 80, PN 63	EN 1092-1 TYPE B2
E E	DN 80, PN 100	EN 1092-1 TYPE B2
E F	DN 80, PN 160	EN 1092-1 TYPE B2
E G	DN 80, PN 250	EN 1092-1 TYPE B2
E H	DN 80, PN 320	EN 1092-1 TYPE B2
E J	DN 80, PN 400	EN 1092-1 TYPE B2
F A	DN 100, PN 16	EN 1092-1 TYPE A
F B	DN 100, PN 25/40	EN 1092-1 TYPE A
F D	DN 100, PN 63	EN 1092-1 TYPE B2
F E	DN 100, PN 100	EN 1092-1 TYPE B2
F F	DN 100, PN 160	EN 1092-1 TYPE B2
F G	DN 100, PN 250	EN 1092-1 TYPE B2
F H	DN 100, PN 320	EN 1092-1 TYPE B2
F J	DN 100, PN 400	EN 1092-1 TYPE B2

Torque Tube Mating Flanges ②

T T	600# Fisher (249B/259B) in carbon steel – as per dimensions on page 18
T U	600# Fisher (249C) in stainless steel – as per dimensions on page 18
U T	600# Masoneilan flange in carbon steel – as per dimensions on page 18
U U	600# Masoneilan flange in stainless steel – as per dimensions on page 18

① Confirm mounting conditions/nozzle diameter to ensure sufficient clearance.
② Always check dimensions if ANSI/EN flanges are not used.



MODEL NUMBER CONTINUED

ENLARGED COAXIAL PROBE

6 | CONSTRUCTION CODES

0	Industrial
K	ASME B31.1
L	ASME B31.3
M	ASME B31.3 & NACE MR0175/MR0103
N	NACE MR0175/MR0103

7 | FLANGE OPTIONS — Offset flanges are only available with small coaxial probes

0	None

8 | MATERIAL OF CONSTRUCTION - FLANGE/NUT/ROD/INSULATION

A	316 SS/316L SS (Probe O.D. 1.75" (45mm))
B	Hastelloy C (Probe O.D. 1.93" (49mm))
C	Monel (Probe O.D. 1.93" (49mm))
R	316 SS/316L SS with Carbon Steel Flange (Probe O.D. 1.75" (45 mm))
S	Hastelloy C with Carbon Steel Flange (Probe O.D. 1.93" (49mm))
T	Monel with Carbon Steel Flange (Probe O.D. 1.93" (49mm))

9 | SPACER MATERIAL

1	TFE (+400° F/+200° C) — Available only with 3rd digit P or T — $\varepsilon_r \geq 1.4$
2	PEEK HT — Available only with 3rd digit D (+650° F/+345° C) — $\varepsilon_r \geq 1.4$
3	Ceramic (High Temp. >+800° F/+425° C) — Available only with 3rd digit D — $\varepsilon_r \geq 2.0$
4	Celazole (+800° F/+425° C) — Available only with 3rd digit D — $\varepsilon_r \geq 1.4$
5	None - with metal shorting rod — $\varepsilon_r \geq 1.4$ — Future

10 | O-RING MATERIALS/SEAL OPTIONS

0	Viton® GFLT — Available only with 3rd digit T
2	Kalrez® 4079 — Available only with 3rd digit T
8	Aegis PF 128 (NACE) — Available only with 3rd digit T
A	Kalrez 6375 — Available only with 3rd digit T
D	None/Glass Ceramic Alloy (dual-seal design with annunciator fitting)—Available only with 3rd digit D or P
N	None/Glass Ceramic Alloy — Available only with 3rd digit D or P

11 | PROBE SIZE/ELEMENT TYPE/FLUSHING CONNECTION

0	Standard Enlarged Coaxial Probe
1	Standard Enlarged Coaxial Probe with Flushing Port

12 | SPECIAL OPTIONS — See page 36

0	Single Length Probe (Non-Segmented)
1	1-piece Enlarged Segmented Probe OD=2.5"(64mm)
2	2-piece Enlarged Segmented Probe OD=2.5"(64mm)
3	3-piece Enlarged Segmented Probe OD=2.5"(64mm)
4	4-piece Enlarged Segmented Probe OD=2.5"(64mm)

13 14 15 | INSERTION LENGTH

X X X	inches (012 – 396) cm (030 – 999)

unit of measure determined by 2nd digit of model number

7														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

MODEL NUMBER

SMALL COAXIAL PROBE

Models available for quick shipment, usually within one week after factory receipt of a complete purchase order, through the Expedite Ship Plan (ESP).

1 | TECHNOLOGY

7	ECLIPSE GWR Probes - Model 706

2 | MEASUREMENT SYSTEM

A	English
C	Metric

3 | CONFIGURATION/STYLE (RIGID)

D	Small Coaxial, High Temp/High Pressure: Overfill w/Glass Seal (+850° F/+450° C) — Only available with 10th digit N or D
P	Small Coaxial, High Pressure: Overfill w/Glass Seal (+400° F/+200° C) — Only available with 10th digit N or D
S	Small Coaxial, Saturated Steam (+575° F/+300° C), Max. Length=240" (610 cm) — Only available with 10th digit N, 11th digit 2
T	Small Coaxial, Overfill Standard O-Ring Seal (+400° F/+200° C) — Not available with 10th digit N or D

4 5 | PROCESS CONNECTION – SIZE/TYPE (consult factory for other process connections)

Threaded

1 1	¾" NPT Thread ③
4 1	2" NPT Thread – Only available with 3rd Digit D

2 2	1" BSP (G1) Thread ③
4 2	2" BSP (G1) Thread – Only available with 3rd Digit D

ANSI Flanges

2 3	1" 150# ANSI RF ① ④	3 8	1 ½" 2500# ANSI RF ④
2 4	1" 300# ANSI RF ① ④	3 N	1 ½" 2500# ANSI RTJ ④
2 5	1" 600# ANSI RF ① ④	4 3	2" 150# ANSI RF
2 K	1" 600# ANSI RTJ ① ④	4 4	2" 300# ANSI RF
3 3	1 ½" 150# ANSI RF ④	4 5	2" 600# ANSI RF
3 4	1 ½" 300# ANSI RF ④	4 7	2" 900/1500# ANSI RF
3 5	1 ½" 600# ANSI RF ④	4 8	2" 2500# ANSI RF
3 K	1 ½" 600# ANSI RTJ ④	4 K	2" 600# ANSI RTJ
3 7	1 ½" 900/1500# ANSI RF④	4 M	2" 900/1500# ANSI RTJ
3 M	1 ½" 900/1500# ANSI RTJ④	4 N	2" 2500# ANSI RTJ

5 3	3" 150# ANSI RF	6 3	4" 150# ANSI RF
5 4	3" 300# ANSI RF	6 4	4" 300# ANSI RF
5 5	3" 600# ANSI RF	6 5	4" 600# ANSI RF
5 6	3" 900# ANSI RF	6 6	4" 900# ANSI RF
5 7	3" 1500# ANSI RF	6 7	4" 1500# ANSI RF
5 8	3" 2500# ANSI RF	6 8	4" 2500# ANSI RF
5 K	3" 600# ANSI RTJ	6 K	4" 600# ANSI RTJ
5 L	3" 900# ANSI RTJ	6 L	4" 900# ANSI RTJ
5 M	3" 1500# ANSI RTJ	6 M	4" 1500# ANSI RTJ
5 N	3" 2500# ANSI RTJ	6 N	4" 2500# ANSI RTJ

EN Flanges

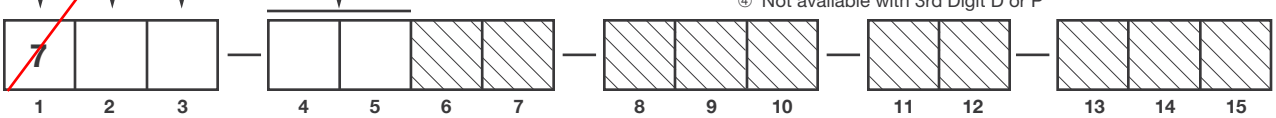
B B	DN 25, PN 16/25/40	EN 1092-1 TYPE A ① ④
B C	DN 25, PN 63/100	EN 1092-1 TYPE B2 ① ④
C B	DN 40, PN 16/25/40	EN 1092-1 TYPE A ④
C C	DN 40, PN 63/100	EN 1092-1 TYPE B2 ④
C F	DN 40, PN 160	EN 1092-1 TYPE B2 ④
C G	DN 40, PN 250	EN 1092-1 TYPE B2 ④
C H	DN 40, PN 320	EN 1092-1 TYPE B2 ④
C J	DN 40, PN 400	EN 1092-1 TYPE B2 ④
D A	DN 50, PN 16	EN 1092-1 TYPE A
D B	DN 50, PN 25/40	EN 1092-1 TYPE A
D D	DN 50, PN 63	EN 1092-1 TYPE B2
D E	DN 50, PN 100	EN 1092-1 TYPE B2
D F	DN 50, PN 160	EN 1092-1 TYPE B2
D G	DN 50, PN 250	EN 1092-1 TYPE B2
D H	DN 50, PN 320	EN 1092-1 TYPE B2
D J	DN 50, PN 400	EN 1092-1 TYPE B2

E A	DN 80, PN 16	EN 1092-1 TYPE A
E B	DN 80, PN 25/40	EN 1092-1 TYPE A
E D	DN 80, PN 63	EN 1092-1 TYPE B2
E E	DN 80, PN 100	EN 1092-1 TYPE B2
E F	DN 80, PN 160	EN 1092-1 TYPE B2
E G	DN 80, PN 250	EN 1092-1 TYPE B2
E H	DN 80, PN 320	EN 1092-1 TYPE B2
E J	DN 80, PN 400	EN 1092-1 TYPE B2
F A	DN 100, PN 16	EN 1092-1 TYPE A
F B	DN 100, PN 25/40	EN 1092-1 TYPE A
F D	DN 100, PN 63	EN 1092-1 TYPE B2
F E	DN 100, PN 100	EN 1092-1 TYPE B2
F F	DN 100, PN 160	EN 1092-1 TYPE B2
F G	DN 100, PN 250	EN 1092-1 TYPE B2
F H	DN 100, PN 320	EN 1092-1 TYPE B2
F J	DN 100, PN 400	EN 1092-1 TYPE B2

Torque Tube Mating Flanges ②

T T	600# Fisher (249B/259B) in carbon steel – as per dimensions on page 18
T U	600# Fisher (249C) in stainless steel – as per dimensions on page 18
U T	600# Masoneilan flange in carbon steel – as per dimensions on page 18
U U	600# Masoneilan flange in stainless steel – as per dimensions on page 18

① Confirm mounting conditions/nozzle diameter to ensure sufficient clearance.
② Always check dimensions if ANSI/EN flanges are not used.
③ Not available with 3rd digit 'D'
④ Not available with 3rd Digit D or P



MODEL NUMBER CONTINUED

SMALL COAXIAL PROBE

6 | CONSTRUCTION CODES

0	Industrial
K	ASME B31.1 (Not available with 4th digits T or U)
L	ASME B31.3
M	ASME B31.3 & NACE MR0175/MR0103
N	NACE MR0175/MR0103

7 | FLANGE OPTIONS — Offset flanges are only available with small coaxial probes

0	None
1	Offset (For use with AURORA) — 4" Only available with 3rd digit P, S or T
2	Offset with ½" NPT Vent (For use with AURORA) — 4" Only available with 3rd digit P, S or T
3	Offset with ¾" NPT Vent (For use with AURORA) — 4" Only available with 3rd digit P, S or T

8 | MATERIAL OF CONSTRUCTION - FLANGE/NUT/ROD/INSULATION

A	316 SS/316L SS
B	Hastelloy C
C	Monel — Not available with 3rd Digit S
R	316 SS/316L SS with Carbon Steel Flange
S	Hastelloy C with Carbon Steel Flange
T	Monel with Carbon Steel Flange — Not available with 3rd Digit S

9 | SPACER MATERIAL

1	TFE (+400° F/+200° C) — Only available with 3rd digit P or T — $\varepsilon_r \geq 1.4$
2	PEEK HT — Only available with 3rd digit D or S (+650° F/+345° C) or S (+575° F/+300° C) — $\varepsilon_r \geq 1.4$
3	Ceramic (Temp. >+650° F/+345° C) — Only available with 3rd digit D — $\varepsilon_r \geq 2.0$
5	None - with metal shorting rod — $\varepsilon_r \geq 1.4$ — Future

10 | O-RING MATERIALS/SEAL OPTIONS

0	Viton® GFLT — Only Available with 3rd digit T
2	Kalrez® 4079 — Only Available with 3rd digit T
8	Aegis PF 128 (NACE) — Only Available with 3rd digit T
A	Kalrez 6375 — Only Available with 3rd digit T
D	None/Glass Ceramic Alloy (dual-seal design with annunciator fitting)—Only available with 3rd digit D or P
N	None/Glass Ceramic Alloy — Available only with 3rd digit D, P or S

11 | PROBE SIZE/ELEMENT TYPE/FLUSHING CONNECTION

2	Small Coaxial (0.875 inches/22 mm)

12 | SPECIAL OPTIONS

0	Single Length Probe (Non-Segmented)

13 14 15 | INSERTION LENGTH

X X X	inches (012 – 240) cm (030 – 610)

unit of measure determined by 2nd digit of model number

7			—				—				—	2		—			
1	2	3		4	5	6	7		8	9	10		11	12		13	14	15

MODEL NUMBER

CAGED PROBE

Models available for quick shipment, usually within one week after factory receipt of a complete purchase order, through the Expedite Ship Plan (ESP).

1 | TECHNOLOGY

7	ECLIPSE GWR Probes - Model 706

2 | MEASUREMENT SYSTEM

A	English
C	Metric

3 | CONFIGURATION/STYLE (RIGID)

G	Overfill Caged Rigid Probe for use in chambers +400° F (+200° C) (Only available with 2", 3", and 4" flanges)
J	Overfill Caged High Temp/High Pressure Probe with Glass Seal for use in chambers +850° F (+450° C) (Only available with 2", 3", and 4" flanges)
L	Overfill Caged High Pressure Probe with Glass Seal for use in chambers +400° F (+200° C) (Only available with 2", 3", and 4" flanges)

4 5 | PROCESS CONNECTION – SIZE/TYPE (consult factory for other process connections) ①

ANSI Flanges

4 3	2"	150# ANSI RF
4 4	2"	300# ANSI RF
4 5	2"	600# ANSI RF
4 7	2"	900/1500# ANSI RF
4 8	2"	2500# ANSI RF
4 K	2"	600# ANSI RTJ
4 M	2"	900/1500# ANSI RTJ
4 N	2"	2500# ANSI RTJ
5 3	3"	150# ANSI RF

5 4	3"	300# ANSI RF
5 5	3"	600# ANSI RF
5 6	3"	900# ANSI RF
5 7	3"	1500# ANSI RF
5 8	3"	2500# ANSI RF
5 K	3"	600# ANSI RTJ
5 L	3"	900# ANSI RTJ
5 M	3"	1500# ANSI RTJ
5 N	3"	2500# ANSI RTJ

6 3	4"	150# ANSI RF
6 4	4"	300# ANSI RF
6 5	4"	600# ANSI RF
6 6	4"	900# ANSI RF
6 7	4"	1500# ANSI RF
6 8	4"	2500# ANSI RF
6 K	4"	600# ANSI RTJ
6 L	4"	900# ANSI RTJ
6 M	4"	1500# ANSI RTJ
6 N	4"	2500# ANSI RTJ

EN Flanges

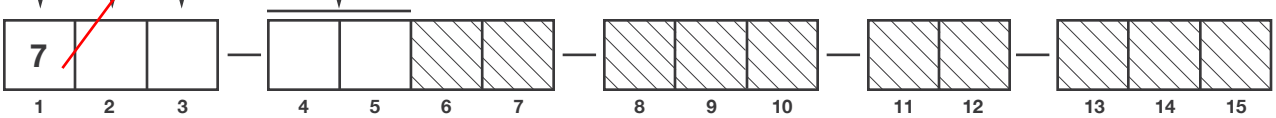
D A	DN 50, PN 16	EN 1092-1 TYPE A
D B	DN 50, PN 25/40	EN 1092-1 TYPE A
D D	DN 50, PN 63	EN 1092-1 TYPE B2
D E	DN 50, PN 100	EN 1092-1 TYPE B2
D F	DN 50, PN 160	EN 1092-1 TYPE B2
D G	DN 50, PN 250	EN 1092-1 TYPE B2
D H	DN 50, PN 320	EN 1092-1 TYPE B2
D J	DN 50, PN 400	EN 1092-1 TYPE B2
E A	DN 80, PN 16	EN 1092-1 TYPE A
E B	DN 80, PN 25/40	EN 1092-1 TYPE A
E D	DN 80, PN 63	EN 1092-1 TYPE B2
E E	DN 80, PN 100	EN 1092-1 TYPE B2

E F	DN 80, PN 160	EN 1092-1 TYPE B2
E G	DN 80, PN 250	EN 1092-1 TYPE B2
E H	DN 80, PN 320	EN 1092-1 TYPE B2
E J	DN 80, PN 400	EN 1092-1 TYPE B2
F A	DN 100, PN 16	EN 1092-1 TYPE A
F B	DN 100, PN 25/40	EN 1092-1 TYPE A
F D	DN 100, PN 63	EN 1092-1 TYPE B2
F E	DN 100, PN 100	EN 1092-1 TYPE B2
F F	DN 100, PN 160	EN 1092-1 TYPE B2
F G	DN 100, PN 250	EN 1092-1 TYPE B2
F H	DN 100, PN 320	EN 1092-1 TYPE B2
F J	DN 100, PN 400	EN 1092-1 TYPE B2

Torque Tube Mating Flanges ②

T T	600# Fisher (249B/259B) in carbon steel – as per dimensions on page 18
T U	600# Fisher (249C) in stainless steel – as per dimensions on page 18
U T	600# Masoneilan flange in carbon steel – as per dimensions on page 18
U U	600# Masoneilan flange in stainless steel – as per dimensions on page 18

① Confirm mounting conditions/nozzle diameter to ensure sufficient clearance.
② Always check dimensions if ANSI/EN flanges are not used.



MODEL NUMBER CONTINUED

CAGED PROBE

6 | CONSTRUCTION CODES

0	Industrial
K	ASME B31.1
L	ASME B31.3
M	ASME B31.3 & NACE MR0175/MR0103
N	NACE MR0175/MR0103

7 | FLANGE OPTIONS

0	None
1	Offset (For use with AURORA)–4" Only available with 3rd digit G and J and 4th digit 6
2	Offset with ½" NPT Vent (For use with AURORA)–4" Only available with 3rd digit G and J and 4th digit 6
3	Offset with ¾" NPT Vent (For use with AURORA)–4" Only available with 3rd digit G and J and 4th digit 6

8 | MATERIAL OF CONSTRUCTION - MFG/NUT/ROD/INSULATION

A	316 SS/316L SS
B	Hastelloy C
C	Monel
R	316 SS/316L SS with Carbon Steel Flange
S	Hastelloy C with Carbon Steel Flange
T	Monel with Carbon Steel Flange

9 | SPACER MATERIAL

2	PEEK HT (+650° F/+345° C)
3	Ceramic (High Temp.>+800° F/+425° C) — Only available with 3rd digit J
4	Celazole® (+800° F/+425° C) — Only available with 3rd digit J

10 | O-RING MATERIALS/SEAL OPTIONS

0	Viton® GFLT — Not available with 3rd digit J or L
2	Kalrez 4079 — Not available with 3rd digit J or L
8	Aegis PF 128 (NACE) — Not available with 3rd digit J or L
A	Kalrez 6375 — Not available with 3rd digit J or L
D	None/Glass Ceramic Alloy (Dual Seal Design with annunciator fitting) — Not available with 3rd digit G
N	None/Glass Ceramic Alloy — Not available with 3rd digit G

11 | PROBE SIZE/ELEMENT TYPE/FLUSHING CONNECTION

0	None

12 | SPECIAL OPTIONS — See page 36

1	Single Length Removable Probe
2	2-piece Segmented Probe
3	3-piece Segmented Probe
4	4-piece Segmented Probe

13 14 15 | INSERTION LENGTH

X X X	inches (012 – 288) cm (030 – 732)

unit of measure determined by 2nd digit of model number

7			—				—				—	0		—			
1	2	3		4	5	6	7		8	9	10		11	12		13	14	15

MODEL NUMBER

SINGLE ROD RIGID PROBE

Models available for quick shipment, usually within one week after factory receipt of a complete purchase order, through the Expedite Ship Plan (ESP).

1 | TECHNOLOGY

7	ECLIPSE GWR Probes - Model 706

2 | MEASUREMENT SYSTEM

A	English
C	Metric

3 | CONFIGURATION/STYLE (RIGID)

F	Single Rod, Standard (+400° F/200° C) for in-tank applications not available with 10th digit N or D
M	Single Rod, High Pressure Probe with glass seal (+400° F/+200° C), for in-tank applications only available with 10th digit N or D
N	Single Rod, High Temp/High Pressure with glass seal (+850° F/+450° C), for in-tank applications only available with 10th digit N or D

4 5 | PROCESS CONNECTION – SIZE/TYPE (consult factory for other process connections) ①

Threaded

2 1	1" NPT Thread ②
4 1	2" NPT Thread

2 2	1" BSP (G1) Thread ②
4 2	2" BSP (G1) Thread

ANSI Flanges

3 3	1 ½"	150# ANSI RF ① ③
3 4	1 ½"	300# ANSI RF ① ③
3 5	1 ½"	600# ANSI RF ① ③
4 3	2"	150# ANSI RF ①
4 4	2"	300# ANSI RF ①
4 5	2"	600# ANSI RF ①
4 7	2"	900/1500# ANSI RF
4 8	2"	2500# ANSI RF
4 K	2"	600# ANSI RTJ
4 M	2"	900/1500# ANSI RTJ

4 N	2"	2500# ANSI RTJ
5 3	3"	150# ANSI RF
5 4	3"	300# ANSI RF
5 5	3"	600# ANSI RF
5 6	3"	900# ANSI RF
5 7	3"	1500# ANSI RF
5 8	3"	2500# ANSI RF
5 K	3"	600# ANSI RTJ
5 L	3"	900# ANSI RTJ
5 M	3"	1500# ANSI RTJ

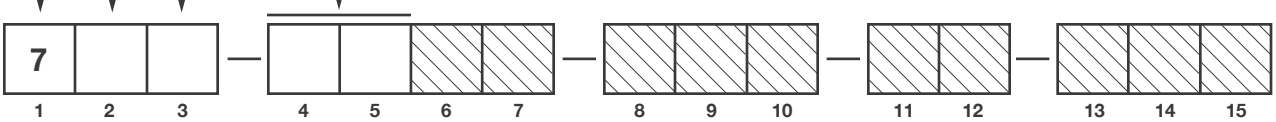
5 N	3"	2500# ANSI RTJ
6 3	4"	150# ANSI RF
6 4	4"	300# ANSI RF
6 5	4"	600# ANSI RF
6 6	4"	900# ANSI RF
6 7	4"	1500# ANSI RF
6 8	4"	2500# ANSI RF
6 K	4"	600# ANSI RTJ
6 L	4"	900# ANSI RTJ
6 M	4"	1500# ANSI RTJ
6 N	4"	2500# ANSI RTJ

EN Flanges

C B	DN 40, PN 16/25/40	EN 1092-1 TYPE A
C C	DN 40, PN 63/100	EN 1092-1 TYPE B2
C F	DN 40, PN 160	EN 1092-1 TYPE B2
C G	DN 40, PN 250	EN 1092-1 TYPE B2
D A	DN 50, PN 16	EN 1092-1 TYPE A ①
D B	DN 50, PN 25/40	EN 1092-1 TYPE A ①
D D	DN 50, PN 63	EN 1092-1 TYPE B2 ①
D E	DN 50, PN 100	EN 1092-1 TYPE B2 ①
D F	DN 50, PN 160	EN 1092-1 TYPE B2
D G	DN 50, PN 250	EN 1092-1 TYPE B2
D H	DN 50, PN 320	EN 1092-1 TYPE B2
D J	DN 50, PN 400	EN 1092-1 TYPE B2
E A	DN 80, PN 16	EN 1092-1 TYPE A ①
E B	DN 80, PN 25/40	EN 1092-1 TYPE A

E D	DN 80, PN 63	EN 1092-1 TYPE B2
E E	DN 80, PN 100	EN 1092-1 TYPE B2
E F	DN 80, PN 160	EN 1092-1 TYPE B2
E G	DN 80, PN 250	EN 1092-1 TYPE B2
E H	DN 80, PN 320	EN 1092-1 TYPE B2
E J	DN 80, PN 400	EN 1092-1 TYPE B2
F A	DN 100, PN 16	EN 1092-1 TYPE A
F B	DN 100, PN 25/40	EN 1092-1 TYPE A
F D	DN 100, PN 63	EN 1092-1 TYPE B2
F E	DN 100, PN 100	EN 1092-1 TYPE B2
F F	DN 100, PN 160	EN 1092-1 TYPE B2
F G	DN 100, PN 250	EN 1092-1 TYPE B2
F H	DN 100, PN 320	EN 1092-1 TYPE B2
F J	DN 100, PN 400	EN 1092-1 TYPE B2

① Confirm mounting conditions/nozzle diameter to ensure sufficient clearance.
② Not available with 3rd Digit N
③ Not available with 3rd Digit M or N



SINGLE ROD RIGID PROBE

6 | CONSTRUCTION CODES

0	Industrial
K	ASME B31.1
L	ASME B31.3
M	ASME B31.3 & NACE MR0175/MR0103
N	NACE MR0175/MR0103

7 | FLANGE OPTIONS

0	None

8 | MATERIAL OF CONSTRUCTION - MFG/NUT/ROD/INSULATION

A	316 SS/316L SS
B	Hastelloy C
C	Monel
F	Faced Flange, PFA coated wetted surfaces — Only available with Digit 3rd digit F
P	PFA coated rod — Only available with Digit 3rd digit F
R	316 SS/316L SS with Carbon Steel Flange
S	Hastelloy C with Carbon Steel Flange
T	Monel with Carbon Steel Flange

9 | SPACER MATERIAL

0	None – Not available with 3rd Digit N
2	PEEK HT (+650° F/+345° C) — Only available with 3rd digit N
3	Ceramic (High Temp.>+800° F/+425° C) — Only available with 3rd digit N
4	Celazole® (+800° F/+425° C) — Only available with 3rd digit N

10 | O-RING MATERIALS/SEAL OPTIONS

0	Viton® GFLT — Not available with 3rd digit M or N
2	Kalrez 4079 — Not available with 3rd digit M or N
8	Aegis PF 128 (NACE) — Not available with 3rd digit M or N
A	Kalrez 6375 — Not available with 3rd digit M or N
D	None/Glass Ceramic Alloy Dual Seal with annunciator fitting — Not available with 3rd digit F
N	None/Glass Ceramic Alloy Dual Seal—Not available with 3rd digit F

11 | PROBE SIZE/ELEMENT TYPE/FLUSHING CONNECTION

0	Standard Single Rod

12 | SPECIAL OPTIONS

0	Non-Removable Rod—Only available with PFA Coated Probes (8th digit F or P)
1	Removable Rod — Not available with PFA Coated Probes (8th Digit F or P)

13 14 15 | INSERTION LENGTH

X X X	inches (012 – 288) cm (030 – 732)

unit of measure determined by 2nd digit of model number

7				0				0						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

MODEL NUMBER

SINGLE FLEXIBLE PROBE

Models available for quick shipment, usually within one week after factory receipt of a complete purchase order, through the Expedite Ship Plan (ESP).

1 | TECHNOLOGY

7	ECLIPSE GWR Probes - Model 706

2 | MEASUREMENT SYSTEM

A	English
C	Metric

3 | SPECIALTY FLEXIBLE PROBES

1	Single Cable Flexible standard for in-tank applications (+400° F/+200° C)
2	Single Cable Flexible Light Duty Bulk Solids
3	Single Cable Flexible HTHP for in-tank applications (+850° F/+450° C) — (Future)
4	Single Cable Flexible standard for chamber applications (+400° F/+200° C) — (Future)
6	Single Cable Flexible HTHP for chamber applications (+850° F/+450° C) — (Future)

4 5 | PROCESS CONNECTION – SIZE/TYPE (consult factory for other process connections)

Threaded

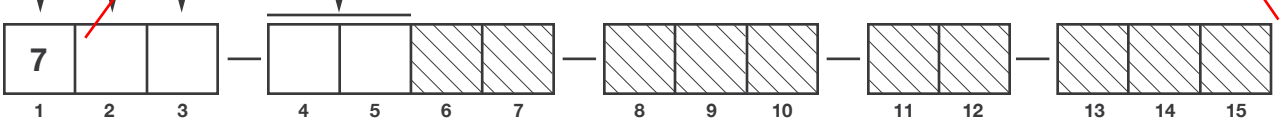
4 1	2" NPT Thread	4 2	2" BSP (G1) Thread

ANSI Flanges

4 3	2"	150# ANSI RF
4 4	2"	300# ANSI RF
4 5	2"	600# ANSI RF
5 3	3"	150# ANSI RF
5 4	3"	300# ANSI RF
5 5	3"	600# ANSI RF
6 3	4"	150# ANSI RF
6 4	4"	300# ANSI RF
6 5	4"	600# ANSI RF

EN Flanges

D A	DN 50, PN 16	EN 1092-1 TYPE A
D B	DN 50, PN 25/40	EN 1092-1 TYPE A
D D	DN 50, PN 63	EN 1092-1 TYPE B2
D E	DN 50, PN 100	EN 1092-1 TYPE B2
E A	DN 80, PN 16	EN 1092-1 TYPE A
E B	DN 80, PN 25/40	EN 1092-1 TYPE A
E D	DN 80, PN 63	EN 1092-1 TYPE B2
E E	DN 80, PN 100	EN 1092-1 TYPE B2
F A	DN 100, PN 16	EN 1092-1 TYPE A
F B	DN 100, PN 25/40	EN 1092-1 TYPE A
F D	DN 100, PN 63	EN 1092-1 TYPE B2
F E	DN 100, PN 100	EN 1092-1 TYPE B2



MODEL NUMBER CONTINUED

SINGLE FLEXIBLE PROBE

6 | CONSTRUCTION CODES

0	Industrial

7 | FLANGE OPTIONS

0	None

8 | MATERIAL OF CONSTRUCTION - MFG/NUT/ROD/INSULATION

A	316 SS/316L SS
R	316 SS/316L SS with Carbon Steel Flange

9 | SPACER MATERIAL

0	None

10 | O-RING MATERIALS/SEAL OPTIONS

0	Viton® GFLT
2	Kalrez 4079
8	Aegis PF 128 (NACE)
A	Kalrez 6375

11 | PROBE SIZE/ELEMENT TYPE/FLUSHING CONNECTION

3	Flexible Cable Probe

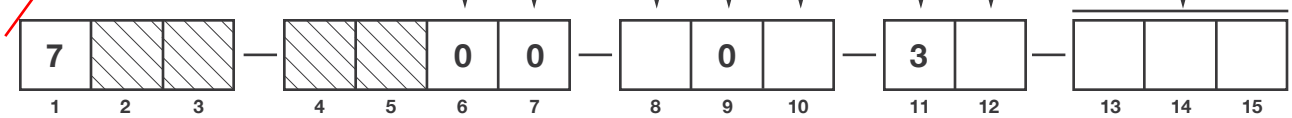
12 | SPECIAL OPTIONS

0	Non-removable Probe Cable (for use with 3rd digit '2' only)
1	Removable Single-piece Probe Cable (for use with 3rd digit '1' only)

13 14 15 | INSERTION LENGTH

X X X	feet (003 – 100) meters (001 – 030)

unit of measure determined by 2nd digit of model number



MODEL NUMBER

TWIN FLEXIBLE PROBE

Models available for quick shipment, usually within one week after factory receipt of a complete purchase order, through the Expedite Ship Plan (ESP).

1 | TECHNOLOGY

7	ECLIPSE GWR Probes - Model 706

2 | MEASUREMENT SYSTEM

A	English
C	Metric

3 | SPECIALTY FLEXIBLE PROBES

5	Twin Flexible Light Duty Bulk Solids with FEP Webbing
7	Twin Flexible - 316 SS with FEP Webbing

4 5 | PROCESS CONNECTION – SIZE/TYPE (consult factory for other process connections)

Threaded ①

2 1	1" NPT Thread (7yF and 7yM only)
4 1	2" NPT Thread

2 2	1" BSP (G1) Thread (7yF and 7yM only)
4 2	2" BSP (G1) Thread

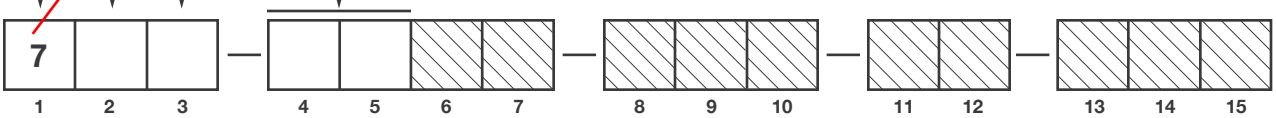
ANSI Flanges

5 3	3"	150 lbs. ANSI RF
5 4	3"	300 lbs. ANSI RF
5 5	3"	600 lbs. ANSI RF
6 3	4"	150 lbs. ANSI RF
6 4	4"	300 lbs. ANSI RF
6 5	4"	600 lbs. ANSI RF

EN Flanges

E A	DN 80, PN 16	EN 1092-1 TYPE A
E B	DN 80, PN 25/40	EN 1092-1 TYPE A
E D	DN 80, PN 63	EN 1092-1 TYPE B2
E E	DN 80, PN 100	EN 1092-1 TYPE B2
F A	DN 100, PN 16	EN 1092-1 TYPE A
F B	DN 100, PN 25/40	EN 1092-1 TYPE A
F D	DN 100, PN 63	EN 1092-1 TYPE B2
F E	DN 100, PN 100	EN 1092-1 TYPE B2

① Confirm mounting conditions/nozzle diameter to ensure sufficient clearance.



MODEL NUMBER CONTINUED

TWIN FLEXIBLE PROBE

6 | CONSTRUCTION CODES

0	Industrial

7 | FLANGE OPTIONS

0	None

8 | MATERIAL OF CONSTRUCTION - MFG/NUT/ROD/INSULATION

A	316 SS/316L SS
R	316 SS/316L SS with Carbon Steel Flange

9 | SPACER MATERIAL

0	None

10 | O-RING MATERIALS/SEAL OPTIONS

0	Viton® GFLT
2	Kalrez 4079 – Only available with 3rd digit 7
8	Aegis PF 128 (NACE) – Only available with 3rd digit 7
A	Kalrez 6375 – Only available with 3rd digit 7

11 | PROBE SIZE/ELEMENT TYPE/FLUSHING CONNECTION

3	Flexible Cable Probe

12 | SPECIAL OPTIONS

0	None

13 14 15 | INSERTION LENGTH

X X X	feet (003 – 100) meters (001 – 030)

unit of measure determined by 2nd digit of model number

7					0	0		0		3	0			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

SEGMENTED PROBE OPTIONS

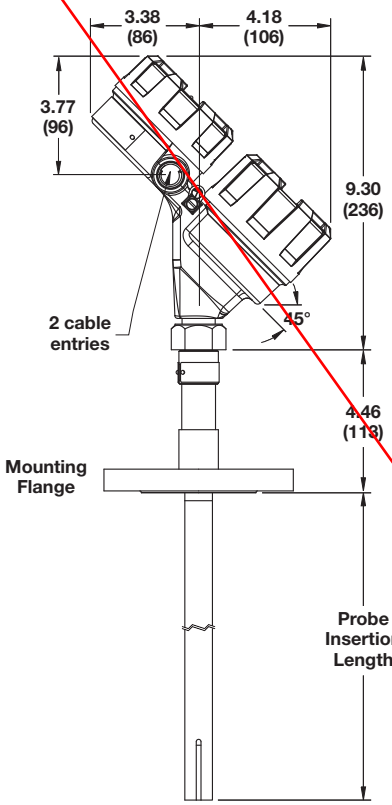
12th DIGIT OF MODEL NUMBER

Probe Model	One Segment	Two Segments	Three Segments	Four Segments
Coaxial Models 7yD, 7yP and 7yT (Enlarged versions only) (3", DN 80 Process Connections and larger)	24 – 120" (60 – 305 cm)	48 – 240" (120 – 610 cm)	72 – 360" (180 – 914 cm)	96 – 396" (240 – 990 cm)
Caged Models 7yG, 7yL and 7yJ	12 – 120" (30 – 305 cm)	24 – 240" (60 – 610 cm)	36 – 288" (90 – 732 cm)	48 – 288" (120 – 732 cm)

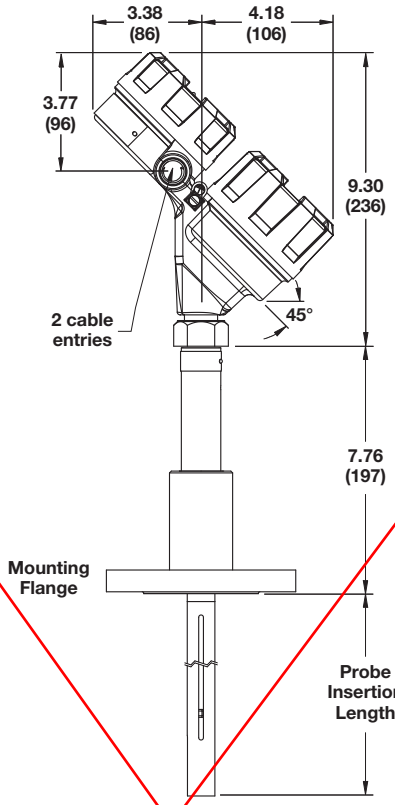
NOTE: Segments will be evenly divided over the length of the probe.

COAXIAL PROBE DIMENSIONS

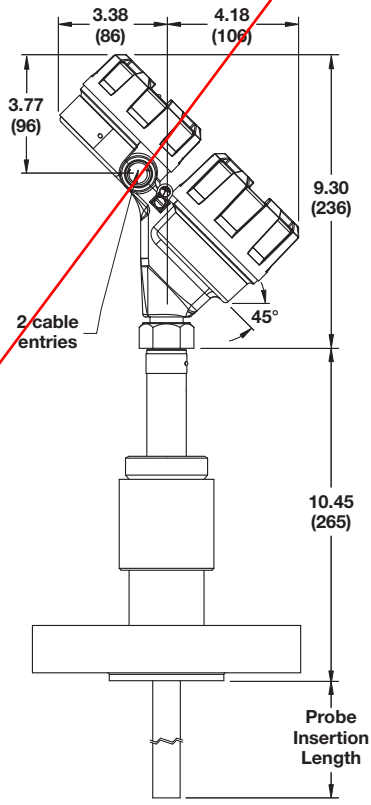
INCHES (mm)



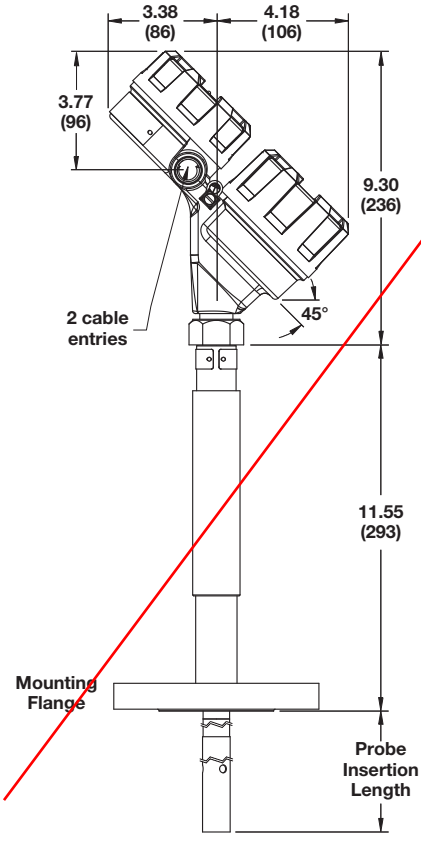
Model 7yT
with flanged connection



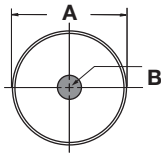
Model 7yP
with flanged connection



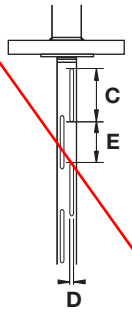
Model 7yD
with flanged connection



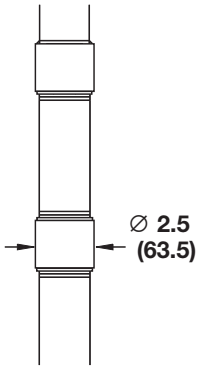
Model 7yS
with flanged connection



Coaxial GWR Probe,
End View



Coaxial Probe Slots



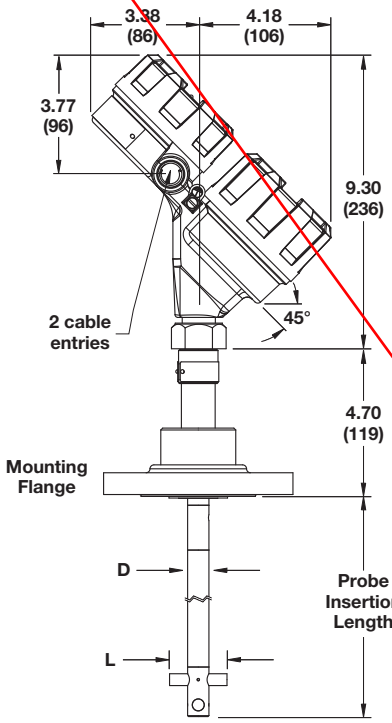
Segmented Enlarged
Coaxial Probe

Inches (mm)

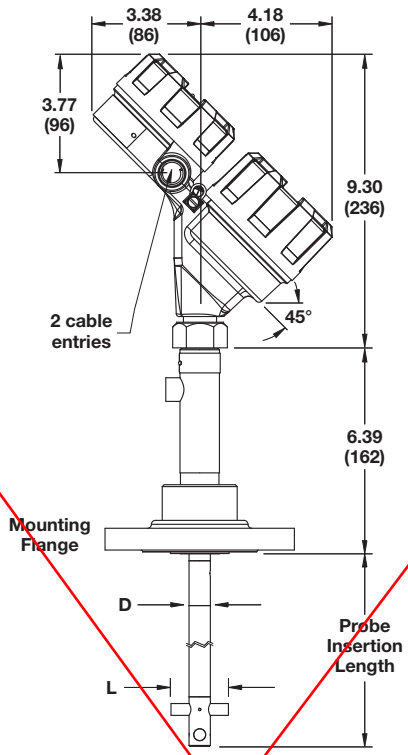
Dim.	Small Diameter	Enlarged (standard)
A	0.88 (22.5)	1.75 (45) - SST 1.92 (49) - HC and Monel
B	0.31 (8)	0.63 (16)
C	4.08 (100)	6.05 (153)
D	0.15 (4)	0.30 (8)
E	3.78 (96)	5.45 (138)

CAGED PROBE DIMENSIONS

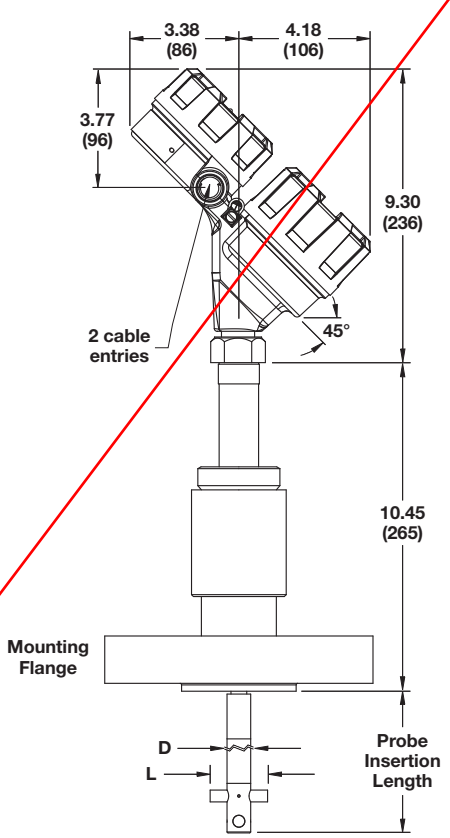
INCHES (mm)



Model 7yG
with flanged connection



Model 7yL
with flanged connection

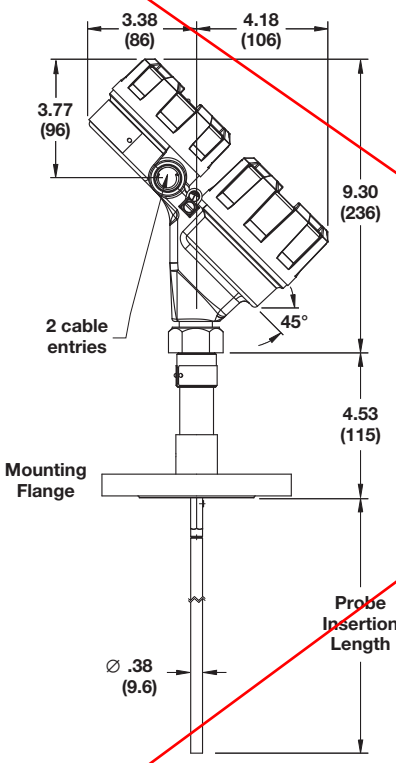


Model 7yJ
with flanged connection

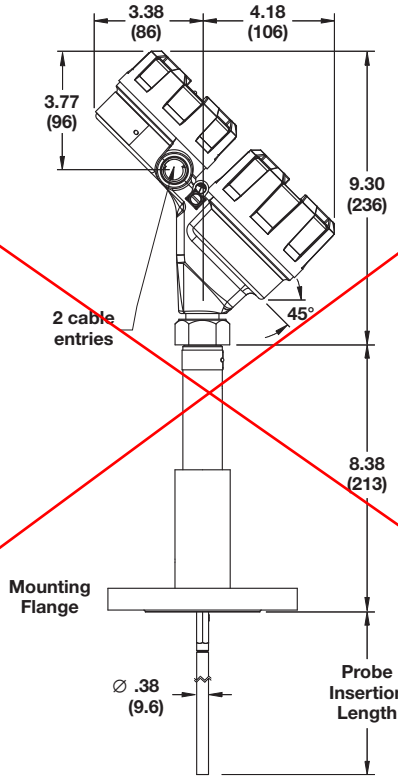
Cage Size	Probe Rod Diameter (D)	Spacer Length (L)
2"	0.5 to 0.75" (13 to 19 mm)	1.82" (46 mm)
3"	0.75 to 1.13" (19 to 29 mm)	2.64" (67 mm)
4"	1.05 to 1.50" (27 to 38 mm)	3.60" (91 mm)

SINGLE ROD RIGID PROBE DIMENSIONS

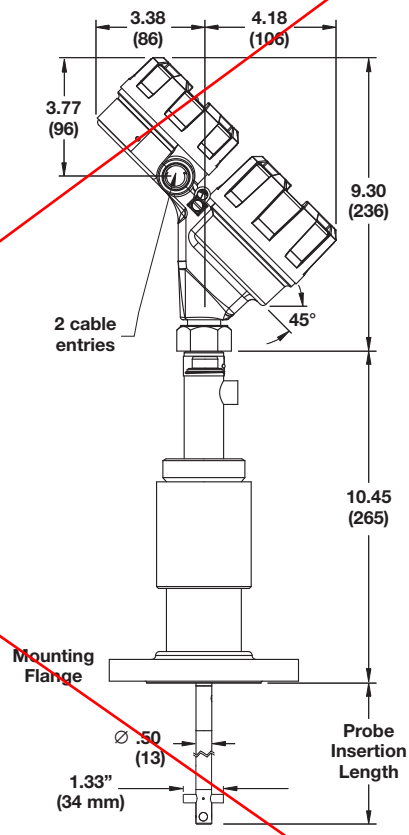
INCHES (mm)



Model 7yF
with flanged connection



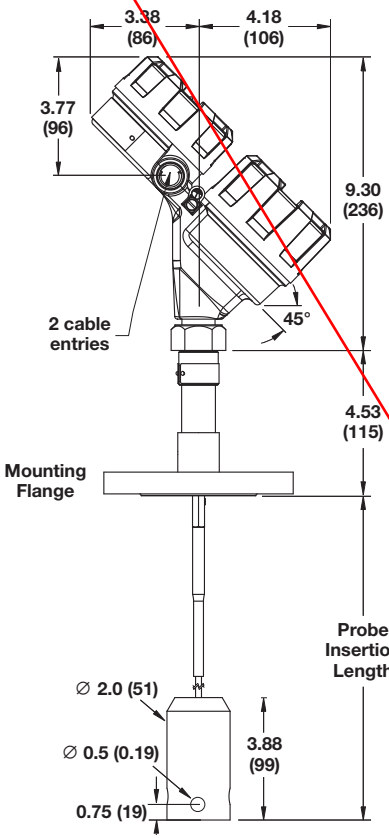
Model 7yM
with flanged connection



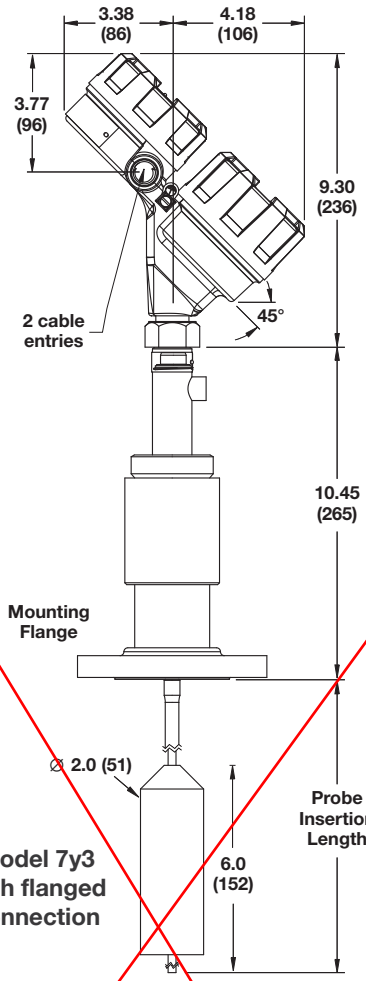
Model 7yN
with flanged connection

SINGLE FLEXIBLE PROBE DIMENSIONS

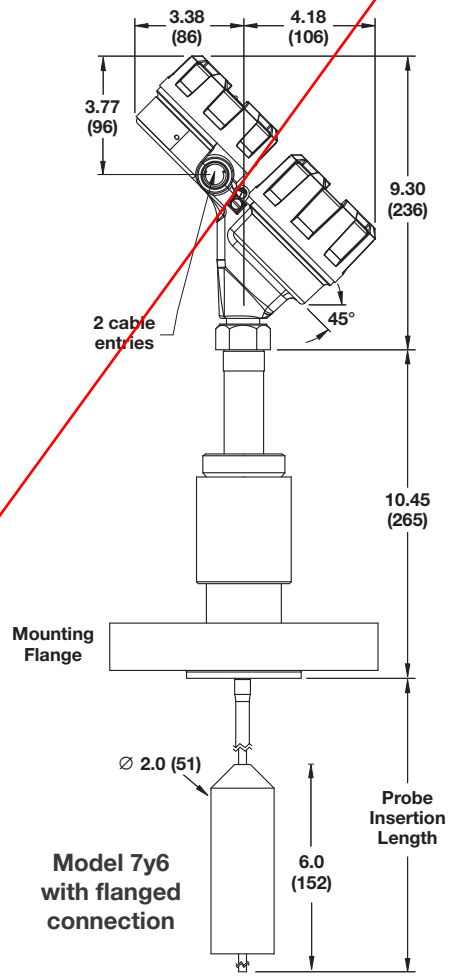
INCHES (mm)



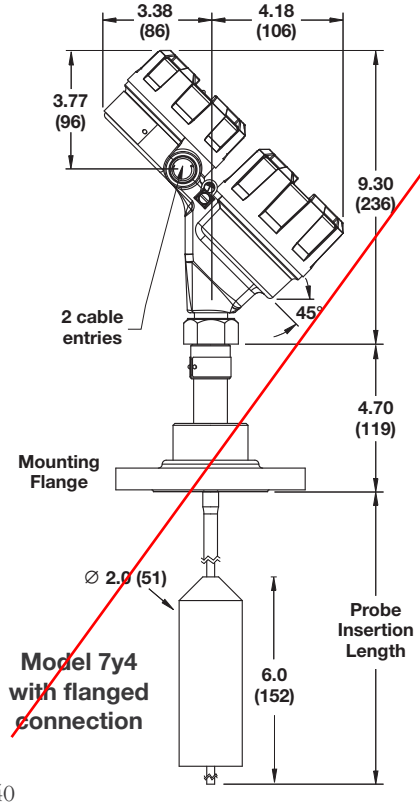
Model 7y1 with flanged connection



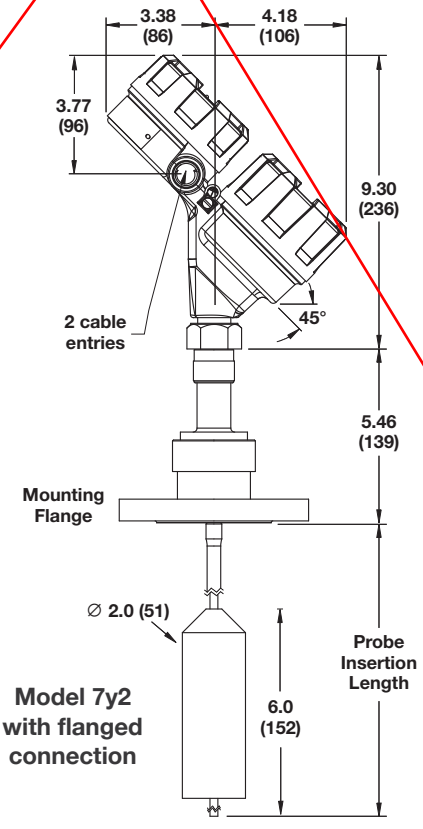
Model 7y3 with flanged connection



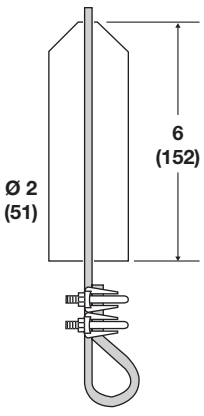
Model 7y6 with flanged connection



Model 7y4 with flanged connection



Model 7y2 with flanged connection



7x2: SST Weight
5 lbs (2.25 kg)
order code: 004-8778-001
(2) 010-1731-001

MOUNTING CONSIDERATIONS

For Rigid Models 7yF, M, N and Flexible Models 7y1, 2, 4 and 6

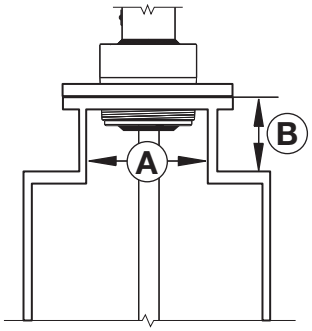
1. Turbulence

The bottom of rigid probes should be stabilized if turbulence will cause a deflection of more than 3" (75 mm) at the end of a 10' (3 m) length. The probe should not make contact with metal.

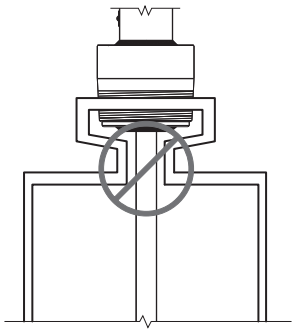
2. Nozzle

Single rod performance in nozzles can be improved by ensuring the following:

- Nozzle must be 2" (50 mm) or larger diameter.
- Nozzle should be as short as possible.
- Nozzle inside diameter (A) should be ≥ to nozzle height (B).
  - If this is not the case, adjustments to BLOCKING DISTANCE and/or SENSITIVITY parameters may be required.



Correct Installation



Pipe reducers should not be used

3. Metallic (conductive) obstructions in tank.

Although it depends on the transmitter configuration, objects in the proximity of the probe can cause erroneous readings. Please refer to the table below for guidelines, but please contact the factory with any questions as the distances shown can be reduced with the use of PACT*ware*™.

Distance to probe	Acceptable objects
< 6" (150 mm)	Continuous, smooth, parallel, conductive surface (e.g. metal tank wall); probe should not touch tank wall
> 6" (150 mm)	< 1"/DN25 diameter pipe and beams, ladder rungs
> 12" (300 mm)	< 3"/DN80 diameter pipe and beams, concrete walls
> 18" (450 mm)	All remaining objects

Note: A metal stillwell/cage of max. 6"/DN150 size or a metal tank wall parallel to the probe within 6" (150 mm) will allow the unit to operate accurately in media with dielectrics down to ε_r 1.4.

4. Non-metallic vessels

A metal flange is highly recommended for optimum performance in plastic vessels.

NOTE: Singe rod probes must be used in metallic vessels or stillwell to maintain CE noise immunity.

Shutdown /Overfill protection

Special consideration is necessary in any shutdown/overfill protection application where single rod GWR probes are used. To ensure proper measurement, use Overfill Capable single rod probes, such as the Model 7yG, L, or J Caged probes in the appropriate cage/chamber/stillwell.

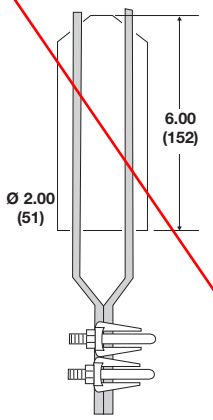
Mounting Considerations for Single Flexible probes measuring Bulk Solids

The Model 7y2 Bulk Solid probe is designed for a 3000 lb. (1360 kg) pull-down force for use in applications such as sand, plastic pellets, and grains.

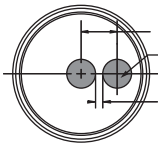
- To reduce excessive stresses on the top of the vessel, do not secure the metal probe weight to the bottom of the vessel.
- Mount the probe at least 12 inches from the wall. The ideal location is ¼ to ½ the diameter to average the angle of repose.

TWIN FLEXIBLE PROBE DIMENSIONS

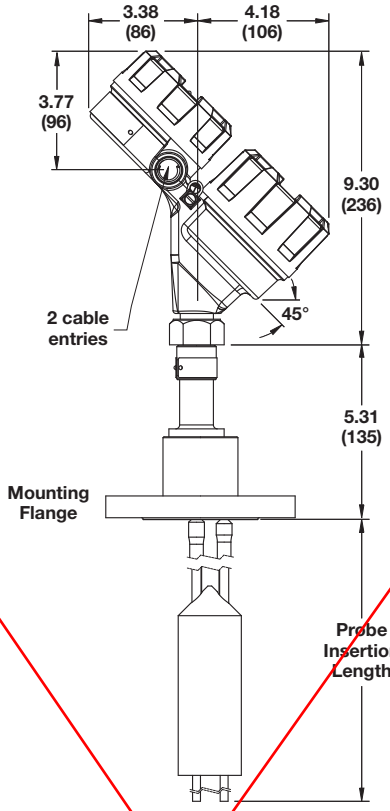
INCHES (mm)



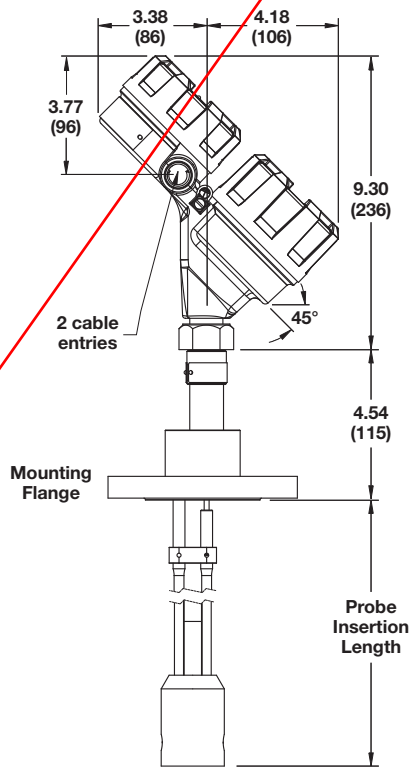
7x5: SST Weight
5 lbs (2.25 kg)
order code: 004-8778-002
+ 2 x 010-1731-001



Twin Flexible GWR Probe end view



Model 7y5 with flanged connection



Model 7y7 with flanged connection

"IN TANK" TWIN FLEXIBLE PROBE

MOUNTING CONSIDERATIONS

For Models 7y7

1. Turbulence

The bottom of Twin Flexible probes can be secured to the bottom of the vessel by using the TFE weight at the bottom of the probe. The TFE weight has a ½" (13 mm) hole that can be utilize to "u-bolt" the probe to the bottom of the vessel.

The probe should not make contact with metal.

2. Nozzle

Twin Flexible probe performance in nozzles can be improved by ensuring the following:

- Nozzle should be 3" (DN80) diameter or larger.
- Nozzle should be as short as possible.

3. Metallic (conductive) obstructions in tank.

Mount the Twin Flexible probe more than 1" (25 mm) from any metallic object/vessel wall.

Mounting Considerations for Twin Flexible Model 7y5 probes measuring Bulk Solids:

The Model 7y5 Bulk Solid probe is designed for a 3000 lb. (1360 kg) pull-down force for use in applications such as sand, plastic pellets, and grains.

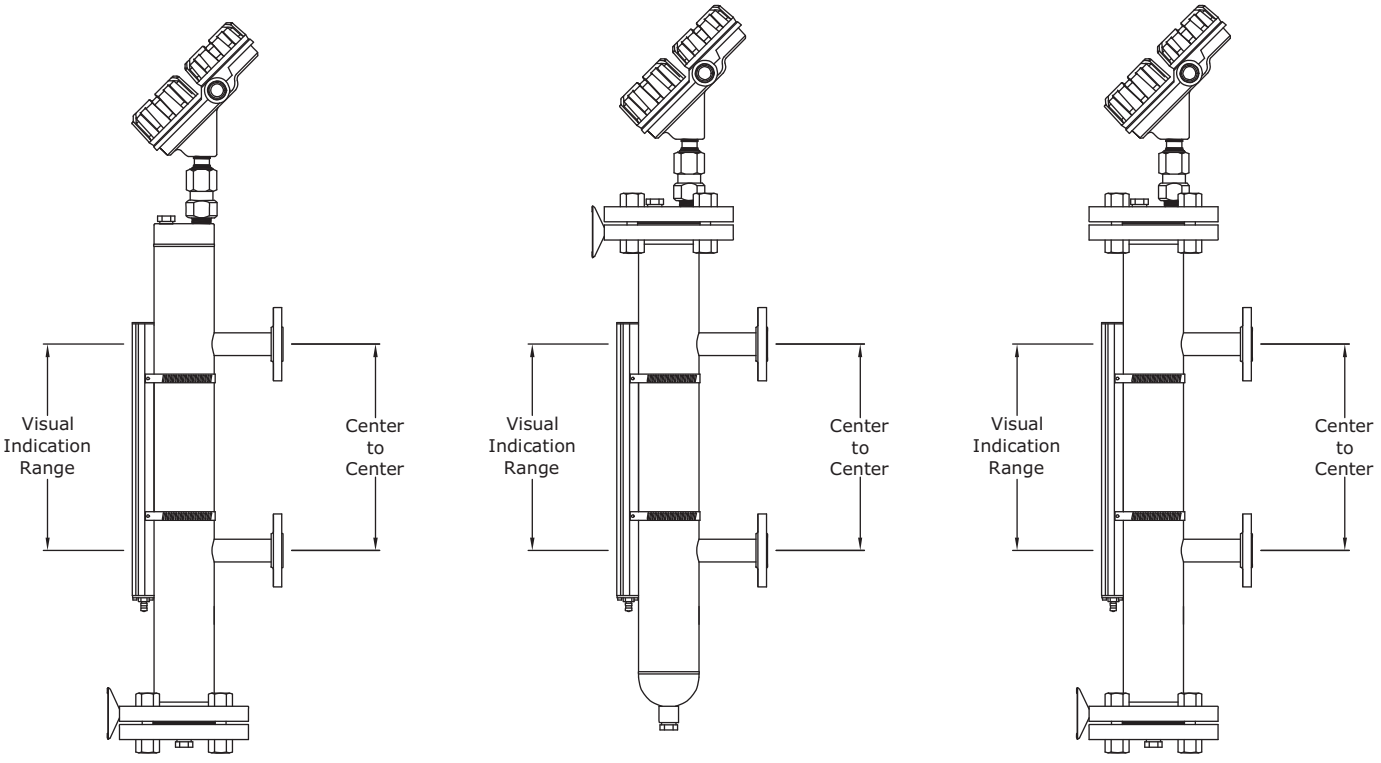
- To reduce excessive stresses on the top of the vessel, do not secure the metal probe weight to the bottom of the vessel.
- Mount the probe at least 12 inches from the wall. The ideal location is ¼ to ½ the diameter to average the angle of repose.

The Orion Instruments® Aurora® is the patented combination of the ECLIPSE Guided Wave Radar transmitter and a Magnetic Level Indicator (MLI). The integration of these two independent technologies provides excellent redundancy. A custom float positioned within the AURORA chamber travels up and down following level changes. The float contains an internal group of magnets that are "coupled" with magnets in the flags of the visual indicator mounted on the outside of the chamber. As the float moves, the flags rotate to expose the color of their opposite side. The position where the flag's color changes corresponds to a point on the measuring scale indicating true level. In addition to this external visual indicator operated by the AURORA internal float, the ECLIPSE Model 706 transmitter reflects electromagnetic radar pulses directly off the liquid surface providing a real-time continuous level output.

Refer to Orion Instruments® Sales Bulletin ORI-138 for details and additional options on AURORA chambers.

Regardless of whether a standard chamber or AURORA chamber is being used it is important to remember:

- Ensure that the Model 706 probe extends at least 4" (100 mm) past the lower process connection of the chamber
- Utilize Overfill-capable probes for optimal GWR performance.



QUALITY

MAGNETROL
REGISTERED TO
ISO 9001
Your Assurance of
Quality and Service

The quality assurance system in place at MAGNETROL guarantees the highest level of quality throughout the company. MAGNETROL is committed to providing full customer satisfaction both in quality products and quality service.

The MAGNETROL quality assurance system is registered to ISO 9001 affirming its commitment to known international quality standards providing the strongest assurance of product/service quality available.

ESP

Expedite
Ship
Plan

Several Models of ECLIPSE Guided Wave Radar Transmitters are available for quick shipment, usually within one week after factory receipt of a complete purchase order, through the Expedite Ship Plan (ESP).

Models covered by ESP service are color coded in the selection data charts.

To take advantage of ESP, simply match the color coded model number codes (standard dimensions apply).

ESP service may not apply to orders of ten units or more. Contact your local representative for lead times on larger volume orders, as well as other products and options.

WARRANTY



All MAGNETROL electronic level and flow controls are warranted free of defects in materials or workmanship for one full year from the date of original factory shipment.

If returned within the warranty period; and, upon factory inspection of the control, the cause of the claim is determined to be covered under the warranty; then, MAGNETROL will repair or replace the control at no cost to the purchaser (or owner) other than transportation.

MAGNETROL shall not be liable for misapplication, labor claims, direct or consequential damage or expense arising from the installation or use of equipment. There are no other warranties expressed or implied, except special written warranties covering some MAGNETROL products.

For additional information, see Instruction Manual 57-606.

ECLIPSE Guided Wave Radar transmitters may be protected by one or more of the following U.S. Patent Nos. US 6,062,095; US 6,247,362; US 6,588,272; US 6,626,038; US 6,640,629; US 6,642,807; US 6,690,320; US 6,750,808; US 6,801,157; US 6,867,729; US 6,879,282; 6,906,662. May depend on model. Other patents pending.

Magnetrol®

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info@magnetrol.com • www.magnetrol.com

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BULLETIN: 57-106.6
EFFECTIVE: August 2014
SUPERCEDES: February 2014

KRÜGER

SECTION 4.9

FLOAT SWITCH

VEOLIA WATER
Solutions & Technologies

VEOLIA	**INSTRUMENT DATASHEET** PROJECT NAME: Massillon, OH PROJECT NO.: 5700235402	
Float Switch		**Train 1 IFAS**

Sensor		Transmitter	
Model No.:	Eco-Float	Model No.:	
Range:	On/Off	Range:	
Power Supply:	Signal	Power Supply:	
Power Requirements:		Power Requirements:	
Output Signal:	Digital	Output Signal:	
Enclosure Rating:	Polypropylene	Enclosure Rating:	
Operating Temp:	32 to 140°F	Operating Temp:	
Process Connection:		Accuracy:	
Cable Length:	20 ft.	Integral/Remote Mount:	
Cable Connection:	Flying Leads	Local Display:	
Sensor Type:	Float	Input Signal:	

Comments:

Function	Signal	Units	Input		Output	
			LRV	URV	LRV	URV
High Level	Digital	Alarm				

Description	Manufacturer	Part Number	Qty
Eco-Float	Anchor Scientific	GSI20NONC	1

Rev	Date	By	Approval	Remarks
0	1/23/2015	MRO		Issued for Approval
1	5/18/2015	MRO		Changed switch to NO/NC

Kruger Inc.
4001 Weston Parkway
Cary, NC 27513 USA
Tel: 919-677-8310 ● Fax: 919-677-0082
Web site: www.krugerusa.com

VEOLIA WATER
Solutions & Technologies

INSTRUMENT DATASHEET

PROJECT NAME: Massillon, OH

PROJECT NO.: 5700235402

Float Switch		Train 2 IFAS

Sensor		Transmitter	
Model No.:	Eco-Float	Model No.:	
Range:	On/Off	Range:	
Power Supply:	Signal	Power Supply:	
Power Requirements:		Power Requirements:	
Output Signal:	Digital	Output Signal:	
Enclosure Rating:	Polypropylene	Enclosure Rating:	
Operating Temp:	32 to 140°F	Operating Temp:	
Process Connection:		Accuracy:	
Cable Length:	20 ft.	Integral/Remote Mount:	
Cable Connection:	Flying Leads	Local Display:	
Sensor Type:	Float	Input Signal:	

Comments:

Function	Signal	Units	Input		Output	
			LRV	URV	LRV	URV
High Level	Digital	Alarm				

Description	Manufacturer	Part Number	Qty
Eco-Float	Anchor Scientific	GSI20NONC	1

Rev	Date	By	Approval	Remarks
0	1/23/2015	MRO		Issued for Approval
1	5/18/2015	MRO		Changed switch to NO/NC

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Cary, NC 27513 USA
Tel: 919-677-8310 ● Fax: 919-677-0082
Web site: www.krugerusa.com

VEOLIA WATER
Solutions & Technologies

INSTRUMENT DATASHEET

PROJECT NAME: Massillon, OH

PROJECT NO.: 5700235402

Float Switch		**Train 3 IFAS**

Sensor		Transmitter	
Model No.:	Eco-Float	Model No.:	
Range:	On/Off	Range:	
Power Supply:	Signal	Power Supply:	
Power Requirements:		Power Requirements:	
Output Signal:	Digital	Output Signal:	
Enclosure Rating:	Polypropylene	Enclosure Rating:	
Operating Temp:	32 to 140°F	Operating Temp:	
Process Connection:		Accuracy:	
Cable Length:	20 ft.	Integral/Remote Mount:	
Cable Connection:	Flying Leads	Local Display:	
Sensor Type:	Float	Input Signal:	

Comments:

Function	Signal	Units	Input		Output	
			LRV	URV	LRV	URV
High Level	Digital	Alarm				

Description	Manufacturer	Part Number	Qty
Eco-Float	Anchor Scientific	GSI20NONC	1

Rev	Date	By	Approval	Remarks
0	1/23/2015	MRO		Issued for Approval
1	5/18/2015	MRO		Changed switch to NO/NC

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Cary, NC 27513 USA
Tel: 919-677-8310 ● Fax: 919-677-0082
Web site: www.krugerusa.com

VEOLIA WATER
Solutions & Technologies

anchor scientific inc.
Box 378, Long Lake, MN 55356
952-473-7115 • FAX 952-473-6002 • www.anchorscientific.com

eco·float

Eco-Float Model G

Description

The Eco-float is a mercury-free float switch for controlling liquid levels in a variety of applications. A snap-action switch is activated by a steel ball rolling back and forth within a switching tube in a plastic float housing. There is a minimum differential between "on" and "off" of approximately 3.5 inches. Greater differentials can be achieved when the pipe mounted or externally weighted mounting styles are used. Various lengths of cable and circuit configurations are available and in stock.

Features

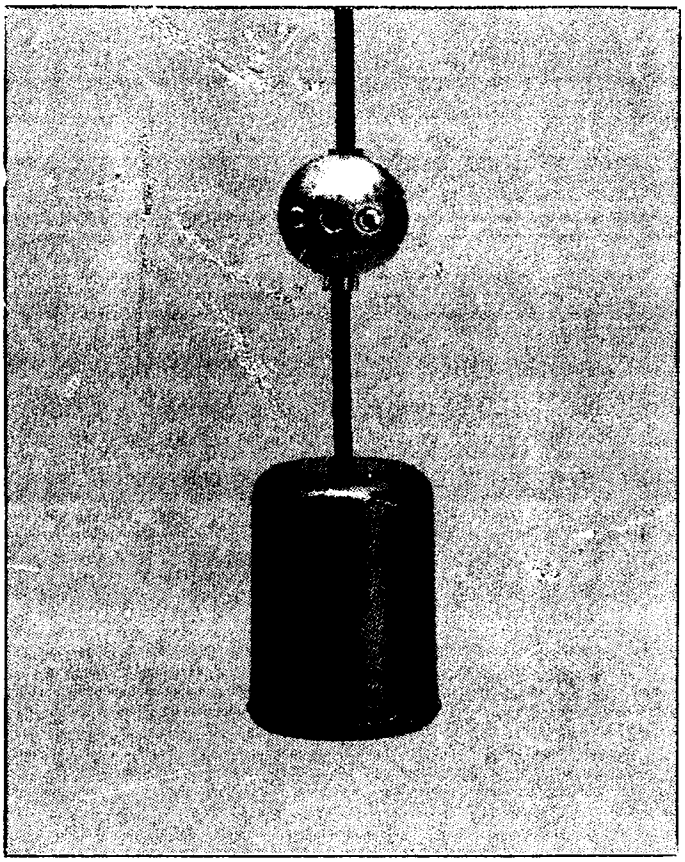
- Mercury Free
- Variety of Mounting Styles
- Variety of Circuit Configurations
- Installation Easy
- Differential In One Float
- Replaces Diaphragm and Mercury Switches

Applications

The Eco-Float can be used in a variety of liquid level monitoring applications including sumps, sewage ejectors, septic tanks, vaults, lift stations, and tanks. Eco-Floats are ruggedly constructed of corrosion resistant materials, enabling them to be used in a variety of different liquids. Some applications are subject to additional requirements described in the National Electric Code.

Specifications

Cable	18-2 or 18-3 SJO W/A, 60 C., 41 x 34 stranding dia. - .29(18-2); .31(18-3)
Float Housing	Polypropylene Dim: 3.0D x 4.25
Electrical Ratings	7A. @ 115 VAC; 3.5A @ 230VAC
Clamp	Polypropylene, (Model GP)
External Weight	Lead, 300 series stainless steel (Model GSE)
Temp. Limit	140° F

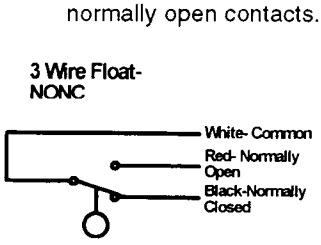


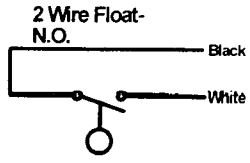
Model GSE

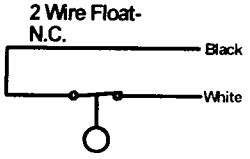
Ordering Information

Specify:	
Model	G
Mounting Style	SE (external weight) SI (internal weight) P (pipe mounted)
Cable Length	10, 15, 20, 30, 40, 50 Custom lengths available
Circuit Configuration	NO (normally open) NC (normally closed) NONC (normally open/ normally closed)

Example
GSI 20NO - Eco-Float, suspended internal wt. 20', normally open contacts.





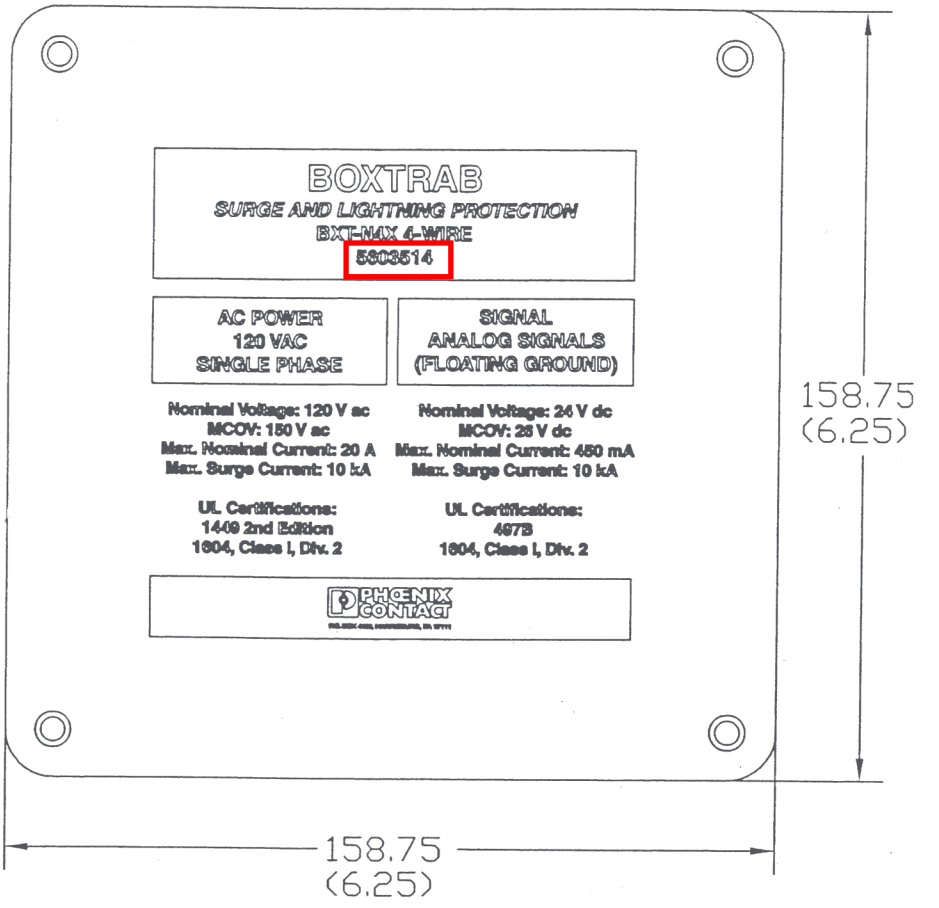


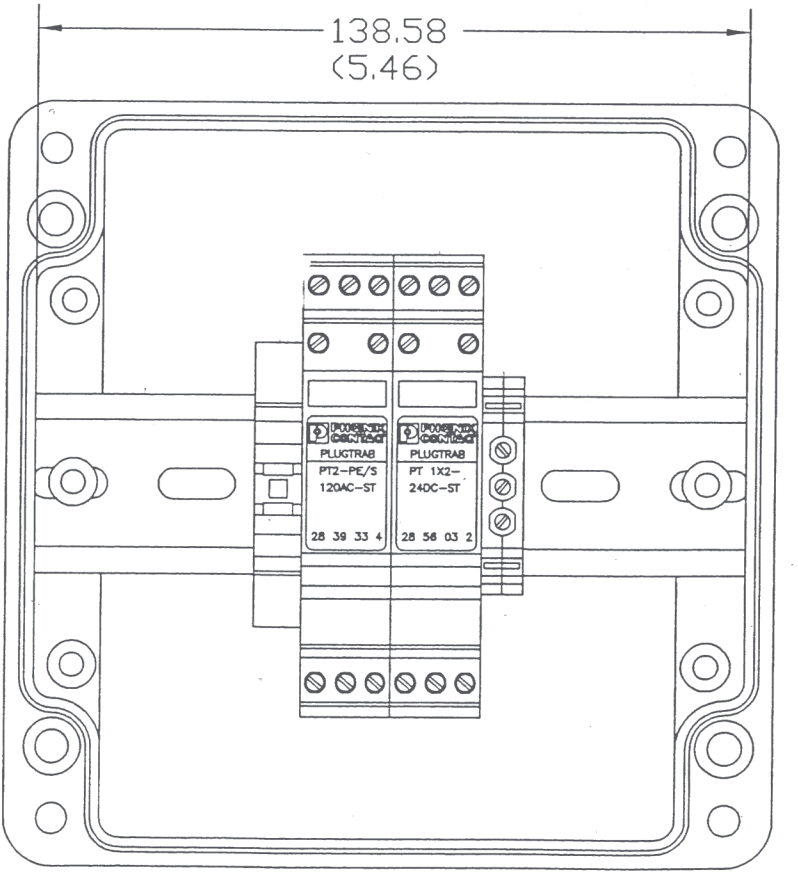
KRÜGER

SECTION 4.10

INSTRUMENT SURGE PROTECTION

VEOLIA WATER
Solutions & Technologies


BOXTRAB
SURGE AND LIGHTNING PROTECTION
BXT-MAX 4-WIRE
5603514
AC POWER
120 VAC
SINGLE PHASE
SIGNAL
ANALOG SIGNALS
(FLOATING GROUND)
Nominal Voltage: 120 V ac
MCOV: 150 V ac
Max. Nominal Current: 20 A
Max. Surge Current: 10 kA
UL Certifications:
1449 2nd Edition
1604, Class I, Div. 2
Nominal Voltage: 24 V dc
MCOV: 28 V dc
Max. Nominal Current: 450 mA
Max. Surge Current: 10 kA
UL Certifications:
497B
1604, Class I, Div. 2
PHOENIX CONTACT
158.75
(6.25)
158.75
(6.25)


138.58
(5.46)
PLUGTRAB
PT2-PE/S
120AC-ST
28 39 33 4
PLUGTRAB
PT 1X2-
240C-ST
28 56 03 2

Surge Voltage Arrester as Device Protection for the Power Supply

MAINS-PLUGTRAB

The MAINS-PLUGTRAB components from the PT series, consisting of a base element and plug, allow surge voltage protection for numerous applications for single-phase or multi-phase power supply networks. The base element has a grounding foot for mounting on mounting rails in accordance with EN 50 022 and EN 50 035, however not on NS 35/15-2,3.

The two-part structure of MAINS-PLUGTRAB, combined with the non-meshed structure of the protective plug, offers particular advantages with regard to testing and system interchangeability.

The plug can be removed from the base element for testing purposes or for exchanging and reinserted without interrupting operation for the connected device. The MAINS-PLUGTRAB base elements and plugs are polarized and coded to reliably prevent errors when the units are plugged in.

Normally MAINS-PLUGTRAB is connected in series upstream the device to be protected so that the max. operating current of 20 A flows through the base element. MAINS-PLUGTRAB can, however, be connected in parallel to the power supply using the base elements without a decoupling inductor and without any operating current flowing through the base element. This is of interest if the operating current of the device to be protected is higher than 20 A.

The base element can be labeled on the input and output side with 6 individual zack strip labels each, ZB 5,8. On the connection plug a takeup for 3 individual ZB 5 labels is provided.

MAINS-PLUGTRAB are arresters for terminal equipment. For extensive protection, the following Phoenix TRABTECH products should be used additionally:



– Surge voltage coarse protection: FLASHTRAB
– Surge voltage medium protection: VALVETRAB MS.

The varistors in the protective circuit can be overloaded by surge voltage loads which are too high or too frequent. The result is too high a leakage current in the components and as a consequence, a rise in temperature. The varistors are therefore monitored by a thermal disconnect device which disconnects the protection path from the power supply before the path overheats. Disconnection is indicated by a red control lamp. In addition, it is possible to communicate this signal via the remote indicator contacts.

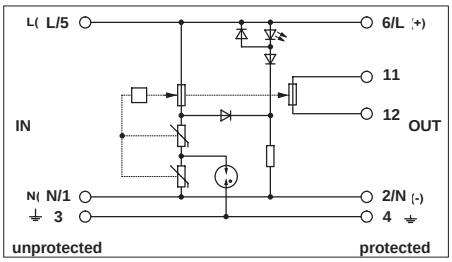
CHECKMASTER

Note

Products bearing this stamp (plug elements) can all be tested with the CHECKMASTER.

Phoenix Contact GmbH & Co. KG • 32823 Blomberg, Germany
Phone +49 52 35 3-00 • Fax +49 52 35 3-4 12 00 • www.phoenixcontact.com
Local Contact: www.phoenixcontact.com/salesnetwork

MAINS-PLUGTRAB PT 2-PE/S



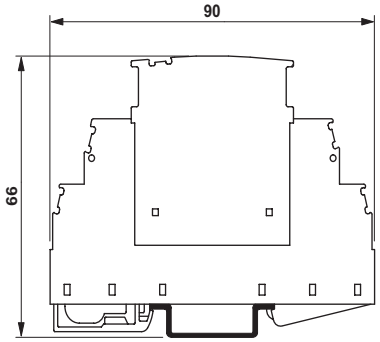


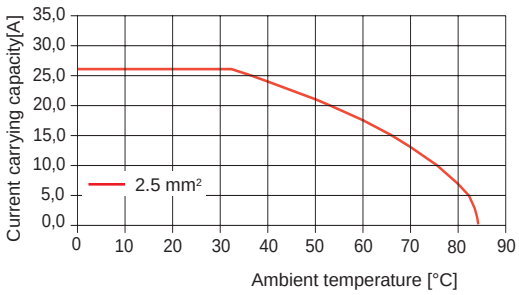
Technical data

		Type	Order No.	Pcs. / Pkt.
MAINS-PLUGTRAB base element, surge voltage protection for single-phase power supplies, with remote indicator contact, with universal foot for mounting on ⊔ or ⊔		**PT-BE/FM**	**28 39 28 2**	**10**
MAINS-PLUGTRAB plug, can be snapped on base element	24 V AC	**PT 2-PE/S- 24AC-ST**	**28 39 31 8**	**10**
	60 V AC	**PT 2-PE/S- 60AC-ST**	**28 39 32 1**	**10**
	120 V AC	**PT 2-PE/S-120AC-ST**	**28 39 33 4**	**10**
	230 V AC	**PT 2-PE/S-230AC-ST**	**28 39 34 7**	**10**
Zack strip, unprinted, 10-section, for marking with M-PEN or CMS system		**ZB 5: UNPRINTED**	**10 50 00 4**	**10**
		ZB 5,8: UNPRINTED	**27 15 20 9**	**10**
Zack strip printed horizontally, 10-section, with consecutive numbers		**ZB 5, LGS: CONSEC.NOS. ZB 5, LGS: 1-10 to ...991-1000**	**10 50 01 7**	**10**
		ZB 5,8, LGS: CONSEC.NOS. ZB 5,8, LGS: 1-10 to ...991-1000	**27 15 21 2**	**10**
Special printing zack strip, 10-section, divisible marking according to customer requirements		**ZB 5: SO/CMS...[1])**	**10 50 29 5**	**1**
		ZB 5,8: SO/CMS...[1])	**10 50 30 5**	**1**

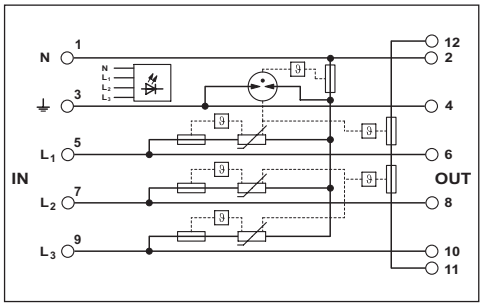
Technical data	**24AC**	**60 AV**	**120 AC**	**230 AC**
IEC category/VDE requirement class:	III / D / T3	III / D / T3	III / D / T3	III / D / T3
Nominal voltage U_N: [V AC]	24	60	120	230
Arrester rated voltage U_C: [V AC]	34 / 44	100 / 130	150 / 200	250 / 275
Nominal current I_N: [A]	26	26	26	26
Operating current I_C at U_C (L-N): [mA]	≤ 2.5	≤ 1.5	≤ 1.1	≤ 1.5
Discharge current to PE at U_N: [µA]	1	2,5	2,5	3
Nominal discharge surge current I_n (8/20) µs: [kA]	2	6,5	10	10
Max. discharge surge current I_{max} (8/20) µs: [kA]	≤ 0.18/≤ 0.55	≤ 0.4/≤ 0.7	≤ 0.62/≤ 0.85	≤ 1.1 /≤ 1.5
Protection level: [kV]	≤ 25/≤ 100	≤ 25/≤ 100	≤ 25/≤ 100	≤ 25/≤ 100
Response time t_a: [ns]	25	25	25	25
Max. required back-up fuse: [A gL/C]	– 40 bis + 85	– 40 bis + 85	– 40 bis + 85	– 40 bis + 85
Temperature range: [°C]	IP 20	IP 20	IP 20	IP 20
Protection type in acc. with IEC 60 529/ EN 60 529:	PA	PA	PA	PA
Insulation housing:	V0	V0	V0	V0
Inflammability class in acc. with UL 94:	8 mm	8 mm	8 mm	8 mm
Stripping length:	M3/0.8 Nm	M3/0.8 Nm	M3/0.8 Nm	M3/0.8 Nm
Thread / Torque:	0,2-4 / 0,2-2,5 / 24-12			
Connection data: [mm²] solid / stranded / AWG	IEC 61643-1, prEN 61643-1,			
Test standards:	E DIN VDE 0675-6/A1, E DIN VDE 0675-6/A2, UL 1449			

[1]) Please specify desired marking when ordering





MAINS-PLUGTRAB PT 4-PE/S





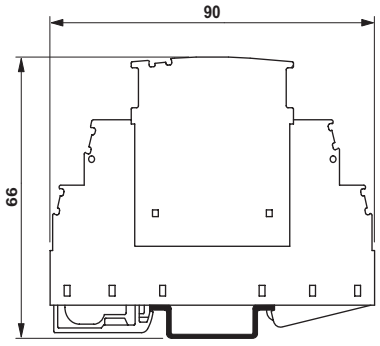
Technical data

	Type	Order No.	Pcs. / Pkt.
MAINS-PLUGTRAB, surge voltage protection for single-phase power supplies, with remote indicator contact, with universal foot for mounting on ⊏⊐ or ⊐⊏	**PT 4-PE/S-230AC**	**28 82 45 9**	**10**
MAINS-PLUGTRAB plug, can be snapped on base element	**PT 4-PE/S- 230AC-ST**	**28 82 46 2**	**10**
Zack strip, unprinted, 10-section, for marking with M-PEN or CMS system	**ZB 5: UNBEDRUCKT** **ZB 5,8: UNBEDRUCKT**	**10 50 00 4** **27 15 20 9**	**10** **10**
Zack strip printed horizontally, 10-section, with consecutive numbers	**ZB 5, LGS: FORTL.ZAHLEN** **ZB 5, LGS: 1-10 bis ...991-1000** **ZB 5,8, LGS: FORTL.ZAHLEN** **ZB 5,8, LGS: 1-10 bis ...991-1000**	**10 50 01 7** **27 15 21 2**	**10** **10**
Special printing zack strip, 10-section, divisible marking according to customer requirements	**ZB 5: SO/CMS...[1])** **ZB 5,8: SO/CMS...[1])**	**10 50 29 5** **10 50 30 5**	**1** **1**

Technical data

IEC category/VDE requirement class:		III / D / T3
Nominal voltage U_N:	L-N / L-L	230 V AC / 400 V AC
Arrester rated voltage U_C:	L-N / N-PE	335 V AC / 255 V AC
Nominal current I_N: [A]		26 A/30°C
Operating current I_C at U_C (L-N):		≤ 30 µA
Nominal discharge surge current I_n (8/20) µs:	L-N / N-PE	1.5 kA / 10 kA
Max. discharge surge current I_{max} (8/20) µs:	L-N / N-PE	4.5 kA / 10 kA
Protection level:	L-N / L-PE;N-PE	≤ 1.2 kV/≤ 1.5 kV
Response time t_a:	L-N / L-PE;N-PE	≤ 25 ns / ≤ 100 ns
Max. required back-up fuse:		25 A (gL/G)
Temperature range:		– 40°C bis + 85°C
Protection type in acc. with IEC 60 529/ EN 60 529:		IP 20
Insulation housing:		PA
Inflammability class in acc. with UL 94:		V0
Stripping length:		8 mm
Thread / Torque:		M3/0.8 Nm
Connection data: [mm²]	solid / stranded / AWG	0.2 mm²-4 mm²/ 0.2 mm²-2.5 mm²/ 24-12
Test standards:		IEC 61643-1, DIN EN 61643-11

[1]) Please specify desired marking when ordering



MNR: 5125113-03 / 03.03.06 Printed in Germany © PHOENIX CONTACT 2006

Pluggable Surge Voltage Protection Cascade
MCR-PLUGTRAB PT

PLUGTRAB PT is a surge voltage arrester. It limits transient surge voltages to values that are below the dielectric strength of the device to be protected. In this way, the device is protected from damage. The system function is retained.

PLUGTRAB PT 2x1... protects 2 signal cores with a common reference potential / ground potential. In combination with base element **PT 2x1-BE,** systems with grounded reference potential at the point of installation are protected.

Systems with ungrounded reference potential at the point of installation are protected in combination with base element **PT 2x1+F-BE**. In this base element, the connection between the reference potential (terminal blocks 9-10) and the base point potential (terminal blocks 3-4) as well as the grounded mounting rail is established via a gas-filled surge arrester.

PLUGTRAB PT 1x2... protects a pair of signal cores ungrounded at the point of installation. In combination with base element **PT 1x2-BE,** the feed-through path (terminal blocks 9-10) is grounded directly, in combination with base element **PT 1x2+F-BE** via a gas-filled surge arrester.

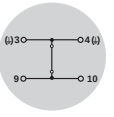
In this way, a cable screen on the base element, for example, can be grounded directly or indirectly.

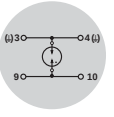
The PLUGTRAB PT surge voltage arrester has a two-piece construction. All the incoming and outgoing conductors are connected to the **base element**. The decoupling elements of the protective circuit are installed in the base element. The contact to protective earth is made by snapping the metal foot onto the metal mounting rail.

The protection elements are integrated in the **protective plug**. This plug can be unplugged or plugged without influencing the signal circuits. The plug can be tested with the CHECKMASTER.



Note:





If the PT 2x2-BE, PT 4x1-BE and PT 4-BE base elements are used, connections 9/10 (GND) are connected directly above the metal mounting foot with the mounting rail, and thus with the local ground potential. In base element PT...+F-BE, connections 9/10 (GND) are linked to the mounting foot via a gas-filled surge arrester.

CHECKMASTER

Note

Products bearing this stamp (plug elements) can all be tested with the CHECKMASTER.

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MCR-PLUGTRAB PT 2x1

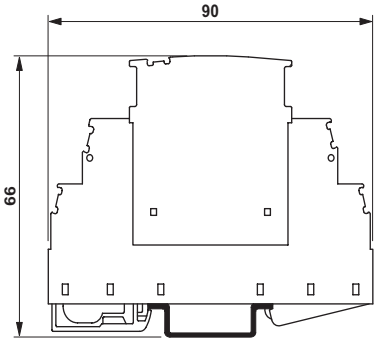
Protection for two signal wires with common reference potential

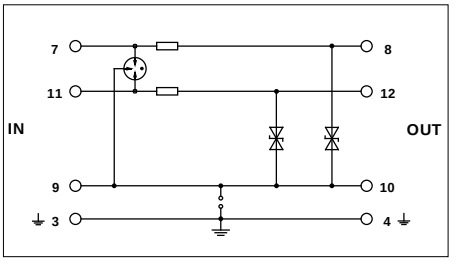


Technical data

		Type	Order No.	Pcs. Pkt.
MCR-PLUGTRAB plug,	5 V DC	**PT 2x1-5DC-ST**	**28 56 06 1**	**10**
	12 V DC	**PT 2x1-12DC-ST**	**28 56 07 4**	**10**
	24 V DC	**PT 2x1-24DC-ST**	**28 56 08 7**	**10**
MCR-PLUGTRAB plug,	12 V AC	**PT 2x1-12AC-ST**	**28 56 09 0**	**10**
	24 V AC	**PT 2x1-24AC-ST**	**28 56 10 0**	**10**
MCR-PLUGTRAB base element, for mounting on ⊓, with **bridge** between connections 3/4 (⏚) and 9/10		**PT 2x1-BE**	**28 56 13 9**	**10**
MCR-PLUGTRAB base element, for mounting on ⊓, with **gas-filled surge arrester** between connections 3/4 (⏚) and 9/10		**PT 2x1+F-BE**	**28 56 14 2**	**10**
Zack strip, 10-section, white, unprinted		**ZB 5: UNPRINTED**	**10 50 00 4**	**10**
		ZB 5,8: UNPRINTED	**27 15 20 9**	**10**

Technical data		**5 DC**	**12 DC**	**12 AC**	**24 DC**	**24 AC**
IEC category/VDE requirement class:		C1, C2, C3, D1				
Arrester rated voltage (highest cont. operating voltage) U_C: DC/AC		6 V/4 V	13 V/9 V	18 V/13 V	28 V/20 V	40 V/28 V
Lightning test current (10/350)µs:	pro Pfad	2.5 kA	2.5 kA	2.5 kA	2.5 kA	2.5 kA
Nominal current I_N at 40 °C:		300 mA	300 mA	300 mA	300 mA	300 mA
Nominal discharge surge current I_n (8/20)µs:	Core-⏚	10 kA	10 kA	10 kA	10 kA	10 kA
Residual surge current (8/20)µs:	Core-⏚	20 kA	20 kA	20 kA	20 kA	20 kA
Output voltage limitation at 1 kV/µs:	Core-⏚	≤ 10 V	≤ 18 V	≤ 25 V	≤ 40 V	≤ 55 V
Residual voltage at I_n:	Core-⏚	≤ 10 V	≤ 18 V	≤ 25 V	≤ 40 V	≤ 55 V
Response time t_a:	Core-⏚	≤ 1 ns	≤ 1 ns	≤ 1 ns	≤ 1 ns	≤ 1 ns
Resistance per path:	7-8; 11-12	4.7 Ω	4.7 Ω	4.7 Ω	4.7 Ω	4.7 Ω
Temperature range:		– 40 °C bis + 85 °C				
Inflammability class in acc. with UL:		V0				
Protection type in acc. with IEC 60 529/EN 60 529:		IP 20				
Test standards:		IEC 61643-21:2000-09, E VDE 0845 T.3-1:1999-07				
Insulation housing:		PA 6.6				
Stripping length:		8 mm				
Thread / Torque:		M3/0,5 Nm				
Connection data:	solid / stranded / AWG	0.2-4 mm² / 0.2-2.5 mm² / 24-12				
Housing width:		17.5 mm				





MCR-PLUGTRAB PT 1x2

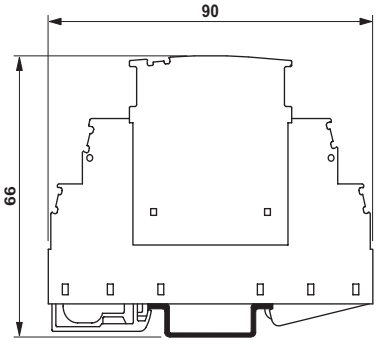
Protection for two ungrounded signal lines

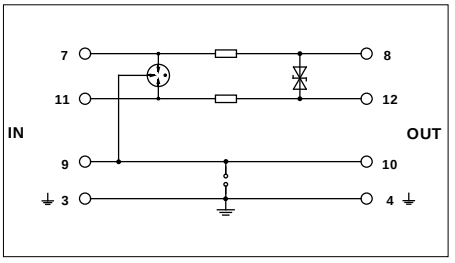


Technical data

Type	Order No.	Pcs. Pkt.
MCR-PLUGTRAB plug, 5 V DC	**PT 1x2-5DC-ST**	**28 56 01 6**	**10**
12 V DC	**PT 1x2-12DC-ST**	**28 56 02 9**	**10**
24 V DC	**PT 1x2-24DC-ST**	**28 56 03 2**	**10**
MCR-PLUGTRAB plug, 12 V AC	**PT 1x2-12AC-ST**	**28 56 04 5**	**10**
24 V AC	**PT 1x2-24AC-ST**	**28 56 05 8**	**10**
MCR-PLUGTRAB base element, for mounting on ⊓, with **bridge** between connections 3/4 (⏚) and 9/10	**PT 1x2-BE**	**28 56 11 3**	**10**
MCR-PLUGTRAB base element, for mounting on ⊓, with **gas-filled surge arrester** between connections 3/4 (⏚) and 9/10	**PT 1x2+F-BE**	**28 56 12 6**	**10**
Zack strip, 10-section, white, unprinted	**ZB 5: UNPRINTED**	**10 50 00 4**	**10**
	ZB 5,8: UNPRINTED	**27 15 20 9**	**10**

Technical data		**5 DC**	**12 DC**	**12 AC**	**24 DC**	**24 AC**
IEC category/VDE requirement class:		C1, C2, C3, D1				
Arrester rated voltage (highest cont. operating voltage) U_C:	DC/AC	6 V/4 V	13 V/9 V	18 V/13 V	28 V/20 V	40 V/28 V
Lightning test current (10/350)µs:	pro Pfad	2.5 kA	2.5 kA	2.5 kA	2.5 kA	2.5 kA
Nominal current I_N at 40 °C:		450 mA	450 mA	450 mA	450 mA	450 mA
Nominal discharge surge current I_n (8/20)µs:	Core-Core/Core-⏚	10 kA/10 kA				
Residual surge current (8/20)µs:	Core-⏚	20 kA	20 kA	20 kA	20 kA	20 kA
Output voltage limitation at 1 kV/µs:	Core-Core	≤ 10 V	≤ 18 V	≤ 25 V	≤ 40 V	≤ 55 V
	Core-⏚	≤ 450 V	≤ 450 V	≤ 450 V	≤ 450 V	≤ 450 V
Residual voltage at I_n:	Core-Core	≤ 10 V	≤ 18 V	≤ 25 V	≤ 40 V	≤ 55 V
	Core-⏚	≤ 450 V	≤ 450 V	≤ 450 V	≤ 450 V	≤ 450 V
Response time t_a:	Core-⏚	≤ 1 ns/≤ 100 ns				
Resistance per path:	7-8; 11-12	2.2 Ω				
Temperature range:		– 40 °C bis + 85 °C				
Inflammability class in acc. with UL:		V0				
Protection type in acc. with IEC 60 529/EN 60 529:		IP 20				
Test standards:		IEC 61643-21:2000-09, E VDE 0845 T.3-1:1999-07				
Insulation housing:		PA 6.6				
Stripping length:		8 mm				
Thread / Torque:		M3/0,5 Nm				
Connection data:	solid / stranded / AWG	0.2-4 mm² / 0.2-2.5 mm² / 24-12				
Housing width:		17.5 mm				





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MNR: 5099964-03/03.03.2006

Extract from the online catalog

S-PT1-2PE-24DC

Order No.: 2818122



http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=2818122

Screw on module for conduit systems, with two conductor protection for a 2-core floating signal circuit. Design: 24 V DC

Commercial data	
EAN	4017918148355
Pack	1 pcs.
Customs tariff	85363010
Weight/Piece	0.3308 KG
Catalog page information	Page 55 (TT-2002)

Product notes

WEEE/RoHS-compliant since: 06/29/2006

http://www.download.phoenixcontact.com
Please note that the data given here has been taken from the online catalog. For comprehensive information and data, please refer to the user documentation. The General Terms and Conditions of Use apply to Internet downloads.

Technical data

General

Color	silver
Standards for air and creepage distances	VDE 0110-1
	IEC 60664-1
Total surge current (8/20) µs	20 kA
Ambient temperature (operation)	-40 °C ... 80 °C

Mounting type	Connection-specific intermediate plugging
Design	Screw-in module
Number of positions	3
Degree of protection	IP40
Direction of action	Line-Line & Line-Earth Ground
Width	33.00 mm
Height	120.00 mm
Length	33.00 mm

Protective circuit

IEC category	C1
	C2
	C3
	D1
Nominal voltage U_N	24 V DC
Max. operating voltage U_{max}	28 V DC
Arrester rated voltage U_C	28 V DC
	20 V AC
Arrester rated voltage U_C (Core-Core)	28 V DC
	20 V AC
Nominal current I_N	250 mA (25°C)
Operating effective current I_C at U_C	≤ 5 µA
Discharge current to PE at U_C	≤ 2 µA
Nominal discharge surge current In (8/20) µs (Core-Core)	10 kA
Nominal discharge surge current I_n (8/20) µs (Core-Earth)	10 kA
Total surge current (8/20) µs	20 kA
Max. discharge surge current Imax (8/20) µs maximum (Core-Core)	10 kA
Max. discharge surge current Imax (8/20) µs maximum (Core-Earth)	10 kA
Nominal pulse current Ian (10/1000) µs (Core-Core)	180 A
Nominal pulse current Ian (10/1000) µs (Core-Earth)	180 A
Output voltage limitation at 1 kV/µs (Core-Core) spike	≤ 60 V

Output voltage limitation at 1 kV/µs (Core-Earth) spike	≤ 450 V
Output voltage limitation at 1 kV/µs (Core-Core) static	≤ 60 V
Residual voltage at I_n, (conductor-conductor)	≤ 40 V
Residual voltage at In, (conductor-ground)	≤ 60 V
Residual voltage with Ian (10/1000)µs (conductor-conductor)	≤ 25 V
Residual voltage with Ian (10/1000)µs (conductor-ground)	≤ 20 V
Protection level U_P (Core-Core)	≤ 55 V
Protection level U_P (Core-Earth)	≤ 550 V
Response time tA (Core-Core)	≤ 1 ns
Response time tA (Core-Earth)	≤ 100 ns
Input attenuation aE, sym.	≤ 1.6 dB (up to 500 kHz, 50 Ω system)
	≤ 0.6 dB (up to 200 kHz, 150 Ω system)
	≤ 0.2 dB (up to 50 kHz, 600 Ω system)
Cut-off frequency fg (3 dB), sym. in 50 Ohm system	Typ. 3.5 MHz
Cut-off frequency fg (3 dB), sym. in 150 Ohm system	Typ. 1.5 MHz
Cut-off frequency fg (3 dB), sym. in 600 Ohm system	Typ. 400 kHz
Capacity (Core-Core)	Typ. 1.5 nF
Resistance in series	10 Ω 5%
Surge carrying capacity in acc. with IEC 61643-21 (Core-Core)	C2 (10 kV/5 kA)
Surge carrying capacity in acc. with IEC 61643-21 (Core-Earth)	C2 (10 kV/5 kA)
	D1 (2.5 kA)
Alternating current carrying capacity in acc. with IEC 61643-21 (Core-Earth)	5 A - 1 s

Connection data

Connection type IN	Screw terminal blocks
Connection type OUT	Screw terminal blocks
Conductor cross section stranded min.	0.14 mm²
Conductor cross section stranded max.	1.5 mm²
Conductor cross section solid min.	0.14 mm²
Conductor cross section solid max.	1.5 mm²

Conductor cross section AWG/kcmil min.	26
Conductor cross section AWG/kcmil max	16

Connection, protective circuit

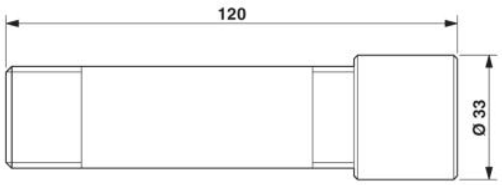
Standards/regulations	IEC 61643-21

Certificates / Approvals

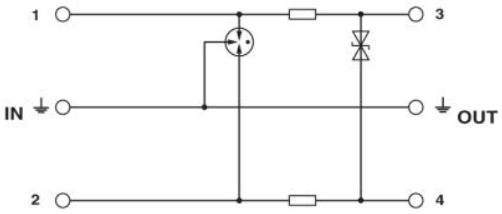
Certification	GOST, UL
Certification Ex:	CUL-EX LIS, UL-EX LIS

Drawings

Dimensioned drawing



Circuit diagram



Approbationslogos (EX-Bereich)





Address

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KRÜGER

SECTION 4.11

BLOWER LOCAL CONTROL PANELS

VEOLIA WATER
Solutions & Technologies

MASSILLON, OH

KRUGER PROJECT 5700235402

IFAS AIR SPARGE BLOWER LOCAL CONTROL PANEL

BILL OF MATERIAL

Typical of 2

	Qty	Panel Tag	Part Number	Description	Manufacturer
	1		SCE-30XEL2510SSLP	TYPE 4X FLANGE MOUNTED SS ENCLOSURE (30"H x 25"W x 10"D)	SAGINAW
	1		SCE-30P24	BACKPANEL (27"H x 21"W)	SAGINAW
	8	MTB	30 44 16 0	UT 10 - FEED-THROUGH TERMINAL BLOCKS	PHOENIX CONTACT
	10	H1, N	30 44 10 2	UT 4 - CONTROL TERMINAL BLOCK	PHOENIX CONTACT
	16	TB1	30 44 81 4	UTTB 4 DOUBLE LEVEL TERMINAL BLOCK	PHOENIX CONTACT
	3	MTB, H1, N	30 47 02 8	D-UT 2,5/10 - END COVER	PHOENIX CONTACT
	16	TB1	30 47 29 3	D-UTTB 2,5/4 - END COVER	PHOENIX CONTACT
	AR		08 00 88 6	E/UK - END STOP	PHOENIX CONTACT
	AR	H1, N, TB1	30 30 34 9	FBS 5-6, PLUG-IN BRIDGE	PHOENIX CONTACT
	1	GROUND BAR	PK12GTA	12-POINT GROUND BAR	SQUARE D
	1	DS1	GS2GEU3N	FUSED DISCONNECT, 60A, 3-POLE, CLASS J	SQUARE D
	1	DS1	GS2AH420	DISCONNECT HANDLE, NEMA 4X, RED/YELLOW	SQUARE D
	1	DS1	GS2AE21	DISCONNECT SHAFT, MAX. LENGTH 15.7"	SQUARE D
	3	F1,F2,F3	LPJ40SP	40A CLASS J FUSES (DISCONNECT)	BUSSMANN
	1	M1	LUB32	SELF-PROTECTED MOTOR STARTER BASE, 460VAC, 20HP	SQUARE D
	1	M1	LUCA32FU	CONTROL UNIT, 460VAC, 8-32A	SQUARE D
	1	M1	LUA1C11	AUXILLARY CONTACT BLOCK, 1NO/1NC	SQUARE D
	1	M1	LU9SP0	LINE PHASE BARRIER FOR UL508E	SQUARE D
	1	T1	9070 T500 D1	480/120VAC 500VA TRANSFORMER W/ FUSEBLOCK	SQUARE D
	1	FB-T1	BC6032PQ	600V CLASS CC FUSEHOLDER	BUSSMANN
	2	FB-T1	SAMI-7N	FUSE COVER	BUSSMANN
	2	F4, F5	FNQ-R-3	3A CLASS CC FUSES, TIME DELAY, REJECTION TYPE	BUSSMANN
	1	MCB1	1489-A1C070	7A CIRCUIT BREAKER	ALLEN-BRADLEY
	1	SS-1	9001 SKS43BH2	SELECTOR SWITCH, 3 POSITION, NON-ILL. MAN. RETUREN	SQUARE D
	2	CR1,2	RXM2AB1F7	RELAY, DPDT, 10A CONTACT, 120VAC COIL	SQUARE D
	2	CR1,2	RXZE2M114	RELAY BASE, 10A 120VAC	SQUARE D
	1	PL-1	9001 SKP1R31	PILOT LIGHT, RED, 120VAC	SQUARE D
	1	PL-2	9001 SKP1A31	PILOT LIGHT, AMBER, 120 VAC	SQUARE D
	LOT	MISC	AS REQUIRED	MISC. (WIRE, CABLE, WIRE DUCT, DIN RAIL, TERMINAL MARKERS, LEGENDS, NAMEPLATES, ETC.)	

Saginaw Control & Engineering
95 Midland Road
Saginaw, MI 48638-5770
Phone: (800)234-6871
Fax: (989)799-4524
http://www.saginawcontrol.com

Part Information - SCE-30XEL2510SSLP

SCE-30XEL2510SSLP

Application -

Designed to house electrical and electronic controls, instruments and components in areas which may be regularly hosed down or are in very wet conditions. Designed to house most standard type disconnects. Provides protection from dust, dirt, oil, and water. For outdoor application a drip shield is recommended.

Construction -

- **0.075" stainless steel Type 304.**
- **Seams continuously welded and ground smooth.**
- **Flange trough collar around all sides of door opening.**
- **Oil-resistant Gasket.**
- **Collar studs provided for mounting optional panels.**
- **Holes provided in body for mounting disconnect operating handle and operating mechanism.**
- **Stainless steel concealed hinge.**
- **Doors are interchangeable and easily removed by pulling hinge pin.**
- **3-point latching mechanism.**
- **Latches are opened or closed with screwdriver (optional tamper-resistant inserts available).**
- **Mounting holes in back of enclosure.**
- **Mounting hardware, sealing washer and hole plug included.**
- **Ground studs on door and body.**
- **Black zinc die cast coinproof/padlocking handle.**

Finish -

#4 brushed finish on all exterior surfaces. Optional sub-panels are powder coated white.

Industry Standards - (IS6)

NEMA Type 3R, 4, 4X, 12 and Type 13
UL Listed Type 3R, 4, 4X and 12
CSA Type 4, 4X and 12
IEC 60529 IP 66

Notes -

Disconnect switch (or circuit breaker) and operating mechanism are not furnished with this enclosure.

Special Instructions apply for IS3, IS4 and IS6 to maintain the environmental rating of Type 3R for these parts. Instructions are located on the enclosure door. Drip shield is required on IS3, drip shield is recommended on IS4 and

Product Specifications -

Part Number:
SCE-30XEL2510SSLP
Description: S.S. XEL Enclosure
Height: 30.00"
Width: 25.38"
Depth: 10.00"
Price Code: S5
List Price: $1,375.82
Catalog Page: 230
Est. Ship Weight: 70.00 lbs



Download CAD Package
Add to Bill of Material

Optional Accessories -

SCE-30P24 - Subpanel, Bent
SCE-BV4XKIT - Kit, Breather Vent
SCE-DF30EL24LP - Panel, Dead Front (Wall Mount)
SCE-DS24SS - Shield, S.S. Drip
SCE-DV4XKIT - Kit, Drain Vent
SCE-ELSP3 - KIT, Swing-Out Panel (20 High & Up)

Similar Part Numbers -

SCE-20XEL2108SSLP - S.S. XEL Enclosure
SCE-24XEL2108SSLP - S.S. XEL Enclosure
SCE-24XEL2508SSLP - S.S. XEL Enclosure
SCE-24XEL2510SSLP - S.S. XEL Enclosure
SCE-30XEL2508SSLP - S.S. XEL Enclosure
SCE-36XEL2508SSLP - S.S. XEL Enclosure
SCE-36XEL3110SSLP - S.S. XEL Enclosure
SCE-36XEL3112SSLP - S.S. XEL Enclosure
SCE-42XEL3110SSLP - S.S. XEL Enclosure
SCE-42XEL3112SSLP - S.S. XEL Enclosure

Installation Information -

Mechanical Defeater (Variable Depth)
Mechanical Defeater (Cable Operated)
Cutler-Hammer Flange Mounted, Disconnects and Circuit Breakers
Allen-Bradley Flange Mounted, Disconnects and Circuit Breakers
Bussmann Flange Mounted, Disconnects and Circuit Breakers
ABB Flange Mounted, Disconnects and Circuit Breakers
GE Flange Mounted, Disconnects and Circuit Breakers
Gould Flange Mounted, Disconnects and Circuit Breakers
Moller Flange Mounted, Disconnects and Circuit Breakers
Siemens Flange Mounted, Disconnects and Circuit Breakers
Square D Flange Mounted, Disconnects and Circuit Breakers
Mounting Foot Kit for Enviroline Enclosures
Drip Shield Kit Assembly
Drain/Vents
Dead Front Wall Mount Installation Instructions
Swing Panel Assembly for Enviroline Enclosures
Swing Panel ELSP for Encl. Height > 16
Sealing Washer Specifications

IS6. Drain holes are required on all.	

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(800)234-6871
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SCE@SaginawControl.com

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Phone: (800)234-6871
Fax: (989)799-4524
http://www.saginawcontrol.com

Part Information - SCE-30P24

SCE-30P24

Options -
Sub-plates can be special ordered in Stainless Steel or Galvanized material. Please consult a factory representative for assistance.

Finish -
Powder Coated White.

Industry Standards - (IS17)
NEMA Not Applicable
UL Not Applicable
CSA N/A

Product Specifications -
Part Number: SCE-30P24
Description: Subpanel, Bent
Height: 27.00"
Width: 21.00"
Depth: 0.88"
Price Code: P3
List Price: $63.29
Catalog Page: 308
Est. Ship Weight: 22.00 lbs
Edge Flanges: Four
Configuration: C



Download CAD Package
Add to Bill of Material

Similar Part Numbers -
SCE-20P20C - Subpanel, Flat
SCE-20P24C - Subpanel, Flat
SCE-20P30C - Subpanel, Flat
SCE-20P12 - Subpanel, Flat
SCE-20P16 - Subpanel, Flat
SCE-20P20 - Subpanel, Flat
SCE-24P16 - Subpanel, Bent
SCE-24P20 - Subpanel, Bent
SCE-24P24 - Subpanel, Bent
SCE-30P16 - Subpanel, Bent

Installation Information -
Sub-Plate Layout & Grounding for 3/8-16

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Saginaw, MI 48638-5770
(800)234-6871
Fax: (989)799-4524
SCE@SaginawControl.com

Extract from the online catalog

UT 10

Order No.: 3044160



http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=3044160

Feed-through modular terminal block, Connection method: Screw connection, Screw connection, Cross section: 0.5 mm² - 16 mm², AWG 20 - 6, Width: 10.2 mm, Color: gray, Mounting type: NS 35/7.5, NS 35/15

Product notes

WEEE/RoHS-compliant since: 01/01/2003

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Commercial data

GTIN (EAN)	4 017918 960445
sales group	A800
Pack	50 pcs.
Customs tariff	85369010
Catalog page information	Page 27 (CL1-2011)

Technical data

General

Number of levels	1
Number of connections	2
Color	gray

Insulating material	PA
Inflammability class acc. to UL 94	V0

Dimensions

Width	10.2 mm
Length	47.7 mm
Height NS 35/7.5	47.5 mm
Height NS 35/15	55 mm

Technical data

Maximum load current	76 A (with 16 mm^2 conductor cross section)
Rated surge voltage	8 kV
Pollution degree	3
Surge voltage category	III
Insulating material group	I
Connection in acc. with standard	IEC 60947-7-1
Nominal current I_N	57 A
Nominal voltage U_N	1000 V
Open side panel	ja

Connection data

Note	Note: Product releases, connection cross sections and notes on connecting aluminum cables can be found in the download area.
Conductor cross section solid min.	0.5 mm²
Conductor cross section solid max.	16 mm²
Conductor cross section stranded min.	0.5 mm²
Conductor cross section stranded max.	16 mm²
Conductor cross section AWG/kcmil min.	20
Conductor cross section AWG/kcmil max	6
Conductor cross section stranded, with ferrule without plastic sleeve min.	0.5 mm²
Conductor cross section stranded, with ferrule without plastic sleeve max.	10 mm²
Conductor cross section stranded, with ferrule with plastic sleeve min.	0.5 mm²
Conductor cross section stranded, with ferrule with plastic sleeve max.	10 mm²
2 conductors with same cross section, solid min.	0.5 mm²
2 conductors with same cross section, solid max.	4 mm²

2 conductors with same cross section, stranded min.	0.5 mm²
2 conductors with same cross section, stranded max.	4 mm²
2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, min.	0.5 mm²
2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, max.	6 mm²
2 conductors with same cross section, stranded, ferrules without plastic sleeve, min.	0.5 mm²
2 conductors with same cross section, stranded, ferrules without plastic sleeve, max.	2.5 mm²
Connection method	Screw connection
Stripping length	10 mm
Internal cylindrical gage	A6
Screw thread	M4
Tightening torque, min	1.5 Nm
Tightening torque max	1.8 Nm

Certificates / Approvals

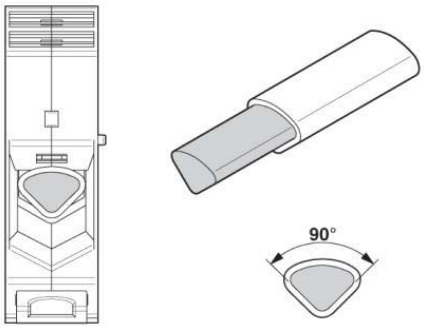
Certification	CB, CSA, CUL, DNV, GL, LR, UL, VDE-PZI
Certification Ex:	IECEx, KEMA-EX

Diagrams/Drawings

Circuit diagram



Schematic diagram



Connecting aluminum cables. Further notes can be found in the download area

Address

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586 Fulling Mill Road
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Extract from the online catalog

D-UT 2,5/10

Order No. 3047028



http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=3047028

End cover, Length: 47.7 mm, Width: 2.2 mm, Height: 48.4 mm, Color: gray

Commercial data	
GTIN (EAN)	4 017918 960346
sales group	A892
Pack	50 pcs.
Customs tariff	85389099
Catalog page information	Page 26 (CL1-2011)

Product notes

WEEE/RoHS-compliant since: 01/01/2003

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Extract from the online catalog

UT 4

Order No.: 3044102



http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=3044102

Feed-through modular terminal block, Connection method: Screw connection, Screw connection, Cross section: 0.14 mm² - 6 mm², AWG 26 - 10, Width: 6.2 mm, Color: gray, Mounting type: NS 35/7.5, NS 35/15

Product notes

WEEE/RoHS-compliant since: 01/01/2003

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Commercial data

GTIN (EAN)	4 017918 960391
sales group	A800
Pack	50 pcs.
Customs tariff	85369010
Catalog page information	Page 27 (CL1-2011)

Technical data

General

Number of levels	1
Number of connections	2
Color	gray

Insulating material	PA
Inflammability class acc. to UL 94	V0

Dimensions

Width	6.2 mm
Length	47.7 mm
Height NS 35/7.5	47.5 mm
Height NS 35/15	55 mm

Technical data

Maximum load current	41 A (with 6 mm^2 conductor cross section)
Rated surge voltage	8 kV
Pollution degree	3
Surge voltage category	III
Insulating material group	I
Connection in acc. with standard	IEC 60947-7-1
Nominal current I_N	32 A (with 4 mm² conductor cross section)
Nominal voltage U_N	1000 V
Open side panel	ja

Connection data

Note	Note: Product releases, connection cross sections and notes on connecting aluminum cables can be found in the download area.
Conductor cross section solid min.	0.14 mm²
Conductor cross section solid max.	6 mm²
Conductor cross section stranded min.	0.14 mm²
Conductor cross section stranded max.	6 mm²
Conductor cross section AWG/kcmil min.	26
Conductor cross section AWG/kcmil max	10
Conductor cross section stranded, with ferrule without plastic sleeve min.	0.14 mm²
Conductor cross section stranded, with ferrule without plastic sleeve max.	4 mm²
Conductor cross section stranded, with ferrule with plastic sleeve min.	0.14 mm²
Conductor cross section stranded, with ferrule with plastic sleeve max.	4 mm²
2 conductors with same cross section, solid min.	0.14 mm²
2 conductors with same cross section, solid max.	1.5 mm²

2 conductors with same cross section, stranded min.	0.14 mm²
2 conductors with same cross section, stranded max.	1.5 mm²
2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, min.	0.5 mm²
2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, max.	2.5 mm²
2 conductors with same cross section, stranded, ferrules without plastic sleeve, min.	0.14 mm²
2 conductors with same cross section, stranded, ferrules without plastic sleeve, max.	1.5 mm²
Connection method	Screw connection
Stripping length	9 mm
Internal cylindrical gage	A4
Screw thread	M3
Tightening torque, min	0.6 Nm
Tightening torque max	0.8 Nm

Certificates / Approvals

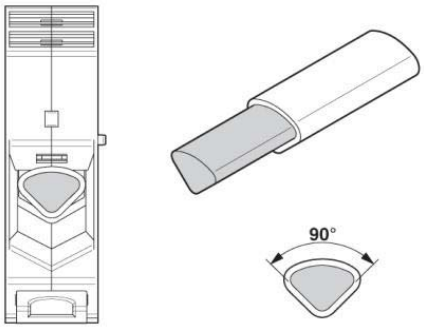
Certification	CB, CSA, CUL, DNV, GL, LR, UL, VDE-PZI
Certification Ex:	IECEx, KEMA-EX

Diagrams/Drawings

Circuit diagram



Schematic diagram



Connecting aluminum cables. Further notes can be found in the download area

Address

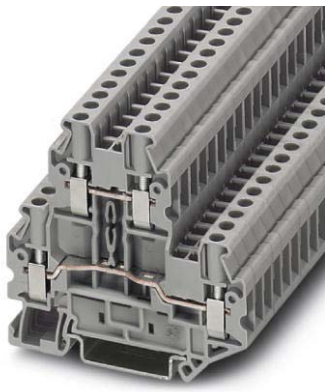
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UTTB 4

Order No.: 3044814



http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=3044814

Double-level terminal block with a screw connection, cross section: 0.14 mm² - 6 mm², AWG: 26 - 10, width: 6.2 mm, color: Gray

Product notes

WEEE/RoHS-compliant since: 08/17/2005

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Commercial data

GTIN (EAN)	4 046356 055512
sales group	A832
Pack	50 pcs.
Customs tariff	85369010
Catalog page information	Page 43 (CL1-2011)

Technical data

General

Number of levels	2
Number of connections	4
Color	gray

Insulating material	PA
Inflammability class acc. to UL 94	V0

Dimensions

Width	6.2 mm
Length	69.9 mm
Height NS 35/7.5	65 mm
Height NS 35/15	72.5 mm

Technical data

Rated surge voltage	8 kV
Pollution degree	3
Surge voltage category	III
Insulating material group	I
Connection in acc. with standard	IEC 60947-7-1
Nominal current I_N	30 A
Nominal voltage U_N	800 V

Connection data

Conductor cross section solid min.	0.14 mm²
Conductor cross section solid max.	6 mm²
Conductor cross section stranded min.	0.14 mm²
Conductor cross section stranded max.	6 mm²
Conductor cross section AWG/kcmil min.	26
Conductor cross section AWG/kcmil max	10
Conductor cross section stranded, with ferrule without plastic sleeve min.	0.14 mm²
Conductor cross section stranded, with ferrule without plastic sleeve max.	4 mm²
Conductor cross section stranded, with ferrule with plastic sleeve min.	0.14 mm²
Conductor cross section stranded, with ferrule with plastic sleeve max.	4 mm²
2 conductors with same cross section, solid min.	0.14 mm²
2 conductors with same cross section, solid max.	1.5 mm²
2 conductors with same cross section, stranded min.	0.14 mm²
2 conductors with same cross section, stranded max.	1.5 mm²

2 conductors with same cross section, stranded, ferrules without plastic sleeve, min.	0.14 mm²
2 conductors with same cross section, stranded, ferrules without plastic sleeve, max.	1.5 mm²
2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, min.	0.5 mm²
2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, max.	2.5 mm²
Connection method	Screw connection
Stripping length	9 mm
Internal cylindrical gage	A4
Screw thread	M3
Tightening torque, min	0.6 Nm
Tightening torque max	0.8 Nm

Certificates / Approvals

Certification	CSA, CUL, GL, UL
Certification Ex:	IECEx, KEMA-EX

Diagrams/Drawings

Circuit diagram





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D-UTTB 2,5/4

Order No.: 3047293



http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=3047293

End cover, Length: 69.9 mm, Width: 2.2 mm, Height: 57.5 mm, Color: gray

Commercial data	
GTIN (EAN)	4 017918 997267
sales group	A892
Pack	50 pcs.
Customs tariff	85389099
Catalog page information	Page 42 (CL1-2011)

Product notes

WEEE/RoHS-compliant since: 01/18/2005

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E/NS 35 N

Order No.: 0800886



http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=0800886

End clamp, width: 9.5 mm, color: gray

Commercial data	
GTIN (EAN)	4 017918 129309
sales group	B220
Pack	50 pcs.
Customs tariff	39269097
Catalog page information	Page 345 (CL2-2011)

Product notes

WEEE/RoHS-compliant since: 02/01/2005

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Technical data

General data

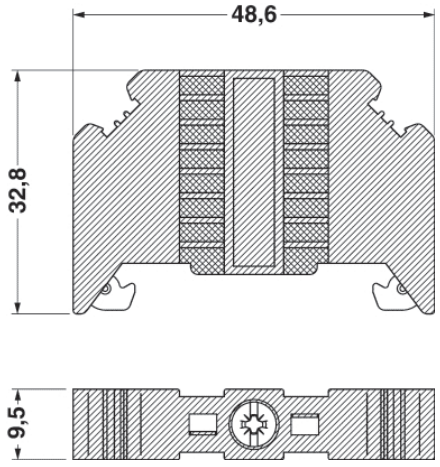
Height	32.8 mm
Length	48.6 mm
Width	9.5 mm
Material	PA
Color	gray

Accessories

Item	Designation	Description
Assembly		
0801762	NS 35/ 7,5 CU UNPERF 2000MM	DIN rail, material: Copper, unperforated, height 7.5 mm, width 35 mm, length: 2 m
0801733	NS 35/ 7,5 PERF 2000MM	DIN rail, material: steel galvanized and passivated with a thick layer, perforated, height 7.5 mm, width 35 mm, length: 2000 mm
0801681	NS 35/ 7,5 UNPERF 2000MM	DIN rail, material: Steel, unperforated, height 7.5 mm, width 35 mm, length: 2 m
1201756	NS 35/15 AL UNPERF 2000MM	DIN rail, deep drawn, high profile, unperforated, 1.5 mm thick, material: aluminum, height 15 mm, width 35 mm, length 2000 mm
1201895	NS 35/15 CU UNPERF 2000MM	DIN rail, material: Copper, unperforated, 1.5 mm thick, height 15 mm, width 35 mm, length: 2 m
1201730	NS 35/15 PERF 2000MM	DIN rail, material: steel galvanized and passivated with a thick layer, perforated, height 15 mm, width 35 mm, length: 2000 mm
1201714	NS 35/15 UNPERF 2000MM	DIN rail, material: Steel, unperforated, height 15 mm, width 35 mm, length: 2 m
1201798	NS 35/15-2,3 UNPERF 2000MM	DIN rail, material: Steel, unperforated, 2.3 mm thick, height 15 mm, width 35 mm, length: 2 m
Marking		
1007235	SBS 8:UNBEDRUCKT	Marker cards for modular terminal blocks, color: white
1050512	ZB 8:SO/CMS	Zack strip, 10-section, divisible, special printing, marking according to customer requirements

Diagrams/Drawings

Dimensioned drawing



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Extract from the online catalog

FBS 5-6

Order No.: 3030349



http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=3030349

Plug-in bridge, Number of positions: 5, Color: red

Commercial data	
GTIN (EAN)	4 017918 188801
sales group	A690
Pack	50 pcs.
Customs tariff	85389099
Catalog page information	Page 390 (CL1-2011)

Product notes

WEEE/RoHS-compliant since: 01/01/2003

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Product Data Sheet

PK12GTA

LOAD CENTER EQUIPMENT GROUND BAR ASSY



SQUARE D by Schneider Electric

Availability **Stock Item: This item is normally stocked in our distribution facility.**

Technical Characteristics

Application	Load Centers
Circuit Breaker Type	PK
Marketing Trade Name	QO and Homeline

Shipping and Ordering

Category	00102 - Load Centers, Accessories, Type QO
Discount Schedule	DE3A
GTIN	00785901026402
Package Quantity	10
Weight	0.14 lbs.
Availability Code	Stock Item: This item is normally stocked in our distribution facility.
Returnability	Y
Country of Origin	US

As standards, specifications, and designs change from time to time, please ask for confirmation of the information given in this document.

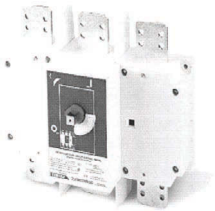
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Example of the parts to order to build a complete GS or LK switch:

Choose a Switch + **Shaft** + **Handle Assembly** + **Lugs if needed**



600 A, LK4SU3N



Shaft 320 mm, GS2AE6



Black Handle, GS2AH150



Lugs Kit, GS1AW503

Example:
LK4SU3N (600 A nonfusible switch, use 15x12 shaft) + **GS2AE6** (320 mm Type S shaft) + **GS2AH150** (black/ black, lockable)

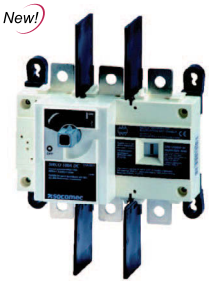
To add auxiliary contacts:
For front-mounted contacts order **LK4AD30N** (front-mounted auxiliary contact holder) + **GS2AM110**.

New!



30–100 A Compact

New!



100–400 A



GS2AH130



GS2AH150



GS2AH170

Table 8.28: LK Nonfusible IEC Style Disconnect Switches

Pole	Rating (A)	Catalog Number	$ Price	Maximum Horsepower Rating				Short Circuit Current Rating 600 Vac		Shaft Sty;e
				240 V	480 V	600 V	250 Vdc	Fuse	SCCR kA	
3	30	LK4DU3CN	**218.00**	10	20	30	—	J	100	AL
3	60	LK4GU3CN	**263.00**	20	40	50	—	J	100	AL
3	100	LK4JU3CN	**458.00**	20	50	50	N/A	J	100	AL
3	100	LK4JU3N	**458.00**	30	75	100	15	J	200	B
3	200	LK4MU3N	**1010.00**	75	150	200	15	J	200	B
3	400	LK4QU3N	**1910.00**	125	250	350	50	J	200	B
3	600	LK4SU3N	**2873.00**	200	400	350	50	J	200	D
3	800	LK4TU3N	**4301.00**	200	500	500	—	L	100	D
3	1000	LK4UU3N	**5372.00**	200	500	500	—	L	100	D
3	1200	LK4WU3N	**6450.00**	200	500	500	—	L	100	D

Table 8.29: Handles and Shafts for LK Switches

Rating (A)	Handle				Shaft: 12.6/320 in./mm		Shaft: 15.7/400 in./mm		Shaft Guide▲		Shaft Style
	Catalog No.	Type	Color	$ Price	Catalog No.	$ Price	Catalog Number	$ Price	Catalog Number	$ Price	
30–100	LK4AH110CN■	1, 3R, 12	Black	**62.00**	LK4AE12CN	**18.60**	—	—	LK4AEAH12CN	**15.50**	AL
30–100	LK4AH120CN■	1, 3R, 12	Red/Yellow	**62.00**							
30–100	LK4AH410CN■	4, 4X	Black	**70.00**							
30–100	LK4AH420CN■	4, 4X	Red/Yellow	**70.00**							
100–400	GS2AH130	1, 3R, 12	Black	**70.00**	GS2AE2	**20.30**	GS2AE21	**25.00**	—	—	B
100–400	GS2AH140	1, 3R, 12	Red/Yellow	**70.00**							
100–400	GS2AH430	4, 4X	Black	**78.00**							
100–400	GS2AH440	4, 4X	Red/Yellow	**78.00**							
600	GS2AH150	4, 4X	Black	**263.00**	GS2AE6	**32.60**	GS2AE61	**40.40**	—	—	D
600	GS2AH160	4, 4X	Red/Yellow	**263.00**							
800–1200	GS2AH170	4, 4X	Black	**296.00**							
800–1200	GS2AH180	4, 4X	Red/Yellow	**296.00**							

▲ Optional on shafts for LK4DU3CN, LK4GU3CN and LK4JU3CN.
■ For use on switches ending with CN only.

Table 8.30: Auxiliary Contacts for LK Switches

Switch Amperes	Catalog Number	Description	$ Price
30–60	MDSAN11	Aux Contact 1 N.O. and 1 N.C.	**14.70**
30–60	MDSAN20	Aux Contact 2 N.O. and 2 N.C.	**27.50**
100–400	LK4AD10N	Aux Contact 1 N.O. and 1 N.C.	**14.70**
100–400	LK4AD20N	Aux Contact 2 N.O. and 2 N.C.	**14.70**
600–1200	LK4AD30N	Aux Contact Holder	**14.70**
600–1200	GS2AM110	Aux Contact 1 N.O.	**14.70**
600–1200	GS2AM101	Aux Contact 1 N.C.	**14.70**

Table 8.31: Terminal Shrouds for LK Switches

Switch Amperes	Catalog Number	Description	$ Price
30–60	LK4AP3CN	Shroud Top and Bottom, 3-Pole	**79.00**
100–200	LK4AP33TN	Shroud Top LK4, 3-Pole, 100/200 A	**101.00**
100–200	LK4AP33BN	Shroud Bottom LK4, 3-Pole, 100/200 A	**101.00**
400	LK4AP53TN	Shroud Top LK4, 3-Pole, 400 A	**140.00**
400	LK4AP53BN	Shroud Bottom LK4, 3-Pole, 400 A	**140.00**
600▲	LK4AP63N	Shroud Bottom LK4, 3-Pole, 600 A	**280.00**
800–1200▲	LK4AP83N	Shroud Bottom LK4, 3-Pole, 800–1200 A	**280.00**

▲ 600–1200 A standard with top shroud.

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New!



GS2GU3N

Table 8.32: GS Fusible IEC Style Disconnect Switches

Pole	Rating (A)	Catalog Number	$ Price	Maximum Horsepower Rating				Short Circuit Current Rating 600 Vac		Shaft Style
				240 V	480 V	600 V	250 Vdc	Fuse	SCCR kA	
3	30	GS1DDU3	**237.00**	7.5	15	20	5	CC	100	AG
3	30	GS1DU3	**260.00**	7.5	15	20	5	J	100	AG
3	30	GS2EEU3	**237.00**	7.5	15	20	5	CC	100	B
3	30	GS2EU3N	**260.00**	7.5	15	20	5	J	100	B
3	60	GS2GU3N	**336.00**	15	30	50	10	J	100	B
3	100	GS2JU3N	**536.00**	30	60	75	20	J	200	B
3	200	GS2MU3N	**1181.00**	60	125	150	40	J	200	B
3	400	GS2QU3N	**2252.00**	125	250	350	50	J	200	B
3	600	GS2SU3	**3378.00**	200	500	500	—	J	200	C
3	800	GS2TU3	**5061.00**	200	500	500	—	J	200	C



GS2AH110
Suggested for
30–60 A



GS2AH150



GS2AH130
100–400 A
Optional
30–60 A

Table 8.33: Handles and Shafts for GS Switches▲

Rating (A)	Handle				Shaft: 12.6 in. (320 mm)		Shaft: 15.7 in. (400 mm)		Shaft Guide		Shaft Style
	Catalog No.	Type	Color	$ Price	Catalog No.	$ Price	Catalog No.	$ Price	Catalog No.	$ Price	
30–60	GS2AH110	1, 3R, 12	Black	**62.00**	GS2AE8	**18.60**	GS2AE81	**22.30**	LKN4AEAH12C	**15.50**	AG
30–60	GS2AH120	1, 3R, 12	Red/Yellow	**62.00**							
30–60	GS2AH410	4, 4X	Black	**70.00**							
30–60	GS2AH420	4, 4X	Red/Yellow	**70.00**							
30–400	GS2AH130	1, 3R, 12	Black	**70.00**	GS2AE2	**20.30**	GS2AE21	**25.00**	—	—	B
30–400	GS2AH140	1, 3R, 12	Red/Yellow	**70.00**							
30–400	GS2AH430	4, 4X	Black	**78.00**							
30–400	GS2AH440	4, 4X	Red/Yellow	**78.00**							
600–800	GS2AH150	4, 4X	Black	**263.00**	GS2AE5	**32.60**	GS2AE51	**40.40**	—	—	C
600–800	GS2AH160	4, 4X	Red/Yellow	**263.00**							

▲ GS2AH100TO200–GS1 to GS2 Handle Adapter if using GS1 holes.

NOTE: *Hole adapter kit for GS1 to GS2 Handles: GS2AH100TO200* ***$17.43****.*

Table 8.34: Auxiliary Contacts for GS Switches▲

Switch Amperes	Catalog Number	Description	$ Price
30–800	GS1AM110	Aux Contact 1 N.O.	**14.70**
30–800	GS1AM101	Aux Contact 1 N.C.	**14.70**
30	GS1AD10	Aux Contact Holder	**46.70**

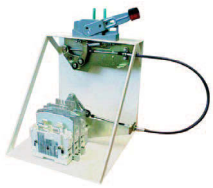
▲ GS1DU3 and GS1DDU3 switches allow up to 4 auxiliary contacts without adding contact holder GS1AD10. For more than 4 contacts, GS1AD10 is required.



Auxiliary Contacts
GS1AD10 + GS2AM110

Table 8.35: Shorting Links

For use on	Shorting Links per Kit	Catalog No.	$ Price
GS2, 60 A	3	GS1AU203	**29.60**
GS2, 100 A	3	GS1AU303	**41.90**
GS2, 200 A	3	GS1AU403	**62.10**
GS2, 400 A	3	GS1AU503	**93.00**
GS2, 600–800 A	3	GS1AU803	**156.00**



Flange Handle
Cable Operator Kit

Table 8.36: Terminal Shrouds for GS Switches, Line or Load▲

Switch Amperes	Catalog Number	Description	$ Price
30–100	—	Standard on product	—
200	GS2AP43	GS2, 3-Pole, 200 A	**101.00**
400	GS2AP53	GS2, 3-Pole, 400 A	**101.00**
600–800	GS2AP73	GS2, 3-Pole, 600–800 A	**140.00**

▲ Order one terminal shroud per side. For example, order one terminal shroud for *either* the line side *or* load side; order two terminal shrouds for *both* the line side *and* load side.



Shorting Links

Table 8.37: Flange Handle Cable Operator Kits for GS2 Switches▲

Catalog Number	Description	$ Price
GS2AH36F	Flange Handle and 36 in. Cable Operator Kit	**417.00**
GS2AH60F	Flange Handle and 60 in. Cable Operator Kit	**432.00**
GS2AH120F	Flange Handle and 120 in. Cable Operator Kit	**476.00**

▲ Compatible with 30 through 200 Amp switches (Not GS100430, GS1063).

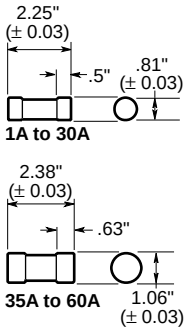
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LOW-PEAK®
Dual-Element Time-Delay Fuses
Class J – 600 Volt

LPJ
1-60 Amps



Dimensional Data



Catalog Symbol: LPJ-_SP
Dual-Element, Time-Delay – 10 seconds (minimum) at 500% rated current
Current-Limiting
Ampere Rating: 1 to 60A
Voltage Rating: 600Vac (or less)
300Vdc (or less)
Interrupting Rating: 300,000A RMS Sym. (UL)
100,000A dc
Agency Information:
UL Listed — Special Purpose*, Guide JFHR, File E56412
CSA Certified, 200,000 AIR, Class J per CSA 22.2 No. 248.8 Class 1422-02, File 53787

*Meets all performance requirements of UL Standard 248-8 for Class J fuses.

Catalog Symbol and Ampere Ratings

LPJ-1SP	LPJ-3SP	LPJ-7SP	LPJ-25SP
LPJ-1¼SP	LPJ-3-⁹⁄₁₀SP	LPJ-8SP	LPJ-30SP
LPJ-1-⁶⁄₁₀SP	LPJ-3½SP	LPJ-9SP	LPJ-35SP
LPJ-1-⁸⁄₁₀SP	LPJ-4SP	LPJ-10SP	LPJ-40SP
LPJ-2SP	LPJ-4½SP	LPJ-12SP	LPJ-45SP
LPJ-2¼SP	LPJ-5SP	LPJ-15SP	LPJ-50SP
LPJ-2½SP	LPJ-5⁶⁄₁₀SP	LPJ-17½SP	LPJ-60SP
LPJ-2⁸⁄₁₀SP	LPJ-6SP	LPJ-20SP	

Carton Quantity and Weight

Ampere Ratings	Carton Qty.	Weight** Lbs.	Weight** Kg.
1–30	10	1.09	0.494
35–60	10	1.78	0.808

**Weight per carton.

CE logo denotes compliance with European Union Low Voltage Directive (50-1000Vac, 75-1500Vdc). Refer to Data Sheet: 8002 or contact Bussmann Application Engineering at 636-527-1270 for more information.

General Information:

- True dual-element fuses with a minimum 10 second time-delay at 500% overload.
- Long time-delay minimizes needless fuse openings due to temporary overloads and transient surges.
- Can often be sized for back-up protection against motor burnout from overload or single-phasing if other overload protective devices fail.
- High interrupting rating to safely interrupt overcurrents up to 300,000A.
- High degree of current limitation due to the fast speed-of-response to short-circuits.
- Faster response to damaging short-circuit currents than mechanical overcurrent protective devices.
- Reduces let-through thermal and magnetic forces in order to protect low withstand rated components.
- Proper sizing provides “no damage” Type “2” coordinated protection for NEMA and IEC motor control in accordance with IEC Standard 947-4-1.
- Dual-element fuses have lower resistance than ordinary fuses so they run cooler.
- Lower watts loss reduces power consumption.
- Unique dimensions assure that another class of fuse with a lesser voltage rating, interrupting rating or current-limiting ability cannot be substituted.
- Space-saving package for equipment down sizing.

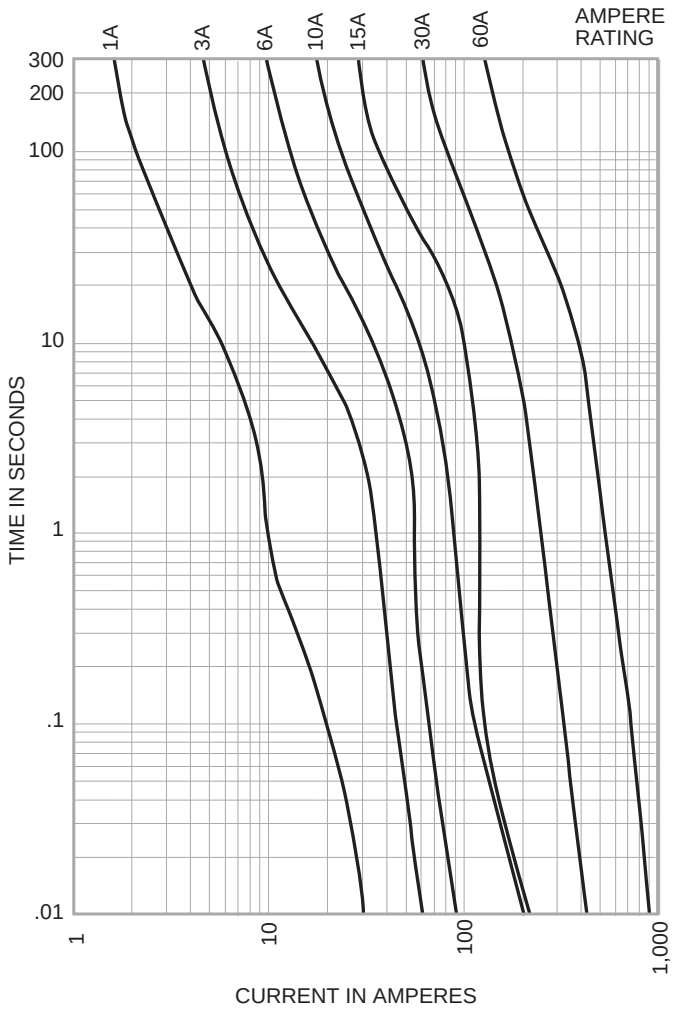


Recommended fuseblocks/fuseholders for Class J 600V fuses
See Data Sheets listed below
- Finger-safe fuseholders - 1152
- Open fuseblocks - 1114
- Open pyramid fuseblocks - 1108

LOW-PEAK®
Dual-Element Time-Delay Fuses
Class J – 600 Volt

LPJ
1-60 Amps

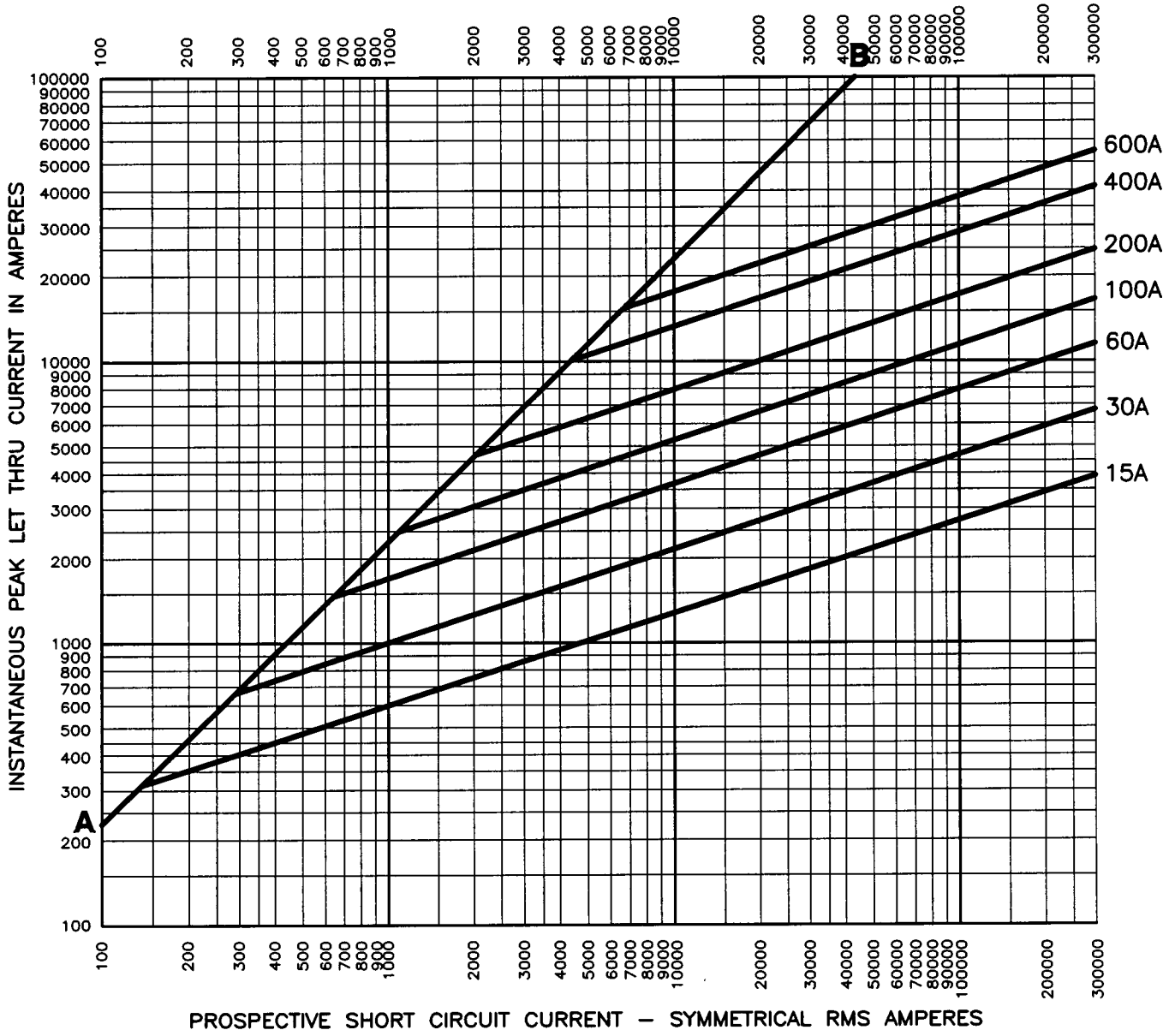
Time-Current Characteristic Curves–Average Melt



LOW-PEAK®
Dual-Element Time-Delay Fuses
Class J – 600 Volt

LPJ
1-60 Amps

Current Limitation Curves



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TeSys®
U-Line Motor Starters

Catalog

2004

File 8502



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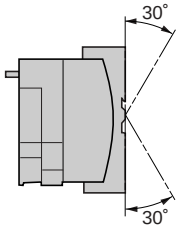
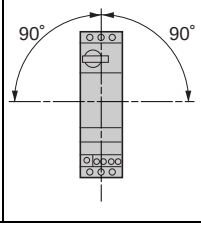
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Telemecanique

CHARACTERISTICS

Environment

Approvals	E164871 NKJH E164862 NLDX, NLDX2 E164862 NLDX	LU•B12, LU•B32 LU•S12, LU•S32 and Accessories LUALB1	LR43364 3211-08 LR43364 3211-04 LR43364 3211-08	LU•B12, LU•B32 and Accessories LU•S12, LU•S32 LUALB1
Conforming to standards	meets the essential requirements of the LV and EMC directives.		IEC/EN 60947-6-2, CSA C22-2 no. 14, Type E UL 508 Type E: (LUtB12, LUtB32 with LU9SP0 incoming line phase barrier)	
Rated insulation voltage (Ui)	Conforming to IEC/EN 60947-1, over voltage category III, degree of pollution: 3		690 V	
	UL508, CSA C22-2 no. 14		600 V	
Rated impulse withstand voltage (Uimp)	Conforming to IEC/EN 60947-6-2		6 kV	
Safety separation of circuits SELV	Conforming to IEC/EN 60947-1 appendix N		Between the control or auxiliary circuit and the main circuit: 400 V	
			Between the control and auxiliary circuits: 400 V	
Degree of protection: Conforming to IEC/EN 60947-1 (protection against direct finger contact)	Front panel outside connection zone		IP 40 (Protection against direct contact with a 1 mm diameter wire)	
	Front panel and wired terminals		IP 20 (Protection against direct finger contact)	
	Other faces		IP 20 (Protection against direct finger contact)	
Protective treatment	Conforming to IEC/EN 60068		"TH" (fungus resistant)	
	Conforming to IEC/EN 60068-2-30		12 cycles	
	Conforming to IEC/EN 60068-2-11		48 h	
Ambient air temperature around the device	Storage		-40 to +185 °F (-40 to +85 °C)	
	Operation		Power bases with standard and advanced control units: -13 to +158 °F (-25 to +70 °C)	
			Power bases with multifunction control units: At temperatures from -13 to +113 °F (-25 to +45 °C), gap not required between products. At temperatures from 113 °F (45 °C) to 131 °F (55 °C), allow a minimum gap of 9 mm between products. At temperatures from 131 °F (55 °C) up to 140 °F (60 °C), allow a minimum gap of 0.79" (20 mm) between products.	
Maximum operating altitude			6560 ft (2000 m)	
Operating positions	In relation to normal vertical mounting plane (Vac and Vdc control)			
Flame resistance	Conforming to UL 94		V2	
	Conforming to IEC/EN 60695-2-12		1760 °F (960 °C) (parts supporting live components)	
			1200 °F (650 °C)	
Environmental restrictions			Cadmium-free and silicone-free, recyclable	
Shock resistance 1/2 sine wave = 11 ms	Conforming to IEC/EN 60068-2-27		Power poles open: 10 gn	
			Power poles closed: 15 gn	
Vibration resistance 5 to 300 Hz	Conforming to IEC/EN 60068-2-6		Power poles open: 2 gn	
			Power poles closed: 4 gn	
Immunity to electrostatic discharge	Conforming to IEC/EN 61000-4-2		In open air: 8 kV—Level 3	
			On contact: 8 kv—Level 4	
Immunity to radiated high-frequency disturbance	Conforming to IEC/EN 61000-4-3		10 V/m—Level 3	
Immunity to fast transient currents	Conforming to IEC/EN 61000-4-4		All circuits except for serial link: 4 kV—Level 4	
			Serial link: 2 kV—Level 3	
Immunity to dissipated shock waves	Conforming to IEC/EN 61000-4-5		**Common mode**	**Serial mode**
	Uc > 200 V		4 kV	2 kV
	Uc < 200 V		2 kV	1 kV
	Uc = 24 Vdc		2 kV	0.5 kV
Immunity to conducted high-frequency disturbance	Conforming to IEC/EN 61000-4-6		10 kV	

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Power Base and Control Unit Type			LUB12, LUS12 + LUCA or LUCB or LUCC or LUCD	LUB32, LUS32 + LUCA or LUCB or LUCC or LUCD	LUB12, LUS12 + LUCM	LUB32, LUS32 + LUCM	LU2M LU6M
Power Circuit Connection Characteristics							
Screw Clamp Terminals - AWG Conductor Size			16–8 AWG (1–6 mm^2) one or two conductors				
Stranded cable without cable end	1 conductor		14–6 AWG (1.5–10 mm^2)				
	2 conductors		14–8 AWG (1.5–6 mm^2)				
Stranded cable with cable end	1 conductor		16–8 AWG (1–6 mm^2)				
	2 conductors		16–8 AWG (1–6 mm^2)				
Solid cable without cable end	1 conductor		16–6 AWG (1–10 mm^2)				
	2 conductors		16–8 AWG (1–6 mm^2)				
Screwdriver			Phillips no. 2 or 1/4" slotted screwdriver				
Tightening torque			15 lb-in (1.7 N•m)				
Control Circuit Connection Characteristics							
Screw Clamp Terminals - AWG Conductor Size			18–14 AWG (0.75–1.5 mm^2) one or two conductors)				
Stranded cable without cable end	1 conductor		18–14 AWG (0.75–1.5 mm^2)				
	2 conductors		18–14 AWG (0.75–1.5 mm^2)				
Stranded cable with cable end	1 conductor		22–14 AWG (0.34–1.5 mm^2)				
	2 conductors		22–14 AWG (0.34–1.5 mm^2)				
Solid cable without cable end	1 conductor		18–14 AWG (0.75–1.5 mm^2)				
	2 conductors		18–14 AWG (0.75–1.5 mm^2)				
Screwdriver			Phillips no. 1 or 3/16" slotted screwdriver				
Tightening torque			7 lb-in (0.8 N•m)				
Control Circuit Characteristics							
Rated voltage of control circuit	50/60 Hz		24–240 Vac		–	–	–
	–		24–240 Vdc		24 Vdc		–
Voltage limits	Operation	24 Vdc	20–27 Vdc		20–28 Vdc		–
		24 Vac	20–26.5 Vac		–	–	–
		48–72 Vac/dc	38.5–72 Vac / 38.5–93 Vdc		–	–	–
		110–240 Vac/dc	88–264 Vac/dc		–	–	–
	Drop-out	24 Vdc	14.5 Vdc				–
		24 Vac	14.5 Vac		–	–	–
		48–72 Vac/dc	29 Vac/dc		–	–	–
		110–240 Vac/dc	55 Vac/dc		–	–	–
Typical consumption	I max Inrush	24 Vdc	130 mA	220 mA	150 mA	200 mA	–
		24 Vac	140 mA	220 mA	–	–	–
		48–72 Vac/dc	280 mA		–	–	–
		110–240 Vac/dc	280 mA		–	–	–
	I rms sealed	24 Vdc	55 mA	70 mA	70 mA	75 mA	–
		24 Vac	70 mA	90 mA	–	–	–
		48–72 Vac/dc	35 mA	45 mA	–	–	–
		110–240 Vac/dc	30 mA	20 mA	–	–	–
Heat dissipation			2 W	3 W	1.7 W	1.8 W	–
Operating time		Closing	24 V: 70 ms / 48 V: 60 ms / ≥ 72 V: 50 ms		75 ms	65 ms	–
		Opening	35 ms				–
Resistance to micro-breaks			3 ms				–
Resistance to voltage drops		IEC/EN 61000-4-11	At least 70% of Uc for 500 ms				–
Mechanical durability	In millions of operating cycles		15				–
Maximum operating rate	In operating cycles per hour		3600				–
Main Pole Characteristics							
Number of poles			3				–
Isolation function to IEC/EN 60947-1	Possible		Yes				–
	Padlocking		1 padlock with Ø 1/4" (7 mm) shank				–
Rated thermal current			12 A	32 A	12 A	32 A	–
Rated operating current (Ue ≤ 440V)	To IEC/ EN 60947-6-2	In cat. AC-41	θ ≤ 158 °F (70 °C): 12 A	θ ≤ 158 °F (70 °C): 32 A	θ ≤ 131 °F (55 °C): 12 A	θ ≤ 131 °F (55 °C): 32 A	–
		In cat. AC-43	θ ≤ 158 °F (70 °C): 12 A	θ ≤ 158 °F (70 °C): 32 A	θ ≤ 131 °F (55 °C): 12 A	θ ≤ 131 °F (55 °C): 32 A	–
Rated operating voltage			690 V				–
Frequency limits	Of the operating current		40–60 Hz				–
Power dissipated in the power circuits	Operating current		3 A / 6 A / 9 A / 12 A / 18 A / 25 A / 32 A				–
	Power dissipated in all three poles		0.1 W / 0.3 W / 0.6 W / 1.1 W / 2.4 W / 4.6 W / 7.5 W				–
Rated breaking capacity on short-circuit—60 Hz			230 V / 440 V / 480 V / 500 V / 690 V				–
			50 kA / 50 kA / 42 kA / 15kA / 4				–
Total breaking time			2 ms / 2 ms / 2 ms				–
Thermal stress limit	With Isc max on 440 V		90 kA^2s	120 kA^2s	90 kA^2s	120 kA^2s	–

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Specific Characteristics of Power Bases LU2B or LU2S and Reverser Blocks LU2M or LU6M

Maximum operating time	Without change of direction		75 ms
	With change of direction		150 ms

General Characteristics of all Auxiliary Contacts

Conventional rated thermal current (Ith)	For ambient temperature θ < 158 °F (70 °C)		5 A
Frequency of the operating current			Up to 400 Hz
Minimum switching capacity $\lambda = 10^{-8}$		U min	17 V
		I min	5 mA
Short-circuit protection	Conforming to IEC/EN 60947-5-1		gL fuse: 4 A
Short-time rating	Permissible for	1 s	30 A
		500 ms	40 A
		100 ms	50 A
Insulation resistance			10 mΩ
Non-overlap time	Guaranteed between N.C. and N.O. contacts		2 ms (on energization and on de-energization)

Specific Characteristics of Auxiliary Contact Built into the Power Base LU9BN

Linked contacts	Conforming to IEC/EN 60947-4-1	Each power base has 1 N.O. contact and 1 N.C. contact which are mechanically linked
Mirror contact	Conforming to draft standard IEC/EN 60947-1	The N.C. contact in each power base reliably represents the state of the power contacts (safety scheme)
Rated operating voltage (Ue)		Up to 690 Vac; 250 Vdc
Rated insulation voltage (Ui)	Conforming to IEC/EN 60947-5-1	690 V
	Conforming to UL, CSA	600 V

Specific Characteristics of Auxiliary Contacts in Modules LUFN, Auxiliary Contacts LUA1 and Reverser Blocks LU2M and LU6M

Rated operating voltage (Ue)		Up to 250 Vac; 250 Vdc
Rated insulation voltage (Ui)	Conforming to IEC/EN 60947-5-1	250 V
	Conforming to UL, CSA	250 V

Operational power of contacts LUFN, LUA1, LU2M, LU6M

Conforming to IEC/EN 60947-5-1

AC supply, categories AC-14 and AC-15

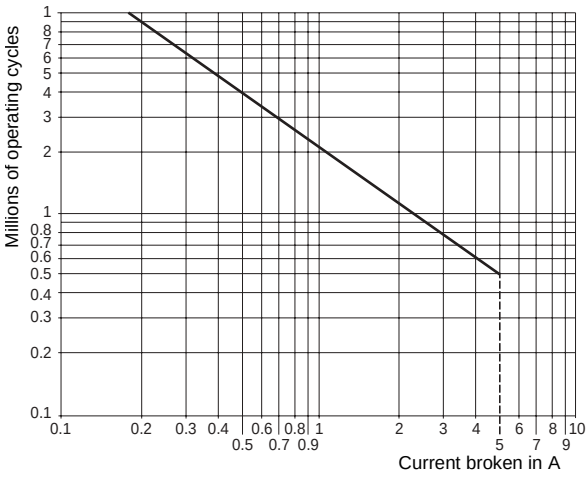
Electrical durability up to 3600 operating cycles/hour on an inductive load such as the coil of an electromagnet: making power (cos φ 0.7) = 10 times the power broken (cos φ = 0.4)

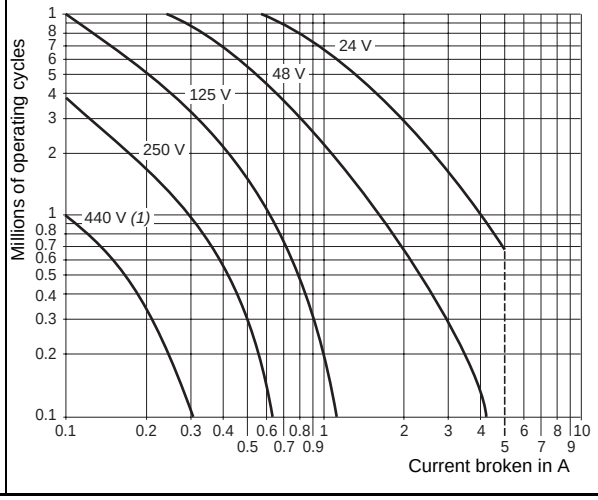
	24 V	**48 V**	**115 V**	**230 V**	**400 V**	**440 V**	**600 V**
1 million operating cycles	60 VA	120 VA	280 VA	560 VA	960 VA	1050 VA	1440 VA
3 million operating cycles	16 VA	32 VA	80 VA	160 VA	280 VA	300 VA	420 VA
10 million operating cycles	4 VA	8 VA	20 VA	40 VA	70 VA	80 VA	100 VA

DC supply, category DC-13

Electrical durability (up to 1200 operating cycles/hour) on an inductive load such as the coil of an electromagnet, without economy resistor, the time constant increasing with the load.

	24 V	**48 V**	**125 V**	**250 V**
1 million operating cycles	120 W	90 W	75 W	68 W
3 million operating cycles	70 W	50 W	38 W	33 W
10 million operating cycles	25 W	18 W	14 W	12 W





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Characteristics of Standard Control Units LUCA

Protection	Motor type	3-phase
	Conforming to standard	IEC/EN 60947-6-2, UL 508, CSA C22-2 no. 14
Overload protection	Tripping class conforming to UL 508, IEC/EN 60947-6-2	10
	Frequency limits of the operating current	40–60 Hz
	Ambient temperature range	-13 to +158 °F (- 25 to + 70 °C)
	Protection against phase imbalance	30 %
Short-circuit protection	Tripping threshold	14.2 x the setting current
	Tripping tolerance	± 20 %

Characteristics of Advanced Control Units LUCB, LUCC and LUCD

Control unit type		LUCB	LUCC	LUCD
Protection	Motor type	3-phase	Single-phase	3-phase
	Conforming to standard	IEC/EN 60947-6-2, UL 508, CSA C22-2 no. 14		
Overload protection	Tripping class conforming to UL 508, IEC/EN 60947-6-2	10		20
	Frequency limits of the operating current	40–60 Hz		
	Ambient temperature range	-13 to +158 °F (- 25 to + 70 °C)		
	Protection against phase imbalance	30 %	–	30 %
Short-circuit protection	Tripping threshold	14.2 x the setting current		
	Tripping tolerance	± 20 %		

Characteristics of Multifunction Control Units LUCM

Protection	Motor type	Selectable: single-phase or 3-phase
	Conforming to standard	IEC/EN 60947-6-2, UL 508
Overload protection	Tripping class conforming to UL 508, IEC/EN 60947-6-2	5, 10, 15, 20, 25, 30 (selectable)
	Frequency limits of the operating current	40–60 Hz
	Ambient temperature range	Power bases with multifunction control units: At temperatures from -13 to +113 °F (-25 to +45 °C), gap not required between products. At temperatures from 113 °F (45 °C) to 131 °F (55 °C), allow a minimum gap of 9 mm between products. At temperatures from 131 °F (55 °C) up to 140 °F (60 °C), allow a minimum gap of 0.79" (20 mm) between products.
Communication interface for terminal on enclosure door	Physical interface	RS-485 multi-drop
	Connector	RJ45 on front panel
	Protocol	Modbus® RTU
	Maximum transmission speed	19,200 bit/s (self-configuration up to this value)
	Maximum return time	200 ms (from PLC to LULC031 communication module to LUCM control unit back to LULC031 and back to PLC)
Display	Type	LCD, 2 lines of 12 characters
	Language version	Multilanguage (English, French, German, Italian, Spanish)
	Accuracy	± 5 %
	Resolution	1 % of Ir
Auxiliary supply	External type	24 Vdc (maximum range of 0.90 to 1.10 of nominal voltage)
	Heat dissipation	0.8 W

Configuration Table for Protection Devices and Alarms on Multifunction Control Units LUCM

	Tripping	Alarm	Adjustment of tripping threshold		Adjustment of time before tripping		Adjustment of alarm threshold	
	Factory setting	Factory setting	Range	Default value	Range	Default value	Range	Default value
Overcurrent	Activated [1]	–	3–17 Ir	14.2	–	–	–	–
Overload	Activated [1]	Activated	0.15–32 A [2]	Ir min	Class: 5–30	5	10–100 % thermal state	85 %
Ground fault	Activated	Activated	0.2–5 Ir min	0.3 Ir min	0.1–1.2 s	0.1 s	0.2–5 Ir min	0.3 Ir min
Phase imbalance	Activated	Activated	10–30 %	10 %	0.2–20 s	5 s	10–30 %	10 %
Over torque (Jam)	Deactivated	Deactivated	1–8 Ir	2 Ir	1–30 s	5 s	1–8 Ir	2 Ir
Underload	Deactivated	Deactivated	0.3–1 Ir	0.5 Ir	1–200 s	10 s	0.3–1 Ir	0.5 Ir
Long starting times	Deactivated	Deactivated	1–8 Ir	Ir	1–200 s	10 s	1–8 Ir	Ir

1 This function cannot be deactivated.

2 The setting range depends on the rating of the control unit used.

Configuration of additional functions on Multifunction Control Units LUCM

	Factory setting	Setting range
Reset	Manual	Manual, automatic or remote
Time before reset	120 s	1–1000 s
Type of load	Motor type	3-phase motor, single-phase motor
	Self-cooled	Self-cooled, auxiliary cooling fan
Language	English	English, French, German, Italian, Spanish
Display	Average current	Average current, thermal state of motor, current in phase 1 / 2 / 3, ground fault current, phase imbalance, cause of last 5 faults

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LUB•2



LUB•20

POWER BASE SELECTION

The U-Line motor starter consists of one power base (selected from this page) and one control unit (select from page 20 or 21) as a minimum. The power bases are available in two control circuit methods:

- With screw clamp terminals
- Without screw clamp terminals

Each power base with control circuit screw clamp terminals includes one N.O. and one N.C. auxiliary contact to indicate the open or closed position of the power contacts.

When ordering power bases without control circuit screw clamp terminals (i.e., when building a reversing unit or pre-wiring the low voltage control), the terminal assemblies must be ordered separately.

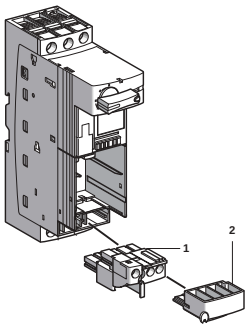
Full Voltage, Non-Reversing for Standard Applications

Control Connection	Max. Current (Amps)	Three Phase (hp max.)				Single Phase (hp max.)		Self-Protected Starter Base	Starter Base	Weight lb (kg)
		200/208 V	220/240 V	460 V	575/600 V	120 V	240 V	Catalog Number	Catalog Number	
With screw terminations	12	3	3	7.5	10	1/2	2	**LUB12**	**LUS12**	1.98 (0.900)
	32	10	10	20	25	2	5	**LUB32**	**LUS32**	1.98 (0.900)
Without [1] terminations	12	3	3	7.5	10	1 1/2	2	**LUB120**	**LUS120**	1.90 (0.865)
	32	10	10	20	25	2	5	**LUB320**	**LUS320**	1.90 (0.865)

[1] Must order LU9BN11, LU9BN11C, LU9MRC or LU9MR1C.

Terminal Blocks for Non-Reversing Power Bases LUB••0, LUS••0 without Terminations

Control Connection	For Use On	Item	Catalog Number	Weight lb (kg)
With screw terminations	LUB120/LUB320 LUS120/LUS320	1 + 2	**LU9BN11**	0.10 (0.45)



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CONTROL UNITS

Function Characteristics

Control Units		Standard	Advanced			Multifunction
		LUCA	LUCB	LUCC	LUCD	LUCM
Overload Protection		[1]				
Magnetic Trip Overcurrent Protection		14.2 x the FLA setting [1]				3 to 17 x the FLA setting [1]
Short-Circuit Protection [2]		14.2 x maximum rated current of the control unit [1]				
Phase Loss Protection		[1]			–	[1]
Phase Imbalance Protection		[1]			–	[1]
Ground Fault Detection (equipment protection only)		–				[1]
Overload Trip Class		10 [1]		10 [1]	20 [1]	5 to 30 [1]
Motor Type (AC only)		3-phase [1]			Single-phase [1]	Single-phase and 3-phase [1]
Test Function		–	[1]			
Overtorque (Jam)		–				[1]
Underload		–				[1]
Long Starting Times		–				[1]
Reset Modes	Manual	[1]	[1]			Parameters can be set via integrated LCD and keypad, communication module LUFDA10 or LULC031, network [1], or PowerSuite™ Software.
	Automatic or Remote	–	With function module LUFDA10 or LULC031			
Alarm		–	With function module LUFW10, or communication module LULC031			Possible for each type of fault. Indication via integrated LCD and keypad, via remote terminal, via PowerSuite Software. [1]
						With function module LUFW10, or communication module LULC031
"Log" Function		–				Log of the last 5 trips includes number of starts, number of trips, number of operating hours. [1]
"Monitoring" Function		–				Indication on integrated LCD and keypad, via remote terminal or PowerSuite Software. [1]

With Function Modules [3]

Thermal Overload Pre-alarm	–	With function module LUFW [1]	–
Fault Differentiation and Manual Reset	–	With function module LUFDH20 [1]	–
Fault Differentiation and Automatic or Remote Reset	–	With function module LUFDA10 [1]	–
Indication of Motor Load (analog signal) 0–10 V or 4–20 mA	–	With function module LUFV [1]	

With Communication Module or via RS-485 Modbus® port on LUCM control unit [3]

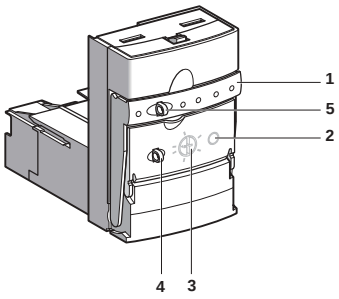
Starter Status (ready, run, trip)	With communication module ASILUFC5 or LULC031		
Reset Mode	–	Parameters can be set via the bus.	
Alarm	–	With Modbus communication module LULC031 (thermal overload alarm only) [1]	With Modbus communication module LULC031 and RS-485 Modbus port on the LUCM control unit (alarm possible for all types of fault) [1]
Remote Reset via the Bus	–		
Indication of Motor Load	–		
Fault Differentiation	–		
Remote Programming and Monitoring of all Functions	–		With Modbus communication module LULC031and RS-485 Modbus port on the LUCM control unit [1]
"Log" Function	–		With Modbus communication module LULC031and RS-485 Modbus® port on the LUCM control unit [1]
"Monitoring" Function	–		With Modbus communication module LULC031and RS-485 Modbus port on the LUCM control unit [1]

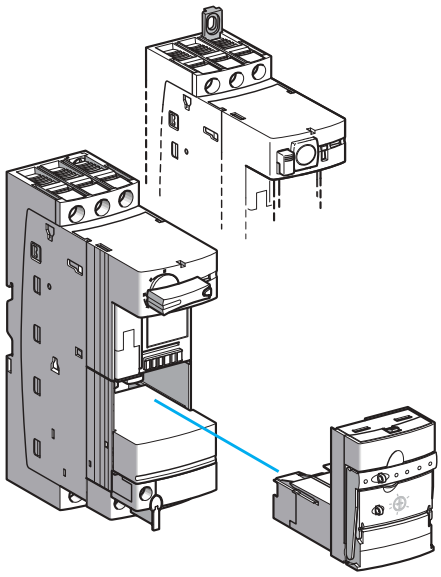
[1] Built-in function

[2] LUS and LU2S require customer provided supplemental short circuit protection (fuses or circuit breaker) per national and local electric codes.

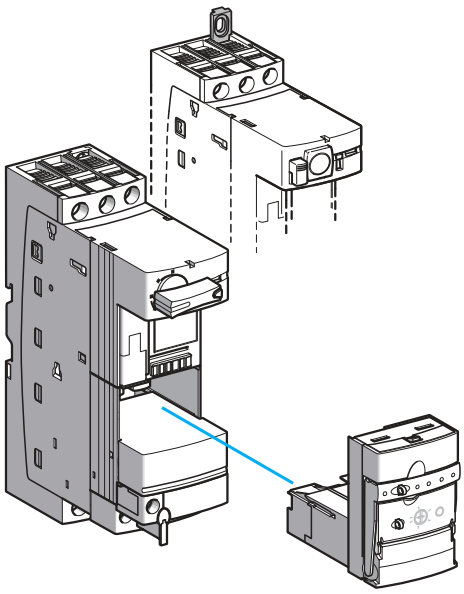
[3] Mounting possibilities:1 function module or 1 communication module.

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LUCA●●●●



LUCB●●●●
LUCC●●●●
LUCD●●●●

Standard and Advanced Control Units

Description	
1	Extraction and locking handle
2	Test button (on advanced control unit only)
3	Adjustable Full Load Amps (FLA) dial
4	Locking of settings by sealing the transparent cover
5	Sealing of locking handle

Standard, 3-Phase, Class 10 Overload Protection

Setting Range (Amps)	Used with power bases	Catalog Number	Weight lb (kg)
0.15–0.6	LU•B12, LU•B32, LU•S12, LU•S32	**LUCAX6** [1]	0.30 (0.135)
0.3–1.4	LU•B12, LU•B32, LU•S12, LU•S32	**LUCA1X** [1]	0.30 (0.135)
1.25–5.0	LU•B12, LU•B32, LU•S12, LU•S32	**LUCA05** [1]	0.30 (0.135)
3–12	LU•B12, LU•B32, LU•S12, LU•S32	**LUCA12** [1]	0.30 (0.135)
4.5–18	LU•B32, LU•S32	**LUCA18** [1]	0.30 (0.135)
8–32	LU•B32, LU•S32	**LUCA32** [1]	0.30 (0.135)

1 Complete the catalog number by selecting the proper voltage code from the table below.

Advanced, 3-Phase, Class 10 Overload Protection

Setting Range (Amps)	Used with power bases	Catalog Number	Weight lb (kg)
0.15–0.6	LU•B12, LU•B32, LU•S12, LU•S32	**LUCBX6** [1]	0.31 (0.140)
0.3–1.4	LU•B12, LU•B32, LU•S12, LU•S32	**LUCB1X** [1]	0.31 (0.140)
1.25–5.0	LU•B12, LU•B32, LU•S12, LU•S32	**LUCB05** [1]	0.31 (0.140)
3–12	LU•B12, LU•B32, LU•S12, LU•S32	**LUCB12** [1]	0.31 (0.140)
4.5–18	LU•B32, LU•S32	**LUCB18** [1]	0.31 (0.140)
8–32	LU•B32, LU•S32	**LUCB32** [1]	0.31 (0.140)

1 Complete the catalog number by selecting the proper voltage code from the table below.

Advanced, Single Phase, Class 10 Overload Protection

Setting Range (Amps)	Used with power bases	Catalog Number	Weight lb (kg)
0.15–0.6	LU•B12, LU•B32, LU•S12, LU•S32	**LUCCX6** [1]	0.31 (0.140)
0.3–1.4	LU•B12, LU•B32, LU•S12, LU•S32	**LUCC1X** [1]	0.31 (0.140)
1.25–5.0	LU•B12, LU•B32, LU•S12, LU•S32	**LUCC05** [1]	0.31 (0.140)
3–12	LU•B12, LU•B32, LU•S12, LU•S32	**LUCC12** [1]	0.31 (0.140)
4.5–18	LU•B32, LU•S32	**LUCC18** [1]	0.31 (0.140)
8–32	LU•B32, LU•S32	**LUCC32** [1]	0.31 (0.140)

1 Complete the catalog number by selecting the proper voltage code from the table below.

Advanced, 3-Phase, Class 20 Overload Protection

Setting Range (Amps)	Used with power bases	Catalog Number	Weight lb (kg)
0.15–0.6	LU•B12, LU•B32, LU•S12, LU•S32	**LUCDX6** [1]	0.31 (0.140)
0.3–1.4	LU•B12, LU•B32, LU•S12, LU•S32	**LUCD1X** [1]	0.31 (0.140)
1.25–5.0	LU•B12, LU•B32, LU•S12, LU•S32	**LUCD05** [1]	0.31 (0.140)
3–12	LU•B12, LU•B32, LU•S12, LU•S32	**LUCD12** [1]	0.31 (0.140)
4.5–18	LU•B32, LU•S32	**LUCD18** [1]	0.31 (0.140)
8–32	LU•B32, LU•S32	**LUCD32** [1]	0.31 (0.140)

1 Complete the catalog number by selecting the proper voltage code from the table below.

Voltage Codes

Volts	24	48–72	110–240
DC	BL [1 2]	–	–
AC	B	–	–
DC or AC	–	ES [3]	FU

1 Voltage code to use for a power base with a communication module.

2 DC voltage with range of 0.90 to 1.10 of nominal.

3 48–72 Vdc; 48 Vac

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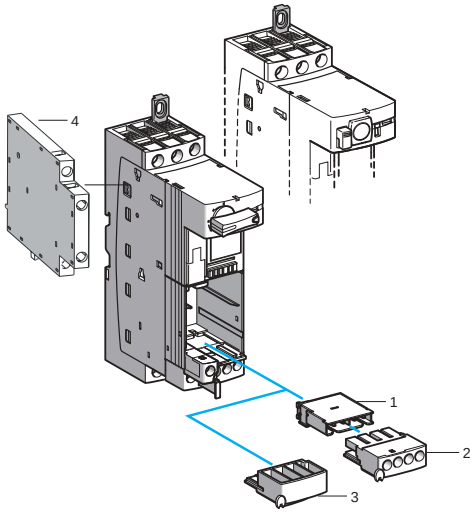
Terminals	Contact Indicates	Contact Normal Status	Auxiliary Contact State for Each Power Base Mode [1]						Catalog Number
			Off	Ready	Run	Short Circuit Trip	Overload Trip (Manual Reset)	Overload Trip (Remote/Auto Reset) [2]	
Screw	Ready condition	N.O.	O	I	I	O	O	I	**LUA1C11**
	Fault condition	N.C.	I	I	I	O	O	I	
Without terminals [3]	Ready condition	N.O.	O	I	I	O	O	I	**LUA1C110**
	Fault condition	N.C.	I	I	I	O	O	I	
Screw	Ready condition	N.O.	O	I	I	O	O	I	**LUA1C20**
	Fault condition	N.O.	O	O	O	I	I	O	
Without terminals [4]	Ready condition	N.O.	O	I	I	O	O	I	**LUA1C200**
	Fault condition	N.O.	O	O	O	I	I	O	

1 I–indicates closed contact; O–indicates open contact

2 Must order LU9BN11, LU9BN11C, LU9MRC or LU9MR1C.

3 Requires multifunction or advanced control unit plus fault indication function module LUFDDA10.

4 Requires multifunction or advanced control unit plus fault indication function module LUFDDA10.



Auxiliary Contact Blocks

Status and Fault Indication	Connection	Item	Catalog Number	Weight lb (kg)
1 N.O. contact indicating that control handle is in "ready" position and 1 N.C. fault signaling contact	Screw clamps	1 + 2	**LUA1C11**	0.07 (0.030)
	Without connections	1	**LUA1C110**	0.03 (0.012)
1 N.O. contact indicating that control handle is in "ready" position and 1 N.O. fault signaling contact	Screw clamps	1 + 2	**LUA1C20**	0.07 (0.030)
	Without connections	1	**LUA1C200**	0.03 (0.012)

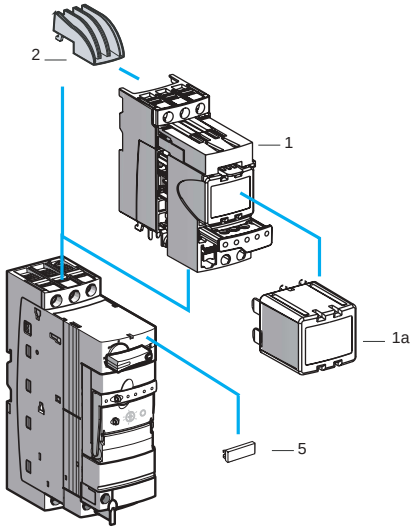
Accessories

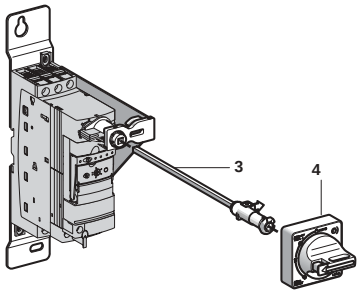
Description	For use on	Item	Catalog Number	Weight lb (kg)
Screw clamp terminal blocks	LUA1D110	2	**LU9BD11**	0.05 (0.022)
	LUA1C110	2	**LU9BC11**	0.05 (0.022)
	LUA1C200	2	**LU9BC20**	0.05 (0.022)
Blanking cover [1]	for auxiliary contact block slot	3	**LU9C2**	0.02 (0.010)
Control circuit contact block [2]	LUB, LU2B	4	**LUA8E20** [2]	

1 Blanking cover is included with every power base and starter only base.

2 For use only with LUB, LU2B power bases. Not for use with LUS power bases. For compliance with NEC 430-74 disconnection of motor control circuits.

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Current Limiter - Isolator Module

Description	Breaking Capacity Iq		For Use With	Item	Catalog Number	Weight lb (kg)
	480 V	600 V				
	kA	kA				
Current limiter-isolator module [3]	130	65	LUB; LU2B	1	**LUALB1** [1]	0.683 (0.310)
Replacement limiter cartridge	–	–	LUALB1	1a	**LUALF1**	0.297 (0.135)

UL508 Type E Phase Barrier for use with LUB•• and LU2B••

Phase barrier LU9SP0 is required to create a UL 508 Type E self-protected combination motor controller. Without the phase barrier, the LUB/LU2B power base is a UL 508 motor starter.

Description	Application	Mounting	Item	Catalog Number	Weight lb (kg)
Incoming line phase barrier	LUB or LU2B 12 or 120 LUB or LU2B 32 or 320 LUA LB1	Direct on terminals L1, L2, L3	2	**LU9SP0**	0.066 (0.030)

Door Interlock Mounting Kit and Handles for use with LUB•• and LU2B••

Description	Item	Catalog Number	Weight lb (kg)
Mounting Kit [2]	3	**LU9AP00**	1.080 (0.490)
Handle kit (black/blue) NEMA Type 12/3R	4	**LU9AP11**	0.330 (0.150)
Handle kit (red/yellow) NEMA Type 12/3R	4	**LU9AP12**	0.330 (0.150)

Other Accessories

Clip-on identification markers	–	–	Power bases, and reversing blocks	5	**LAD90** [3]	0.002 (0.001)

1 LUALB1 supplied with LUALF1 limiter cartridge. LUB, LU2B power bases are rated for 480 V/60 Hz/42 kA short circuit breaking capacity. For applications requiring higher short circuit breaking capacity, add the LUALB1 current limiter-isolator module which provides capacity at 480 V/60 Hz/130 kA, 600 V/60 Hz/65 kA and 690 V/60 Hz/70 kA. LUALB1 is required for all 600 V / 690 V motor load applications.

2 For enclosures with 7.5" to 20" (190.5 mm to 508 mm) mounting depth.

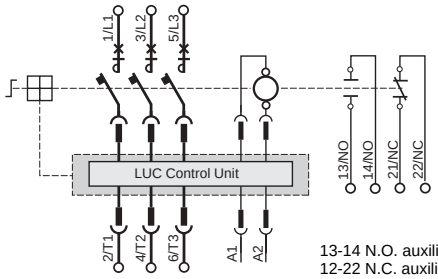
3 Sold in lots of 100.

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Power Bases, 12 or 32 A

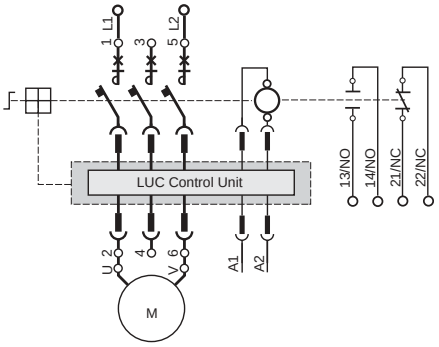
For additional wiring information refer to pages 53 - 56.

Non-reversing 3-phase motor
LUB/LUS

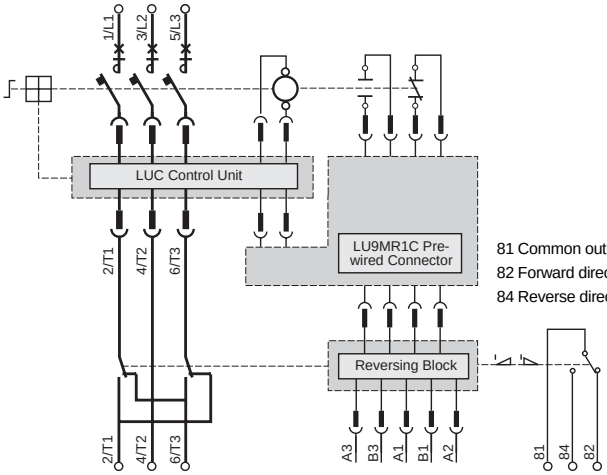


13-14 N.O. auxiliary contact
12-22 N.C. auxiliary contact

With control unit LUCC or LUCM
Single-phase motor
LUB/LUS

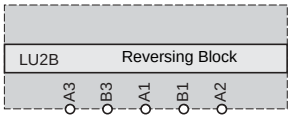


Reversing 3-phase motor
LU2B/LU2S



81 Common output from reverser block
82 Forward direction indication output contact
84 Reverse direction indication output contact

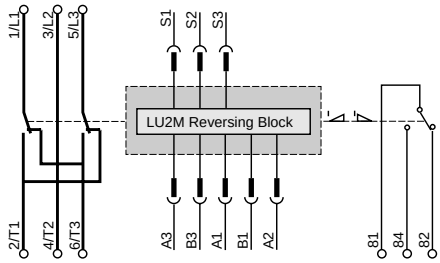
Control terminal block



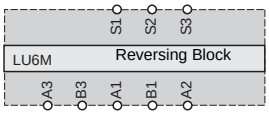
A1 Forward direction start input (+ Vdc)
A2 Common input (- Vdc)
A3 Reverse direction start input (+ Vdc)
B1 Holding circuit for A1 (direction 1)
B3 Holding circuit for A3 (direction 2)

Reverser Blocks

LU2M

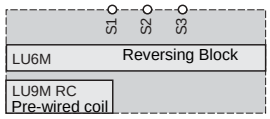


LU6M—Control terminal blocks



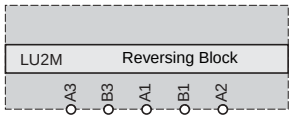
A1 Forward direction start input (+ Vdc)
A2 Common input (- Vdc)
A3 Reverse direction start input (+ Vdc)
B1 Holding circuit for A1 (direction 1)
B3 Holding circuit for A3 (direction 2)
S1 Momentary input to A1 coil terminal on power base
S2 N.O. holding circuit for A1 to auxiliary contact terminals 13
S3 N.C. reverser electrical interlock to auxiliary contact terminals 21

LU6M with pre-wired connector LU9MRC



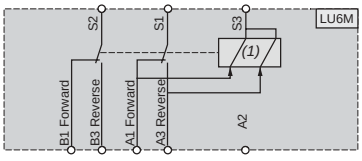
S1 Momentary input to A1 coil
S2 N.O. holding circuit for A1
S3 N.C. reverser electrical interlock

Control terminal block



A1 Forward direction start input (+ Vdc)
A2 Common input (- Vdc)
A3 Reverse direction start input (+ Vdc)
B1 Holding circuit for A1
B3 Holding circuit for A3

LU6M Basic internal scheme



A1 Forward direction start input (+ Vdc)
A2 Common input (- Vdc)
A3 Reverse direction start input (+ Vdc)
B1 Holding circuit for A1
B3 Holding circuit for A3
S1 Momentary input to A1 coil terminal on power base
S2 N.O. holding circuit for A1 to auxiliary terminals 13
S3 N.C. reverser electrical interlock to auxiliary terminals 21

Auxiliary Contact Blocks

LUA1D11	LUA1C11	LUA1C20
53 54 95 96	17 18 95 96	17 18 97 98

Auxiliary Contact Function Modules

LUFN20	LUFN11	LUFN02
33 34 43 44	43 44 31 32	31 32 41 42

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Type T VA Ratings

UL, cUL, CSA and NOM VA Rating	CE VA Rating
25	25
50	50
75	75
100	100
150	150
200	200
250	160
300	200
350	250
500	300
750	500
1000	630
1500	1000
2000	1500
3000	2000
5000	3000

Type T Listings

Listing	File	VA Range
UL	E61239, Guide XPTQ2	25–5000
cUL	E61239	1500–5000
CSA	LR37055, Guide 184-N-90	25–1000
EN	947923, EN 61 558/01.89 (TUV ref: 00941-RAG/sg E9371495E01)	25–200
	9579078, EN 61 558/01.89 (TUV ref: 00941-RAG/sg E9471921E01)	250–1000
	9579078, EN 61 558/01.89 (TUV ref: 00941-RAG/sg E9471921.02E01)	1500–3000

TYPE T TRANSFORMERS

The Type T units are designed for the global market and are the best choice when size and cost are of concern. This is our most popular and complete offering of industrial control transformers. The following features are included:

- 50/60 Hz rated
- Customer installed accessories (Finger-Safe covers, fuse blocks, fuse clips)
- Type T transformers are designed with various temperature classes:
  - — 25–150 VA with a 55° C temperature rise, 105° C insulation
  - — 200–350 VA with a 80° C temperature rise, 130° C insulation
  - — 500–5000 VA with a 115° C temperature rise, 180° C insulation

Schneider Electric manufactures a wide variety of voltage combinations for control transformers. The voltage combinations are expressed as “Voltage Codes”, and are embedded within the catalog number of the transformer. Standard codes are listed. If the voltage combination you need is not listed, please call your Schneider Electric distributor for assistance.

CE Marking

Industrial control transformers (ICTs) entering the European Union (EU) after January 1, 1997 are required by EU standards to have CE marking or Declaration of Conformity to CE. EU documentation requires compliance with specification EN 61 558 of the Low Voltage Directive. Type T ICTs from Schneider Electric comply with this specification and are third party tested to TÜV standards, which adhere to, and are accepted by, EU standards. A Declaration of Conformity for all Type T units is available upon request.

Because of different overload criteria in the CE specification, Schneider Elecric dual rates these transformers for UL VA, cUL VA, CSA VA, NOM VA and CE VA ratings (see “Type T VA Ratings” table). Because they are widely used with control circuit panels, ICTs are also required to comply with EN 60 204 and EN 61 558 in these applications. The Type T transformer line complies with EN 60 204 when Fingersafe® covers are installed.

For more information regarding CE marking, please contact your local Schneider Electric field sales office.

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Selection Guide

1. Determine inrush and sealed VA of each coil in the control circuit and VA of all other components.
2. Total all sealed VA of all operating coils and other loads VA (determines minimal VA size required for the circuit).
3. Total the inrush VA of all coils that are starting at the same time and all loads and coils that are running (using the regulation chart to give possible units to be used).
4. Take VA size from step 2, go to standard VA size in chart below. Make sure inrush VA from chart is greater than total VA from step 3. If not, go to next larger VA size and repeat.

If your supply voltage is stable and fluctuates less than 5%, we recommend you use the 90% secondary voltage column. If your supply voltage is not stable and fluctuates more than 10%, we recommend you use the 95% secondary voltage column. We recommend that you never use the 85% secondary voltage column since magnetic devices lose life expectancy if they are continuously started at 85% of rated voltage.

Example:

This example assumes the following:

- Two NEMA size 0 contactors do not start together, but one could be ON when the other starts.
- One NEMA size 2 contactor can start with either of the other contactors.
- One pilot light at 2 VA

1. VA and inrush are:
   NEMA 0: sealed 27 VA; inrush 245 VA
   NEMA 2: sealed 37 VA; inrush 311 VA; pilot light 2 VA
2. Total VA: 27 + 27 + 37 + 2 = 93 VA
3. Total inrush VA: 245 + 311 + 27 + 2 = 582 VA
4. From Regulation Chart for Type T at right below:
   100 VA minimum unit; inrush 499 VA will not work at 90%
   150 VA (next standard size); inrush 666 VA will work at 95%

Regulation Chart for Type T

VA	Secondary Voltage					
	Inrush UL VA at 20% Power Factor			Inrush UL VA at 40% Power Factor		
	95%	90%	85%	95%	90%	85%
50	193	266	339	151	215	282
75	271	396	520	210	318	430
100	339	499	659	266	404	549
150	666	893	1120	529	731	942
200	588	815	1041	459	659	866
250	1416	1910	2388	1057	1494	1936
300	1634	2184	2709	1194	1681	2169
350	1894	2592	3261	1392	2005	2621
500	3197	4104	4981	2374	3195	4019
750	3770	5515	7231	2887	4391	5945
1000	6587	9079	11430	4706	6886	9051
1500	19324	23983	28607	15066	19361	23756
2000	31384	38777	46161	24794	31630	38667
3000	26539	39934	52713	19355	30721	42216
5000	53111	85265	116277	39368	66309	93882

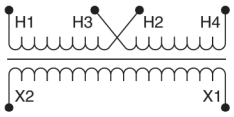
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Industrial Control Transformers
Type T Transformers

120 Volt Control Secondary

Voltage and Connection Options

Voltage Code	Voltages		Connections	
	Primary	Secondary	Primary	Secondary
D1	220 x 440 230 x 460 240 x 480	110 115 120	220/230/240 V:Connect to H1 and H4 Jumper H1 with H3 Jumper H2 with H4 440/460/480 V:Connect to H1 and H4 Jumper H2 with H3	Connect to X1 and X2



Dimensions

VA		Catalog Number	Figure	Acc. Key	A		B		C		E		F		Slots	
UL	CE				IN	mm	IN	mm	IN	mm	IN	mm	IN	mm	IN	mm
25	25	9070T25D1	1	I	3.09	79	3.00	76	2.58	66	2.00	51	2.50	64	0.20 x 0.38	5 x 10
50	50	9070T50D1	1	I	3.09	79	3.00	76	2.58	66	2.00	51	2.50	64	0.20 x 0.38	5 x 10
75	75	9070T75D1	1	I	3.34	85	3.38	86	2.89	73	2.38	61	2.81	71	0.20 x 0.48	5 x 12
100	100	9070T100D1	1	I	3.34	85	3.38	86	2.89	73	2.38	61	2.81	71	0.20 x 0.48	5 x 12
150	150	9070T150D1	1	I	3.59	91	3.75	95	3.20	81	2.88	73	3.13	80	0.20 x 0.38	5 x 10
200	200	9070T200D1	1	I	3.59	91	3.75	95	3.20	81	2.88	73	3.13	80	0.20 x 0.38	5 x 10
250	160	9070T250D1	2	I	5.30	135	3.75	95	3.21	82	2.88	73	3.13	80	0.20 x 0.38	5 x 10
300	200	9070T300D1	2	I	4.74	120	4.50	114	3.84	98	2.56	65	3.75	95	0.20 x 0.38	5 x 10
350	250	9070T350D1	2	I	5.11	130	4.50	114	3.84	98	3.00	76	3.75	95	0.20 x 0.38	5 x 10
500	300	9070T500D1	2	I	5.49	139	4.50	114	3.84	98	3.56	90	3.75	95	0.20 x 0.38	5 x 10
750	500	9070T750D1	2	I	5.61	143	5.25	133	4.51	115	3.43	87	4.38	111	0.28 x 0.56	7 x 14
1000	630	9070T1000D1	2	I	6.30	160	5.25	133	4.51	115	4.31	109	4.38	111	0.28 x 0.56	7 x 14
1500	1000	9070T1500D1	2	I	5.92	150	7.06	179	6.17	157	4.13	105	5.81	148	0.28 x 0.56	7 x 14
2000	1500	9070T2000D1	2	I	7.17	182	7.06	179	6.17	157	4.56	116	5.81	148	0.28 x 0.56	7 x 14
3000	2000	9070T3000D1	3	I	7.24	184	9.00	229	8.75	222	4.63	118	7.63	194	0.44 x 1.13	11 x 29
5000	3000	9070T5000D1	3	I	9.15	232	9.00	229	8.75	222	6.56	167	7.63	194	0.44 x 1.13	11 x 29

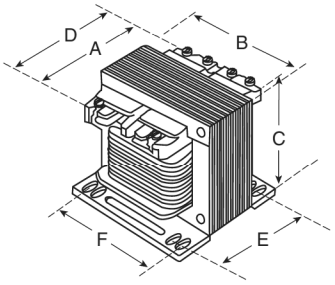


Figure 1

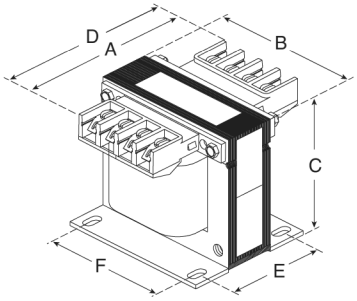


Figure 2

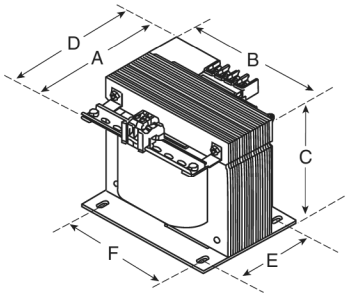


Figure 3

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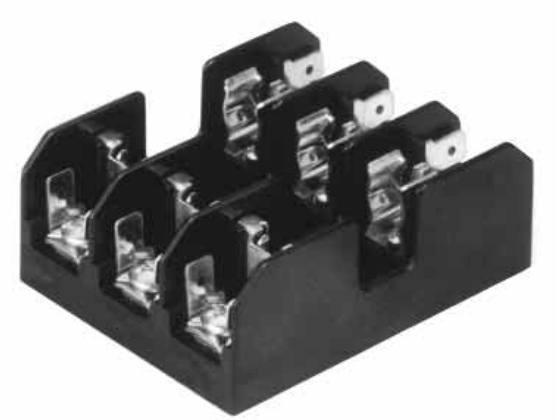
TYPE T PERFORMANCE DATA

Catalog Number	Core Watts	Coil Watts	FL Total Watts	Reg 1.0PF	Eff 100%	%IZ	X/R	BTU/hr					Inrush (x FL RMS)	
								100%	75%	50%	25%	No Load	60HZ	50HZ
9070T25D1	4.5	3.7	8.2	3.81	75.3	3.84	10.9	28	22	19	16	15	25.0	30.0
9070T50D1	4.5	7.1	11.6	7.97	81.1	8.01	10.5	40	29	21	17	15	24.1	28.9
9070T75D1	7.3	6.8	14.1	4.94	84.2	5.00	15.9	48	38	31	26	25	28.0	33.6
9070T100D1	7.3	10.2	17.5	6.82	85.1	6.9	15.4	60	45	34	27	25	26.8	32.2
9070T150D1	10.5	10.8	21.3	4.77	87.6	5.25	20.2	73	57	45	38	36	31.2	37.4
9070T200D1	10.5	19.5	30.0	7.70	86.9	7.83	18.0	102	73	53	40	36	19.7	23.7
9070T250D1	14.1	17.8	31.9	5.73	88.7	5.73	3.5	109	82	63	52	48	22.9	27.5
9070T300D1	13.3	18.8	32.1	5.60	90.3	5.62	6.0	110	82	61	49	45	11.0	13.2
9070T350D1	16.4	19.9	36.3	5.07	90.6	5.08	4.9	124	94	73	60	56	16.0	19.2
9070T500D1	20.7	30.6	51.3	5.47	90.7	5.48	5.3	175	129	97	77	71	12.9	15.5
9070T750D1	30.8	37.9	68.7	4.57	91.6	4.58	5.7	235	178	138	113	105	17.4	20.9
9070T1000D1	35.4	51.3	86.7	4.83	92.0	4.84	6.0	296	219	165	132	121	10.3	12.3
9070T1500D1	51.5	51.3	102.8	3.25	93.6	3.30	8.0	351	274	220	187	176	10.5	12.6
9070T2000D1	81.8	50.0	131.8	2.31	93.8	2.31	6.3	450	375	322	290	279	15.6	18.8
9070T3000D1	81.9	67.2	149.1	2.24	96.1	2.04	9.3	532	415	338	294	285	7.7	9.3
9070T5000D1	143.3	83.7	227.0	1.67	95.6	1.52	7.2	781	648	558	507	495	8.5	10.2
9070T50D3	4.5	7.1	11.6	7.97	81.1	8.01	10.5	40	29	21	17	15	24.1	28.9
9070T75D3	7.3	6.8	14.1	4.94	84.2	5.00	15.9	48	38	31	26	25	28.0	33.6
9070T100D3	7.3	10.2	17.5	6.82	85.1	6.90	15.4	60	45	34	27	25	26.8	32.2
9070T150D3	10.5	10.8	21.3	4.77	87.6	5.25	20.2	73	57	45	38	36	31.2	37.4
9070T200D3	10.5	19.5	30.0	7.70	86.9	7.83	18.0	102	73	53	40	36	19.7	23.7
9070T250D3	14.1	17.8	31.9	5.73	88.7	5.73	3.5	109	82	63	52	48	22.9	27.5
9070T300D3	13.3	18.8	32.1	5.60	90.3	5.62	6.0	110	82	61	49	45	11.0	13.2
9070T350D3	16.4	19.9	36.3	5.07	90.6	5.08	4.9	124	94	73	60	56	16.0	19.2
9070T500D3	20.7	30.6	51.3	5.47	90.7	5.48	5.3	175	129	97	77	71	12.9	15.5
9070T750D3	30.8	37.9	68.7	4.57	91.6	4.58	5.7	235	178	138	113	105	17.4	20.9
9070T1000D3	35.4	51.3	86.7	4.83	92.0	4.84	6.0	296	219	165	132	121	10.3	12.3
9070T1500D3	51.5	51.3	102.8	3.25	93.6	3.30	8.0	351	274	220	187	176	10.5	12.6
9070T2000D3	81.8	50.0	131.8	2.31	93.8	2.31	6.3	450	375	322	290	279	15.6	18.8
9070T3000D3	81.9	74.5	156.4	2.37	95	2.39	11.9	534	423	343	296	280	7.7	9.3
9070T5000D3														
9070T50D20	7.3	6.8	14.1	4.94	84.2	5.00	15.9	48	38	31	26	25	28.0	33.6
9070T75D20	7.3	10.2	17.5	6.82	85.1	6.90	15.4	60	45	34	27	25	26.8	32.2
9070T100D20	10.5	10.8	21.3	4.77	87.6	5.25	20.2	73	57	45	38	36	31.2	37.4
9070T150D20	10.5	19.5	30.0	7.70	86.9	7.83	18.0	102	73	53	40	36	19.7	23.7
9070T200D20	14.1	17.8	31.9	5.73	88.7	5.73	3.5	109	82	63	52	48	22.9	27.5
9070T250D20	13.3	18.8	32.1	5.60	90.3	5.62	6.0	110	82	61	49	45	11.0	13.2
9070T300D20	16.4	19.9	36.3	5.07	90.6	5.08	4.9	124	94	73	60	56	16.0	19.2
9070T350D20	20.7	30.6	51.3	5.47	90.7	5.48	5.3	175	129	97	77	71	12.9	15.5
9070T500D20	30.8	37.9	68.7	4.57	91.6	4.58	5.7	235	178	138	113	105	17.4	20.9
9070T750D20	35.4	51.3	86.7	4.83	92.0	4.84	6.0	296	219	165	132	121	10.3	12.3
9070T1000D20	51.5	51.3	102.8	3.25	93.6	3.30	8.0	351	274	220	187	176	10.5	12.6
9070T1500D20	81.8	50.0	131.8	2.31	93.8	2.31	6.3	450	375	322	290	279	15.6	18.8
9070T2000D20	81.9	74.5	156.4	2.37	95.0	2.39	11.9	534	423	343	296	280	7.7	9.3
9070T3000D20	143.3	84.8	228.1	1.63	95.6	1.64	11.8	779	652	562	507	489	8.5	10.2

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Class CC Fuseblocks
600 Volt, 30 Amps

BC Series



Catalog Symbol: BC Series
Class CC Fuseblocks
For use with Class CC Fuses (Bussmann LP-CC, KTK-R, and FRQ-R)
Ampere Rating: 1/10 to 30A
Voltage Rating: 600V
Withstand Rating: 200,000A RMS Sym.
Agency Information:
UL Listed, UL 512, Guide IZLT, File E14853
CSA Certified, C22.2 No. 39, Class 6225-01, File 47235
UL Flammability: 94VO
Materials: Base - Thermoplastic
Clips - Bright tin-plated bronze
DIN-RAIL Adapters: DRA-1 and DRA-2

Catalog Data

		Terminal Type				
Amps	Poles	Screw	Screw with Quick Connect*	Pressure Plate	Pressure Plate w/ Quick Connect*	Box Lug
1/10	1	BC6031S	BC6031SQ	BC6031P	BC6031PQ	BC6031B
to	2	BC6032S	BC6032SQ	BC6032P	BC6032PQ	BC6032B
30	3	BC6033S	BC6033SQ	BC6033P	BC6033PQ	BC6033B

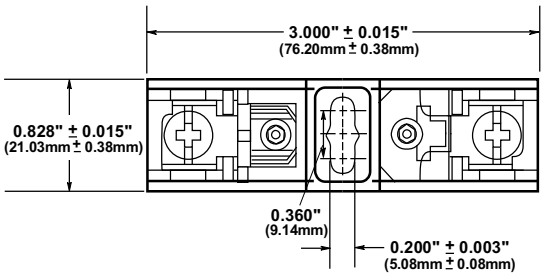
Wire Range CU Only					
					
	#10-#14	#10-#14	#10-#14	#10-#14	#6-#14

* QUICK CONNECT RATED FOR 20A MAXIMUM.

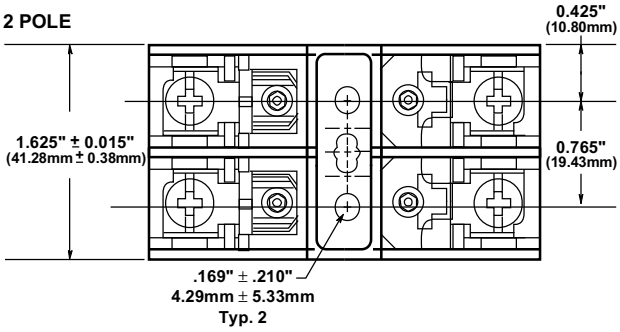
CE CE logo denotes compliance with European Union Low Voltage Directive (50-1000 Vac, 75-1500 Vdc). Refer to Data Sheet: 8002 or contact Bussmann Application Engineering at 636-527-1270 for more information.

Dimensional Data

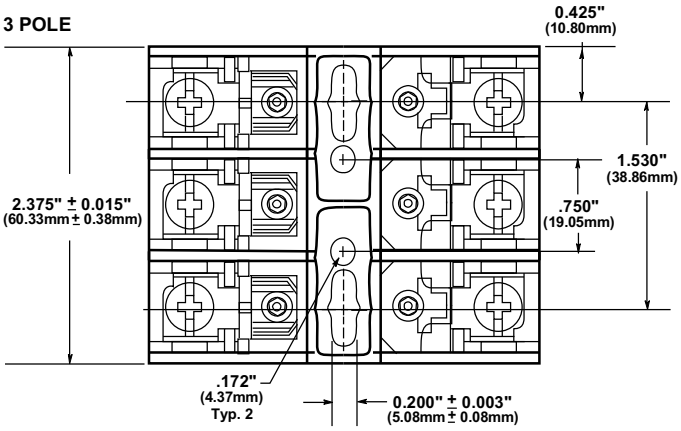
1 POLE



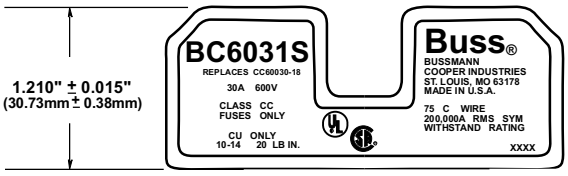
2 POLE



3 POLE



FUSEBLOCK LABEL (EXAMPLE SHOWN)

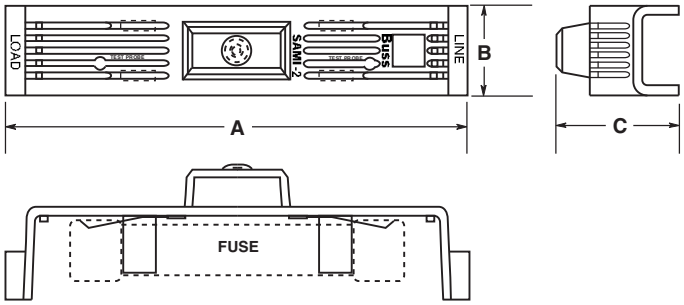


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SAMI
Indicating Fuse Covers

SAMI





Catalog Symbol: SAMI Series
For Class J, R, H, K5, CC, G and Midget type fuses.
Ampere Rating: 0 to 100A
Voltage Rating:
Non-Indicating - 0 to 600Vac/dc
Indicating - 90 to 600Vac
- 115 to 600Vdc
Agency Approvals:
All UL Listed, except SAMI-7I and SAMI 7N are UL Recognized.
CSA Certified, Class 6225-01, File LR47235
Material: Black thermoplastic with a flammability rating of UL 94-V2

General Information:

- Innovative design, covers exposed terminals and contacts of Bussmann fuseblocks.
- Fits most competitive fuseblocks.
- Buss yellow light on indicating SAMI shows when the fuse is open – helps trouble shoot the system and reduces downtime.
- All versions are reusable – no need to pay for indication every time a fuse opens.
- Indication contacts have teeth to break oxidation layer on the existing fuse endcap to provide a clear signal path.
- Less than .6mA leakage current at 600 volt.
- Visual marking of line and load side.
- SAMI cover ends can easily be cut away if necessary to fit cover over existing wiring or to fit most safety switches.
- Dead-front construction provides added protection against accidental contact by maintenance personnel.
- Labels are provided with the SAMI fuse cover for writing in circuit or fuse information.
- One cover is required for each pole.
- SAMI-8_ fusecover includes adapter for use with short body Class R fuses. Adapter available separately as part number SAMI-8A.

WARNING: To avoid electrical shock, turn power off before installing, removing or servicing.

Dimensional Data (inches) All dimensions (± .020)

Catalog Number*	Description	A	B	C
SAMI-1_	600V, J (0-30A) and 600V, T (35-60A)* 250V, R, K5, H (35-60A)	5.02	1.03	1.94
SAMI-2_	600V, R, K5, H (0-30A)	7.03	1.30	2.07
SAMI-3_	600V, J (65-100A)	7.03	1.30	2.33
SAMI-4_	250V, R, K5, H (65-100A)	8.20	1.30	2.18
SAMI-5_	600V, R, K5, H (35-60A)	8.20	1.30	2.18
SAMI-6_	600V, J (35-60A)	4.98	1.17	2.14
SAMI-7_	600V, Midget, Class CC	3.82	0.75	1.72
SAMI-8_	600V, R, H (65-100A), K5	10.38	1.50	2.33
SAMI-9_	250V, R, K5, H (0-30A)	3.82	0.75	1.72

* Available in non-indicating only

***Catalog Numbers**
For Indicating cover, add suffix **I.**
For Non-indicating cover, add suffix **N.**
Example: SAMI-7I = Indicating
SAMI-7N = Non-indicating

Indicating feature requires a minimum of 90Vac or 115Vdc to illuminate lamp.

For fuse and fuseblock applications, see page 2.

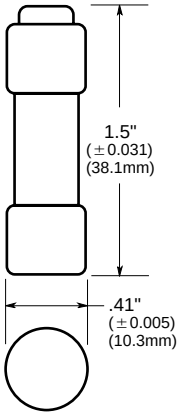
CE CE logo denotes compliance with European Union Low Voltage Directive (50-1000 VAC, 75-1500 VDC). Refer to BIF document #8002 or contact Bussmann Application Engineering at 636-527-1270 for more information.

CC-TRON®
Time-Delay Fuses
13/32″ × 1½″, 600 Volt, ¼ to 30 Amps

FNQ-R



Dimensional Data



General Information:

- The Bussmann CC-TRON® (FNQ-R) was designed to meet the needs of control circuit transformer protection.
- Current-limitation protects down stream components against damaging thermal and magnetic effects of short-circuit currents.
- **High inrush time-delay.** Control circuit transformers can experience inrush currents up to 85 times their full-load current rating. FNQ-R fuses can be sized according to NEC and UL requirements and still allow the high inrush currents, with significantly more time-delay than the UL minimum value of 12 seconds at 200% for Class CC fuses.
- Melamine tube. Nickel-plated brass endcaps.

Catalog Symbol: FNQ-R
Time-Delay
Application: Circuit Transformer Protection
Ampere Rating: ¼ to 30A
Voltage Rating: 600Vac (or less)†
Interrupting Rating: 200,000A RMS Sym. (UL)
Agency Information:
UL Listed, Std. 248-4, Class CC, Guide JDDZ, File E4273
CSA Certified, Class CC CSA, Class 1422-01,
File 53787–HRC-MISC

†12-30A is 300Vdc and 10k AIR.

Maximum Acceptable Rating of Overcurrent Device*

Rated Primary Current (Amperes)	Maximum Rating of Overcurrent Protective Device Expressed As A Percent of Transformer Primary Current Rating
Less than 2A	500**
2A to less than 9A	167
9A or more	125

*UL 508A Table 42.1.
**300% for other than motor control applications.

CE CE logo denotes compliance with European Union Low Voltage Directive (50-1000Vac, 75-1500Vdc). Refer to Data Sheet: 8002 or contact Bussmann Application Engineering at 636-527-1270 for more information.

Electrical Ratings (Catalog Symbol and Amperes)

FNQ-R-¼	FNQ-R-1 3/10	FNQ-R-3 2/10	FNQ-R-8
FNQ-R-3/10	FNQ-R-1 4/10	FNQ-R-3½	FNQ-R-9
FNQ-R-4/10	FNQ-R-1½	FNQ-R-4	FNQ-R-10
FNQ-R-½	FNQ-R-1 6/10	FNQ-R-4½	FNQ-R-12
FNQ-R-6/10	FNQ-R-1 8/10	FNQ-R-5	FNQ-R-15
FNQ-R-¾	FNQ-R-2	FNQ-R-5 6/10	FNQ-R-17½
FNQ-R-8/10	FNQ-R-2¼	FNQ-R-6	FNQ-R-20
FNQ-R-1	FNQ-R-2½	FNQ-R-6¼	FNQ-R-25
FNQ-R-1⅛	FNQ-R-2 8/10	FNQ-R-7	FNQ-R-30
FNQ-R-1¼	FNQ-R-3	FNQ-R-7½	—

Carton Quantity and Weight

Ampere Ratings	Carton Qty.	Weight*	
		Lbs.	Kg.
¼-30	10	.200	.091

*Weight per carton

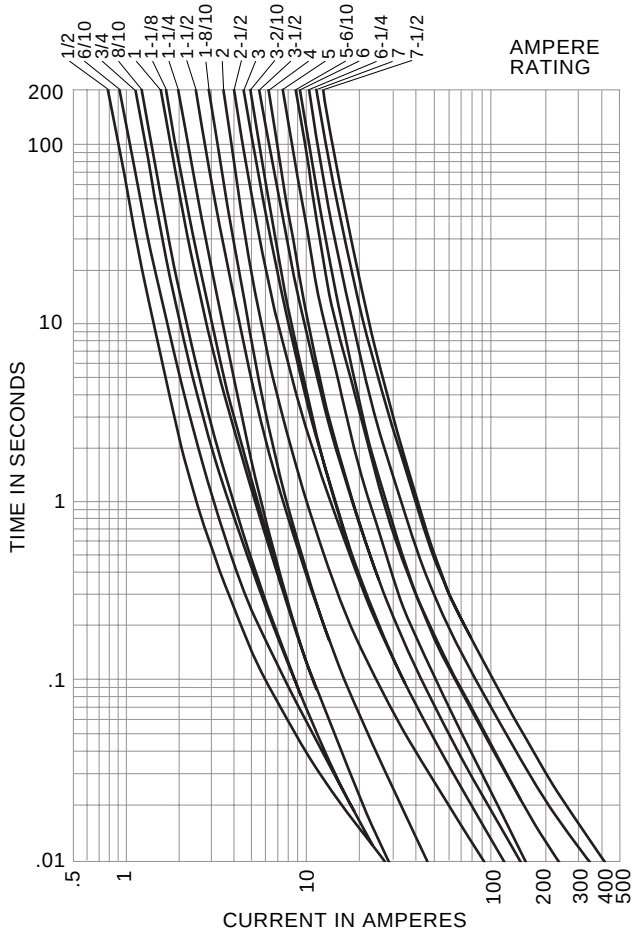
CC-TRON®

FNQ-R

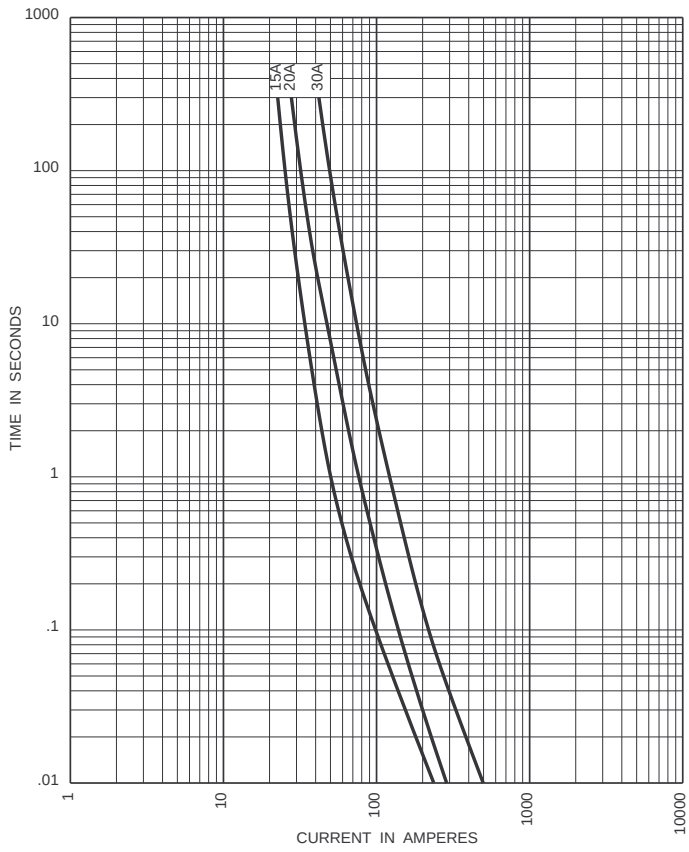
Time-Delay Fuses

13/32″ × 1½″, 600 Volt, ¼ to 30 Amps

Time-Current Characteristics–Average Melt



Time-Current Characteristics–Average Melt





Recommended fuseblocks/fuseholders for Class CC 600V fuses

See Data Sheets listed below

- Open fuseblocks - 1105
- Finger-safe fuseholders - 1109, 1102, 1103, 1151
- Panel-mount fuseholders - 2114, 2113
- In-line fuseholders - 2126

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Industrial DIN Rail Circuit Breakers

UL489 Listed for U.S. Applications CSA 22.2 No. 5 for Canadian Applications IEC 60 947-2 for IEC Applications

Allen-Bradley

Bulletin 1489

The Rockwell Automation line of circuit breakers is approved for branch circuit applications in the United States and Canada and certified as a Miniature Circuit Breaker for IEC applications. Allen-Bradley Bulletin 1489 Circuit Breakers are UL489 listed. They are also CSA-rated 22.2 No. 5 to provide branch circuit protection and are MCBs per IEC 60 947-2.

Versatility

The Bulletin 1489 Circuit Breakers provide a variety of product configurations in both AC and DC configurations.

Bulletin 1489 DIN Rail-mounted circuit breakers are similar in width and current range to MCBs and supplementary protectors with the added benefit of providing a listed branch circuit protection circuit breaker for US/Canada applications. Bulletin 1489 features finger safe IPX/2 from the front of the circuit breaker. Also available for control circuit applications are add-on auxiliary and signal contacts plus shunt trip modules to provide modern control circuit applications.

A lock-off attachment is available for applications requiring that feature.

Listed bus bars may be added to applications for convenience in panel assembly.

Simplified Maintenance

A convenient on (red) off (green) indicator is provided for quickly checking the status of the circuit breaker.

Terminals for applications requiring ring terminal connectors are available. This unique terminal may be field converted to accept normal wire connection using included lugs.



1489-A AC (standard) Configuration

- DIN rail mounting
- Thermal-Magnetic
- Finger safe (front)
- Current Limiting
- Line and Load may be top or bottom

UL/CSA		IEC	
Up to 14,000 A Interrupting		15,000 A Interrupting	
Max Voltage	Current Range	Max Voltage	Current Range
480Y/277V AC	0.5…32 A	415V AC	0.5…40 A
240V AC	0.5…40 A		
48V DC 1 pole	0.5…40 A	48V DC	
96V DC 2 pole			

1489-D DC Configuration

- DIN rail mounting
- Thermal-Magnetic
- Finger safe (front)
- Polarity must be observed

UL/CSA		IEC	
10,000 A Interrupting		10,000 A Interrupting	
Max Voltage	Current Range	Max Voltage	Current Range
1 pole – 125V DC	2…40 A	1 pole – 250V DC	2…40 A
2 pole – 250V DC		2 pole – 500V DC	

LISTEN. THINK. SOLVE.®

Specification Overview

<table>
<tr><th></th><th colspan="5">1489-A</th><th colspan="4">1489-D</th></tr>
<tr><td>Number of Poles</td><td colspan="5">1, 2 and 3 pole</td><td colspan="4">1 and 2 pole</td></tr>
<tr><td>Specification/ Rating/Certification</td><td colspan="9">UL489, CSA 22.2 No. 5, IEC 60 947-2</td></tr>
<tr><td>Approvals</td><td colspan="5">UL Listed Circuit Breaker, File Number E197878),
CSA Certified, VDE Certified, CE</td><td colspan="4">UL Listed Circuit Breaker, File Number E197878),
CSA Certified, CE</td></tr>
<tr><td>HACR Rating (US/Canada)</td><td colspan="5">Yes</td><td colspan="4">N/A</td></tr>
<tr><td>SWD Rating (US/Canada)</td><td colspan="5">Yes</td><td colspan="4">N/A</td></tr>
<tr><td>Calibration Temperature</td><td colspan="9">UL/CSA – 40 °C EN/IEC – 30 °C</td></tr>
<tr><td rowspan="8">Rated Interrupting Capacity</td><td>Trip Curve</td><td colspan="2">Rated Current (In)</td><td>Interrupt Rating (UL/CSA)</td><td>Icu (EN/IEC)</td><td>Interrupt Rating (UL/CSA)</td><td colspan="3">Icu (EN/IEC)</td></tr>
<tr><td rowspan="3">C curve</td><td colspan="2">0.5…15 A</td><td>10,000 A</td><td rowspan="6">15,000 A</td><td rowspan="6">10,000 A</td><td colspan="3" rowspan="6">10,000 A</td></tr>
<tr><td colspan="2">16…25 A</td><td>14,000 A</td></tr>
<tr><td colspan="2">30…40 A</td><td>10,000 A</td></tr>
<tr><td rowspan="3">D curve</td><td colspan="2">0.5…10 A</td><td>10,000 A</td></tr>
<tr><td colspan="2">13…20 A</td><td>14,000 A</td></tr>
<tr><td colspan="2">25…40 A</td><td>10,000 A</td></tr>
<tr><td rowspan="5">Rated Tripping Current</td><td colspan="2">UL/CSA</td><td colspan="2">IEC</td><td colspan="2">UL/CSA</td><td colspan="2">IEC</td></tr>
<tr><td>Max Voltage</td><td>Current Range</td><td>Max Voltage</td><td>Current Range</td><td>Max Voltage</td><td>Current Range</td><td>Max Voltage</td><td>Current Range</td></tr>
<tr><td>480Y/277V AC</td><td>0.5…32 A</td><td rowspan="2">415V AC</td><td rowspan="3">0.5…40 A</td><td rowspan="3">1 pole – 125V DC
2 pole – 250V DC</td><td rowspan="3">2…40 A</td><td rowspan="3">1 pole – 250V DC
2 pole – 500V DC</td><td rowspan="3">2…40 A</td></tr>
<tr><td>240V AC</td><td>0.5…40 A</td></tr>
<tr><td>48V DC 1 pole
96V DC 2 pole</td><td>0.5…40 A</td><td>48V DC</td></tr>
<tr><td>Degree of Protection</td><td colspan="9">Finger Safe from Front – (IP20 per IEC 529 from Front – IP00 at wire terminals)</td></tr>
<tr><td>Normal Operating Environment</td><td colspan="9">-25 C…+55 C (non-condensing) with rerating due to ambient temperature</td></tr>
<tr><td>Trip Curves</td><td colspan="5">C Curve (Inductive) 5…10 In
D Curve (Highly Inductive) 10…20 In)</td><td colspan="4">C Curve 7…15 In</td></tr>
</table>

Additional, add-on components

- Auxiliary Contacts
- Signal Contacts
- Shunt Trip Modules
- Lock Off Attachments
- Bus Bars

1489* – A 1 C 050 R

Bulletin Number
UL489/CSA 22.2 No 5 Circuit Breaker IEC 60 947-2 MCB

Configuration	
A	AC (standard) configuration
D	DC configuration

Number of Poles	
1	1 pole
2	2 pole
3	3 pole

Trip Curve	
C	Standard (inductive)
D	Highly Inductive

Current Rating	
005	0.5 A
010	1 A
015	1.5 A
020	2 A
030	3 A
040	4 A
050	5 A
060	6 A
070	7 A
080	8 A
100	10 A
130	13 A
150	15 A
160	16 A
200	20 A
250	25 A
300	30 A
320	32 A
350	35 A
400	40 A

Optional	
R	Ring Terminal

* Important: The following catalog number breakdown is for explanation purposes only. It is NOT a product configurator. Not all combinations of fields may be valid catalog numbers.

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Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation NV, Pegasus Park, De Kleetlaan 12a, 1831 Diegem, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

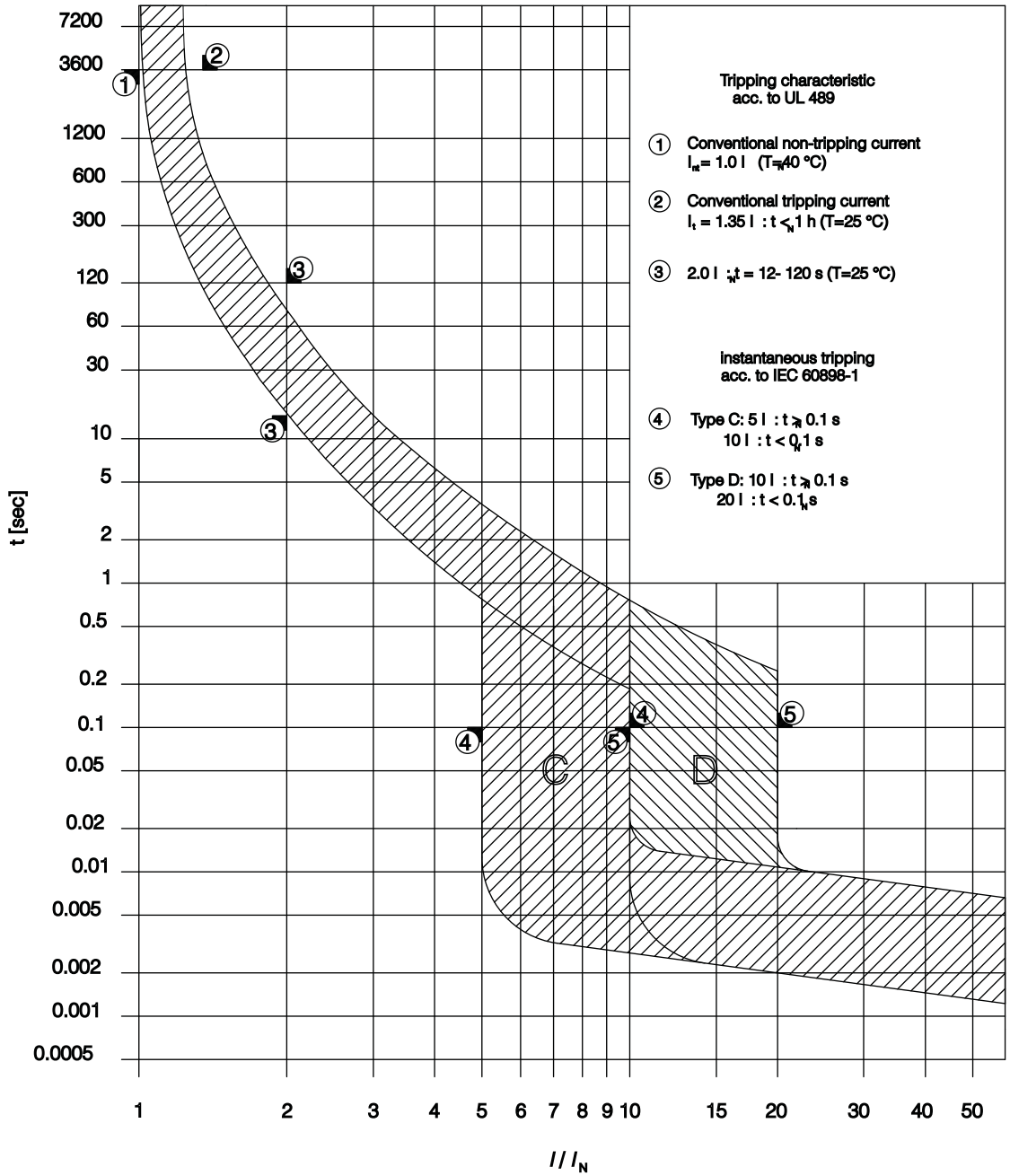
Publication 1489-PP001B-EN-P – December 2010
Supersedes Publication 1489-PP001A-EN-P – August 2005

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Time-Current Characteristic Bulletin 1489

Type C and D

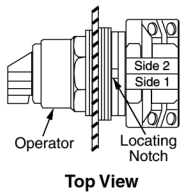
Ambient Temperature 40 °C



Harmony™ 9001K/SK/KX
30 mm push buttons
9001SK – Selector switches

Note: When ordering, add prefix "9001" to the reference.

3-Position Selector Switches



Top View

Contact Block Required			1 — Contact Closed																	
Contact Block Position	Quantity and Type	Mount on Side	Center	Center	Center	Center	Center	Center	Center	Center	Center									
KA1 or KA3	KA1 or KA3	KA1 #2 or KA3 #2	1 0 0	1 0 0	0 0 1	1 0 0	1 0 0	1 0 0	1 0 0	1 0 0	0 1 0	1 1 0								
	KA2	KA2 #2	0 1 1	0 0 1	0 1 0	0 1 0	0 0 1	0 1 1	0 1 1	1 0 0	0 0 1									
KA1 or KA3	KA1 or KA3	KA1 #1 or KA3 #1	0 0 1	1 0 0	0 0 1	1 0 0	0 1 0	0 0 1	1 0 1	0 0 1	0 1 1									
	KA2	KA2 #1	1 1 0	0 0 1	0 1 0	0 1 0	0 0 1	1 0 0	0 1 0	0 1 0	1 0 0									
Cam (see page 47)			**B**	**C**	**D**	**E**	**F**	**G**	**J**	**L**	**M**									

Non-Illuminated Operators

Manual Return, Operator Only (without contact blocks) *(1)*									
Without Knob	**SKS42**	**SKS43**	**SKS44**	**SKS45**	**SKS46**	**SKS47**	**SKS49**	**SKS401**	**SKS402**
With Knob (select style and color from table below)	**SKS42♦**	**SKS43♦**	**SKS44♦**	**SKS45♦**	**SKS46♦**	**SKS47♦**	**SKS49♦**	**SKS401♦**	**SKS402♦**
Operator with Contact Blocks and Standard black knob *(4)*									
With 1 KA1 on Side #2 (H13)	**SKS42BH13**	**SKS43BH13**	**SKS44BH13**	**SKS45BH13**	**SKS46BH13**	**SKS47BH13**	**SKS49BH13**	**SKS401BH13**	**SKS402BH13**
With 1 KA1 on Side #1 (H1)	**SKS42BH1**	**SKS43BH1**	**SKS44BH1**	**SKS45BH1**	**SKS46BH1**	**SKS47BH1**	**SKS49BH1**	**SKS401BH1**	**SKS402BH1**
With 1 KA1 on Side #1 and 1 KA1 on side #2 (H2)	**SKS42BH2**	**SKS43BH2**	**SKS44BH2**	**SKS45BH2**	**SSKS46BH2**	**SKS47BH2**	**SKS49BH2**	**SKS401BH2**	**SKS402BH2**
Spring Return from Left to Center, Operator Only (without contact blocks) *(1)*									
Without Knob	**SKS62**	**SKS63**	**SKS64**	**SKS65**	**SKS66**	**SKS67**	**SKS69**	**SKS601**	**SKS602**
With Knob (select style and color from table below)	**SKS62♦**	**SKS63♦**	**SKS64♦**	**SKS65♦**	**SKS66♦**	**SKS67♦**	**SKS69♦**	**SKS601♦**	**SKS602♦**
Spring Return from Right to Center, Operator Only (without contact blocks) *(1)*									
Without Knob	**SKS72**	**SKS73**	**SKS74**	**SKS75**	**SKS76**	**SKS77**	**SKS79**	**SKS701**	**SKS702**
With Knob (select style and color from table below)	**SKS72♦**	**SKS73♦**	**SKS74♦**	**SKS75♦**	**SKS76♦**	**SKS77♦**	**SKS79♦**	**SKS701♦**	**SKS702♦**
Spring Return from Both Sides to Center, Operator Only (without contact blocks) *(1)*									
Without Knob	**SKS52**	**SKS53**	**SKS54**	**SKS55**	**SKS56**	**SKS57**	**SKS59**	**SKS501**	**SKS502**
With Knob (select style and color from table below)	**SKS52♦**	**SKS53♦**	**SKS54♦**	**SKS55♦**	**SKS56♦**	**SKS57♦**	**SKS59♦**	**SKS501♦**	**SKS502♦**

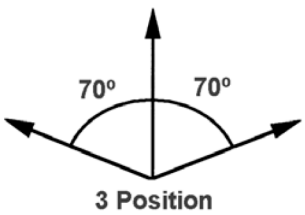
Illuminated Operators

Manual Return, Operator Only (without contact blocks) *(1)*									
Without Knob, 110-120V 50-60 Hz Transformer	**SK42J1**	**SK43J1**	**SK44J1**	**SK45J1**	**SK46J1**	**SK47J1**	**SK49J1**	**SK401J1**	**SK402J1**
With Standard Red Knob, 110-120V 50-60 Hz Transformer	**SK42J1R**	**SK43J1R**	**SK44J1R**	**SK45J1R**	**SK46J1R**	**SK47J1R**	**SK49J1R**	**SK401J1R**	**SK402J1R**
With Other Color Knob and other voltage Light Module *(2) (3)*	**SK42J■♦**	**SK43J■♦**	**SK44J■♦**	**SK45J■♦**	**SK46J■♦**	**SK47J■♦**	**SK49J■♦**	**SK401J■♦**	**SK402J■♦**
Spring Return from Left to Center, Operator Only (without contact blocks) *(1)*									
Without Knob, 110-120V 50-60 Hz Transformer	**SK62J1**	**SK63J1**	**SK64J1**	**SK65J1**	**SK66J1**	**SK67J1**	**SK69J1**	**SK601J1**	**SK602J1**
With Standard Red Knob, 110-120V 50-60 Hz Transformer	**SK62J1R**	**SK63J1R**	**SK64J1R**	**SK65J1R**	**SK66J1R**	**SK67J1R**	**SK69J1R**	**SK601J1R**	**SK602J1R**
With Other Color Knob and other voltage Light Module *(2) (3)*	**SK62J■♦**	**SK63J■♦**	**SK64J■♦**	**SK65J■♦**	**SK66J■♦**	**SK67J■♦**	**SK69J■♦**	**SK601J■♦**	**SK602J■♦**
Spring Return from Right to Center, Operator Only (without contact blocks) *(1)*									
Without Knob, 110-120V 50-60 Hz Transformer	**SK72J1**	**SK73J1**	**SK74J1**	**SK75J1**	**SK76J1**	**SK77J1**	**SK79J1**	**SK701J1**	**SK702J1**
With Standard Red Knob, 110-120V 50-60 Hz Transformer	**SK72J1R**	**SK73J1R**	**SK74J1R**	**SK75J1R**	**SK76J1R**	**SK77J1R**	**SK79J1R**	**SK701J1R**	**SK702J1R**
With Other Color Knob and other voltage Light Module *(2) (3)*	**SK72J■♦**	**SK73J■♦**	**SK74J■♦**	**SK75J■♦**	**SK76J■♦**	**SK77J■♦**	**SK79J■♦**	**SK701J■♦**	**SK702J■♦**
Spring Return from Both Sides to Center, Operator Only (without contact blocks) *(1)*									
Without Knob, 110-120V 50-60 Hz Transformer	**SK52J1**	**SK53J1**	**SK54J1**	**SK55J1**	**SK56J1**	**SK57J1**	**SK59J1**	**SK501J1**	**SK502J1**
With Standard Red Knob, 110-120V 50-60 Hz Transformer	**SK52J1R**	**SK53J1R**	**SK54J1R**	**SK55J1R**	**SK56J1R**	**SK57J1R**	**SK59J1R**	**SK501J1R**	**SK502J1R**
With Other Color Knob and other voltage Light Module *(2) (3)*	**SK52J■♦**	**SK53J■♦**	**SK54J■♦**	**SK55J■♦**	**SK56J■♦**	**SK57J■♦**	**SK59J■♦**	**SK501J■♦**	**SK502J■♦**

▲ *These operators can be ordered complete with contact blocks. Add the "H code" from page 51 as needed for your application.*
■ *Replace ■ with the voltage assembly code as chosen from the tables on page 54. Example: K25J■ with 208Vac = K25J3.*
♦ *Replace ♦ with the color code as chosen from the color code table below. For LED, knob color must match LED.*
★ *For other color knobs replace the B with knob color code from table below.*

Selector Switch Assembly Code and Knob Cat. No.

Color	Standard Knob ♦ Knob Code	Reference	Gloved Hand Knob ♦ Knob Code	Reference
Black	B	**B11**	FB	**B25**
Red	R	**R8**	FR	**R24**
Green	G	**G8**	FG	**G24**
Yellow	Y	**Y8**	FY	**Y24**
Blue	L	**L8**	FL	**L24**
White	W	**W8**	FW	**W24**
Amber	A	**A8**	FA	**A24**
Clear	C	**C8**	FC	**C24**



To select and order Contact Blocks, Light Modules, Knobs, and Accessories, see pages 50 to 59.

Product range: page 36 | Specifications: page 38 | Dimensions: page 60 | Mounting: page 61

Harmony™ 9001K/SK/KX
30 mm push buttons
9001SK

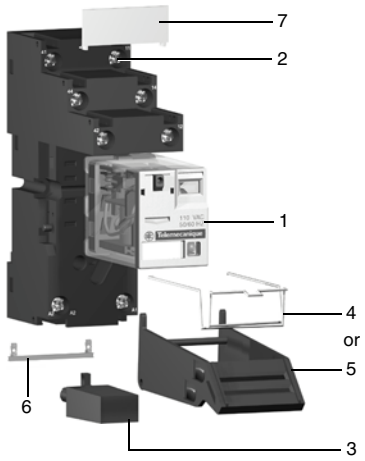
Environmental specifications

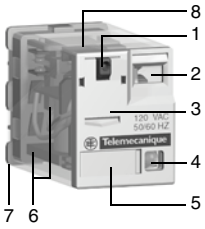
Conforming to standards	CE Marked		EN/IEC 60947-1, EN/IEC 60947-5-1, EN/IEC 60947-5-4, JIS C 4520 and 852, UL 508, CSA C22-2 n° 14, CE marked, RoHS compliant
Product certifications	UL File E78403 CCN NKCR; CSA File LR25490 Class 3211-03		UL File E78403, CCN NKCR and CSA File LR25490, Class 3211-03
Protective treatment standard version			"TC"
Ambient air temperature around the device	Storage	**°F (°C)**	-40 to +158 (-40 to +70)
	Operation	**°F (°C)**	-13 to +158 (-25 to +70)
Vibration resistance	Conforming to IEC 60068-2-6		Frequency: 2 to 500 Hz: 7gn Ford Standard EA-1
Shock resistance	Conforming to IEC 60068-2-27		Half sine wave: 50 gn
Electric shock protection	Conforming to IEC 61140		Class II
Degree of protection	Conforming to EN/IEC 60529		IP 66
	Conforming to NEMA		Types 1, 2, 3, 3R, 4, 12 and 13
Mechanical life (in millions of operating cycles)	Push buttons, spring return		5
	Illuminated push buttons		5
	Selector switches and key switches		0.5
Mounting position			All positions

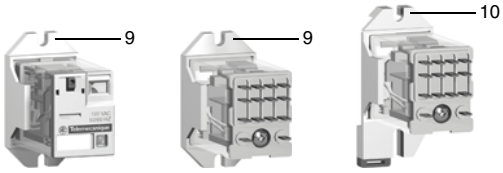
Electrical characteristics of contact blocks

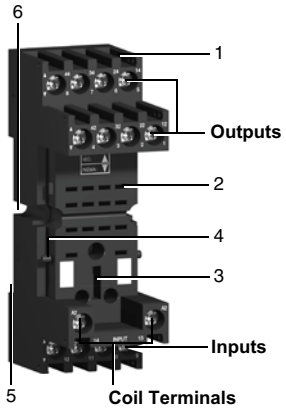
Rated operational characteristics	~ AC-15		3 A, 240 V			
	⎓ DC-13		0.55 A, 125 V			
Rated insulation voltage	Conforming to EN/IEC 60947-1	**V**	Ui = 250 degree of pollution 3 (except pilot lights with incandescent bulb: degree of pollution 2)			
Rated impulse withstand voltage	Conforming to EN/IEC 60947-1	**kV**	Uimp = 2.5			
Contact material	Normal environment and usage		Silver alloy			
Contact operation	"N/C" ou "N/O"		Slow break			
Positive operation	Conforming to EN/IEC 60947-5-1	**N**	N/C contact(s) with positive opening operation			
Short-circuit protection	Conforming to EN/IEC 60947-5-1	**A**	Cartridge fuse mounted upstream: 10			
Cabling capacity (9001KA contact blocks and 9001KM light modules)	Conforming to EN/IEC 60947-1	**mm²** **mm²**	Screw clamp terminals (cross headedslotted screw) Mini: 1 x 0.22 Maxi: 2 x 1.5 Recommended tightening torque: 0.8 N.m (10 in-lbs)			
Thermal current	Ith	**A**	10			
Maximum operation current	a.c. supply: utilization category AC-15 NEMA A600		Contact making capacity			
		V	120	240	480	600
		A	60	30	15	12
		VA	7200	7200	7200	7200
			Breaking capacity			
		V	120	240	480	600
		A	6	3	1.5	1.2
		VA	720	720	720	720
	d.c.supply: utilization category DC-13 NEMA Q600		Contact making capacity and breaking capacity			
		V	125	250	600	
		A	0.55	0.27	0.1	

Product range: page 36 | References: page 41 | Dimensions: page 60 | Mounting: page 61









Product Description

The RXM miniature relay range consists of:

1. 12 A relays with 2 C/O contacts, 10 A relays with 3 C/O contacts, 6 A relays with 4 C/O contacts, and 3 A “low level” relays with 4 C/O contacts. All these relays have the same dimensions.
2. Sockets with mixed or separate contact terminals.
3. Protection modules (diode, RC circuit or varistor). All these modules are common to all sockets.
4. A metal hold-down clip for all sockets.
5. A plastic hold-down clip for all sockets.
6. A 2-pole bus jumper that can be used on sockets with separate contact terminals to simplify wiring when creating a jumper between the coil terminals.
7. Clip-in markers for all the sockets except RXZ E2M114.

Relay Description

1. Spring return push button for testing the contacts (green: DC, red: AC).
2. Mechanical “relay status” indicator.
3. Removable lock-down door enabling forced maintaining of the contacts for test or maintenance purposes. During operation, this lock-down door must always be in the closed position.
4. Bipolar LED (depending on version) indicating the relay status.
5. Removable marker for relay identification.
6. Four notches for DIN rail mounting adapter or panel mounting adapter.
7. Eight, eleven, or fourteen pins.
8. Area by which the product can be easily gripped.
9. Mounting adapter enabling direct mounting of the relay on a panel.
10. Mounting adapter enabling direct mounting of the relay on a DIN rail.

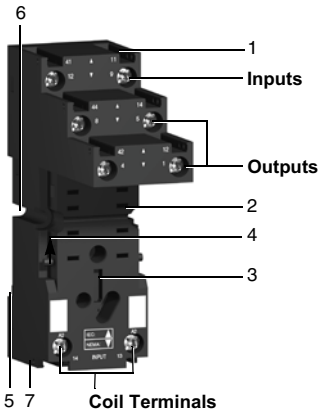
Socket Description

Sockets with Mixed Contact Terminals

1. Connection by screw clamp terminals or box lug connector.
2. Fourteen female contacts for the relay pins.
3. Location for protection modules.
4. Locking components for plastic and metal hold-down clips.
5. Locating slot for mounting on DIN rail.
6. Two or four mounting holes for panel mounting.

NOTE: The inputs are mixed with the relay coil terminals, with the outputs being located on the opposite side of the socket.

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Sockets with Separate Contact Terminals

1. Box lug connector.
2. Eight, eleven, or fourteen female contacts for the relay pins.
3. Location for protection modules.
4. Locking components for plastic and metal hold-down clips.
5. Locating slot for mounting on DIN rail.
6. Two mounting holes for panel mounting.
7. Location for bus jumpers (see mounting on sockets on page 10).

NOTE: The inputs and outputs are separated from the relay coil terminals.

General Characteristics

Conforming to standards		IEC/EN 61810-1 (iss. 2), UL 508, CSA C22-2 n° 14
Product certifications		cULus File E164862 CCN NLDX, NLDX7; cURus File E164862 CCN NLDX2, NLDX8; CSA pending; CE; RoHS compliant
Ambient air temperature around the device	Storage	-40—185 °F (-40—85 °C)
	Operation	-40—131 °F (-40—55 °C)
Vibration resistance	Conforming to IEC/EN 60068-2-6	> 6 gn (10–50 Hz)
Degree of protection	Conforming to IEC/EN 60529	IP 40
Shock resistance conforming to IEC/EN 60068-2-27	Opening	10 gn
	Closing	5 gn
Protection category (see page 36)		RT I
Mounting position		Any

Insulation characteristics

Rated insulation voltage (Ui)		250 V (IEC), 300 V (UL, CSA)
Rated impulse withstand voltage (Uimp)		3.6 kV (1.2/50 µs)
Dielectric strength (rms voltage)	Between coil and contact	2,500 Vac
	Between poles	2,500 Vac
	Between contacts	1,500 Vac

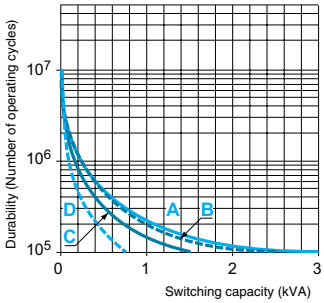
Contact characteristics

Relay type			**RXM 2AB●●●**	**RXM 3AB●●●**	**RXM 4AB●●●**	**RXM 4GB●●●**
Number and type of contacts (see page 11)			2 C/O	3 C/O	4 C/O	4 C/O
Contact materials			AgNi			AgAu
Conventional thermal current (Ith)	For ambient temperature ⩽ 131 °F (55 °C)		12 A	10 A	6 A	3 A
Rated operational current	Conforming to IEC in utilization category AC-1	N/O	12 A	10 A	6 A	2 A
		N/C	6 A	5 A	3 A	1 A
	Conforming to UL (resistive@277 Vac)		12 A	10 A	6 A	3 A
Maximum operating rate In operating cycles/hour	No load		18,000			
	Under load		1,200			
Switching voltage	Maximum		250 Vac/Vdc			
Switching capacity	Minimum		10 mA on 17 V			2 mA on 5 V
	Maximum		3,000 VA	2,500 VA	1,500 VA	750 VA
Utilization coefficient			20%			
Mechanical durability in millions of operating cycles			10			
Electrical durability in millions of operating cycles	Resistive load		0.1			

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Electrical Durability of Contacts

Resistive load AC



A=RXM 2AB●●● B=RXM 3AB●●● C=RXM 4AB●●● D=RXM 4GB●●●

Coil characteristics

Average consumption		AC	1.2 VA
		DC	0.9 W
Drop-out voltage threshold		AC	⩾ 0.15 Uc
		DC	⩾ 0.1 Uc
Operating time (response time)	Between coil energization and making of the N/O contact	AC	20 ms
		DC	20 ms
	Between coil de-energization and making of the N/C contact	AC	20 ms
		DC	20 ms

Coil voltage Uc			**12 V**	**24 V**	**48 V**	**110 V**	**120 V**	**125 V**	**220 V**	**230 V**	**240 V**
Relay coil voltage codes			**JD**	**BD**	**ED**	**FD**	**–**	**GD**	**MD**	**–**	**–**
DC	Average resistance at 68 °F (20 °C) ± 10%		160 Ω	650 Ω	2,600 Ω	11,000 Ω	–	11,000 Ω	14,000 Ω	–	–
	Operating voltage limits	Min.	9.6 V	19.2 V	38.4 V	88 V	–	100 V	176 V	–	–
		Max.	13.2 V	26.4 V	52.8 V	121 V	–	138 V	242 V	–	–
Relay coil voltage codes			**–**	**B7**	**E7**	**–**	**F7**	**–**	**M7**	**P7**	**U7**
AC	Average resistance at 68 °F (20 °C) ± 15%		–	180 Ω	770 Ω	–	4,430 Ω	–	15,000 Ω	15,000 Ω	15,500 Ω
	Operating voltage limits	Min.	–	19.2 V	38.4 V	–	96 V	–	176 V	184 V	192 V
		Max.	–	26.4 V	52.8 V	–	132 V	–	242 V	253 V	264 V

Socket characteristics

Socket type		**RXZ E2S108M**	**RXZ E2S111M**	**RXZ E2S114M**	**RXZ E2M114**	**RXZ E2M114M**
Relay types used		**RXM 2●●●●●**	**RXM 3●●●●●**	**RXM 4●●●●●**	**RXM 2●●●●●**[1] **RXM 4●●●●●**	**RXM 2●●●●●**[1] **RXM 4●●●●●**
Product certifications		cURus File E172326 CCN SWIV2, SWIV8; CSA (pending); CE; RoHS compliant				
Conventional thermal current (Ith)		12 A	10 A			
Degree of protection	Conforming to IEC/EN 60529	IP 20				
Connection	Solid wire without cable end	1 conductor: AWG 20–12 (0.5–2.5 mm^2) 2 conductors: AWG 20–14 (0.5–1.5 mm^2)				
	Flexible wire with cable end	1 conductor: AWG 24–14 (0.2–2.5 mm^2) 2 conductors: AWG 24–16 (0.2–1.5 mm^2)				
	Flexible wire without cable end	1 conductor: AWG 24–14 (0.2–2.5 mm^2) 2 conductors: AWG 24–16 (0.2–1.5 mm^2)				
Maximum tightening torque		5.3 lbf-in (0.6 N●m) (M3 screw)				
Contact terminal arrangement		Separate			Mixed	
Bus jumper Ith: 5 A		Yes			No	

[1] When mounting relay RXM 2●●●●● on socket RXZ E2M●●●●, the thermal current must not exceed 10 A.

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RXM ●AB2F7

Miniature relays without LED (sold in lots of 10)

	Number and type of contacts - Thermal current (Ith)										
	2 C/O -12 A			3 C/O - 10 A			4 C/O - 6 A				
Coil Voltage	Catalog Number	Weight		Catalog Number	Weight		Catalog Number	Weight	
		lb.	kg		lb.	kg		lb.	kg
12 Vdc	**RXM 2AB1JD**	0.08	0.037	**RXM 3AB1JD**	0.08	0.038	**RXM 4AB1JD**	0.08	0.036
24 Vdc	**RXM 2AB1BD**	0.08	0.037	**RXM 3AB1BD**	0.08	0.038	**RXM 4AB1BD**	0.08	0.036
48 Vdc	**RXM 2AB1ED**	0.08	0.037	**RXM 3AB1ED**	0.08	0.038	**RXM 4AB1ED**	0.08	0.036
110 Vdc	**RXM 2AB1FD**	0.08	0.037	**RXM 3AB1FD**	0.08	0.038	**RXM 4AB1FD**	0.08	0.036
220 Vdc	–	–	–	–	–	–	**RXM 4AB1MD**	0.08	0.036
24 Vac	**RXM 2AB1B7**	0.08	0.037	**RXM 3AB1B7**	0.08	0.038	**RXM 4AB1B7**	0.08	0.036
48 Vac	**RXM 2AB1E7**	0.08	0.037	**RXM 3AB1E7**	0.08	0.038	**RXM 4AB1E7**	0.08	0.036
120 Vac	**RXM 2AB1F7**	0.08	0.037	**RXM 3AB1F7**	0.08	0.038	**RXM 4AB1F7**	0.08	0.036
230 Vac	**RXM 2AB1P7**	0.08	0.037	**RXM 3AB1P7**	0.08	0.038	**RXM 4AB1P7**	0.08	0.036
240 Vac	–	–	–	–	–	–	**RXM 4AB1U7**	0.08	0.036
Miniature relays with LED (sold in lots of 10)									
12 Vdc	**RXM 2AB2JD**	0.08	0.037	**RXM 3AB2JD**	0.08	0.038	**RXM 4AB2JD**	0.08	0.036
24 Vdc	**RXM 2AB2BD**	0.08	0.037	**RXM 3AB2BD**	0.08	0.038	**RXM 4AB2BD**	0.08	0.036
48 Vdc	**RXM 2AB2ED**	0.08	0.037	**RXM 3AB2ED**	0.08	0.038	**RXM 4AB2ED**	0.08	0.036
110 Vdc	**RXM 2AB2FD**	0.08	0.037	**RXM 3AB2FD**	0.08	0.038	**RXM 4AB2FD**	0.08	0.036
125 Vdc	–	–	–	–	–	–	**RXM 4AB2GD**	0.08	0.036
24 Vac	**RXM 2AB2B7**	0.08	0.037	**RXM 3AB2B7**	0.08	0.038	**RXM 4AB2B7**	0.08	0.036
48 Vac	**RXM 2AB2E7**	0.08	0.037	**RXM 3AB2E7**	0.08	0.038	**RXM 4AB2E7**	0.08	0.036
120 Vac	**RXM 2AB2F7**	0.08	0.037	**RXM 3AB2F7**	0.08	0.038	**RXM 4AB2F7**	0.08	0.036
230 Vac	**RXM 2AB2P7**	0.08	0.037	**RXM 3AB2P7**	0.08	0.038	**RXM 4AB2P7**	0.08	0.036



RXM 4GB2F7

Miniature relays with low level contacts, without LED (sold in lots of 10)

Number and type of contacts - Thermal current (Ith)			
4 C/O -3 A			
Coil Voltage	Catalog Number	Weight	
		lb.	kg
12 Vdc	**RXM 4GB1JD**	0.08	0.036
24 Vdc	**RXM 4GB1BD**	0.08	0.036
48 Vdc	**RXM 4GB1ED**	0.08	0.036
110 Vdc	**RXM 4GB1FD**	0.08	0.036
24 Vac	**RXM 4GB1B7**	0.08	0.036
48 Vac	**RXM 4GB1E7**	0.08	0.036
120 Vac	**RXM 4GB1F7**	0.08	0.036
230 Vac	**RXM 4GB1P7**	0.08	0.036

Miniature relays with low level contacts, with LED (sold in lots of 10)

Number and type of contacts - Thermal current (Ith)			
4 C/O -3 A			
Coil Voltage	Catalog Number	Weight	
		lb.	kg
12 Vdc	**RXM 4GB2JD**	0.08	0.036
24 Vdc	**RXM 4GB2BD**	0.08	0.036
48 Vdc	**RXM 4GB2ED**	0.08	0.036
110 Vdc	**RXM 4GB2FD**	0.08	0.036
24 Vac	**RXM 4GB2B7**	0.08	0.036
48 Vac	**RXM 4GB2E7**	0.08	0.036
120 Vac	**RXM 4GB2F7**	0.08	0.036
230 Vac	**RXM 4GB2P7**	0.08	0.036
240 Vac	**RXM 4GB2U7**	0.08	0.036

See page 8 for sockets and accessories.

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RXZ E2M114M with relay RXM 4AB2P7TQ

Miniature relays without LED (sold in lots of 100)

Coil Voltage	Number and type of contacts - Thermal current (Ith)					
	2 C/O - 12 A			4 C/O - 6 A		
	Catalog Number	Weight		Catalog Number	Weight	
		lb.	kg		lb.	kg
12 Vdc	–	–	–	**RXM 4AB1JDTQ**	0.08	0.036
24 Vdc	**RXM 2AB1BDTQ**	0.08	0.037	**RXM 4AB1BDTQ**	0.08	0.036
48 Vdc	–	–	–	**RXM 4AB1EDTQ**	0.08	0.036
110 Vdc	–	–	–	**RXM 4AB1FDTQ**	0.08	0.036
220 Vdc	–	–	–	**RXM 4AB1MDTQ**	0.08	0.036
24 Vac	**RXM 2AB1B7TQ**	0.08	0.037	**RXM 4AB1B7TQ**	0.08	0.036
48 Vac	–	–	–	**RXM 4AB1E7TQ**	0.08	0.036
120 Vac	**RXM 2AB1F7TQ**	0.08	0.037	**RXM 4AB1F7TQ**	0.08	0.036
230 Vac	**RXM 2AB1P7TQ**	0.08	0.037	**RXM 4AB1P7TQ**	0.08	0.036
Miniature relays with LED (sold in lots of 100)						
24 Vdc	–	–	–	**RXM 4AB2BDTQ**	0.08	0.036
24 Vac	**RXM 2AB2B7TQ**	0.08	0.037	**RXM 4AB2B7TQ**	0.08	0.036
230 Vac	**RXM 2AB2P7TQ**	0.08	0.037	**RXM 4AB2P7TQ**	0.08	0.036

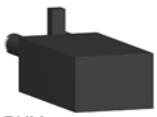


RXZ E2S114M with relay RXM 4AB2F7TQ

Sockets (sold in lots of 10)

Contact terminal arrangement	Connection	Relay type	Catalog Number	Weight	
				lb.	kg
Mixed	Screw clamp terminals	RXM 2●●●● [1] RXM 4●●●●	**RXZ E2M114** [2]	0.11	0.048
	Box lug connector	RXM 2●●●● [1] RXM 4●●●●	**RXZ E2M114M** [2]	0.12	0.056
Separate	Box lug connector	RXM 2●●●●	**RXZ E2S108M** [3]	0.13	0.058
		RXM 3●●●●	**RXZ E2S111M** [2]	0.15	0.066
		RXM 4●●●●	**RXZ E2S114M** [2]	0.15	0.070

1 When mounting relay RXM 2●●●●● on socket RXZ E2M●●●●, the thermal current must not exceed 10 A.
2 Thermal current Ith: 10 A
3 Thermal current Ith: 12 A



RXM 041●●7

Protection modules (sold in lots of 20)

Description	Voltage	For use with	Catalog Number	Weight	
				oz.	g
Diode	6–250 Vdc	All sockets	**RXM 040W**	0.11	3.0
RC circuit	24–60 Vac	All sockets	**RXM 041BN7**	0.35	10.0
	110–240 Vac	All sockets	**RXM 041FU7**	0.35	10.0
Varistor	6–24 Vac/Vdc	All sockets	**RXM 021RB**	1.06	30.0
	24–60 Vac/Vdc	All sockets	**RXM 021BN**	1.06	30.0
	110–240 Vac/Vdc	All sockets	**RXM 021FP**	1.06	30.0



RE XL4●●

Timing relays

Description	For use with	Catalog Number	Weight	
			lb.	kg
2 timed C/O contacts (function A—On-delay)	Sockets RXZ E●●●●●	**RE XL2●●** [4]	0.09	0.042
4 timed C/O contacts (function A—On-delay)		**RE XL4●●** [4]	0.09	0.042

4 Please refer to the *Zelio® Time - Timers* catalog (9050CT0001R2/05).



RXZ 400

Accessories (sold in lots of 10)

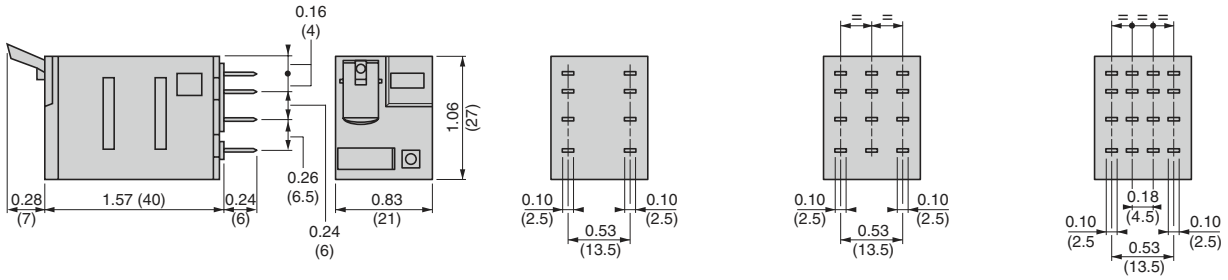
Description	For use with	Catalog Number	Weight	
			oz.	g
Metal hold-down clip	All sockets	**RXZ 400**	0.04	1.0
Plastic hold-down clip	All sockets	**RXZ R335**	0.18	5.0
Bus jumper, 2-pole (Ith: 5 A)	All sockets with separate contacts	**RXZ S2**	0.18	5.0
Mounting adapter for DIN rail [5]	All relays	**RXZ E2DA**	0.14	4.0
Mounting adapter for mounting directly to a panel	All relays	**RXZ E2FA**	0.07	2.0
Clip-in markers	All relays (sheet of 108 markers)	**RXZ L520**	2.82	80.0
	All sockets except RXZ E2M114	**RXZ L420**	0.04	1.0

5 Test button becomes inaccessible.

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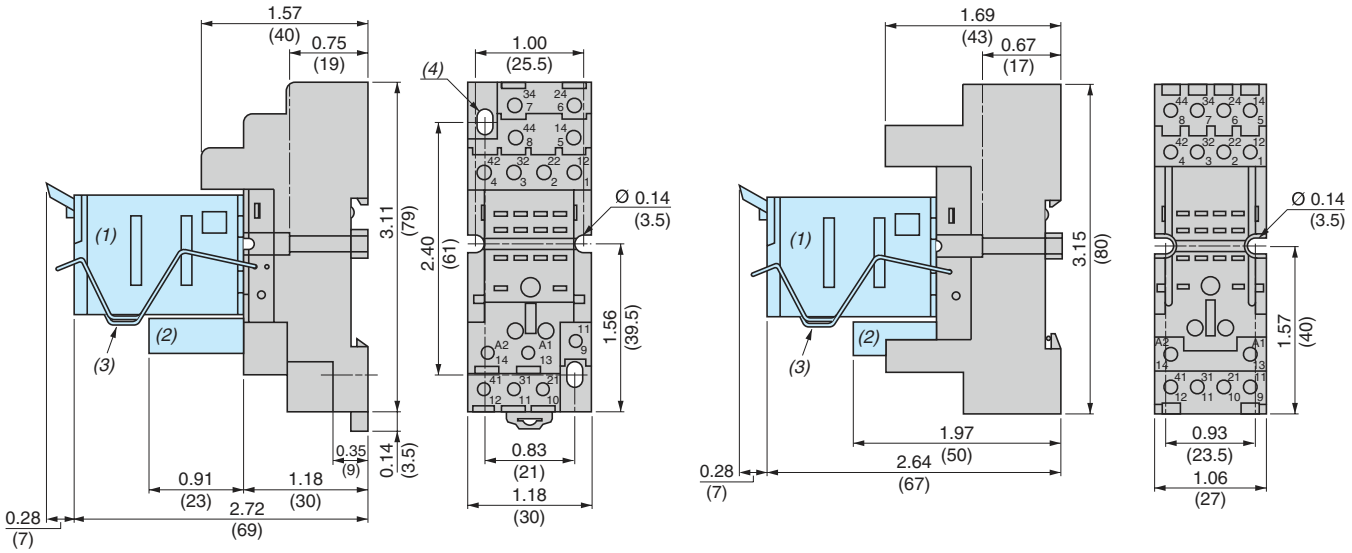
Relays

RXM ●●●●●●	RXM 2	RXM 3	RXM 4
Common view	Pin side view		

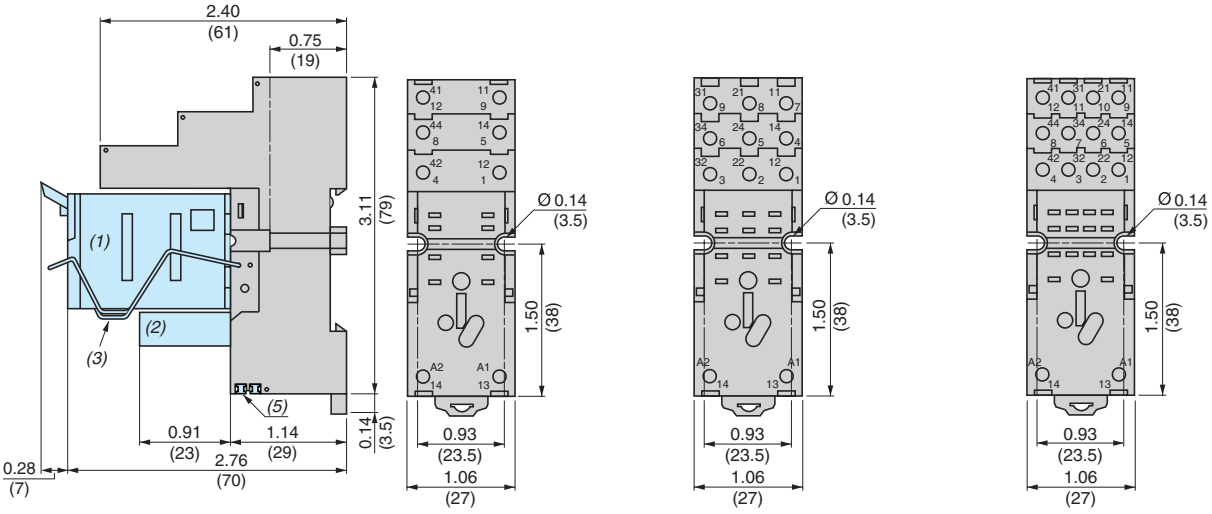


Sockets

RXZ E2M114	RXZ E2M114M



RXZ E2S●●●●	RXZ E2S108M	RXZ E2S111M	RXZ E2S114M
Common side view	Pin side view		



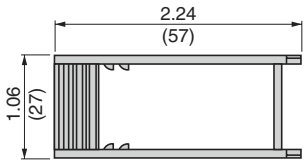
(1) Relays
(2) Add-on protection module
(3) Hold-down clip
(4) 2 elongated holes Ø 0.14 x 0.26 (3.5 x 6.5)
(5) 2 bus jumpers

Dimensions = Inches / (mm)

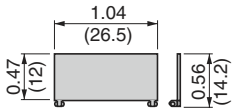
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Plastic clamp and clip-in markers

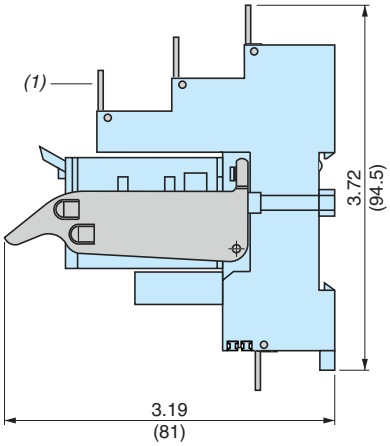
RXZ R335



RXZ L420



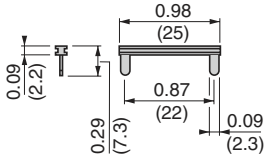
Mounting on all sockets



(1) Clip-in markers for all sockets except RXZ E2M114.

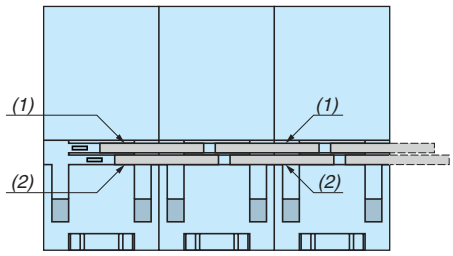
Bus jumper

RXZ S2



Mounting on sockets with separate contacts (view from below)

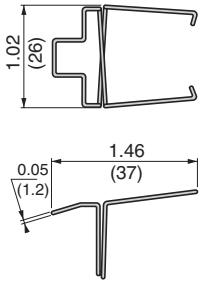
Example of bus jumper mounting on sockets



(1) 2 bus jumpers (polarity A2)
(2) 2 bus jumpers (polarity A1)

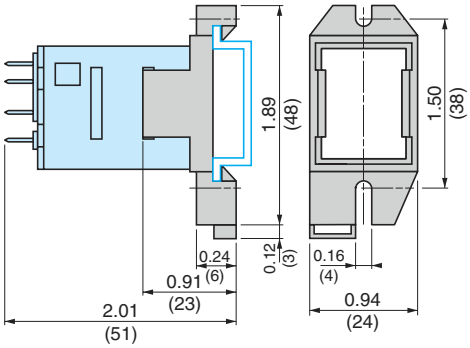
Metal clamp

RXZ 400



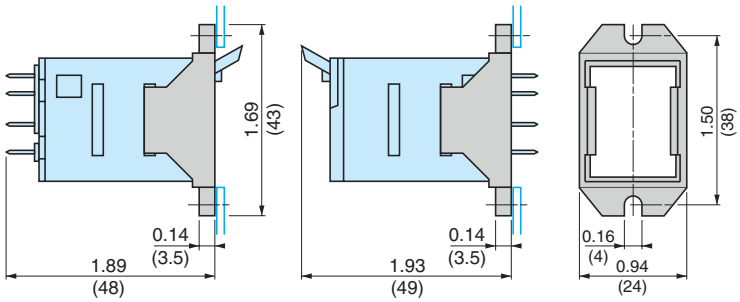
Mounting adapter for rail [1]

RXZ E2DA



Mounting adapter for panel

RXZ E2FA



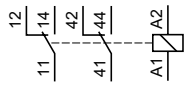
[1] Test button becomes inaccessible

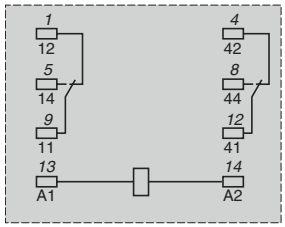
Dimensions = Inches / (mm)

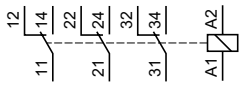
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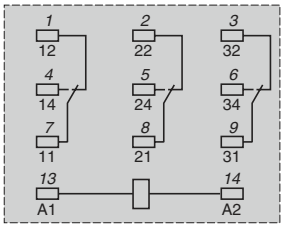
Miniature relays

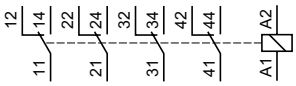
RXM 2●●●●●	RXM 3●●●●●	RXM 4●●●●●

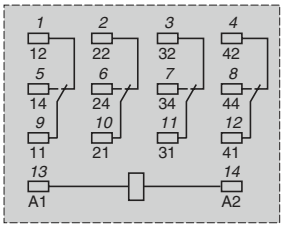












Numbers shown in *italics* correspond to NEMA marking. Viewed from pin end.

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Pilot Lights – UL Types 4, 4X, 13/NEMA Types 4, 4X, 13
For use in hazardous locations – See page 150. Legend Plate Not Included.

Description	Voltage	Style	With Red Fresnel Color Cap	With Green Fresnel Color Cap	With Other Color Cap	Without Color Cap
 Standard Pilot Light (Plastic fresnel color cap shown)	110-120 V, 50-60 Hz	Transformer	SKP1R31	SKP1G31	SKP1②	SKP1
	220-240 V, 50-60 Hz	Transformer	SKP7R31	SKP7G31	SKP7②	SKP7
	24-28 Vac-dc	Full Voltage	SKP35R31	SKP35G31	SKP35②	SKP35
	For other voltages see Table ①	Transformer, Flashing or LED ③	SKP①R31	SKP①G31	SKP①②	SKP①
		Full Voltage, Neon or Resistor ④	SKP①R31	SKP①G31	SKP①②	SKP①
 Push-To-Test Pilot Light (Plastic fresnel color cap shown)	110-120 V, 50-60 Hz	Transformer	SKT1R31	SKT1G31	SKT1②	SKT1
	220-240 V, 50-60 Hz	Transformer	SKT7R31	SKT7G31	SKT7②	SKT7
	24-28 Vac-dc	Full Voltage	SKT35R31	SKT35G31	SKT35②	SKT35
	For other voltages see Table ①	Transformer, Flashing or LED ③	SKT①R31	SKT①G31	SKT①②	SKT①
		Full Voltage, Neon or Resistor ④	SKT①R31	SKT①G31	SKT①②	SKT①
 Remote Test Pilot Light (Plastic fresnel color cap shown)	120 Vac Only	Resistor ⑤	SKTR38R31	SKTR38G31	SKTR38②	SKTR38
	24-28 Vac Only	Full Voltage ⑤	SKTR35R31	SKTR35G31	SKTR35②	SKTR35
	For other voltages see Tables ①②⑤	Full Voltage or Resistor⑤	SKTR①R31	SKTR①⑤G31	SKTR①②⑤	SKTR①
 Pilot Light For Intrinsically Safe Circuits (NEMA 4X)	Intrinsically safe equipment must not release electrical or thermal energy capable of igniting certain explosive or combustible hazardous atmosphere, for which the equipment has been tested. These pilot lights are intrinsically safe when used with a suitable approved barrier or barrier relay (Class 8501 Type TO or NY2). These pilot lights are Factory Mutual (FM approved). Consult your local Square D Sales Office for further details. These pilot lights are fully encapsulated — there are no replaceable parts — except for the SK40 ring nut. Use KN100 series plastic legend plates as shown on pages 152 and 153		KP44R	KP44G	KP44Y (Yellow Color Cap)	–
	Operating Voltage Range: 20-30 Vac/dc	Nominal Current: 25 mA	V max = 32 V I max = 165 mA			

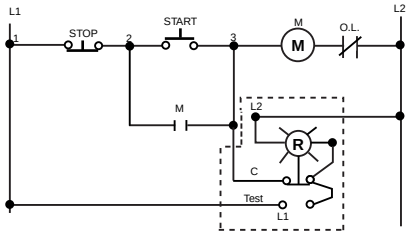
① Add the voltage assembly code as chosen from voltage assembly code table, page 145.
EXAMPLE: SKT①R31 with a 60Vac red LED voltage = SKT37LRR31.
② Add the color code as chosen from the color cap table below.
EXAMPLE: SKP1② with a blue fresnel cap = SKP1L31.
③ The color cap must be the same color as the LED voltage chosen (i.e., green LED use a green color cap) or use a clear cap.
④ On neon voltages use clear color caps only.
⑤ Use only full voltage or resistor voltage assembly codes on remote test pilot lights. Do not choose LED, or neon transformer codes. For AC use only.

Voltage Assembly Codes
See Page 145

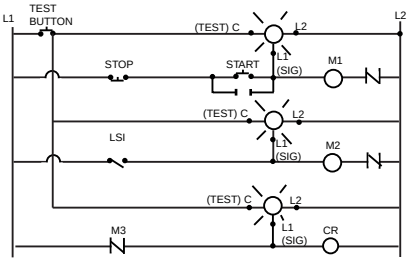
Color Caps

Color	② Plastic Fresnel	② Plastic Domed
		
Amber	A31	A9
Blue	L31	L9
Clear	C31	C9
Green	G31	G9
Red	R31	R9
White	W31	W9
Yellow	Y31	Y9

Typical Push-To-Test Wiring Diagram



Typical Remote Test Pilot Light Wiring Diagram

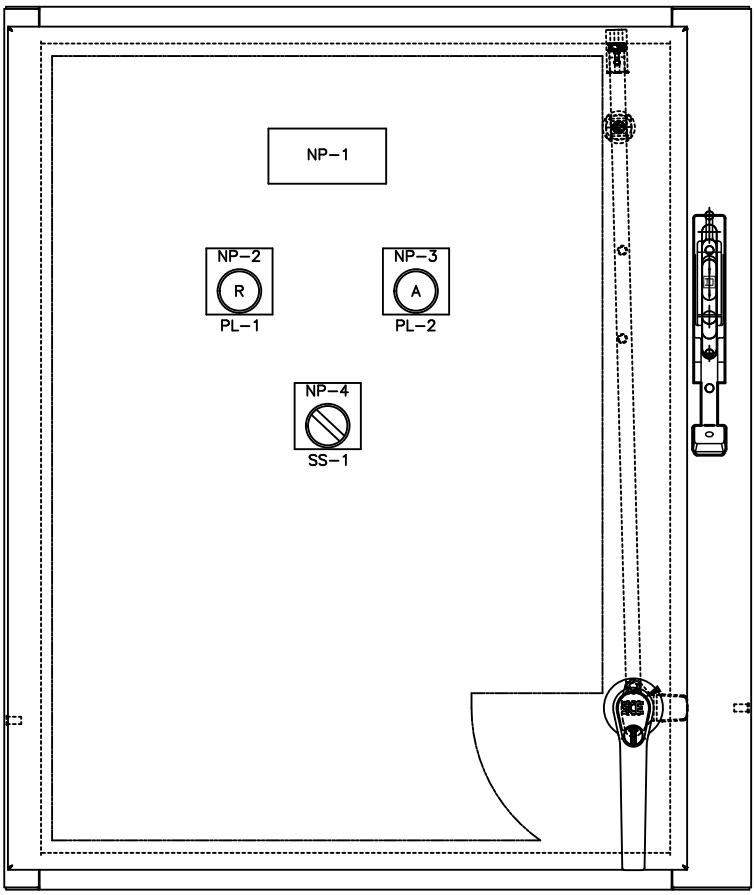


Basic Operators . . . . . Page 155
Boots . . . . . Page 154
Lamps . . . . . Page 148
Legend Plates . . . . . Pages 152-153
Light Modules . . . . . Page 148
Lockouts . . . . . Page 154
Outline Dimensions . . . . . Pages 159-160
Ratings . . . . . Pages 148
Replacement Parts . . . . . Page 158
Ring Nuts . . . . . Page 158

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REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		3/12/15

NAMEPLATE SCHEDULE			
No.	SIZE AND TEXT	FIRST LINE	SECOND LINE
NP–1	2" x 5", 3/8" LETTERS	AIR SPARGE	BLOWER X
NP–2	2–1/4" x 2–1/4", 5/32" LETTERS	RUNNING	
NP–3	2–1/4" x 2–1/4", 5/32" LETTERS	FAULT	
NP–4	2–1/4" x 2–1/4", 5/32" LETTERS	HAND OFF AUTO	
*NOTE: THERE ARE TWO CONTROL PANELS AIR SPARGE BLOWER 1, AIR SPARGE BLOWER 2			



NEMA 4X WALL MOUNT ENCLOSURE (30"H x 24"W x 10"D)
P/N: SCE–30XEL2410SSLP

DRAWING TYPICAL OF TWO:
AIR SPARGE BLOWER 1
AIR SPARGE BLOWER 2

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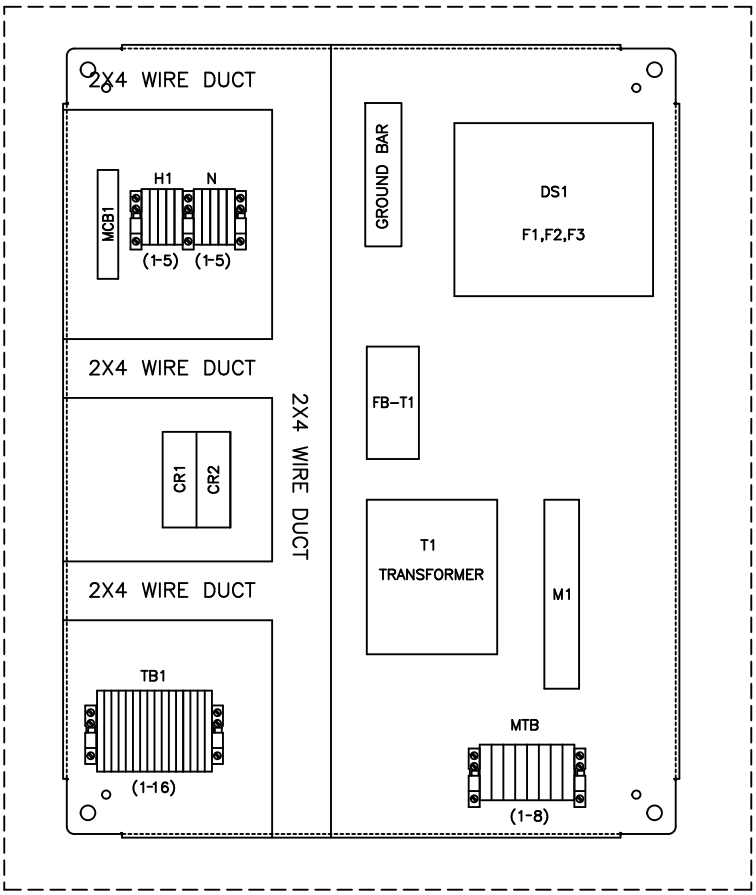
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I. KRUGER, INC.
4001 WESTON PARKWAY
CARY, NC 27513
(919) 677-8310

5700235402
MASSILLON, OH

IFAS
AIR SPARGE BLOWER LOCAL CONTROL PANEL
FRONT PANEL LAYOUT

DRAWN	CHECKED		SCALE	DRAWING NO	SHEET	REV
MRO	MRO			P-001	1 of 4	0

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		3/12/15



BACKPANEL 27"H x 21"W
P/N: SCE-30P24

DRAWING TYPICAL OF TWO:
AIR SPARGE BLOWER 1
AIR SPARGE BLOWER 2

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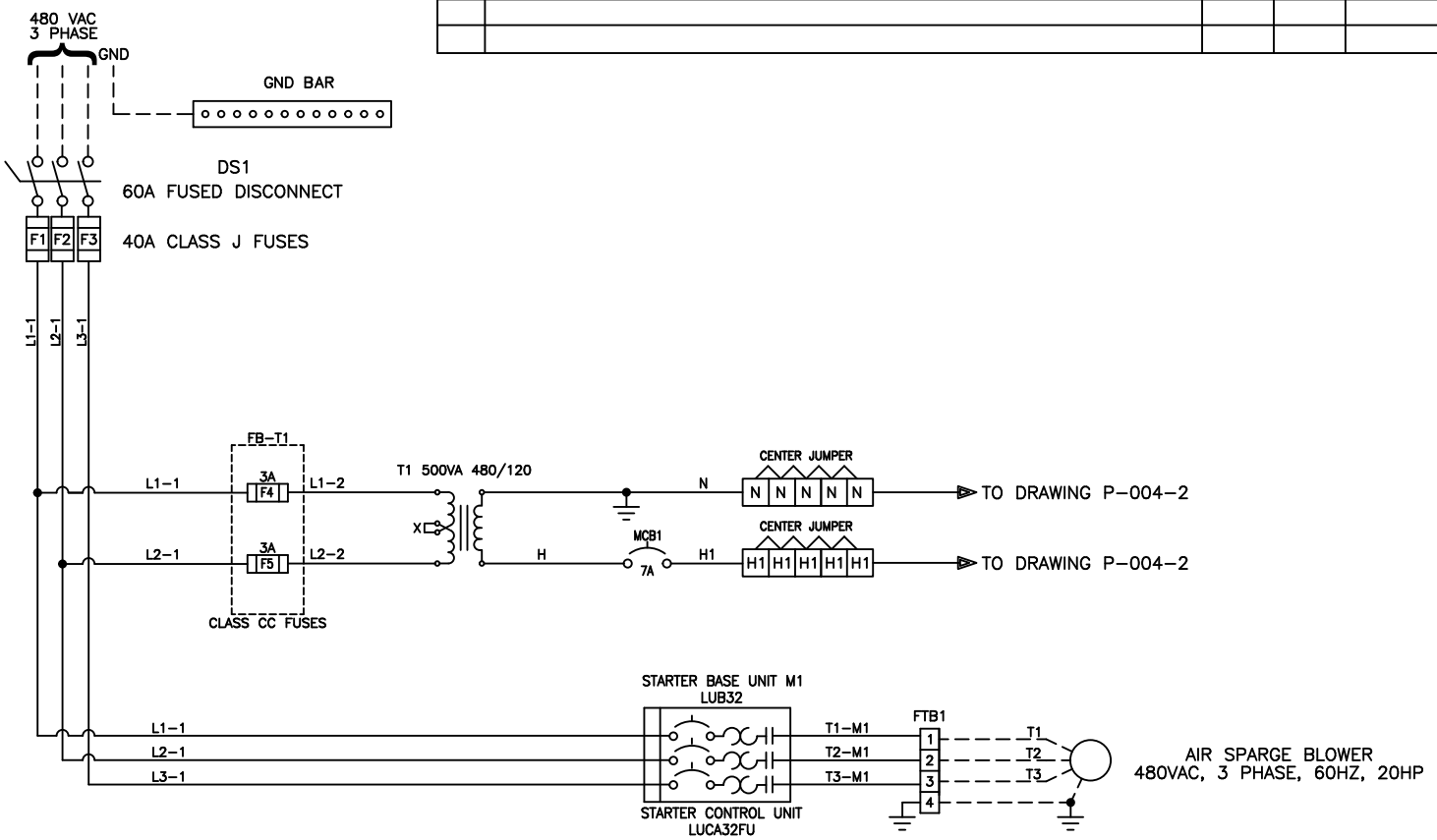
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IFAS
AIR SPARGE BLOWER LOCAL CONTROL PANEL
BACK PANEL LAYOUT

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRO	MRO		P-002	2 of 4	0

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		3/12/15



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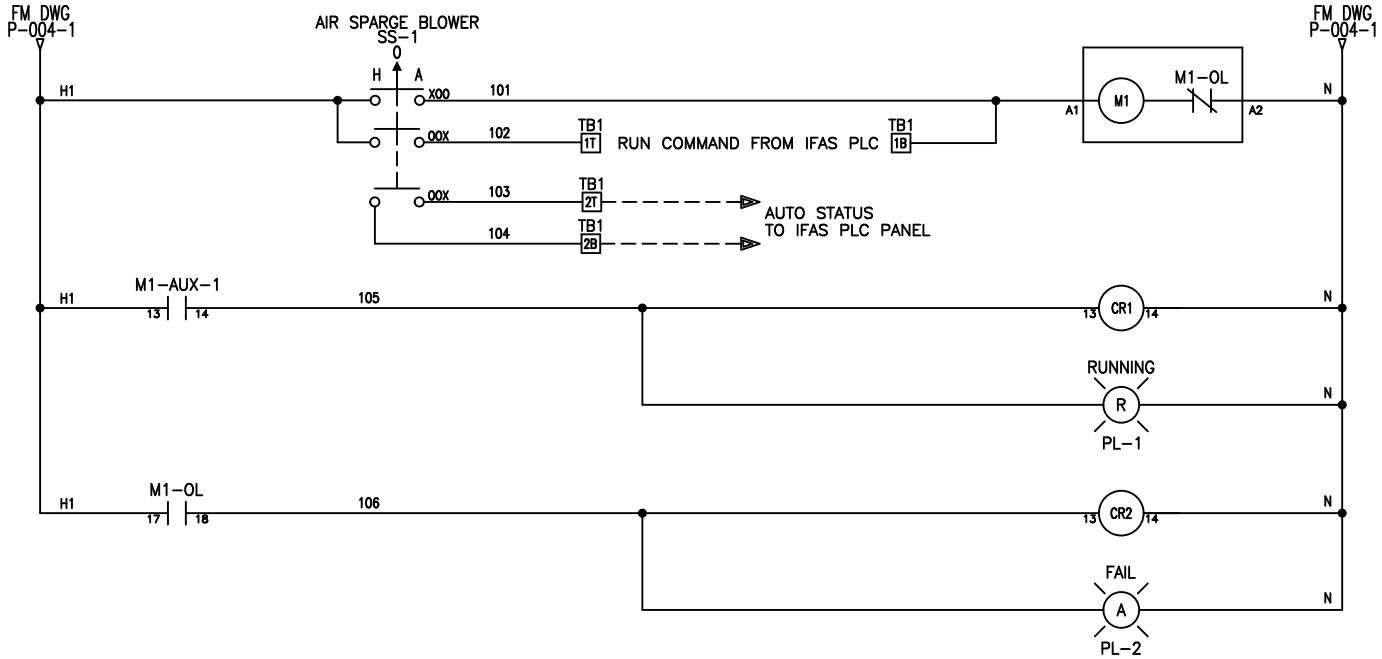
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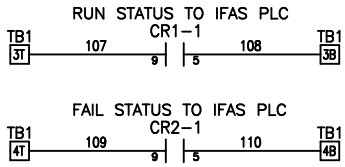
5700235402
MASSILLON, OH

IFAS
AIR SPARGE BLOWER LOCAL CONTROL PANEL
POWER DISTRIBUTION

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRO	MRO		P-004-1	3 of 4	0

REV	DESCRIPTION	DRAWN	APPR	DATE
0	ISSUED FOR APPROVAL	MRO		3/12/15





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(919) 677-8310

5700235402
MASSILLON, OH

IFAS
AIR SPARGE BLOWER LOCAL CONTROL PANEL
POWER DISTRIBUTION

DRAWN	CHECKED	SCALE	DRAWING NO	SHEET	REV
MRO	MRO		P-004-2	4 of 4	0

KRÜGER

SECTION 4.12

I/O LIST

VEOLIA WATER
Solutions & Technologies

Massillon, OH 5700235402 IFAS Control Panel

	Tag Number	I/O Type	I/O PLC	Off/Signal	On/Range	Source	Destination	Checked
Loss of Control Power Alarm		DI	Form C	Normal	Ack	IFASCP	IFASCP	
Alarm Silence		DI	Form C	Normal	Ack	IFASCP	IFASCP	
Alarm Reset		DI	Form C	Normal	Alarm	IFASCP	IFASCP	
Alarm Horn		DO	Form C	Normal	Alarm	IFASCP	Alarm Horn	
IFAS Influent Ammonia	AE/AIT-270A	AI	4-20mA	0-		Ammonia Analyzer	IFASCP	
IFAS Influent Ammonia Trouble	XS-270A	DI	Form C			Ammonia Analyzer	IFASCP	
IFAS Influent Nitrate	AE/AIT-270B	AI	4-20mA	0-		Nitrate Analyzer	IFASCP	
IFAS Influent Nitrate Trouble	XS-270B	DI	Form C			Nitrate Analyzer	IFASCP	
Train 1 Anoxic Turbidity	AE/AIT-308-1	AI	4-20mA	0-	NTU	Turbidity Meter	IFASCP	
Train 1 Influent Flow	FE/FIT-328-1	AI	4-20mA	0-	GPM	Flow Meter	IFASCP	
Train 1 IFAS Dissolved Oxygen	AE/AIT-380-1	AI	4-20mA	0-		Dissolved Oxygen Analyzer	IFASCP	
Train 1 IFAS Level	LE/LIT-320-1	AI	4-20mA	0-	Feet	Guided Level Transmitter	IFASCP	
Train 1 IFAS High Level	LSHH-320-1	DI	Form C	Normal	Alarm	Float Switch	IFASCP	
Train 1 De-Ox pH	AE/AIT-330-1	AI	4-20mA	0-		pH Analyzer	IFASCP	
Train 1 Internal Recycle Flow	FE/FIT-327-1	AI	4-20mA	0-	GPM	Flow Meter	IFASCP	
Train 1 Anoxic Mixer 1 Run Status	RS-305-1	DI	Form C	Stopped	Running	MCC	IFASCP	
Train 1 Anoxic Mixer 1 Fail Status	XS-305-1	DI	Form C	Normal	Alarm	MCC	IFASCP	
Train 1 Anoxic Mixer 1 Auto Status	HS-305-1	DI	Form C	Manual	Auto	MCC	IFASCP	
Train 1 Anoxic Mixer 1 High Temperature	TSH-305-1	DI	Form C	Normal	Alarm	MCC	IFASCP	
Train 1 Anoxic Mixer 1 Seal Fail	MSH-305-1	DI	Form C	Normal	Alarm	MCC	IFASCP	
Train 1 Anoxic Mixer 1 Run Command	HC-305-1	DO	Form C	Stop	Start	IFASCP	MCC	
Train 1 Anoxic Mixer 2 Run Status	RS-305-2	DI	Form C	Stopped	Running	MCC	IFASCP	
Train 1 Anoxic Mixer 2 Fail Status	XS-305-2	DI	Form C	Normal	Alarm	MCC	IFASCP	
Train 1 Anoxic Mixer 2 Auto Status	HS-305-2	DI	Form C	Manual	Auto	MCC	IFASCP	
Train 1 Anoxic Mixer 2 High Temperature	TSH-305-2	DI	Form C	Normal	Alarm	MCC	IFASCP	
Train 1 Anoxic Mixer 2 Seal Fail	MSH-305-2	DI	Form C	Normal	Alarm	MCC	IFASCP	
Train 1 Anoxic Mixer 2 Run Command	HC-305-2	DO	Form C	Stop	Start	IFASCP	MCC	
Train 1 Anaerobic Mixer Run Status	RS-305-3	DI	Form C	Stopped	Running	MCC	IFASCP	
Train 1 Anaerobic Mixer Fail Status	XS-305-3	DI	Form C	Normal	Alarm	MCC	IFASCP	
Train 1 Anaerobic Mixer Auto Status	HS-305-3	DI	Form C	Manual	Auto	MCC	IFASCP	
Train 1 Anaerobic Mixer High Temperature	TSH-305-3	DI	Form C	Normal	Alarm	MCC	IFASCP	
Train 1 Anaerobic Mixer Seal Fail	MSH-305-3	DI	Form C	Normal	Alarm	MCC	IFASCP	
Train 1 Anaerobic Mixer Run Command	HC-305-3	DO	Form C	Stop	Start	IFASCP	MCC	
Train 1 De-Ox Valve Open Status	ZSO-377-1	DI	Form C	Closed	Open	Actuator	IFASCP	
Train 1 De-Ox Valve Closed Status	ZSC-377-1	DI	Form C	Open	Closed	Actuator	IFASCP	
Train 1 De-Ox Valve Fail Status	XS-377-1	DI	Form C	Normal	Alarm	Actuator	IFASCP	
Train 1 De-Ox Valve Auto Status	HS-377-1	DI	Form C	Manual	Auto	Actuator	IFASCP	
Train 1 De-Ox Valve Open Command	ZCO-377-1	DO	Form C	Closed	Open	IFASCP	Actuator	
Train 1 Air Valve Open Status	ZSO-375-1	DI	Form C	Closed	Open	Actuator	IFASCP	
Train 1 Air Valve Closed Status	ZSC-375-1	DI	Form C	Open	Closed	Actuator	IFASCP	
Train 1 Air Valve Fail Status	XS-375-1	DI	Form C	Normal	Alarm	Actuator	IFASCP	
Train 1 Air Valve Auto Status	HS-375-1	DI	Form C	Manual	Auto	Actuator	IFASCP	
Train 1 Air Valve Position Feedback	ZI-375-1	AI	4-20mA	0-100	%Open	Actuator	IFASCP	
Train 1 Air Valve Position Command	ZC-375-1	AO	4-20mA	0-100	%Open	IFASCP	Actuator	
Train 1 Air Flow	FE/FIT-376-1	AI	4-20mA	0-	SCFM	Thermal Mass Flow Meter	IFASCP	
Train 1 IFAS IMLR Pump 1 Run Status	RS-325-1A	DI	Ethernet	Stopped	Running	Plant Network	IFASCP	
Train 1 IFAS IMLR Pump 1 Fail Status	XS-325-1A	DI	Ethernet	Manual	Auto	Plant Network	IFASCP	
Train 1 IFAS IMLR Pump 1 Auto Status	HS-325-1A	DI	Ethernet	Normal	Alarm	Plant Network	IFASCP	
Train 1 IFAS IMLR Pump 1 Run Command	HC-325-1A	DO	Ethernet	Stop	Start	IFASCP	Plant Network	
Train 1 IFAS IMLR Pump 1 Speed Feedback	SI-325-1A	AI	Ethernet	0-100	%Running	Plant Network	IFASCP	
Train 1 IFAS IMLR Pump 1 Speed Command	SC-325-1A	AO	Ethernet	0-100	%Running	IFASCP	Plant Network	
Train 1 IFAS IMLR Pump 2 Run Status	RS-325-1B	DI	Ethernet	Stopped	Running	Plant Network	IFASCP	
Train 1 IFAS IMLR Pump 2 Fail Status	XS-325-1B	DI	Ethernet	Manual	Auto	Plant Network	IFASCP	
Train 1 IFAS IMLR Pump 2 Auto Status	HS-325-1B	DI	Ethernet	Normal	Alarm	Plant Network	IFASCP	
Train 1 IFAS IMLR Pump 2 Run Command	HC-325-1B	DO	Ethernet	Stop	Start	IFASCP	Plant Network	
Train 1 IFAS IMLR Pump 2 Speed Feedback	SI-325-1B	AI	Ethernet	0-100	%Running	Plant Network	IFASCP	
Train 1 IFAS IMLR Pump 2 Speed Command	SC-325-1B	AO	Ethernet	0-100	%Running	IFASCP	Plant Network	
Train 1 Effluent IMLR Pump Run Status	RS-326-1	DI	Ethernet	Stopped	Running	Plant Network	IFASCP	
Train 1 Effluent IMLR Pump Fail Status	XS-326-1	DI	Ethernet	Manual	Auto	Plant Network	IFASCP	
Train 1 Effluent IMLR Pump Auto Status	HS-326-1	DI	Ethernet	Normal	Alarm	Plant Network	IFASCP	

Train 1 Effluent IMLR Pump Run Command	HC-326-1	DO	Ethernet	Stop	Start	IFASCP	Plant Network	
Train 1 Effluent IMLR Pump Speed Feedback	SI-326-1	AI	Ethernet	0-100	%Running	Plant Network	IFASCP	
Train 1 Effluent IMLR Pump Speed Command	SC-326-1	AO	Ethernet	0-100	%Running	IFASCP	Plant Network	
Train 2 Anoxic Turbidity	AE/AIT-308-2	AI	4-20mA	0-	NTU	Turbidity Meter	IFASCP	
Train 2 Influent Flow	FE/FIT-328-2	AI	4-20mA	0-	GPM	Flow Meter	IFASCP	
Train 2 IFAS Dissolved Oxygen	AE/AIT-380-2	AI	4-20mA	0-		Dissolved Oxygen Analyzer	IFASCP	
Train 2 IFAS Level	LE/LIT-320-2	AI	4-20mA	0-	Feet	Guided Level Transmitter	IFASCP	
Train 2 IFAS High Level	LSHH-320-2	DI	Form C	Normal	Alarm	Float Switch	IFASCP	
Train 2 De-Ox pH	AE/AIT-330-2	AI	4-20mA	0-		pH Analyzer	IFASCP	
Train 2 Internal Recycle Flow	FE/FIT-327-2	AI	4-20mA	0-	GPM	Flow Meter	IFASCP	
Train 2 Anoxic Mixer 1 Run Status	RS-306-1	DI	Form C	Stopped	Running	MCC	IFASCP	
Train 2 Anoxic Mixer 1 Fail Status	XS-306-1	DI	Form C	Normal	Alarm	MCC	IFASCP	
Train 2 Anoxic Mixer 1 Auto Status	HS-306-1	DI	Form C	Manual	Auto	MCC	IFASCP	
Train 2 Anoxic Mixer 1 High Temperature	TSH-306-1	DI	Form C	Normal	Alarm	MCC	IFASCP	
Train 2 Anoxic Mixer 1 Seal Fail	MSH-306-1	DI	Form C	Normal	Alarm	MCC	IFASCP	
Train 2 Anoxic Mixer 1 Run Command	HC-306-1	DO	Form C	Stop	Start	IFASCP	MCC	
Train 2 Anoxic Mixer 2 Run Status	RS-306-2	DI	Form C	Stopped	Running	MCC	IFASCP	
Train 2 Anoxic Mixer 2 Fail Status	XS-306-2	DI	Form C	Normal	Alarm	MCC	IFASCP	
Train 2 Anoxic Mixer 2 Auto Status	HS-306-2	DI	Form C	Manual	Auto	MCC	IFASCP	
Train 2 Anoxic Mixer 2 High Temperature	TSH-306-2	DI	Form C	Normal	Alarm	MCC	IFASCP	
Train 2 Anoxic Mixer 2 Seal Fail	MSH-306-2	DI	Form C	Normal	Alarm	MCC	IFASCP	
Train 2 Anoxic Mixer 2 Run Command	HC-306-2	DO	Form C	Stop	Start	IFASCP	MCC	
Train 2 Anaerobic Mixer Run Status	RS-306-3	DI	Form C	Stopped	Running	MCC	IFASCP	
Train 2 Anaerobic Mixer Fail Status	XS-306-3	DI	Form C	Normal	Alarm	MCC	IFASCP	
Train 2 Anaerobic Mixer Auto Status	HS-306-3	DI	Form C	Manual	Auto	MCC	IFASCP	
Train 2 Anaerobic Mixer High Temperature	TSH-306-3	DI	Form C	Normal	Alarm	MCC	IFASCP	
Train 2 Anaerobic Mixer Seal Fail	MSH-306-3	DI	Form C	Normal	Alarm	MCC	IFASCP	
Train 2 Anaerobic Mixer Run Command	HC-306-3	DO	Form C	Stop	Start	IFASCP	MCC	
Train 2 De-Ox Valve Open Status	ZSO-377-2	DI	Form C	Closed	Open	Actuator	IFASCP	
Train 2 De-Ox Valve Closed Status	ZSC-377-2	DI	Form C	Open	Closed	Actuator	IFASCP	
Train 2 De-Ox Valve Fail Status	XS-377-2	DI	Form C	Normal	Alarm	Actuator	IFASCP	
Train 2 De-Ox Valve Auto Status	HS-377-2	DI	Form C	Manual	Auto	Actuator	IFASCP	
Train 2 De-Ox Valve Open Command	ZCO-377-2	DO	Form C	Closed	Open	IFASCP	Actuator	
Train 2 Air Valve Open Status	ZSO-375-2	DI	Form C	Closed	Open	Actuator	IFASCP	
Train 2 Air Valve Closed Status	ZSC-375-2	DI	Form C	Open	Closed	Actuator	IFASCP	
Train 2 Air Valve Fail Status	XS-375-2	DI	Form C	Normal	Alarm	Actuator	IFASCP	
Train 2 Air Valve Auto Status	HS-375-2	DI	Form C	Manual	Auto	Actuator	IFASCP	
Train 2 Air Valve Position Feedback	ZI-375-2	AI	4-20mA	0-100	%Open	Actuator	IFASCP	
Train 2 Air Valve Position Command	ZC-375-2	AO	4-20mA	0-100	%Open	IFASCP	Actuator	
Train 2 Air Flow	FE/FIT-376-2	AI	4-20mA	0-	SCFM	Thermal Mass Flow Meter	IFASCP	
Train 2 IFAS IMLR Pump 1 Run Status	RS-325-2A	DI	Ethernet	Stopped	Running	Plant Network	IFASCP	
Train 2 IFAS IMLR Pump 1 Fail Status	XS-325-2A	DI	Ethernet	Manual	Auto	Plant Network	IFASCP	
Train 2 IFAS IMLR Pump 1 Auto Status	HS-325-2A	DI	Ethernet	Normal	Alarm	Plant Network	IFASCP	
Train 2 IFAS IMLR Pump 1 Run Command	HC-325-2A	DO	Ethernet	Stop	Start	IFASCP	Plant Network	
Train 2 IFAS IMLR Pump 1 Speed Feedback	SI-325-2A	AI	Ethernet	0-100	%Running	Plant Network	IFASCP	
Train 2 IFAS IMLR Pump 1 Speed Command	SC-325-2A	AO	Ethernet	0-100	%Running	IFASCP	Plant Network	
Train 2 IFAS IMLR Pump 2 Run Status	RS-325-2B	DI	Ethernet	Stopped	Running	Plant Network	IFASCP	
Train 2 IFAS IMLR Pump 2 Fail Status	XS-325-2B	DI	Ethernet	Manual	Auto	Plant Network	IFASCP	
Train 2 IFAS IMLR Pump 2 Auto Status	HS-325-2B	DI	Ethernet	Normal	Alarm	Plant Network	IFASCP	
Train 2 IFAS IMLR Pump 2 Run Command	HC-325-2B	DO	Ethernet	Stop	Start	IFASCP	Plant Network	
Train 2 IFAS IMLR Pump 2 Speed Feedback	SI-325-2B	AI	Ethernet	0-100	%Running	Plant Network	IFASCP	
Train 2 IFAS IMLR Pump 2 Speed Command	SC-325-2B	AO	Ethernet	0-100	%Running	IFASCP	Plant Network	
Train 2 Effluent IMLR Pump Run Status	RS-326-2	DI	Ethernet	Stopped	Running	Plant Network	IFASCP	
Train 2 Effluent IMLR Pump Fail Status	XS-326-2	DI	Ethernet	Manual	Auto	Plant Network	IFASCP	
Train 2 Effluent IMLR Pump Auto Status	HS-326-2	DI	Ethernet	Normal	Alarm	Plant Network	IFASCP	
Train 2 Effluent IMLR Pump Run Command	HC-326-2	DO	Ethernet	Stop	Start	IFASCP	Plant Network	
Train 2 Effluent IMLR Pump Speed Feedback	SI-326-2	AI	Ethernet	0-100	%Running	Plant Network	IFASCP	
Train 2 Effluent IMLR Pump Speed Command	SC-326-2	AO	Ethernet	0-100	%Running	IFASCP	Plant Network	
Train 3 Anoxic Turbidity	AE/AIT-308-3	AI	4-20mA	0-	NTU	Turbidity Meter	IFASCP	
Train 3 Influent Flow	FE/FIT-328-3	AI	4-20mA	0-	GPM	Flow Meter	IFASCP	
Train 3 IFAS Dissolved Oxygen	AE/AIT-380-3	AI	4-20mA	0-		Dissolved Oxygen Analyzer	IFASCP	
Train 3 IFAS Level	LE/LIT-320-3	AI	4-20mA	0-	Feet	Guided Level Transmitter	IFASCP	
Train 3 IFAS High Level	LSHH-320-3	DI	Form C	Normal	Alarm	Float Switch	IFASCP	
Train 3 De-Ox pH	AE/AIT-330-3	AI	4-20mA	0-		pH Analyzer	IFASCP	
Train 3 Internal Recycle Flow	FE/FIT-327-3	AI	4-20mA	0-	GPM	Flow Meter	IFASCP	

Train 3 Anoxic Mixer 1 Run Status	RS-307-1	DI	Form C	Stopped	Running	MCC	IFASCP	
Train 3 Anoxic Mixer 1 Fail Status	XS-307-1	DI	Form C	Normal	Alarm	MCC	IFASCP	
Train 3 Anoxic Mixer 1 Auto Status	HS-307-1	DI	Form C	Manual	Auto	MCC	IFASCP	
Train 3 Anoxic Mixer 1 High Temperature	TSH-307-1	DI	Form C	Normal	Alarm	MCC	IFASCP	
Train 3 Anoxic Mixer 1 Seal Fail	MSH-307-1	DI	Form C	Normal	Alarm	MCC	IFASCP	
Train 3 Anoxic Mixer 1 Run Command	HC-307-1	DO	Form C	Stop	Start	IFASCP	MCC	
Train 3 Anoxic Mixer 2 Run Status	RS-307-2	DI	Form C	Stopped	Running	MCC	IFASCP	
Train 3 Anoxic Mixer 2 Fail Status	XS-307-2	DI	Form C	Normal	Alarm	MCC	IFASCP	
Train 3 Anoxic Mixer 2 Auto Status	HS-307-2	DI	Form C	Manual	Auto	MCC	IFASCP	
Train 3 Anoxic Mixer 2 High Temperature	TSH-307-2	DI	Form C	Normal	Alarm	MCC	IFASCP	
Train 3 Anoxic Mixer 2 Seal Fail	MSH-307-2	DI	Form C	Normal	Alarm	MCC	IFASCP	
Train 3 Anoxic Mixer 2 Run Command	HC-307-2	DO	Form C	Stop	Start	IFASCP	MCC	
Train 3 Anaerobic Mixer Run Status	RS-307-3	DI	Form C	Stopped	Running	MCC	IFASCP	
Train 3 Anaerobic Mixer Fail Status	XS-307-3	DI	Form C	Normal	Alarm	MCC	IFASCP	
Train 3 Anaerobic Mixer Auto Status	HS-307-3	DI	Form C	Manual	Auto	MCC	IFASCP	
Train 3 Anaerobic Mixer High Temperature	TSH-307-3	DI	Form C	Normal	Alarm	MCC	IFASCP	
Train 3 Anaerobic Mixer Seal Fail	MSH-307-3	DI	Form C	Normal	Alarm	MCC	IFASCP	
Train 3 Anaerobic Mixer Run Command	HC-307-3	DO	Form C	Stop	Start	IFASCP	MCC	
Train 3 De-Ox Valve Open Status	ZSO-377-3	DI	Form C	Closed	Open	Actuator	IFASCP	
Train 3 De-Ox Valve Closed Status	ZSC-377-3	DI	Form C	Open	Closed	Actuator	IFASCP	
Train 3 De-Ox Valve Fail Status	XS-377-3	DI	Form C	Normal	Alarm	Actuator	IFASCP	
Train 3 De-Ox Valve Auto Status	HS-377-3	DI	Form C	Manual	Auto	Actuator	IFASCP	
Train 3 De-Ox Valve Open Command	ZCO-377-3	DO	Form C	Closed	Open	IFASCP	Actuator	
Train 3 Air Valve Open Status	ZSO-375-3	DI	Form C	Closed	Open	Actuator	IFASCP	
Train 3 Air Valve Closed Status	ZSC-375-3	DI	Form C	Open	Closed	Actuator	IFASCP	
Train 3 Air Valve Fail Status	XS-375-3	DI	Form C	Normal	Alarm	Actuator	IFASCP	
Train 3 Air Valve Auto Status	HS-375-3	DI	Form C	Manual	Auto	Actuator	IFASCP	
Train 3 Air Valve Position Feedback	ZI-375-3	AI	4-20mA	0-100	%Open	Actuator	IFASCP	
Train 3 Air Valve Position Command	ZC-375-3	AO	4-20mA	0-100	%Open	IFASCP	Actuator	
Train 3 Air Flow	FE/FIT-376-3	AI	4-20mA	0-	SCFM	Thermal Mass Flow Meter	IFASCP	
Train 3 IFAS IMLR Pump 1 Run Status	RS-325-3A	DI	Ethernet	Stopped	Running	Plant Network	IFASCP	
Train 3 IFAS IMLR Pump 1 Fail Status	XS-325-3A	DI	Ethernet	Manual	Auto	Plant Network	IFASCP	
Train 3 IFAS IMLR Pump 1 Auto Status	HS-325-3A	DI	Ethernet	Normal	Alarm	Plant Network	IFASCP	
Train 3 IFAS IMLR Pump 1 Run Command	HC-325-3A	DO	Ethernet	Stop	Start	IFASCP	Plant Network	
Train 3 IFAS IMLR Pump 1 Speed Feedback	SI-325-3A	AI	Ethernet	0-100	%Running	Plant Network	IFASCP	
Train 3 IFAS IMLR Pump 1 Speed Command	SC-325-3A	AO	Ethernet	0-100	%Running	IFASCP	Plant Network	
Train 3 IFAS IMLR Pump 2 Run Status	RS-325-3B	DI	Ethernet	Stopped	Running	Plant Network	IFASCP	
Train 3 IFAS IMLR Pump 2 Fail Status	XS-325-3B	DI	Ethernet	Manual	Auto	Plant Network	IFASCP	
Train 3 IFAS IMLR Pump 2 Auto Status	HS-325-3B	DI	Ethernet	Normal	Alarm	Plant Network	IFASCP	
Train 3 IFAS IMLR Pump 2 Run Command	HC-325-3B	DO	Ethernet	Stop	Start	IFASCP	Plant Network	
Train 3 IFAS IMLR Pump 2 Speed Feedback	SI-325-3B	AI	Ethernet	0-100	%Running	Plant Network	IFASCP	
Train 3 IFAS IMLR Pump 2 Speed Command	SC-325-3B	AO	Ethernet	0-100	%Running	IFASCP	Plant Network	
Train 3 Effluent IMLR Pump Run Status	RS-326-3	DI	Ethernet	Stopped	Running	Plant Network	IFASCP	
Train 3 Effluent IMLR Pump Fail Status	XS-326-3	DI	Ethernet	Manual	Auto	Plant Network	IFASCP	
Train 3 Effluent IMLR Pump Auto Status	HS-326-3	DI	Ethernet	Normal	Alarm	Plant Network	IFASCP	
Train 3 Effluent IMLR Pump Run Command	HC-326-3	DO	Ethernet	Stop	Start	IFASCP	Plant Network	
Train 3 Effluent IMLR Pump Speed Feedback	SI-326-3	AI	Ethernet	0-100	%Running	Plant Network	IFASCP	
Train 3 Effluent IMLR Pump Speed Command	SC-326-3	AO	Ethernet	0-100	%Running	IFASCP	Plant Network	
Air Sparge Blower 1 Run Status	RS-390-1	DI	Form C	Stopped	Running	Blower LCP	IFASCP	
Air Sparge Blower 1 Fail Status	XS-390-1	DI	Form C	Normal	Alarm	Blower LCP	IFASCP	
Air Sparge Blower 1 Auto Status	HS-390-1	DI	Form C	Manual	Auto	Blower LCP	IFASCP	
Air Sparge Blower 1 Run Command	HC-390-1	DO	Form C	Stop	Start	IFASCP	Blower LCP	
Air Sparge Blower 2 Run Status	RS-390-2	DI	Form C	Stopped	Running	Blower LCP	IFASCP	
Air Sparge Blower 2 Fail Status	XS-390-2	DI	Form C	Normal	Alarm	Blower LCP	IFASCP	
Air Sparge Blower 2 Auto Status	HS-390-2	DI	Form C	Manual	Auto	Blower LCP	IFASCP	
Air Sparge Blower 2 Run Command	HC-390-2	DO	Form C	Stop	Start	IFASCP	Blower LCP	
IFAS Effluent Nitrate	AE/AIT-340	AI	4-20mA	0-		Nitrate Analyzer	IFASCP	
IFAS Effluent Nitrate Trouble	XS-340	DI	Form C			Nitrate Analyzer	IFASCP	

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SECTION 5

PROCESS DESIGN INFORMATION

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5.2 AERATION CALCULATIONS
5.3 HYDRAULIC CALCULATIONS
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SECTION 5.1

PROCESS DESIGN CALCULATIONS

VEOLIA WATER
Solutions & Technologies



KRÜGER

Massillon WWTP BNR Upgrade
Process Design Calculations



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9/11/2015
Rev 4

VEOLIA WATER
Solutions & Technologies

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It is not to be disclosed to a third party without the written consent of Veolia Water Solutions & Technologies

Introduction

The calculations presented herein represent a more detailed explanation of the design output generated by the IFAS Design Software developed by Kruger. The design software utilizes the activated sludge model ASM1 for most of the calculations concerning the suspended fractions of the process. Calculations concerning the IFAS media are based on equations and experience developed by Anox Kaldness over the last 15 plus years and do not necessarily represent the current approach in the ASM model.

The software solution is an iterative approach that closes the mass balance on COD and nutrients. Not all calculations inherent to the software model are presented herein, e.g. commonly accepted calculations for cellular growth, decay, and hydrolysis. The calculations presented herein provide the mass balance of the model solution(s) for COD and nutrients. Where appropriate values within the calculations herein are referenced from model output which is also attached. For example all of the standard ASM calculations that develop the active heterotrophic biomass component of the MLSS are not detailed herein but that biomass value is cited from the model output summary and used to calculate denitrification rates in primary anoxic zones.

These calculations are intended to illustrate anticipated performance based on operating conditions. They are based on the following assumptions:

a. There will be sufficient alkalinity, either present in the wastewater or by means of chemical addition, to maintain a pH in the range of 6.7 - 8.0 in the process tanks.
b. With the exception of temperature, all values listed are maximum values and include contributions of all recycle streams except unadulterated flows from return activated sludge and internal mixed liquor recycle.
c. The minimum and maximum temperatures are based upon a seven (7) day average.
d. The average influent temperature of the flow to the biological treatment system for the winter period (November 1 to April 31) shall be ≥ 13.2 °C and the average influent temperature of the flow to the biological treatment system for the summer period (April 1 to October 31) shall be ≥ 18 °C.
e. The wastewater being biodegradable with no inhibitory concentrations of toxic compounds present.
f. The effluent refractory organic nitrogen after secondary clarification shall not exceed 1.0 mg/L.
g. The influent to the biological treatment system shall have an inlet volatile fatty acid to total phosphorous (VFA/TP) ratio > 8:1.
h. The influent to the biological treatment system shall have an inlet readily biodegradable COD to total nitrogen (rbCOD/TN) ratio > 3.7:1.

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Section 1

Design Calculations for Winter Average Temperature of 13 C

Project **Massillon WWTP BNR Upgrade** **Rev** 4
Process Design Calcs- Winter Average 13 °C **Date** 9/11/2015

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Line							
						Comment	
1	***Flow Balance***						
2		Qinf	17.90	MGD	Influent Flow		
3		QIR	35.2	MGD	Internal recirculation	197%	of influent flow
4		Qras	17.9	MGD	RAS	100%	of influent flow
5		QTIR	53.1	MGD	Total Recycle Flow		
6		QF	**71.0**	**MGD**	**Total Forward Flow**		
7							
8	***Process Volumes***				***Process HRTs***		
9					**Nominal**	**Actual**	
10		Anaerobic Selector	0.460	MG	0.62 hrs	0.31	hrs
11		Primary Anoxic # 1	0.475	MG	0.64 hrs	0.16	hrs
12		Primary Anoxic # 2	0.475	MG	0.64 hrs	0.16	hrs
13		IFAS Zone	2.510	MG	3.37 hrs	0.85	hrs
14		Deoxygenation	0.195	MG	0.26 hrs	0.07	hrs
15							
16	***Process Loading***						
17		CBOD5	167.0	mg/L	24,931 lbs/day		
18		TSS	110.0	mg/L	16,421 lbs/day		
19		TKN	36.6	mg/L	5,464 lbs/day		
20		TP	5.4	mg/L	806 lbs/day		
		Temp	13	C			
21							

Line					Comment
22	***Nitrogen Balance***				
23					
24	***Compute the TKN nitrified***		TKNnitrified = TKNinfluent -TKNassimilated - TKNeffluent		
25					
26		**TKNinf**	**5,464**	**lbsN/Day**	TKNinf x Qinf
27		WAS Production	15,861	lbs TSS/day	From Output Summary, Cell H35 (includes effluent TSS)
28		%NWAS	7.0%		
29		**TKNassimilated in BioMass**	**1,012**	**lbsN/day**	%NWAS x WAS Production - N in Effluent TSS
30					
31		Effluent NH3-N	0.85	mg/L	Cell B13 From Output Summary
32		Total eff TKN	2.65	mg/L	eff organic TKN + Effluent NH3N (from Output Summary)
33		**TKNeff**	**396**	**lbsN/day**	Total eff TKN x Oinf x 8.34
34					
35		**TKNnitrified to NO3N**	**4,057**	**lbsN/day**	TKNinf - TKNassimilated - TKNeff
36		**Effluent TN Target**	**9.5**	**mg/L**	
37					
38		Effluent TKN	2.65	mg/L	Line 32
39		NO3N in IMLR Required	6.85	mg/L	Effluent NOX-N Required
40			1023		NOX-N dicharged in effluent (lbs/day)
41		**% NO3-N denitrified**	75%		
42					
43	***Determine NO3N recycle requirements***				
44					
45		Total Reycle Requirement	297%		% NO3-N denitrified / (1-%NO3-N denitrified)
46		RAS	100%		Assumed RAS Recycle Rate
47		Minimum IMLR required	197%		
48					
49	NO3N recycled to Anoxic Zone and Selectors		**3,034**	**lbs/day**	NO3N in IMLR x QTIR x 8.34 = NO3-N denitrified
50					
51	**NOTE:** *Effluent Nitate concentration is equal to the nitrate concentration passing through the aerobic reactors as forward flow since there are no secondary zones*				
52		**Effluent Nitrate**	**6.85**	**mg/L**	Effluent nitrate equal to nitrate in IMLR
53					

Line					Comment
54	***COD BALANCE***				
55	**Determine rbCOD required for P-Removal in the Selector**				
56		Influent P	5.4	mg/L	Per Specification
57			806.1	lbs/day	
58		WAS	15,861	lbs/day	
59		eff TSS	10	mg/L	Assumed Effluent TSS
60			1,493	lbs/day	
61					
62		Eff PO4-P required	0.5	mg/L	Target Effluent PO4-P Requirement
63		%P in WAS Solids	4.4%		
64					
65		TPinf	806	lbs/day	
66	lbs/P removed biologically in WAS by PAOs	TPwas	698	lbs/day	%PWAS x WAS
67		TPeff	108	lbs/day	Inf P - TPwas
68			0.73	mg/L	Tpeff /Qinf/8.34
69		TSS P in effluent	0.44	mg/L	%PWAS x eff TSS
70		PO4-P in effluent	0.29	mg/L	Tpeff - TSS P in effluent
71					
72		Assumption	2.0	lbs acetate as rbCOD absorbed / lb P removed Biologically	
73					
74	**NOTE:** In reality, the rbCOD uptake (PAOs and GAOs) is likely signficantly higher but sequestration rates are not well defined.				
75					
76		**rBCOD Required for bio P removal**	**1,396**	**lbs/day**	lbs rbCOD required / lb P x Tpwas
	Note: Typical selector retention times are 1 to 1.h hrs in order to allow for fermentation of rbCOD to VFAs . The available selector volume limits the amount of rbCOD that can be fermented , so much of the required VFA would need to be present in the influent. VFA concentrations should be 7 to 10 times the influent TP concentration to ensure that VFA is non-limiting for enhanced bioP removal.				
77					

Line						
78	**Determine the rbCOD required for Nitrate Removal**					**Comment**
79						
80	NO3-N to be Denitrified	3,034	lbs/day		Line 49	
81						
82	*Determine the Nitrate equivalents recyled via the RAS and the IMLR Flows*					
83	DO in RAS	1	mg/L			
84	NO3N in RAS	6.85	mg/L			
85	Qras	17.90	MGD		Line 11	
86	DO in IMLR	1.5	mg/L		After reduction in Deoxygenation Zone	
87	NO3N in IMLR	6.85	mg/L		Line 39	
88	QIR	35.21	MGD		Line 10	
89						
90	Total NO3N recycled	3034	lbsN/day		NO3NRAS x Qras x 8.34+N03NIMLR x QIR x 8.034	
91	Total DO NO3Neq recycled	206	lbs as N/day		DORAS x Qras x 8.34 x 0.35 +DOIMLR x QIR x 8.034 x 0.35	
92	**Total NO3Neq**	**3240**	**lbsN/day**		Total DO nitrate equivalents recycled	
93						
94	rBCOD / NO3Neq	5.5			ratio of lbs rbCOD required per lbs NO3Neq removed	
95	rbCOD required for denitrification	**17,822**	**lbs/day**			
96						
97	total rbCOD Required	1,396			for P - Removal	Line 76
98		17,822			for Denitirifcaiton	Line 95
99		**19,218**			TOTAL Requirement	
100	**COD Fractionation requirements**					
101	COD/BOD5 ratio		2.1		**Assumed**	
102	biogradable COD as % to Total COD		80%		**Assumed**	
103						
104	Total COD		52,355	lbs/day	COD/BOD x BODinf x Qinf x 8.34	
105	BioDegradable COD		41,884	lbs/day		
106	**rbCOD required**		**19,218**	**lbs/day**		
107	**rbCOD required as % of total COD**		**37%**		**The typical range of rbCOD as fraction of total COD is 20 to 35%.**	
108	Slowly Degradable COD		22,666	lbs/day		
109						

Line				Comment
110	**Final COD Balance Required**			
111	Influent COD	52,355	lbs/day	
112	BioDegradable BOD	41,884	lbs/day	
113	COD Removed in Selector and Anoxic zone	19,218	lbs /day	
114	COD Removed in IFAS Zone	22,666	lbs/day	
115				
116	**Determine if the available denitrification volume is sufficient**			
117				
118	Denitrification in the primary anoxic zone occurs at two different rates, K1 and K2 occuring simultaneously. K1 occurs as the result of utilization of rbCOD and is quite rapid. K2 occurs as result of utilization of slowly degradable COD which is dictated by hydrolosis rates. (***Theory, Design, and Operation of Nutrient Removal Activated Sludge Processes, Ekama, G.A. and Marais, G.v.R)***			
119				
120	$N_{pa} = (K1_T + K2_T) \times Xa \times V_{PA} \times 8.34$			
121	where			
122	N_{pa}: Denitrification Potential of the available primary anoxic zone volume, mg NO3-Neq/day under non limiting conditions for rbCOD and slowly degradble COD			
123	$K1_T$: Denitrification rate for rbCOD at design temperature per mg/L of active biomass - lbs N/ lb Xa-day			
124	$K2_T$: Denitrification ate for slowly degradable COD at design temperature per mg/L of active biomass - Xa, lbs N / lb Xa-day			
125	Xa: active hetertrophic biomass concentration , mg VASS/L			
126	V_{PA}: Primary Anoxic Volume, MG			
127				
128	$K1_T = K1_{20C} \times \Theta^{(T-20)}$			
129	$K1_{20C}$ -	0.72	mg N / mg Xa-hr	
130	Θ =	1.2		
131	T=	13.00	C	
132	$K1_T$ =	**0.20**	mgN / mg Xa-hr	

Line						
133	$K2_T = K2_{20C} \times \Theta^{(T-20)}$					
134						
135			$K2_{20C}$ -	0.1	mg N / mg Xa-hr	
136			Θ =	1.08		
137			T=	13.00	C	
138			$K2_T$ =	**0.06**	mgN / mg Xa-hr	
139						
140			Xa=	1730	mg VASS/L	Cell B20 Outpute Summary
141			Vpa =	0.95	MG	
142						
143		Removal Potential	**N_{PA} =**	**3554**	**lbs NO3-Neq/day**	From Equation Line 120
144		Removal Required		**3240**	**lbs NO3-Neq/day**	Line 92
145						
146	***Conclusion*** *The available primary anoxic volume may be just adequate assuming that rbCOD is nonlimiting.*					
147						

Line				Comment
148	***Nitrification and Media Volume Calculations***			
149				
150	**Assumption:** *Nitirifiers growing on media surface will slough off into MLSS at a rate equal to their growth rate effectivley seeding the MLSS so that*			
151				
152	Y_N	0.125		yield of nitrifier biomass per lb of NH3-N nitrified
153	**Nitrifiers Produced**			
154	TKN Nitrified	4,057	lbs/day	
155	Nitrifiers produced	507	lbs/day	TKNnitrified x Yn
156	Sludge Production	15,861	lbs/day	Waste and Effluent TSS from Output Summary
157	Percentage of Nitrifier in Sludge	3.2%		Weight % of nitrifiers per lb of Waste Sludge
158				
159	**Assumption** The percentage of nitrifiers in the MLSS is equal to the percentage of nitrifiers in the Waste Sludge			
160				
161	Percentage of Nitrifier in MLSS	3.2%		%nitirifers
162	MLSS Concentration	3521	mg/L	From Output Summary
163				
164	***Calculate the mass of nitrifiers in the Aerobic Volume***			
165	Total Aerobic Volume	2.51	MG	(Sum of IFAS and aerobic non-media volumes)
166	media Fill	35%		Fraction of total aeobic volume occupied by media
167	Media Displacement	11%		Liquid Displacement per unit volume of media
168	Total liquid aerobic volume in IFAS Reactors	2.41	MG	Aerobic Volume x (1-Media Fill x Media Displacement)
169	Liquid Volume in aerobic non media reactors	0.195	MG	
170	**Total Aerobic Volume**	**2.61**	MG	
171				
172	Total lbs Nitrifiers in Aerobic Volume	2449	lbs	%nitrifiers x liquid Aerobic Volume x MLSS x 8.34
173				
174	In order to determine the amount of media required for nitrification, the amount of ammonia removed by the nitrifiers in the MLSS must be determined. The NH4-N oxidation rate of nitfriers is dependant on ambient conditions but the rate of pure nitrifiers at a temperature of 15 C has been documented to be be about 50 gr-N/KG of nitrifier biomass per hour.			
175				
176	Nitrifier Ammonium Removal Rate	50	g-N/KG SSN-hr	NH4N nitrified per kg of nitrifier BioMass (SSN) at 15c
177				

Line				Comment
178	The Rate must be adjusted for Ambient temperature			
179		R = 50 gN/hr x Θ^(T-15)		
180		Θ = 1.103	Arrehnius coefficient	
181		13.00	Ambiement Temperature	
182				
183	Temperature Adjusted Rate	41.1	g-N/KG SSN-hr	NH4N nitrified per kg of nitrifier BioMass (SSN)
184				
185	NH4N nitrifiers by Nitrifiers in MLSS			
186	Lbs Nitrifier in MLSS	2449	lbs	Line 172
187	Temperature Adjusted Rate	41.1	g-N/KG SSN-hr	Line 183
188		0.99	lbs N/lb SSN-day	Units conversion
189				
190	Amount of NH4N nitrified in the MLSS	**2,416**	**lbs N/day**	
191				
192	***Calculate the amount of NH4N nitrified on the media***			
193	Total TKN nitrifed	4,057	lbsN/day	
194	Amount of NH4N nitrified in the MLSS	2,416	lbsN/day	
195	**TKN to be nitrified on the media**	**1,641**	**lbsN/day**	
196				

Line					
197	***Calculate the Nitrification Potential of the Media***				**Comment**
198					
199	*The nitrification rate is a function of the Organic load (F/M ratio) in the IFAS Basin based on biodegradable COD and MLSS inventory*				
200					
201	biodgradable COD removed in the IFAS Zone	22,666	lbs/day	Line	114
202	MLSS in IFAS Zone	3521	mg/L		
203	Volume of IFAS Zone	2.41	MG	Volume in IFAS Reactor after media displacement	
204	MLSS inventory	70,874	lbs MLSS		
205					
206	F/M Ratio	0.32	lbs biodegradabe COD / lb MLSS-day		
207					
208	*Media Surface Removal Rate Constant*				
209	K_{10C}	0.53	gr NH4N/m2-day	Rate Constant is based on Anox Kaldness Design guidelines for	
210				the computed F/M Ratio at a temperature of 10 °C	
211	Adjust the Rate Constant, K_{10C}, for Bulk liquid temperatue				
212					
213	$K_T = K_{10C} \times \theta^{(T-10)}$			Where	Θ = 1.07
214					
215	Temperature	13.0	C		
216	**K_T =**	**0.65**	**gr NH4N/m2-day**		
217					

Line					Comment
218	*The potential Surface Removal Rate (SSR) can be limited by the impact of the ambient DO or NH4-N concentration in the bulk MLSS. The impact on the rate*				
219	*constant determined according to the following criteria.*				
220					
221		$SRR = k \times \left(\frac{DO - 1.0}{3.2}\right)^{0.7}$ when $\frac{DO - 1.0}{3.2} \leq NH4N$			
222					
223					
224		$SRR = k \times (NH4N)^{0.7}$ when $\frac{DO - 1.0}{3.2} > NH4N$			
225					
226					
227		Bulk liquid DO	3	mg/L	
228		Bulk Liquid NH4N	0.85	mg/L	From Simulation Tool Output
229					
230		$\frac{DO - 1.0}{3.2} =$	0.63		DO concentration governs
231					
232		**SRR =**	**0.47**	**gr NH4N/m2-day**	
233					

Line					Comment
234	***Determine the nitrification capacity of the media potential based on the SLR and media surface area in the Reactor***				
235					
236		IFAS Reactor Volume	2.510	MG	
237		Media Fill	35%		
238			335,561	ft3	
239		Media Volume	117,447	ft3	
240		Specific effective Surface Area	243.8	ft2/ft3 of media	
241		Total Effective Surface Area	2.863E+07	ft2	
242			2.661E+06	M^2	Convert Area to meters
243					
244		NH4N removal potential	1.243E+06	grN/day	SLR x Total Effective surface area
245			**2,741**	**lbs/day**	
246		**NH4N removel Required**	**1,641**	**lbs/day**	Calculated earlier
		The nitrification potential of the media volume is greater than the nitrification required			
247					
248		**Effluent N Summary**			
249					
250			NH3N	0.85	mg/L
251			TKN	2.65	mg/L
252			NO3-N	6.9	mg/L
253			**TN**	**9.50**	mg/L

Line	Comment
254	**Aeration Calculations**
255	
256	Calculation for air requirements are completed per the following standard equations
257	
258	$$SOR = \frac{AOR}{\alpha \times \left[\frac{(\beta \times C_{wAlt} \times D_C) - C_L}{(C_{20} \times D_C)}\right] \times \theta^{(T_w - 20)}}$$
259	
260	
261	
262	Where
263	SOR- Standard Oxygen Requirement (lbs O2/day)
264	AOR- Actual Oxygen Requirement (lbs-O2/day)
265	a- alpha value for field conditions
266	b - Saturation Correction value for field condtions
267	C_{wAlt}- Surface Saturation DO at the Wastewater Temperature and site elevation
268	C_L - Bulk liquid DO concentration, (mg/L) =
269	D_c- Diffuser Depth Correction Factor
270	C_{20}- Surface Saturation DO at 20 C and 1 atm
271	T_w- Wastewater temperature
272	Θ - Temperature Correction Coefficient

Line	Comment
273	
274	
275	And
276	$$D_c = Patm \times \left(1 + C \times \frac{D}{2.31}\right)$$
277	
278	
279	Where
280	C- Bubble Depth factor (typical 0.3 to 0.5)
281	D- Diffuser Depth
282	Patm- Local Barometric Pressure at site elevation
283	
284	The air requirement is given by
285	
286	$$Q_{Air} = \frac{SOR}{\rho \times w \times D \times SOTE \times 60\ {}^{min}/_{hr}}$$
287	
288	
289	Where
290	Q_{air} Volumetric airflow requirement at Standard Condition of 68 F and 1 atm. (SCFM)
291	ρ- Density of air at standard conditions (0.075 lbs/ft^3)
292	W- Weight fraction of O2 in air at standard conditions (0.232)
293	D- Diffuser Depth (ft)
294	SOTE- fraction of oxygen transferred per foot of depth at standard conditions and clean water (%/ft)
295	

Line							
296	***Compute the SOR and air requirement in the IFAS Reactor***						
297							
298	AOR =	37,900	lbs O2/day	From Model Simulation Output			
299		1579	lbs O2/hr				
300							
301	Site Elevation =	1000	ft	Patm =	14.20	PSIA	
302	a=	0.8		T_w=	13.00	C	
303	b=	0.95		ϴ =	1.024		
304	C_L=	3.0	mg/L	C =	0.5		
305	C_{wAlt}=	10.15	mg/L	D=	13	ft	
306	C_{20}=	9.08	mg/L	SOTE=	1.20%	%/ft	
307							
308	D_c=	1.20					
309							
310	**SOR =**	**2,963**	**lbs O2/hr**				
311							
312	**Qair =**	**18,194**	**SCFM**				
313							
314	***Compute the air requirement in the Deoxygenation Reactor***						
315							
316	The air requirement for this reacor is determined to be the minimum air requirment for mixing						
317	Total Reactor Volume =	0.195	MG				
318		26,070	ft3				
319	Coarse Bubble Mixing Rate	20	SCFM/ 1000 ft3				
320	**Air Requirement =**	**521**	**SCFM**				

	A	B	C	D	E	F	G	H	I	J
1	**Kruger IFAS Design Tool (V4) - Output Summary**						Project Name: Massillon, Winter Average			
2							Project Number: 5700235402			
3	Flow and Concn.	Flow Rate, MGD	CBOD, mg/L	COD, mg/L	TSS, mg/L	TKN, mg/L	Nitrate-N, mg/L	DO, mg/L	**WW Temp, C**	Site Elev., ft
4	Influent	17.90	167.00	344.44	110.00	36.60	0.00	0.00	**13.00**	1000.00
5	Clarifier Effluent	17.36	4.63	47.20	10.00	2.65	6.85	1.48		
6										
7	COD Concentrations	Readily. Biod., mg/L	Slowly Biod., mg/L	Tot. Biod., mg/L	Sol. Inert, mg/L	Part. Inert, mg/L	Tot. Non-Biod., mg/L	Tot. Soluble, mg/L	Tot. Particulate, mg/L	Total COD, mg/L
8	Influent	96.44	179.11	275.55	34.44	34.44	68.89	172.22	172.22	344.44
9	Clarifier Effluent	1.46	6.18	7.64	34.44	4.38	38.82	35.90	10.56	47.20
10										
11	Nitrogen Concn., mg-N/L	Ammonia-N	Nitrate-N	Sol. Refr. Org-N	Sol. Biod. Org-N	Part. Inert Org-N	Part. Biod Org-N	Total N		
12	Influent	27.45	0.00	1.10	3.38	0.94	3.74	36.60		
13	Clarifier Effluent	0.85	6.85	1.10	0.00	0.20	0.50	9.50		
14										
15	Suspended Solids Concn., mg-SS/L	Biod. VSS	Non-Biod. VSS	Inorg. SS	Total SS		Tot. Reac. Vol., Mil. Gal.	Tot. Infl. HRT, Hour	Tot. Oxic Infl. HRT, Hour	Tot. Anx. Infl. HRT, Hour
16	Influent	74.80	18.70	16.50	110.00		3.66	4.90	3.63	1.27
17	Effluent	4.34	3.08	1.55	10.00					
18										
19	MLSS Components	Heterotrophs (Incl. Xpdn), mgTSS/L	Autotrophs, mgTSS/L	Biomass Debris Incl. Xpdnd), mgTSS/L	Biod. VSS, mgTSS/L	Non-biod VSS, mgSS/L	Inorg. SS, mgSS/L	MLVSS, mgSS/L	**MLSS, mgSS/L**	% Unbalance
20	MLSS Fractions	1730.09	53.04	551.51	19.97	619.79	546.87	2612.69	**3521.26**	0.00
21										
22	Process Nitrogen Balance	Tot. Nitrogen	**Org-N in Waste Sludge**	Sol. Inert Org-N	TKN Avail. for Nitr.	Nitrif. in Sus. Growth	Nitrif. on Media Surface	NH4 in Fin. Effl.	Nitrate	% Unblance
23	Concn., mg/L of infl	36.60	**8.27**	1.10	27.23	8.19	18.18	0.85	6.85	0.04
24										
25	Biod COD Balance incl. Ext. Carb.	bCOD Rem. by SG inc Ext. Carb.	bCOD Rem by Media (Oxic)	bCOD Rem. by WAS	Tot. bCOD Removal (Incl ext. Carb).	% Unblance		Ratio of RAS to Infl.	Ratio of IRS to Infl.	Ratio of WAS to Infl.
26	Concn., mg/L of influent	198.42	67.37	1.11	274.09	2.62		0.80	2.05	0.03
27										
28	Biod COD Balance with AOR and Sludge	Endo. AOR On Media	AOR for COD Rem. Media (incl. Ext. COD	Deni. Credit	AOR for COD Rem. Sus. Growth	Oxic Endo AOR in Sus. Growth	Unhydolyzed Biod. VSS by Wasting	Biomass COD Rem. by Wasting	Biod. COD Rem. in System	% of Unbalance
29	lb-COD/d	5456.16	3520.19	9131.73	4791.66	5484.51	165.68	9351.22	40918.01	7.37
30										
31	SRTs and Seeding Effects	**Total Susp. SRT**	Oxic Susp. SRT	SRT based on Total Mass	**% of Seeding (Nitrifiers)**	Min. Tot. SRT w/o Seeding	Min. Tot. SRT with Seeding	**Safety Factor W/O Seeding**	**Safety Factor With Seeding**	**Safety Factor Based on Total Biomass**
32	SF should be > 2.3 for Effl. NH4-N < 1.0 mg/L	**6.57**	4.81	11.92	**16.96**	3.10	2.36	**2.12**	**2.79**	**3.84**
33										
34	Media and Media Biomass	Tot. Media Vol., 1000 x ft3	Tot. Media Surf. Area, 1000 x ft2	Tot. Biofim Biomass, 1000 x lb	Tot. Susp. Biomass, 1000 x lb	Biomass Ratio Fixed to Susp., %	Volatile Fraction of MLSS, %	Sludge Production, lb-SS/d incl. Effl TSS	**Sludge Yield incl. ext carb, g-TSS/g-COD**	Sewage Sludge Yield (no ext.), g-TSS/g-BOD
35	English Units	117.44	28643.60	84.87	104.16	81.48	74.20	15860.53	**0.39**	**0.64**

	A	B	C	D	E	F	G
1	**Design Tool (V4) Output - Concentration Profiles**					Project Name: Massillon, Winter	
2							
3	Reactor Serial Number	Influent	Reactor 1	Reactor 2	Reactor 4	Reactor 8	Effluent
4	Process Configuration	----	Prim. Anx 1	Prim. Anx 2	Oxic 1	Deoxygen	----
5							
6	Reactor Volume, 1,000 Gallon	----	475.00	475.00	2510.00	195.00	----
7	Nominal Influent HRT, Hour		0.64	0.64	3.37	0.26	
8	Actual Liquid HRT, Hour	----	0.17	0.17	0.84	0.07	----
9	DO Profile, mg/L	0.00	0.00	0.00	3.00	1.48	1.48
10	Avail. rbCOD Prof. (inc. ext COD), mg/L	96.44	30.54	15.87	40.10	3.76	----
11	rbCOD Profile, mg/L	96.44	11.61	5.35	1.09	1.46	1.46
12	Slowly Biod COD, mg/L	179.11	78.48	74.21	39.46	36.78	0.10
13	Endo. COD Prod., mg/L	---	3.36	3.36	33.98	2.76	---
14	rbCOD Removal, lb/d	---	10884.82	6049.69	22424.68	1323.46	---
15	Ext. COD Profile, mg/L	0.00	0.00	0.00	0.00	0.00	0.00
16	Ext. COD Removal, lb/d	---	0.00	0.00	0.00	0.00	---
17	Ammonia Profile, mg/L	27.45	7.70	7.70	0.98	0.85	0.85
18	Ammonia Removal, lb/d	----	0.00	0.00	3864.41	72.08	----
19	Nitrate Profile, mg-N/L	0.00	**2.07**	**0.00**	6.72	6.85	6.85
20	NO3 Equivalent. Rem., lb/d	----	2002.20	1190.71	-3864.41	0.00	----
21	Susp. G. Endo. AOR, lb-O2/d				5072.69		
22	Susp. G. Initial Carb. AOR, lb-O2/d				4328.45		
23	Susp. G. Nitrogenous AOR, lb-O2/d				5291.81		
24	AOR due to DO Setpoint Change, lb-O2/d				1724.25		
25	Total AOR for Suspended Growth, lb-O2/d				16417.20		
26	Heterotroph Layer SD, g-SS/m2				6.38		
27	Autotroph Layer SD, g-SS/m2				0.52		
28	Biomass Debris Layer SD, g-SS/m2				4.41		
29	Non-Biod VSS (Inf) Layer SD, g-SS/m2				2.44		
30	FSS Layer SD, g-SS/m2				0.71		
31	Total Biofilm SD, g-SS/m2				14.47		
32	Het. Seed by Detachment, mg_SS/L				21.71		
33	Aut. Seed by Detachment, mg-SS/L				1.78		
34	Ext. Carb. Seed by detach., mg-SS/L				0.00		
35	% Volatile for Biofilm Biomass				0.83		
36	FM Ratio, g-rbCOD/g-MLSS/d				0.33		
37	rbCOD SRR at design T, g-COD/m2/d				1.63		
38	Actual rbCOD SRR, g-COD/m2/d				1.72		
39	Ammonia SRR K at 10C, g-N/m2/d				0.53		
40	Ammonia SRR at design T, g-N/m2/d				0.64		
41	Actual Ammonia SRR, g-N/m2/d				0.63		
42	Media rbCOD removal, lb-COD/d				10057.20		
43	Media Ammonia Removal, lb-N/d				2714.02		
44	AOR for Media Initial COD Rem., lb-O2/d				3520.19		
45	Meida Endog. AOR, lb-O2/d				5456.16		
46	AOR for Media NH4 Removal, lb-O2/d				12484.49		
47	Total AOR by Media Biomass, lb-O2/d				21460.84		
48	Total AOR both Suspended and Fix-Film				37878.04		
49	Detachment Rate, 1/d				0.09		
50	Biofilm Age, day				11.54		
51	Attachment Rate, 1/d				0.10		
52	Media Type				K5		
53	% Media Fill				35.00		
54	Media Vol./Zone, 1000 x ft3				117.44		
55	Media Surf. Area/Zone, x 1000 ft2				28643.60		
56	Media Biomass/Zone, lb				84.76		
57	Biomass Ratio Media to Susp.				0.00		
58	Number of Bags of Media, 1 m3/bag				3332.00		
59	Diffuser Type				Medium Bubble		
60	Alpha				0.80		
61	Aeration Tank SWD, ft				14.00		
62	SOTE, % of ft SWD				1.20		
63	SOR, lb-O2/day				72606.95		
64	Airflow, SCFM				18552.52		
65	Carbonacious OUR, mg/L/h				38.22		
66	Nitrogenous OUR, mg/L/h				36.97		
67	Total OUR, mg/L/h				75.20		

Section 2

Design Calculations for Summer Average Temperature of 18 C

Project **Massillon WWTP** **Rev** 4

Process Design Calcs : Summer Average 18 °C **Date** 9/11/2015

KRÜGER

Line							Comment
1	***Flow Balance***						
2		Qinf	17.90	MGD	Influent Flow		
3		QIR	35.6	MGD	Internal recirculation	199%	of influent flow
4		Qras	16.1	MGD	RAS	90%	of influent flow
5		QTIR	51.7	MGD	Total Recycle Flow		
6		QF	**69.6**	**MGD**	**Total Forward Flow**		
7							
8	***Process Volumes***				***Process HRTs***		
9					**Nominal**	**Actual**	
10		Anaerobic Selector	0.460	MG	0.62 hrs	0.32	hrs
11		Primary Anoxic # 1	0.475	MG	0.64 hrs	0.16	hrs
12		Primary Anoxic # 2	0.475	MG	0.64 hrs	0.16	hrs
13		IFAS Zone	2.510	MG	3.37 hrs	0.87	hrs
14		Deoxygenation	0.195	MG	0.26 hrs	0.07	hrs
15							
16	***Process Loading***						
17		CBOD5	167.0	mg/L	24,931 lbs/day		
18		TSS	110.0	mg/L	16,421 lbs/day		
19		TKN	36.6	mg/L	5,464 lbs/day		
20		TP	5.4	mg/L	806 lbs/day		
		Temp	18	C			
21							

Line					Comment
22	***Nitrogen Balance***				
23					
24	***Compute the TKN nitrified***				TKNnitrified = TKNinfluent -TKNassimilated - TKNeffluent
25					
26		**TKNinf**	**5,464**	**lbsN/Day**	TKNinf x Qinf
27		WAS Production	15,392	lbs TSS/day	From Output Summary, Cell H35 (includes effluent TSS)
28		%NWAS	6.9%		
29		**TKNassimilated in BioMass**	**965**	**lbsN/day**	%NWAS x WAS Production - N in Effluent TSS
30					
31		Effluent NH3-N	0.57	mg/L	Cell B13 From Output Summary
32		Total eff TKN	2.36	mg/L	eff organic TKN + Effluent NH3N (from Output Summary)
33		**TKNeff**	**352**	**lbsN/day**	Total eff TKN x Oinf x 8.34
34					
35		**TKNnitrified to NO3N**	**4,146**	**lbsN/day**	TKNinf - TKNassimilated - TKNeff
36		**Effluent TN Target**	**9.5**	**mg/L**	
37					
38		Effluent TKN	2.36	mg/L	Line 32
39		NO3N in IMLR Required	7.14	mg/L	Effluent NOX-N Required
40			1066		NOX-N dicharged in effluent (lbs/day)
41		**% NO3-N denitrified**	74%		
42					
43	***Determine NO3N recycle requirements***				
44					
45		Total Reycle Requirement	289%		% NO3-N denitrified / (1-%NO3-N denitrified)
46		RAS	90%		Assumed RAS Recycle Rate
47		Minimum IMLR required	199%		
48					
49	NO3N recycled to Anoxic Zone and Selectors		**3,080**	**lbs/day**	NO3N in IMLR x QTIR x 8.34 = NO3-N denitrified
50					
51	**NOTE:** *Effluent Nitate concentration is equal to the nitrate concentration passing through the aerobic reactors as forward flow since there are no secondary zones*				
52		**Effluent Nitrate**	**7.14**	**mg/L**	Effluent nitrate equal to nitrate in IMLR
53					

Line					Comment
54	***COD BALANCE***				
55	**Determine rbCOD required for P-Removal in the Selector**				
56		Influent P	5.4	mg/L	Per Specification
57			806.1	lbs/day	
58		WAS	15,392	lbs/day	
59		eff TSS	10	mg/L	Assumed Effluent TSS
60			1,493	lbs/day	
61					
62		Eff PO4-P required	0.5	mg/L	Target Effluent PO4-P Requirement
63		%P in WAS Solids	4.5%		
64					
65		TPinf	806	lbs/day	
66	lbs/P removed biologically in WAS by PAOs	TPwas	693	lbs/day	%PWAS x WAS
67		TPeff	114	lbs/day	Inf P - TPwas
68			0.76	mg/L	Tpeff /Qinf/8.34
69		TSS P in effluent	0.45	mg/L	%PWAS x eff TSS
70		PO4-P in effluent	0.31	mg/L	Tpeff - TSS P in effluent
71					
72		Assumption	2.0	lbs acetate as rbCOD absorbed / lb P removed Biologically	
73					
74	**NOTE:** In reality, the rbCOD uptake (PAOs and GAOs) is likely signficantly higher but sequestration rates are not well defined.				
75					
76		**rBCOD Required for bio P removal**	**1,385**	**lbs/day**	lbs rbCOD required / lb P x Tpwas
	Note: Typical selector retention times are 1 to 1.h hrs in order to allow for fermentation of rbCOD to VFAs . The available selector volume limits the amount of rbCOD that can be fermented , so much of the required VFA would need to be present in the influent. VFA concentrations should be 7 to 10 times the influent TP concentration to ensure that VFA is non-limiting for enhanced bioP removal.				
77					

Line						
78	**Determine the rbCOD required for Nitrate Removal**				**Comment**	
79						
80	NO3-N to be Denitrified	3,080	lbs/day		Line 49	
81						
82	*Determine the Nitrate equivalents recyled via the RAS and the IMLR Flows*					
83	DO in RAS	1	mg/L			
84	NO3N in RAS	7.14	mg/L			
85	Qras	16.11	MGD		Line 11	
86	DO in IMLR	1	mg/L		After reduction in Deoxygenation Zone	
87	NO3N in IMLR	7.14	mg/L		Line 39	
88	QIR	35.63	MGD		Line 10	
89						
90	Total NO3N recycled	3080	lbsN/day		NO3NRAS x Qras x 8.34+N03NIMLR x QIR x 8.034	
91	Total DO NO3Neq recycled	151	lbs as N/day		DORAS x Qras x 8.34 x 0.35 +DOIMLR x QIR x 8.034 x 0.35	
92	**Total NO3Neq**	**3231**	**lbsN/day**		Total DO nitrate equivalents recycled	
93						
94	rBCOD / NO3Neq	5.5			ratio of lbs rbCOD required per lbs NO3Neq removed	
95	rbCOD required for denitrification	**17,773**	**lbs/day**			
96						
97	total rbCOD Required	1,385			for P - Removal	Line 76
98		17,773			for Denitirifcaiton	Line 95
99		**19,158**			TOTAL Requirement	
100	**COD Fractionation requirements**					
101	COD/BOD5 ratio		2.1		**Assumed**	
102	biogradable COD as % to Total COD		80%		**Assumed**	
103						
104	Total COD		52,355	lbs/day	COD/BOD x BODinf x Qinf x 8.34	
105	BioDegradable COD		41,884	lbs/day		
106	**rbCOD required**		**19,158**	**lbs/day**		
107	**rbCOD required as % of total COD**		**37%**		**The typical concentration of rbCOD as fraction of total influent COD is 20 to 35%.**	
108	Slowly Degradable COD		22,725	lbs/day		
109						

Line				Comment
110	**Final COD Balance Required**			
111	Influent COD	52,355	lbs/day	
112	BioDegradable BOD	41,884	lbs/day	
113	COD Removed in Selector and Anoxic zone	19,158	lbs /day	
114	COD Removed in IFAS Zone	22,725	lbs/day	
115				
116	**Determine if the available denitrification volume is sufficient**			
117				
118	Denitrification in the primary anoxic zone occurs at two different rates, K1 and K2 occuring simultaneously. K1 occurs as the result of utilization of rbCOD and is quite rapid. K2 occurs as result of utilization of slowly degradable COD which is dictated by hydrolosis rates. (***Theory, Design, and Operation of Nutrient Removal Activated Sludge Processes, Ekama, G.A. and Marais, G.v.R)***			
119				
120	$N_{pa} = (K1_T + K2_T) \times Xa \times V_{PA} \times 8.34$			
121	where			
122	N_{pa}: Denitrification Potential of the available primary anoxic zone volume, mg NO3-Neq/day under non limiting conditions for rbCOD and slowly degradble COD			
123	$K1_T$: Denitrification rate for rbCOD at design temperature per mg/L of active biomass - lbs N/ lb Xa-day			
124	$K2_T$: Denitrification ate for slowly degradable COD at design temperature per mg/L of active biomass - Xa, lbs N / lb Xa-day			
125	Xa: active hetertrophic biomass concentration , mg VASS/L			
126	V_{PA}: Primary Anoxic Volume, MG			
127				
128	$K1_T = K1_{20C} \times \Theta^{(T-20)}$			
129	$K1_{20C}$ -	0.72	mg N / mg Xa-hr	
130	Θ =	1.2		
131	T=	18.00	C	
132	$K1_T$ =	**0.50**	mgN / mg Xa-hr	

Line						
133	$K2_T = K2_{20C} \times \Theta^{(T-20)}$					
134						
135		$K2_{20C}$ -	0.1	mg N / mg Xa-hr		
136		Θ =	1.08			
137		T=	18.00	C		
138		$K2_T$ =	**0.09**	mgN / mg Xa-hr		
139						
140		Xa=	1424	mg VASS/L	Cell B20 Outpute Summary	
141		Vpa =	0.95	MG		
142						
143	Removal Potential	**NPA =**	**6607**	**lbs NO3-Neq/day**	From Equation Line	120
144	Removal Required		**3231**	**lbs NO3-Neq/day**	Line 92	
145						
146	***Conclusion*** *The available primary anoxic volume is sufficient adequate assuming that rbCOD is nonlimiting.*					
147						

Line				Comment
148	***Nitrification and Media Volume Calculations***			
149				
150	**Assumption:** *Nitirifiers growing on media surface will slough off into MLSS at a rate equal to their growth rate effectivley seeding the MLSS so that*			
151				
152	Y_N	0.125		yield of nitrifier biomass per lb of NH3-N nitrified
153	**Nitrifiers Produced**			
154	TKN Nitrified	4,146	lbs/day	
155	Nitrifiers produced	518	lbs/day	TKNnitrified x Yn
156	Sludge Production	15,392	lbs/day	Waste and Effluent TSS from Output Summary
157	Percentage of Nitrifier in Sludge	3.4%		Weight % of nitrifiers per lb of Waste Sludge
158				
159	**Assumption** The percentage of nitrifiers in the MLSS is equal to the percentage of nitrifiers in the Waste Sludge			
160				
161	Percentage of Nitrifier in MLSS	3.4%		%nitirifers
162	MLSS Concentration	3019	mg/L	From Output Summary
163				
164	***Calculate the mass of nitrifiers in the Aerobic Volume***			
165	Total Aerobic Volume	2.51	MG	(Sum of IFAS and aerobic non-media volumes)
166	media Fill	35%		Fraction of total aeobic volume occupied by media
167	Media Displacement	11%		Liquid Displacement per unit volume of media
168	Total liquid aerobic volume in IFAS Reactors	2.41	MG	Aerobic Volume x (1-Media Fill x Media Displacement)
169	Liquid Volume in aerobic non media reactors	0.195	MG	
170	**Total Aerobic Volume**	**2.61**	MG	
171				
172	Total lbs Nitrifiers in Aerobic Volume	2211	lbs	%nitrifiers x liquid Aerobic Volume x MLSS x 8.34
173				
174	In order to determine the amount of media required for nitrification, the amount of ammonia removed by the nitrifiers in the MLSS must be determined. The NH4-N oxidation rate of nitfriers is dependant on ambient conditions but the rate of pure nitrifiers at a temperature of 15 C has been documented to be be about 50 gr-N/KG of nitrifier biomass per hour.			
175				
176	Nitrifier Ammonium Removal Rate	50	g-N/KG SSN-hr	NH4N nitrified per kg of nitrifier BioMass (SSN) at 15c
177				

Line				Comment
178	The Rate must be adjusted for Ambient temperature			
179		R = 50 gN/hr x Θ^(T-15)		
180		Θ = 1.103	Arrehnius coefficient	
181		18.00	Ambiement Temperature	
182				
183	Temperature Adjusted Rate	67.1	g-N/KG SSN-hr	NH4N nitrified per kg of nitrifier BioMass (SSN)
184				
185	NH4N nitrifiers by Nitrifiers in MLSS			
186	Lbs Nitrifier in MLSS	2211	lbs	Line 172
187	Temperature Adjusted Rate	67.1	g-N/KG SSN-hr	Line 183
188		1.61	lbs N/lb SSN-day	Units conversion
189				
190	Amount of NH4N nitrified in the MLSS	**3,561**	**lbs N/day**	
191				
192	***Calculate the amount of NH4N nitrified on the media***			
193	Total TKN nitrifed	4,146	lbsN/day	
194	Amount of NH4N nitrified in the MLSS	3,561	lbsN/day	
195	**TKN to be nitrified on the media**	**586**	**lbsN/day**	
196				

Line					
197	***Calculate the Nitrification Potential of the Media***				**Comment**
198					
199	*The nitrification rate is a function of the Organic load (F/M ratio) in the IFAS Basin based on biodegradable COD and MLSS inventory*				
200					
201	biodgradable COD removed in the IFAS Zone	22,725	lbs/day	Line	114
202	MLSS in IFAS Zone	3019	mg/L		
203	Volume of IFAS Zone	2.41	MG	Volume in IFAS Reactor after media displacement	
204	MLSS inventory	60,758	lbs MLSS		
205					
206	F/M Ratio	0.37	lbs biodegradabe COD / lb MLSS-day		
207					
208	*Media Surface Removal Rate Constant*				
209	K_{10C}	0.52	gr NH4N/m2-day	Rate Constant is based on Anox Kaldness Design guidelines for	
210				the computed F/M Ratio at a temperature of 10 ℃	
211	Adjust the Rate Constant, K_{10C}, for Bulk liquid temperatue				
212					
213	$K_T = K_{10C} \times \theta^{(T-10)}$			Where	Θ = 1.07
214					
215	Temperature	18.0	C		
216	**K_T =**	**0.89**	**gr NH4N/m2-day**		
217					

Line					Comment
218	*The potential Surface Removal Rate (SSR) can be limited by the impact of the ambient DO or NH4-N concentration in the bulk MLSS. The impact on the rate*				
219	*constant determined according to the following criteria.*				
220					
221		$SRR = k \times \left(\frac{DO - 1.0}{3.2}\right)^{0.7}$ when $\frac{DO - 1.0}{3.2} \leq NH4N$			
222					
223					
224		$SRR = k \times (NH4N)^{0.7}$ when $\frac{DO - 1.0}{3.2} > NH4N$			
225					
226					
227		Bulk liquid DO	2.5	mg/L	
228		Bulk Liquid NH4N	0.57	mg/L	From Simulation Tool Output
229					
230		$\frac{DO - 1.0}{3.2} =$	0.47		DO concentration governs
231					
232		**SRR =**	**0.53**	**gr NH4N/m2-day**	
233					

Line				Comment
234	***Determine the nitrification capacity of the media potential based on the SLR and media surface area in the Reactor***			
235				
236	IFAS Reactor Volume	2.510	MG	
237	Media Fill	35%		
238		335,561	ft3	
239	Media Volume	117,447	ft3	
240	Specific effective Surface Area	243.8	ft2/ft3 of media	
241	Total Effective Surface Area	2.863E+07	ft2	
242		2.661E+06	M^2	Convert Area to meters
243				
244	NH4N removal potential	1.399E+06	grN/day	SLR x Total Effective surface area
245		**3,084**	**lbs/day**	
246	**NH4N removel Required**	**586**	**lbs/day**	Calculated earlier
	The nitrification potential of the media volume is greater than the nitrification required			

Line	Comment
254	**Aeration Calculations**
255	
256	Calculation for air requirements are completed per the following standard equations
257	
258	$$SOR = \frac{AOR}{\alpha \times \left[\frac{(\beta \times C_{wAlt} \times D_C) - C_L}{(C_{20} \times D_C)}\right] \times \theta^{(T_w - 20)}}$$
259	
260	
261	
262	Where
263	SOR- Standard Oxygen Requirement (lbs O2/day)
264	AOR- Actual Oxygen Requirement (lbs-O2/day)
265	a- alpha value for field conditions
266	b - Saturation Correction value for field condtions
267	C_{wAlt}- Surface Saturation DO at the Wastewater Temperature and site elevation
268	C_L - Bulk liquid DO concentration, (mg/L) =
269	D_c- Diffuser Depth Correction Factor
270	C_{20}- Surface Saturation DO at 20 C and 1 atm
271	T_w- Wastewater temperature
272	Θ - Temperature Correction Coefficient

Line	Comment
273	
274	
275	And
276	$D_c = Patm \times \left(1 + C \times \frac{D}{2.31}\right)$
277	
278	
279	Where
280	C- Bubble Depth factor (typical 0.3 to 0.5)
281	D- Diffuser Depth
282	Patm- Local Barometric Pressure at site elevation
283	
284	The air requirement is given by
285	
286	$Q_{Air} = \frac{SOR}{\rho \times w \times D \times SOTE \times 60\ {}^{min}/_{hr}}$
287	
288	
289	Where
290	Q_{air} Volumetric airflow requirement at Standard Condition of 68 F and 1 atm. (SCFM)
291	ρ- Density of air at standard conditions (0.075 lbs/ft^3)
292	W- Weight fraction of O2 in air at standard conditions (0.232)
293	D- Diffuser Depth (ft)
294	SOTE- fraction of oxygen transferred per foot of depth at standard conditions and clean water (%/ft)
295	

Line							
296	***Compute the SOR and air requirement in the IFAS Reactor***						
297							
298	AOR =	38,900	lbs O2/day	From Model Simulation Output			
299		1621	lbs O2/hr				
300							
301	Site Elevation =	1000	ft	Patm =	14.20	PSIA	
302	a=	0.8		T_w=	18.00	C	
303	b=	0.95		Θ =	1.024		
304	C_L=	2.5	mg/L	C =	0.5		
305	C_{wAlt}=	9.12	mg/L	D=	13	ft	
306	C_{20}=	9.08	mg/L	SOTE=	1.20%	%/ft	
307							
308	D_c=	1.20					
309							
310	**SOR =**	**2,934**	**lbs O2/hr**				
311							
312	**Qair =**	**18,018**	**SCFM**				
313							
314	***Compute the air requirement in the Deoxygenation Reactor***						
315							
316	The air requirement for this reacor is determined to be the minimum air requirment for mixing						
317	Total Reactor Volume =	0.195	MG				
318		26,070	ft3				
319	Coarse Bubble Mixing Rate	20	SCFM/ 1000 ft3				
320	**Air Requirement =**	**521**	**SCFM**				

	A	B	C	D	E	F	G	H	I	J
1	**Kruger IFAS Design Tool (V4) - Output Summary**						Project Name: Massillon, Summer Condition			
2							Project Number: 5700235402			
3	Flow and Concn.	Flow Rate, MGD	CBOD, mg/L	COD, mg/L	TSS, mg/L	TKN, mg/L	Nitrate-N, mg/L	DO, mg/L	**WW Temp, C**	Site Elev., ft
4	Influent	17.90	167.00	344.44	110.00	36.60	0.00	0.00	**18.00**	1000.00
5	Clarifier Effluent	17.29	4.30	46.91	10.00	2.36	7.17	0.99		
6										
7	COD Concentrations	Readily. Biod., mg/L	Slowly Biod., mg/L	Tot. Biod., mg/L	Sol. Inert, mg/L	Part. Inert, mg/L	Tot. Non-Biod., mg/L	Tot. Soluble, mg/L	Tot. Particulate, mg/L	Total COD, mg/L
8	Influent	96.44	179.11	275.55	34.44	34.44	68.89	172.22	172.22	344.44
9	Clarifier Effluent	1.19	5.90	7.09	34.44	4.60	39.05	35.63	10.51	46.91
10										
11	Nitrogen Concn., mg-N/L	Ammonia-N	Nitrate-N	Sol. Refr. Org-N	Sol. Biod. Org-N	Part. Inert Org-N	Part. Biod Org-N	Total N		
12	Influent	27.45	0.00	1.10	3.38	0.94	3.74	36.60		
13	Clarifier Effluent	0.57	7.17	1.10	0.00	0.21	0.48	9.53		
14										
15	Suspended Solids Concn., mg-SS/L	Biod. VSS	Non-Biod. VSS	Inorg. SS	Total SS		Tot. Reac. Vol., Mil. Gal.	Tot. Infl. HRT, Hour	Tot. Oxic Infl. HRT, Hour	Tot. Anx. Infl. HRT, Hour
16	Influent	74.80	18.70	16.50	110.00		3.66	4.90	3.63	1.27
17	Effluent	4.14	3.24	1.60	10.00					
18										
19	MLSS Components	Heterotrophs (Incl. Xpdn), mgTSS/L	Autotrophs, mgTSS/L	Biomass Debris Incl. Xpdnd), mgTSS/L	Biod. VSS, mgTSS/L	Non-biod VSS, mgSS/L	Inorg. SS, mgSS/L	MLVSS, mgSS/L	**MLSS, mgSS/L**	% Unbalance
20	MLSS Fractions	1423.63	40.32	510.44	13.69	547.49	483.08	2229.68	**3018.65**	0.00
21										
22	Process Nitrogen Balance	Tot. Nitrogen	**Org-N in Waste Sludge**	Sol. Inert Org-N	TKN Avail. for Nitr.	Nitrif. in Sus. Growth	Nitrif. on Media Surface	NH4 in Fin. Effl.	Nitrate	% Unblance
23	Concn., mg/L of infl	36.60	**7.66**	1.10	27.84	6.57	20.68	0.57	7.17	0.04
24										
25	Biod COD Balance incl. Ext. Carb.	bCOD Rem. by SG inc Ext. Carb.	bCOD Rem by Media (Oxic)	bCOD Rem. by WAS	Tot. bCOD Removal (Incl ext. Carb).	% Unblance		Ratio of RAS to Infl.	Ratio of IRS to Infl.	Ratio of WAS to Infl.
26	Concn., mg/L of influent	189.61	76.90	0.86	274.36	2.55		0.80	2.00	0.03
27										
28	Biod COD Balance with AOR and Sludge	Endo. AOR On Media	AOR for COD Rem. Media (incl. Ext. COD	Deni. Credit	AOR for COD Rem. Sus. Growth	Oxic Endo AOR in Sus. Growth	Unhydolyzed Biod. VSS by Wasting	Biomass COD Rem. by Wasting	Biod. COD Rem. in System	% of Unbalance
29	lb-COD/d	6016.73	4018.00	9143.27	4325.23	5496.39	128.58	8710.88	40958.03	7.61
30										
31	SRTs and Seeding Effects	**Total Susp. SRT**	Oxic Susp. SRT	SRT based on Total Mass	**% of Seeding (Nitrifiers)**	Min. Tot. SRT w/o Seeding	Min. Tot. SRT with Seeding	**Safety Factor W/O Seeding**	**Safety Factor With Seeding**	**Safety Factor Based on Total Biomass**
32	SF should be > 2.3 for Effl. NH4-N < 1.0 mg/L	**5.80**	4.25	11.08	**20.45**	2.14	1.66	**2.71**	**3.50**	**5.17**
33										
34	Media and Media Biomass	Tot. Media Vol., 1000 x ft3	Tot. Media Surf. Area, 1000 x ft2	Tot. Biofim Biomass, 1000 x lb	Tot. Susp. Biomass, 1000 x lb	Biomass Ratio Fixed to Susp., %	Volatile Fraction of MLSS, %	Sludge Production, lb-SS/d incl. Effl TSS	**Sludge Yield incl. ext carb, g-TSS/g-COD**	Sewage Sludge Yield (no ext.), g-TSS/g-BOD
35	English Units	117.44	28643.60	81.34	89.30	91.09	73.86	15392.06	**0.38**	**0.62**

Design Tool (V4) Output - Concentration Profiles

Reactor Serial Number	Influent	Reactor 1	Reactor 2	Reactor 4	Reactor 8	Effluent
Process Configuration	----	Prim. Anx 1	Prim. Anx 2	Oxic 1	Deoxygen	----
Reactor Volume, 1,000 Gallon	----	475.00	475.00	2510.00	195.00	----
Nominal Influent HRT, Hour		0.64	0.64	3.37	0.26	
Actual Liquid HRT, Hour	----	0.17	0.17	0.85	0.07	----
DO Profile, mg/L	0.00	0.00	0.00	2.50	0.99	0.99
Avail. rbCOD Prof. (inc. ext COD), mg/L	96.44	31.30	15.33	40.63	3.42	----
rbCOD Profile, mg/L	96.44	10.51	6.23	0.83	1.19	1.19
Slowly Biod COD, mg/L	179.11	67.02	62.20	27.80	25.22	0.08
Endo. COD Prod., mg/L	---	3.37	3.37	34.05	2.76	---
rbCOD Removal, lb/d	---	11794.62	5159.41	22574.08	1263.73	---
Ext. COD Profile, mg/L	0.00	0.00	0.00	0.00	0.00	0.00
Ext. COD Removal, lb/d	---	0.00	0.00	0.00	0.00	---
Ammonia Profile, mg/L	27.45	7.74	7.74	0.66	0.57	0.57
Ammonia Removal, lb/d	----	0.00	0.00	4017.90	51.30	----
Nitrate Profile, mg-N/L	0.00	**1.84**	**0.00**	7.08	7.17	7.17
NO3 Equivalent. Rem., lb/d	----	2155.27	1041.67	-4017.90	0.00	----
Susp. G. Endo. AOR, lb-O2/d				5083.68		
Susp. G. Initial Carb. AOR, lb-O2/d				3882.93		
Susp. G. Nitrogenous AOR, lb-O2/d				4278.14		
AOR due to DO Setpoint Change, lb-O2/d				1418.22		
Total AOR for Suspended Growth, lb-O2/d				14662.96		
Heterotroph Layer SD, g-SS/m2				5.78		
Autotroph Layer SD, g-SS/m2				0.50		
Biomass Debris Layer SD, g-SS/m2				4.68		
Non-Biod VSS (Inf) Layer SD, g-SS/m2				2.25		
FSS Layer SD, g-SS/m2				0.66		
Total Biofilm SD, g-SS/m2				13.87		
Het. Seed by Detachment, mg_SS/L				18.85		
Aut. Seed by Detachment, mg-SS/L				1.63		
Ext. Carb. Seed by detach., mg-SS/L				0.00		
% Volatile for Biofilm Biomass				0.83		
FM Ratio, g-rbCOD/g-MLSS/d				0.38		
rbCOD SRR at design T, g-COD/m2/d				2.18		
Actual rbCOD SRR, g-COD/m2/d				1.96		
Ammonia SRR K at 10C, g-N/m2/d				0.52		
Ammonia SRR at design T, g-N/m2/d				0.90		
Actual Ammonia SRR, g-N/m2/d				0.67		
Media rbCOD removal, lb-COD/d				11479.80		
Media Ammonia Removal, lb-N/d				3087.87		
AOR for Media Initial COD Rem., lb-O2/d				4018.00		
Meida Endog. AOR, lb-O2/d				6016.73		
AOR for Media NH4 Removal, lb-O2/d				14204.22		
Total AOR by Media Biomass, lb-O2/d				24238.95		
Total AOR both Suspended and Fix-Film				38901.91		
Detachment Rate, 1/d				0.08		
Biofilm Age, day				12.04		
Attachment Rate, 1/d				0.10		
Media Type				K5		
% Media Fill				35.00		
Media Vol./Zone, 1000 x ft3				117.44		
Media Surf. Area/Zone, x 1000 ft2				28643.60		
Media Biomass/Zone, lb				81.23		
Biomass Ratio Media to Susp.				0.00		
Number of Bags of Media, 1 m3/bag				3332.00		
Diffuser Type				Medium Bubble		
Alpha				0.80		
Aeration Tank SWD, ft				14.00		
SOTE, % of ft SWD				1.20		
SOR, lb-O2/day				71674.10		
Airflow, SCFM				18314.16		
Carbonacious OUR, mg/L/h				39.52		
Nitrogenous OUR, mg/L/h				38.44		
Total OUR, mg/L/h				77.97		

Section 3

Design Calculations for Winter Minimum Temperature of 10 C

Line							
1	***Flow Balance***				**Comment**		
2		Qinf	17.90	MGD	Influent Flow		
3		QIR	35.8	MGD	Internal recirculation	200%	of influent flow
4		Qras	14.3	MGD	RAS	80%	of influent flow
5		QTIR	50.1	MGD	Total Recycle Flow		
6		QF	**68.0**	**MGD**	**Total Forward Flow**		
7							
8	***Process Volumes***				***Process HRTs***		
9					**Nominal**		**Actual**
10		Anaerobic Selector	0.460	MG	0.62	hrs	0.34 hrs
11		Primary Anoxic # 1	0.475	MG	0.64	hrs	0.17 hrs
12		Primary Anoxic # 2	0.475	MG	0.64	hrs	0.17 hrs
13		IFAS Zone	2.510	MG	3.37	hrs	0.89 hrs
14		Deoxygenation	0.195	MG	0.26	hrs	0.07 hrs
15							
16	***Process Loading***						
17		CBOD5	167.0	mg/L	24,931	lbs/day	
18		TSS	110.0	mg/L	16,421	lbs/day	
19		TKN	36.6	mg/L	5,464	lbs/day	
20		TP	5.4	mg/L	806	lbs/day	
		Temp	10	C			
21							

Line					Comment
22	***Nitrogen Balance***				
23					
24	***Compute the TKN nitrified***				TKNnitrified = TKNinfluent -TKNassimilated - TKNeffluent
25					
26		**TKNinf**	**5,464**	**lbsN/Day**	TKNinf x Qinf
27		WAS Production	16,473	lbs TSS/day	From Output Summary, Cell H35 (includes effluent TSS)
28		%NWAS	7.1%		
29		**TKNassimilated in BioMass**	**1,073**	**lbsN/day**	%NWAS x WAS Production - N in Effluent TSS
30					
31		Effluent NH3-N	1.07	mg/L	Cell B13 From Output Summary
32		Total eff TKN	3.07	mg/L	eff organic TKN + Effluent NH3N (from Output Summary)
33		**TKNeff**	**458**	**lbsN/day**	Total eff TKN x Oinf x 8.34
34					
35		**TKNnitrified to NO3N**	**3,934**	**lbsN/day**	TKNinf - TKNassimilated - TKNeff
36		**Effluent TN Target**	**10.0**	**mg/L**	
37					
38		Effluent TKN	3.07	mg/L	Line 32
39		NO3N in IMLR Required	6.93	mg/L	Effluent NOX-N Required
40			1035		NOX-N dicharged in effluent (lbs/day)
41		**% NO3-N denitrified**	74%		
42					
43	***Determine NO3N recycle requirements***				
44					
45		Total Reycle Requirement	280%		% NO3-N denitrified / (1-%NO3-N denitrified)
46		RAS	80%		Assumed RAS Recycle Rate
47		Minimum IMLR required	200%		
48					
49	NO3N recycled to Anoxic Zone and Selectors		**2,898**	**lbs/day**	NO3N in IMLR x QTIR x 8.34 = NO3-N denitrified
50					
51	**NOTE:** *Effluent Nitate concentration is equal to the nitrate concentration passing through the aerobic reactors as forward flow since there are no secondary zones*				
52		**Effluent Nitrate**	**6.93**	**mg/L**	Effluent nitrate equal to nitrate in IMLR
53					

Line					Comment
54	***COD BALANCE***				
55	**Determine rbCOD required for P-Removal in the Selector**				
56		Influent P	5.4	mg/L	Per Specification
57			806.1	lbs/day	
58		WAS	16,473	lbs/day	
59		eff TSS	10	mg/L	Assumed Effluent TSS
60			1,493	lbs/day	
61					
62		Eff PO4-P required	0.5	mg/L	Target Effluent PO4-P Requirement
63		%P in WAS Solids	4.2%		
64					
65		TPinf	806	lbs/day	
66	lbs/P removed biologically in WAS by PAOs	TPwas	692	lbs/day	%PWAS x WAS
67		TPeff	114	lbs/day	Inf P - TPwas
68			0.77	mg/L	Tpeff /Qinf/8.34
69		TSS P in effluent	0.42	mg/L	%PWAS x eff TSS
70		PO4-P in effluent	0.35	mg/L	Tpeff - TSS P in effluent
71					
72		Assumption	2.0	lbs acetate as rbCOD absorbed / lb P removed Biologically	
73					
74	**NOTE:** In reality, the rbCOD uptake (PAOs and GAOs) is likely signficantly higher but sequestration rates are not well defined.				
75					
76		**rBCOD Required for bio P removal**	**1,384**	**lbs/day**	lbs rbCOD required / lb P x Tpwas
	Note: Typical selector retention times are 1 to 1.h hrs in order to allow for fermentation of rbCOD to VFAs . The available selector volume limits the amount of rbCOD that can be fermented , so much of the required VFA would need to be present in the influent. VFA concentrations should be 7 to 10 times the influent TP concentration to ensure that VFA is non-limiting for enhanced bioP removal.				
77					

Line						
78	**Determine the rbCOD required for Nitrate Removal**					
79						
80	NO3-N to be Denitrified	2,898	lbs/day	Line 49		
81						
82	*Determine the Nitrate equivalents recyled via the RAS and the IMLR Flows*					
83	DO in RAS	1	mg/L			
84	NO3N in RAS	6.93	mg/L			
85	Qras	14.32	MGD	Line 11		
86	DO in IMLR	2.5	mg/L	After reduction in Deoxygenation Zone		
87	NO3N in IMLR	6.93	mg/L	Line 39		
88	QIR	35.80	MGD	Line 10		
89						
90	Total NO3N recycled	2898	lbsN/day	NO3NRAS x Qras x 8.34+N03NIMLR x QIR x 8.034		
91	Total DO NO3Neq recycled	303	lbs as N/day	DORAS x Qras x 8.34 x 0.35 +DOIMLR x QIR x 8.034 x 0.35		
92	**Total NO3Neq**	**3202**	**lbsN/day**	Total DO nitrate equivalents recycled		
93						
94	rBCOD / NO3Neq	5.5		ratio of lbs rbCOD required per lbs NO3Neq removed		
95	rbCOD required for denitrification	**17,609**	**lbs/day**			
96						
97	total rbCOD Required	1,384		for P - Removal	Line 76	
98		17,609		for Denitirifcaiton	Line 95	
99		**18,992**		TOTAL Requirement		
100	**COD Fractionation requirements**					
101	COD/BOD5 ratio	2.1		**Assumed**		
102	biogradable COD as % to Total COD	80%		**Assumed**		
103						
104	Total COD	52,355	lbs/day	COD/BOD x BODinf x Qinf x 8.34		
105	BioDegradable COD	41,884	lbs/day			
106	**rbCOD required**	**18,992**	**lbs/day**			
107	**rbCOD required as % of total COD**	**36%**		**The typical range of influent rbCOD as fraction of COD is 20 to 35%.**		
108	Slowly Degradable COD	22,891	lbs/day			
109						

Line					Comment
110	**Final COD Balance Required**				
111		Influent COD	52,355	lbs/day	
112		BioDegradable BOD	41,884	lbs/day	
113	COD Removed in Selector and Anoxic zone		18,992	lbs /day	
114		COD Removed in IFAS Zone	22,891	lbs/day	
115					
116	**Determine if the available denitrification volume is sufficient**				
117					
118	Denitrification in the primary anoxic zone occurs at two different rates, K1 and K2 occuring simultaneously. K1 occurs as the result of utilization of rbCOD and is quite rapid. K2 occurs as result of utilization of slowly degradable COD which is dictated by hydrolosis rates. (***Theory, Design, and Operation of Nutrient Removal Activated Sludge Processes, Ekama, G.A. and Marais, G.v.R)***				
119					
120	$N_{pa} = (K1_T + K2_T) \times Xa \times V_{PA} \times 8.34$				
121	where				
122	N_{pa}: Denitrification Potential of the available primary anoxic zone volume, mg NO3-Neq/day under non limiting conditions for rbCOD and slowly degradble COD				
123	$K1_T$: Denitrification rate for rbCOD at design temperature per mg/L of active biomass - lbs N/ lb Xa-day				
124	$K2_T$: Denitrification ate for slowly degradable COD at design temperature per mg/L of active biomass - Xa, lbs N / lb Xa-day				
125	Xa: active hetertrophic biomass concentration , mg VASS/L				
126	V_{PA}: Primary Anoxic Volume, MG				
127					
128	$K1_T = K1_{20C} \times \Theta^{(T-20)}$				
129		$K1_{20C}$ -	0.72	mg N / mg Xa-hr	
130		Θ =	1.2		
131		T=	10.00	C	
132		$K1_T$ =	**0.12**	mgN / mg Xa-hr	

Line						
133	$K2_T = K2_{20C} \times \Theta^{(T-20)}$					
134						
135			$K2_{20C}$ -	0.1	mg N / mg Xa-hr	
136			Θ =	1.08		
137			T=	10.00	C	
138			$K2_T$ =	**0.05**	mgN / mg Xa-hr	
139						
140			Xa=	1817	mg VASS/L	Cell B20 Output Summary
141			Vpa =	0.95	MG	
142						
143		Removal Potential	**NPA =**	**2341**	**lbs NO3-Neq/day**	From Equation Line 120
144		Removal Required		**3202**	**lbs NO3-Neq/day**	Line 92
145						
146	***Conclusion*** *The effluent TN goal is not applicable at this temperature condition.*					
147						

Line				Comment
148	***Nitrification and Media Volume Calculations***			
149				
150	**Assumption:** *Nitirifiers growing on media surface will slough off into MLSS at a rate equal to their growth rate effectivley seeding the MLSS so that*			
151				
152	Y_N	0.125		yield of nitrifier biomass per lb of NH3-N nitrified
153	**Nitrifiers Produced**			
154	TKN Nitrified	3,934	lbs/day	
155	Nitrifiers produced	492	lbs/day	TKNnitrified x Yn
156	Sludge Production	16,473	lbs/day	Waste and Effluent TSS from Output Summary
157	Percentage of Nitrifier in Sludge	3.0%		Weight % of nitrifiers per lb of Waste Sludge
158				
159	**Assumption** The percentage of nitrifiers in the MLSS is equal to the percentage of nitrifiers in the Waste Sludge			
160				
161	Percentage of Nitrifier in MLSS	3.0%		%nitirifers
162	MLSS Concentration	3522	mg/L	From Output Summary
163				
164	***Calculate the mass of nitrifiers in the Aerobic Volume***			
165	Total Aerobic Volume	2.51	MG	(Sum of IFAS and aerobic non-media volumes)
166	media Fill	35%		Fraction of total aeobic volume occupied by media
167	Media Displacement	11%		Liquid Displacement per unit volume of media
168	Total liquid aerobic volume in IFAS Reactors	2.41	MG	Aerobic Volume x (1-Media Fill x Media Displacement)
169	Liquid Volume in aerobic non media reactors	0.195	MG	
170	**Total Aerobic Volume**	**2.61**	MG	
171				
172	Total lbs Nitrifiers in Aerobic Volume	2287	lbs	%nitrifiers x liquid Aerobic Volume x MLSS x 8.34
173				
174	In order to determine the amount of media required for nitrification, the amount of ammonia removed by the nitrifiers in the MLSS must be determined. The NH4-N oxidation rate of nitfriers is dependant on ambient conditions but the rate of pure nitrifiers at a temperature of 15 C has been documented to be be about 50 gr-N/KG of nitrifier biomass per hour.			
175				
176	Nitrifier Ammonium Removal Rate	50	g-N/KG SSN-hr	NH4N nitrified per kg of nitrifier BioMass (SSN) at 15c
177				

Line				Comment
178	The Rate must be adjusted for Ambient temperature			
179		R = 50 gN/hr x Θ^(T-15)		
180		Θ = 1.103	Arrehnius coefficient	
181		10.00	Ambiement Temperature	
182				
183	Temperature Adjusted Rate	30.6	g-N/KG SSN-hr	NH4N nitrified per kg of nitrifier BioMass (SSN)
184				
185	NH4N nitrifiers by Nitrifiers in MLSS			
186	Lbs Nitrifier in MLSS	2287	lbs	Line 172
187	Temperature Adjusted Rate	30.6	g-N/KG SSN-hr	Line 183
188		0.74	lbs N/lb SSN-day	Units conversion
189				
190	Amount of NH4N nitrified in the MLSS	**1,681**	**lbs N/day**	
191				
192	***Calculate the amount of NH4N nitrified on the media***			
193	Total TKN nitrifed	3,934	lbsN/day	
194	Amount of NH4N nitrified in the MLSS	1,681	lbsN/day	
195	**TKN to be nitrified on the media**	**2,252**	**lbsN/day**	
196				

Line					
197	***Calculate the Nitrification Potential of the Media***				
198					
199	*The nitrification rate is a function of the Organic load (F/M ratio) in the IFAS Basin based on biodegradable COD and MLSS inventory*				
200					
201	biodgradable COD removed in the IFAS Zone	22,891	lbs/day	Line	114
202	MLSS in IFAS Zone	3522	mg/L		
203	Volume of IFAS Zone	2.41	MG	Volume in IFAS Reactor after media displacement	
204	MLSS inventory	70,898	lbs MLSS		
205					
206	F/M Ratio	0.32	lbs biodegradabe COD / lb MLSS-day		
207					
208	*Media Surface Removal Rate Constant*				
209	K_{10C}	0.52	gr NH4N/m2-day	Rate Constant is based on Anox Kaldness Design guidelines for	
210				the computed F/M Ratio at a temperature of 10 °C	
211	Adjust the Rate Constant, K_{10C}, for Bulk liquid temperatue				
212					
213	$K_T = K_{10C} \times \theta^{(T-10)}$			Where	Θ = 1.07
214					
215	Temperature	10.0	C		
216	**K_T =**	**0.52**	**gr NH4N/m2-day**		
217					

Line					Comment
218	*The potential Surface Removal Rate (SSR) can be limited by the impact of the ambient DO or NH4-N concentration in the bulk MLSS. The impact on the rate*				
219	*constant determined according to the following criteria.*				
220					
221		$SRR = k \times \left(\frac{DO - 1.0}{3.2}\right)^{0.7}$ when $\frac{DO - 1.0}{3.2} \leq NH4N$			
222					
223					
224		$SRR = k \times (NH4N)^{0.7}$ when $\frac{DO - 1.0}{3.2} > NH4N$			
225					
226					
227		Bulk liquid DO	3.5	mg/L	
228		Bulk Liquid NH4N	1.07	mg/L	From Simulation Tool Output
229					
230		$\frac{DO - 1.0}{3.2} =$	0.78		DO concentration governs
231					
232		**SRR =**	**0.44**	**gr NH4N/m2-day**	
233					

Line				Comment
234	***Determine the nitrification capacity of the media potential based on the SLR and media surface area in the Reactor***			
235				
236	IFAS Reactor Volume	2.510	MG	
237	Media Fill	35%		
238		335,561	ft3	
239	Media Volume	117,447	ft3	
240	Specific effective Surface Area	243.8	ft2/ft3 of media	
241	Total Effective Surface Area	2.863E+07	ft2	
242		2.661E+06	M^2	Convert Area to meters
243				
244	NH4N removal potential	1.164E+06	grN/day	SLR x Total Effective surface area
245		**2,567**	**lbs/day**	
246	**NH4N removel Required**	**2,252**	**lbs/day**	Calculated earlier
	The nitrification potential of the media volume is greater than the nitrification required			

Line	Comment
254	**Aeration Calculations**
255	
256	Calculation for air requirements are completed per the following standard equations
257	
258	$$SOR = \frac{AOR}{\alpha \times \left[\frac{(\beta \times C_{wAlt} \times D_C) - C_L}{(C_{20} \times D_C)} \right] \times \theta^{(T_W - 20)}}$$
259	
260	
261	
262	Where
263	SOR- Standard Oxygen Requirement (lbs O2/day)
264	AOR- Actual Oxygen Requirement (lbs-O2/day)
265	a- alpha value for field conditions
266	b - Saturation Correction value for field condtions
267	C_{wAlt}- Surface Saturation DO at the Wastewater Temperature and site elevation
268	C_L - Bulk liquid DO concentration, (mg/L) =
269	D_c- Diffuser Depth Correction Factor
270	C_{20}- Surface Saturation DO at 20 C and 1 atm
271	T_w- Wastewater temperature
272	ϴ - Temperature Correction Coefficient

Line	Comment
273	
274	
275	And
276	$D_c = Patm \times \left(1 + C \times \frac{D}{2.31}\right)$
277	
278	
279	Where
280	C- Bubble Depth factor (typical 0.3 to 0.5)
281	D- Diffuser Depth
282	Patm- Local Barometric Pressure at site elevation
283	
284	The air requirement is given by
285	
286	$Q_{Air} = \frac{SOR}{\rho \times w \times D \times SOTE \times 60\ \text{min}/\text{hr}}$
287	
288	
289	Where
290	Q_{air} Volumetric airflow requirement at Standard Condition of 68 F and 1 atm. (SCFM)
291	ρ- Density of air at standard conditions (0.075 lbs/ft^3)
292	W- Weight fraction of O2 in air at standard conditions (0.232)
293	D- Diffuser Depth (ft)
294	SOTE- fraction of oxygen transferred per foot of depth at standard conditions and clean water (%/ft)
295	

Line						
296	***Compute the SOR and air requirement in the IFAS Reactor***					
297						
298	AOR =	37,000	lbs O2/day	From Model Simulation Output		
299		1542	lbs O2/hr			
300						
301	Site Elevation =	1000	ft	Patm =	14.20	PSIA
302	a=	0.8		T_w=	10.00	C
303	b=	0.95		ϴ =	1.024	
304	C_L=	3.5	mg/L	C =	0.5	
305	C_{wAlt}=	10.88	mg/L	D=	13	ft
306	C_{20}=	9.08	mg/L	SOTE=	1.20%	%/ft
307						
308	D_c=	1.20				
309						
310	**SOR =**	**2,992**	**lbs O2/hr**			
311						
312	**Qair =**	**18,371**	**SCFM**			
313						
314	***Compute the air requirement in the Deoxygenation Reactor***					
315						
316	The air requirement for this reacor is determined to be the minimum air requirment for mixing					
317	Total Reactor Volume =	0.195	MG			
318		26,070	ft3			
319	Coarse Bubble Mixing Rate	20	SCFM/ 1000 ft3			
320	**Air Requirement =**	**521**	**SCFM**			

	A	B	C	D	E	F	G	H	I	J
1	**Kruger IFAS Design Tool (V4) - Output Summary**						Project Name: Massillon Winter 10C		% Err. allowed in Iter.: 1	
2							Project Number: 5700235402			
3	Flow and Concn.	Flow Rate, MGD	CBOD, mg/L	COD, mg/L	TSS, mg/L	TKN, mg/L	Nitrate-N, mg/L	DO, mg/L	**WW Temp, C**	Site Elev., ft
4	Influent	17.90	167.00	344.44	110.00	36.60	0.00	0.00	**10.00**	1000.00
5	Clarifier Effluent	17.34	5.01	47.55	10.00	3.07	7.00	1.99		
6										
7	COD Concentrations	Readily. Biod., mg/L	Slowly Biod., mg/L	Tot. Biod., mg/L	Sol. Inert, mg/L	Part. Inert, mg/L	Tot. Non-Biod., mg/L	Tot. Soluble, mg/L	Tot. Particulate, mg/L	Total COD, mg/L
8	Influent	96.44	179.11	275.55	34.44	34.44	68.89	172.22	172.22	344.44
9	Clarifier Effluent	1.76	6.51	8.27	34.44	4.11	38.56	36.21	10.62	47.55
10										
11	Nitrogen Concn., mg-N/L	Ammonia-N	Nitrate-N	Sol. Refr. Org-N	Sol. Biod. Org-N	Part. Inert Org-N	Part. Biod Org-N	Total N		
12	Influent	27.45	0.00	1.28	3.19	0.94	3.74	36.60		
13	Clarifier Effluent	1.07	7.00	1.28	0.00	0.19	0.53	10.07		
14										
15	Suspended Solids Concn., mg-SS/L	Biod. VSS	Non-Biod. VSS	Inorg. SS	Total SS		Tot. Reac. Vol., Mil. Gal.	Tot. Infl. HRT, Hour	Tot. Oxic Infl. HRT, Hour	Tot. Anx. Infl. HRT, Hour
16	Influent	74.80	18.70	16.50	110.00		3.66	4.91	3.63	1.28
17	Effluent	4.56	2.90	1.50	10.00					
18										
19	MLSS Components	Heterotrophs (Incl. Xpdn), mgTSS/L	Autotrophs, mgTSS/L	Biomass Debris Incl. Xpdnd), mgTSS/L	Biod. VSS, mgTSS/L	Non-biod VSS, mgSS/L	Inorg. SS, mgSS/L	MLVSS, mgSS/L	**MLSS, mgSS/L**	% Unbalance
20	MLSS Fractions	1817.32	54.48	501.42	25.53	596.95	526.72	2628.03	**3522.43**	0.00
21										
22	Process Nitrogen Balance	Tot. Nitrogen	**Org-N in Waste Sludge**	Sol. Inert Org-N	TKN Avail. for Nitr.	Nitrif. in Sus. Growth	Nitrif. on Media Surface	NH4 in Fin. Effl.	Nitrate	% Unblance
23	Concn., mg/L of infl	36.60	**8.94**	1.28	26.37	7.96	17.32	1.07	7.00	0.06
24										
25	Biod COD Balance incl. Ext. Carb.	bCOD Rem. by SG inc Ext. Carb.	bCOD Rem by Media (Oxic)	bCOD Rem. by WAS	Tot. bCOD Removal (Incl ext. Carb).	% Unblance		Ratio of RAS to Infl.	Ratio of IRS to Infl.	Ratio of WAS to Infl.
26	Concn., mg/L of influent	200.16	65.20	1.47	273.79	2.54		0.80	2.00	0.03
27										
28	Biod COD Balance with AOR and Sludge	Endo. AOR On Media	AOR for COD Rem. Media (incl. Ext. COD	Deni. Credit	AOR for COD Rem. Sus. Growth	Oxic Endo AOR in Sus. Growth	Unhydolyzed Biod. VSS by Wasting	Biomass COD Rem. by Wasting	Biod. COD Rem. in System	% of Unbalance
29	lb-COD/d	5212.34	3406.82	8722.05	5113.60	5122.38	219.89	10198.43	40872.46	7.04
30										
31	SRTs and Seeding Effects	**Total Susp. SRT**	Oxic Susp. SRT	SRT based on Total Mass	**% of Seeding (Nitrifiers)**	Min. Tot. SRT w/o Seeding	Min. Tot. SRT with Seeding	**Safety Factor W/O Seeding**	**Safety Factor With Seeding**	**Safety Factor Based on Total Biomass**
32	SF should be > 2.3 for Effl. NH4-N < 1.0 mg/L	**6.33**	4.63	11.50	**17.16**	3.89	2.77	**1.63**	**2.29**	**2.96**
33										
34	Media and Media Biomass	Tot. Media Vol., 1000 x ft3	Tot. Media Surf. Area, 1000 x ft2	Tot. Biofim Biomass, 1000 x lb	Tot. Susp. Biomass, 1000 x lb	Biomass Ratio Fixed to Susp., %	Volatile Fraction of MLSS, %	Sludge Production, lb-SS/d incl. Effl TSS	**Sludge Yield incl. ext carb, g-TSS/g-COD**	Sewage Sludge Yield (no ext.), g-TSS/g-BOD
35	English Units	117.44	28643.60	85.20	104.32	81.67	74.61	16472.60	**0.40**	**0.66**

Design Tool (V4) Output - Concentration Profiles

Project Name: Massillon Winter 10C
Project Number: 5700235402
% Err. allowed in Iter.: 1

Reactor Serial Number	Influent	Reactor 1	Reactor 2	Reactor 4	Reactor 8	Effluent
Process Configuration	----	Prim. Anx 1	Prim. Anx 2	Oxic 1	Deoxygen	----
Reactor Volume, 1,000 Gallon	----	475.00	475.00	2510.00	195.00	----
Nominal Influent HRT, Hour		0.64	0.64	3.37	0.26	
Actual Liquid HRT, Hour	----	0.17	0.17	0.85	0.07	----
DO Profile, mg/L	0.00	0.00	0.00	3.50	1.99	1.99
Avail. rbCOD Prof. (inc. ext COD), mg/L	96.44	30.84	17.11	41.91	4.15	----
rbCOD Profile, mg/L	96.44	13.06	6.31	1.38	1.76	1.76
Slowly Biod COD, mg/L	179.11	89.43	85.38	49.79	47.02	0.13
Endo. COD Prod., mg/L	---	3.15	3.15	31.74	2.58	---
rbCOD Removal, lb/d	---	10085.07	6125.72	22990.91	1353.17	---
Ext. COD Profile, mg/L	0.00	0.00	0.00	0.00	0.00	0.00
Ext. COD Removal, lb/d	---	0.00	0.00	0.00	0.00	---
Ammonia Profile, mg/L	27.45	7.72	7.72	1.20	1.07	1.07
Ammonia Removal, lb/d	----	0.00	0.00	3699.08	75.33	----
Nitrate Profile, mg-N/L	0.00	**2.45**	**0.35**	6.87	7.00	7.00
NO3 Equivalent. Rem., lb/d	----	1857.09	1192.58	-3699.08	0.00	----
Susp. G. Endo. AOR, lb-O2/d				4737.74		
Susp. G. Initial Carb. AOR, lb-O2/d				4640.00		
Susp. G. Nitrogenous AOR, lb-O2/d				5119.26		
AOR due to DO Setpoint Change, lb-O2/d				1985.50		
Total AOR for Suspended Growth, lb-O2/d				16482.51		
Heterotroph Layer SD, g-SS/m2				6.86		
Autotroph Layer SD, g-SS/m2				0.54		
Biomass Debris Layer SD, g-SS/m2				4.10		
Non-Biod VSS (Inf) Layer SD, g-SS/m2				2.35		
FSS Layer SD, g-SS/m2				0.68		
Total Biofilm SD, g-SS/m2				14.53		
Het. Seed by Detachment, mg_SS/L				23.41		
Aut. Seed by Detachment, mg-SS/L				1.85		
Ext. Carb. Seed by detach., mg-SS/L				0.00		
% Volatile for Biofilm Biomass				0.83		
FM Ratio, g-rbCOD/g-MLSS/d				0.34		
rbCOD SRR at design T, g-COD/m2/d				1.37		
Actual rbCOD SRR, g-COD/m2/d				1.66		
Ammonia SRR K at 10C, g-N/m2/d				0.52		
Ammonia SRR at design T, g-N/m2/d				0.52		
Actual Ammonia SRR, g-N/m2/d				0.60		
Media rbCOD removal, lb-COD/d				9733.38		
Media Ammonia Removal, lb-N/d				2586.20		
AOR for Media Initial COD Rem., lb-O2/d				3406.82		
Meida Endog. AOR, lb-O2/d				5212.34		
AOR for Media NH4 Removal, lb-O2/d				11896.53		
Total AOR by Media Biomass, lb-O2/d				20515.69		
Total AOR both Suspended and Fix-Film				36998.19		
Detachment Rate, 1/d				0.09		
Biofilm Age, day				11.50		
Attachment Rate, 1/d				0.10		
Media Type				K5		
% Media Fill				35.00		
Media Vol./Zone, 1000 x ft3				117.44		
Media Surf. Area/Zone, x 1000 ft2				28643.60		
Media Biomass/Zone, lb				85.08		
Biomass Ratio Media to Susp.				0.00		
Number of Bags of Media, 1 m3/bag				3332.00		
Diffuser Type				Medium Bubble		
Alpha				0.80		
Aeration Tank SWD, ft				14.00		
SOTE, % of ft SWD				1.20		
SOR, lb-O2/day				73474.38		
Airflow, SCFM				18774.17		
Carbonacious OUR, mg/L/h				37.43		
Nitrogenous OUR, mg/L/h				35.39		
Total OUR, mg/L/h				72.83		

Section 4

Summary of Air Requirements

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Summary of Air Requirements

Aeration Process Summary for IFAS Zone

	α , β, SOTE	AOR (lb/day)	DO (mg/L)	SOR (lb/hr)	Air flow (SCFM)
Design Load- 17.9 MGD, , BOD = 24,899 ppd, TSS = 16,468 ppd, TKN = 5,468 ppd					
10 C	0.8 0.95, 1.2%	37,160	3.5	3,000	18,500
13 C	0.8, 0.95, 1.2%	37,900	3.0	2,965	18,200
18 C	0.8, 0.95, 1.2%	38,900	2.5	2,930	18,000
Existing Load – 16.7 MGD, BOD = 23,134 ppd, TSS = 15,026 ppd, TKN = 5,071 ppd					
10 C	0.8, 0.95, 1.2%	35,070	3.5	2,684	17,400
13 C	0.8, 0.95, 1.2%	35,640	3.0	2,790	17,150
18 C	0.8, 0.95, 1.2%	36,420	2.5	2,750	16,900

Other Air Requirements

Sieve Scour air ≈ 400 SCFM

Deoxygenation Zone Mixing Air ≈ 550 SCFM

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SECTION 5.2

AERATION CALCULATIONS

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I. Kruger, Inc.

Aeration Calculations

Massilon, OH WWTP

For an AnoxKaldnes™ Biofilm Technology

Hybas™ Biological Treatment System

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Revision 0
January 14, 2015

VEOLIA WATER
Solutions & Technologies

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1. Process and Mixing Air Calculations 1
2. Aeration Grid Flow Balance Calculations 5
3. Attachments 15

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1.0 Process and Mixing Air Calculations

Summary of Air Requirements

	α , β, SOTE	AOR (lb/hr)	DO (mg/L)	SOR (lb/hr)	Process Demand Air flow (SCFM)	Mixing Demand[1] Airflow (SCFM)
Winter – (MLSS Temp =10 C)						
IFAS Zone	0.80, 0.95, 1.15%	1,550	4	3,040	19,500	13,100
Deoxy Zone[1]	N/A	N/A	N/A	N/A	NA	570
Total	-	-	-	-	*20,100*	
Summer – (MLSS Temp =18 C)						
IFAS Zone	0.80, 0.95, 1.15%	1,610	3	2,970	19,000	13,100
Deoxy Zone[1]	N/A	N/A	N/A	N/A	NA	570
Total		-		-	*19,600*	

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Process Air Calculations

Process air for meeting oxygen demand at design loading have been performed using the following standard aeration equation:

$$SOR = \frac{AOR}{\alpha\left[\frac{(\beta * C_{wAlt} * D_C) - C_L}{(C_{20} * D_C)}\right] * \theta^{(T_W - 20)}}$$

Where:

SOR = Standard Oxygen Requirement, lb/hr

AOR = Actual (Process) Oxygen Requirement, lb/hr

α = Ratio of oxygen transfer coefficient (K_{LA}) of the wastewater to that of tap water

β = Ratio of oxygen saturation of the wastewater to that of tap water

C_{wAlt} = Surface saturation dissolved oxygen concentration in clean water at the Waste water temperature (T_W) and local barometric pressure (Patm), mg/L

D_C = Diffuser Depth Correction Factor

= (Patm + 0.5*Diffuser Depth/2.31)/Patm = 1.19

C_L = Residual Dissolved Oxygen concentration, mg/L

C_{20} = Surface saturation D.O. concentration in clean water at 20°C and 760 mm Hg

θ = Temperature correction coefficient = 1.024

T_W = Wastewater Temperature, °C

Patm = Barometric Pressure corrected to local elevation = 14.65 PSIG

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The AnoxKaldnes aeration system design has been used in MBBR and IFAS systems for over 20 years. To date clean water tests have been performed on the aeration system by itself with no media. Testing from the several WWTP shows an average transfer efficiency of 1.1 to 1.3% per ft efficiency.

Based on this clean water test we are using a clean water oxygen transfer efficiency of 1.15% per ft of diffuser depth for both aerobic reactors, a diffuser depth of 13 ft, 0.075 lb /ft^3 of air, a site elevation of 100 ft AMSL.

$$Q_{Air} = \frac{SOR}{\rho * w * D * OTE/100 * 60\,{}^{min}/_{hr}}$$

Where:

Q_{Air}	=	Air flow (scfm)
SOR	=	Standard Oxygen Requirement (lb/hr)
ρ	=	Density of air at standard temperature and pressure (0.075 lb/ft^3)
w	=	Mass fraction of oxygen in air (0.232 lb_{O2}/lb_{Air})
D	=	Diffuser Depth = 14.5 ft
OTE	=	Oxygen Transfer Efficiency = 1.15%

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Mixing Air

IFAS Zone:

Mixing Criteria – (0.45 CFM/ft2 of floor area) for media basins

Total Floor area = 60' W x 136 ft L x 3 zones = 24,480 ft2

Total Air Requirement = 0.45 x 24,480 = CFM

Assuming pressure and Temp at the point of discharge into the water column is 5.9 PSIG @ 170 F and local barometric pressure = 14.7 PSIA, by ideal gas equation the air requirement is **13,100 SCFM**.

Deoxygenation Zone

Mixing Criteria: 17 CFM/1000 ft3

Volume per Deoxy Zone: = 12.3 x 55 x 14ft x 3 zones = 28,400 ft3

Total Air Requirement = 17 CFM/1000 ft3 x 28,400 ft3 = 480 CFM

Assuming pressure and Temp at the point of discharge into the water column is 5.9 PSIG @ 170 F and local barometric pressure = 14.7 PSIA, by ideal gas equation the air requirement is **570 SCFM**.

Scour Air

Air is also required for the sieve scour system. The sieve scour system aids in pushing media away from the upper row of sieves in the Hybas tank during periods of high flow. The flow per sieve in the top row is 11 to 13 ACFM. The total sieve scour flow per tank (11 sieves in the top row of each IFAS zone for a total of 33 sieves) is **360 to 430 ACFM**. The sieve scour diffusers are installed approximately 1 to 1.5 feet below the centerline of the upper row of sieves at a depth of 2 to 4 feet below water level.

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2.0 Aeration Grid Flow Balance and Pressure Calculations

The solution for distribution across a grid is an iterative finite difference approach that accounts for heat losses and resulting density changes in the air. Comments included in the spreadsheet output should provide adequate information on the general approach taken. Calculations for minimum flows per basin were completed to evaluate distribution at maximum turndown; however, it is accepted that an aeration grid balanced at peak flow conditions will remain similarly balanced at lower flows. Where appropriate, references and supplementary attachments are provided for equations and assumptions utilized.

Table 2 IFAS Zones Aeration Grid: Summary of Calculations

	Minimum Flow (2500SCFM/Basin)		**Peak Design Flow[1] (11,100 SCFM/Basin)**	
Top of Drop Leg Pressure (PSIG)	5.7		6.0	
# Grids per Basin	13		13	
Flow per grid (SCFM)	190		850	
	First Lateral along Manifold	***Last Lateral along Manifold***	***First Lateral along Manifold***	***Last Lateral along Manifold***
# Lateral per Grid	23		23	
Flow per lateral (ACFM)	7.5	7.2	33	32

1. Peak Design flow for the grid is 1.7 times the process air design flow for meeting oxygen demand thereby having sufficient capacity for removal of one basin from service. Min Design airflow is 0.75 times the estimated air flow for mixing

The following pages are spreadsheets of the grid calculations for both minimum and peak flow.

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IFAS Grid Calculation Sheets

Peak Airflow per Basin- 11,100 SCFM Sheets 1 to 4

Minimum Airflow per Basin - 2,500 SCFM Sheets 5 to 8

Project: Massillon, OH

Calculation By: LGW

Date January 13, 2015

Basin: IFAS Basin

Airflow: Peak

STEP 1: Enter design and Operating Data for Basin (Yellow Cells)

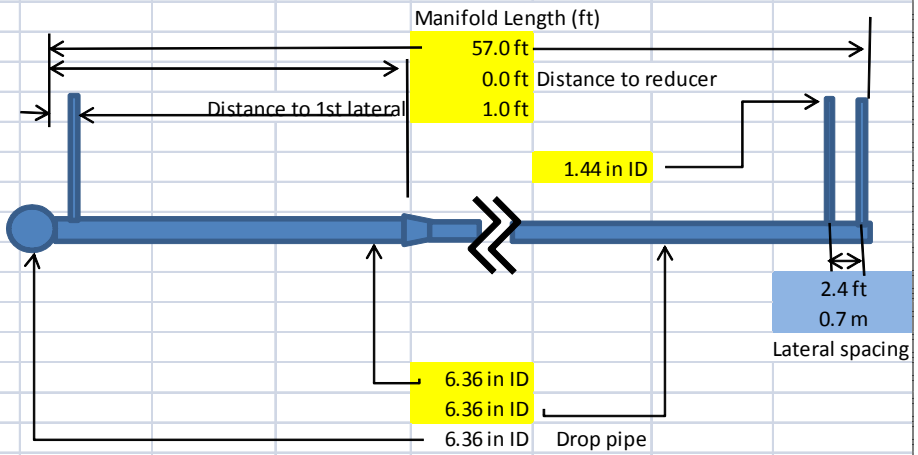
Site and Grid Data

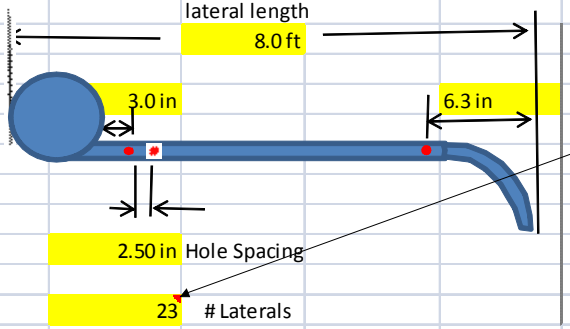
Yellow Cells - User INPUT

Air flow to basin (SCFM)	11100			
Grids/basin	13			
drop pipes / basin	13			
Safety factor on grid	**1**			
Specific Gas Constant for air	287			
Air temperature at top of Drop Pipe	180	F	355	K
Temperature of MLSS	75	F	297	K
Site Elevation	100	ft	30	m
Diffuser Depth	13	ft		
overall heat transfer coeff (U) at turbulent flow	15	BTU/hr-Ft^2-F	85	W/m2-K
Multiplier on U for transition and laminar flow	0.25			
specific heat of air			1010	j/kg-K
mass flow rate of air			6.403	kg/sec
Standard Pressure (corrected to elevation)	14.63	PSI	100,923	Pa
Internal Diameter of Drop Pipe (in)	6.36	in	0.16	m
Length of Drop Pipe	17	ft	5.18	m
Wetted length of Drop Pipe	13	ft	3.96	m
Moody Roughness Factor for pipe, ε			4.60E-05	m

Luke Wood: If balance is reasonable at peak flow then flow will be similarly balanced at lower flows.

Luke Wood:
Table 11-3 (page 11-25)
Typical Overall Heat Transfer Coefficents in Tubular Heat Exchangers
Perry's Chemical Engineers Handbook 7th ed.





Luke Wood:
Enter Total # of Laterals. Finite difference calcs accommodate up to 70 laterals per manifold and 70 holes per lateral.

PAGE 1

Basin: IFAS Basin
Airflow: Peak

Drop Pipe Calculations

STEP 4
Enter initial guess here from Cell B46 then complete STEPs 5 and 6 and compare the calculated value with the guess. If difference within 5% no need to repeat iteration again . If difference > 5%, enter calculated value again and repeat steps 5 and 6

Yellow Cells - User INPUT

DROP PIPE ITERATION				
Totalized loses (drop pipe, orifice, manifold)	**Calculated**		**Initial Guess**	
	271.4	mm H20	272.0	mm H20
	Difference	0.2%		

Gauge Pressure at top of Drop Pipe Manifold	**6.01**	**PSI**	**41,476**	Pa
Absolute pressure at top of drop pipe	20.6	PSI	142,399	Pa
Actual Flow to basin	9,719	CFM	4.59	m3/sec
mass rate per drop pipe (inclusive of safety factor)			0.49	kg/sec
Flow per drop pipe (ACFM)	**747.65**	**ACFM**	0.35	m3/sec
Velocity	3391	fpm	17.23	m/sec
Density			1.396	kg/m3
mass flux through pipe - G			24.05	kg/m2 sec
Absolute viscosity			2.13E-05	(kg/m2-s2)
Reynolds number, Nre			182,276	
Fanning Friction Factor			0.004	
Churchill variable - A			1.59642E+21	
Churchill variable - B			1.04327E-11	
Friction losses down drop pipe	**0.48**	**in H20**	118.9	Pa
Absolute Pressure at Bottom of Drop Pipe	20.63	PSI	142,280	Pa
Gauge Pressure at Bottom of Drop Pipe	6.00	PSI	41,357	Pa
Temp at bottom of drop pipe	177	F	354	K
Density at bottom of drop pipe			1.401	kg/m3
Actual Flow at Bottom of drop pipe	745	CFM	0.35	m3/sec
Flow into manifold	745	CFM		
averaged flow per lateral	32.4	CFM		
#holes/lateral	32			
total # holes per manifold	736			
Average flow /hole over whole grid			**1.72**	m3/hr
orifice los at average flow/hole (mm h20)			216	mm H20
			347.7	
Temp at front of manifold	177	F	354	K
Temp at end of manifold	166	F	348	K
Pressure at front of manifold			142,280	Pa
Pressure at end of manifold			142,136	Pa
Total Friction loss along manifold (Pa)			144	Pa
Total Friction loss along manifold length			14.7	mm H20

Luke Wood:
Viscosity at air temperature calculated by Sutherland's formula
(reference attached)

Luke Wood:
For turbulent flow, the Fanning friction factor is 1/4 of Darcy factor calculated according to Churchil's approximation,
For laminar flow (Nre < 3000), f = 16/Nre
(reference attached)

Luke Wood:
Friction Losses
$\Delta P = (4 f L G^2) / (2 d \rho)$
where
ΔP = pressure loss
f- fanning friction factor
G = mass flux in pipe
d = diameter
ρ = density

Eq 2.10-9 (page 91)
Transport Processes and Unit Operations (3rd

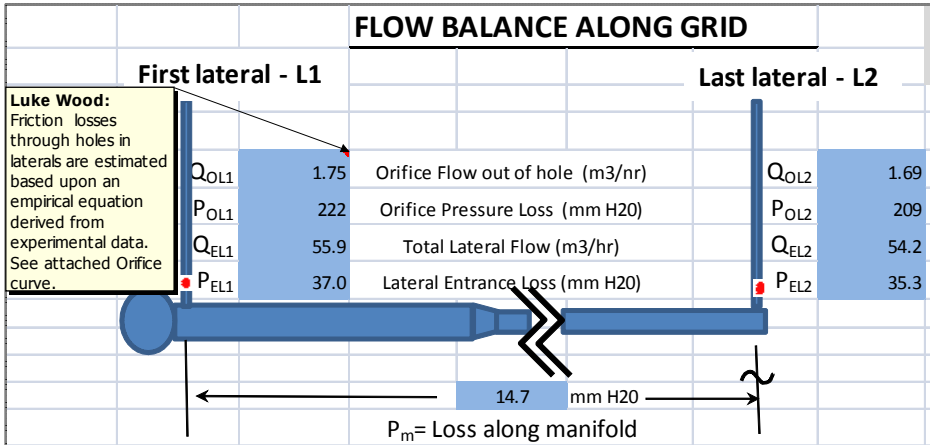
Luke Wood:
Change hole spacing (cell J33) until this value between 1 and 1.7 at peak design flow. Can go higher if safety factor on grid > 1

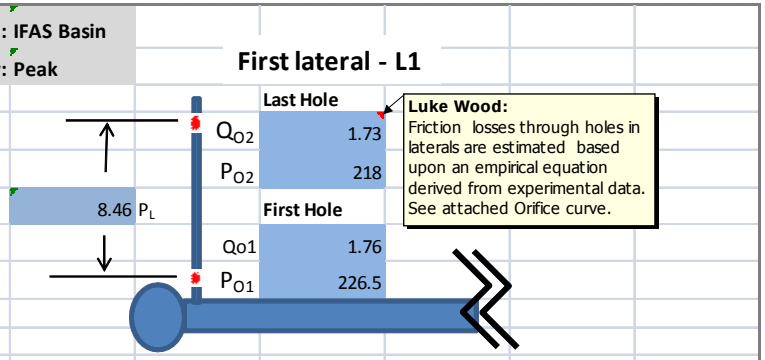
PAGE 2

FLOW BALANCE ALONG GRID

Basin: IFAS Basin

Airflow: Peak





For Pressure Balance between first and last lateral

$(P_{OL1} + P_{EL1}) - (P_m+P_{EL2}+P_{OL2}) \approx 0$

For Pressure Balance along 1st lateral

$P_{O1} - (P_L+P_{O2}) \approx 0$

MANIFOLD ITERATION

	$(P_{OL1} + P_{EL1})$	$(P_m+P_{EL2}+P_{OL2})$
Sum of Losses (mm H20)	259.3	259.3
Difference	0.00	
	0.0%	

STEP 5: Run Goal seek to get this cell to 0 by changing Cell L63 (average orifice flow rate in 1st lateral). Goto to Step 6.

STEP 2: Prior to initial iteration (STEP 5 & 6) enter here the average flow per hole (Cell D76)

	Lateral First	Lateral Last
Orifice flow (m3/hr)	1.75	1.69
orifice loss (mm H20)	222	209
Total Flow into lateral (m3/hr)	**55.9**	**54.2**
(CFM)	**32.9**	**31.9**
Variance from average flow per lateral	**2%**	**-2%**
Velocity into lateral (m/s)	14.8	14.3
Temperature at lateral (K)	354	348
Absolute Pressure at entrance to lateral (Pa)	142,280	142,136
Air density at lateral (kg/m3)	1.401	1.424
Friction loss into lateral (Pa)	363	346
(mm H20)	37	35

Luke Wood:
orifice loss equation
(eq 6-149) Perry's Chemical Engineers Handbook 7th ed.

$(1/C^2)(\rho V^2)/2$

where C = orifice coefficient - 0.65 (dimensionless)

ρ = air density (kg/m^3)

V = velocity into orifice (m/s)

MANIFOLD ITERATION

	P_{O1}	(
Sum of Losses (mm H20)	226.5	
Difference	0.00	
	0.0%	

STEP 6: Run Goal seek to get this cell to 0 by changing Cell L63 (orifice flow rate in 1st hole in lateral). Goto to Step 4 and compare calculated pressure at top of drop pipe with initial guess..

STEP 3 Prior to initial iteration (STEP 5 & 6) enter here the average flow per hole (Cell D76)

	Hole First	Hole Last
Orifice flow (m3/hr)	1.76	1.73
orifice loss (mm H20)	227	218
Variance from average flow per hole	**1%**	**-1%**

Finite Difference Calculations

IFAS Basin Peak

Luke Wood: Since calcs are repetative, only a portion of the finitite difference calcs for each section (drop pipe, manifold, and laterals) is provided

Heat Loss Along Drop Pipe

Luke Wood: Drop pipe is divided into 70 equal segments

wetted length	3.96 m									
Length of Increment	0.05660295 m									
area of segment	0.029 m2									
Cumulative Depth (m)		0.1	0.11	0.17	0.23	0.28	0.34	0.40	0.45	0.51	0.57
Air Temp at top of segment (K)		355.4	355.4	355.3	355.3	355.3	355.3	355.2	355.2	355.2	355.2
heat loss along segment (watts)		142	142	142	142	142	142	142	142	142	141
Temperature at bottom of segment (K)		355.4	355.3	355.3	355.3	355.3	355.2	355.2	355.2	355.2	355.2

Luke Wood: Manifold is divided into segments equal in length to the distance between laterals. Finite Difference Calcs for friction loss, heat loss, and gas property changes (viscosity, density, etc) are completed for each segment

Heat and Friction Losses Along Grid Manifold

Manifold Segment # (also Lateral #)	1	2	3	4	5	6	7	8	9	10
manifold ID in segment between laterals (in)	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36
cross section of pipe (m2)	0.0205	0.0205	0.0205	0.0205	0.0205	0.0205	0.0205	0.0205	0.0205	0.0205
Flow at Front of Segment (m3/hr)	1,266	1,210	1,154	1,098	1,043	987	931	876	821	765
(m3/sec)	0.352	0.336	0.321	0.305	0.290	0.274	0.259	0.243	0.228	0.213
Velocity along segment (m/s)	17.16	16.40	15.65	14.89	14.14	13.38	12.63	11.88	11.13	10.38
Pressure at front of segment (Pa)	142,280	142,263	142,248	142,233	142,220	142,209	142,198	142,188	142,180	142,172
Temp at front of segment (K)	353.9	353.6	353.3	353.0	352.7	352.5	352.2	351.9	351.7	351.4
density at front of segment (kg/m3)	1.401	1.402	1.403	1.404	1.405	1.406	1.407	1.408	1.409	1.410
Mass Rate through segment (kg/sec)	0.493	0.471	0.450	0.428	0.407	0.385	0.364	0.343	0.321	0.300
Mass flux through segment G (kg/ m2 sec)	24.04	23.00	21.95	20.91	19.86	18.81	17.77	16.72	15.68	14.63
absolute viscosity (kg/m2-s2)	2.125E-05	2.124E-05	2.122E-05	2.121E-05	2.120E-05	2.119E-05	2.117E-05	2.116E-05	2.115E-05	2.114E-05
Reynolds Number along segment	182,789	174,938	167,078	159,210	151,334	143,449	135,556	127,654	119,743	111,824
Fanning Friction Factor	0.0045	0.0045	0.0045	0.0045	0.0046	0.0046	0.0046	0.0047	0.0047	0.0048
Churchill variable - A	1.601E+21	1.534E+21	1.465E+21	1.395E+21	1.323E+21	1.250E+21	1.176E+21	1.100E+21	1.023E+21	9.443E+20
Churchill variable - B	9.974E-12	2.013E-11	4.201E-11	9.089E-11	2.047E-10	4.818E-10	1.192E-09	3.115E-09	8.670E-09	2.591E-08
Friction loss along manifold segment (Pa)	**16.95**	**15.58**	**14.27**	**13.01**	**11.81**	**10.67**	**9.58**	**8.55**	**7.58**	**6.66**
surface area of segment (m2)	0.377	0.377	0.377	0.377	0.377	0.377	0.377	0.377	0.377	0.377
heat transfer coefficient (W/m2-K)	85	85	85	85	85	85	85	85	85	85
heat loss along segment (W)	1,813	1,804	1,795	1,787	1,778	1,769	1,760	1,752	1,743	1,734
Temp at end of segment (K)	353.6	353.3	353.0	352.7	352.5	352.2	351.9	351.7	351.4	351.1
Pressure at the end of the segment (Pa)	142,263	142,248	142,233	142,220	142,209	142,198	142,188	142,180	142,172	142,166
density at end of the segment (kg/m3)	1.402	1.403	1.404	1.405	1.406	1.407	1.408	1.409	1.410	1.411
Flow into lateral at end of segment (m3/hr)	55.90	55.83	55.75	55.67	55.59	55.51	55.43	55.35	55.27	55.19

Luke Wood: Lateral is divided into segments equal in length to the distance between holes. Calcs for friction loss, heat loss, and gas property changes (viscosity, density, etc) are completed for each segment

Heat and Friction Losses Along Lateral

Lateral segment (also hole #)	1	2	3	4	5	6	7	8	9	10
manifold ID in segment between laterals (in)	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44
cross section of pipe (m2)	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011
Flow at Front of Segment (m3/hr)	55.9	54.1	52.4	50.6	48.9	47.1	45.3	43.6	41.8	40.1
(m3/sec)	0.016	0.015	0.015	0.014	0.014	0.013	0.013	0.012	0.012	0.011
Velocity along segment (m/s)	14.79	14.32	13.85	13.39	12.92	12.46	11.99	11.53	11.06	10.60
Pressure at front of segment (Pa)	142,280	142,272	142,265	142,259	142,254	142,248	142,243	142,238	142,234	142,230
Temp at front of segment (K)	353.9	353.8	353.8	353.8	353.8	353.8	353.8	353.8	353.8	353.8
density at front of segment (kg/m3)	1.401	1.401	1.401	1.401	1.401	1.401	1.401	1.401	1.401	1.401
Mass Rate through segment (kg/sec)	0.022	0.021	0.020	0.020	0.019	0.018	0.018	0.017	0.016	0.016
Mass flux through segment G (kg/ m2 sec)	20.72	20.06	19.41	18.75	18.10	17.45	16.80	16.15	15.49	14.84
absolute viscosity (kg/m2-s2)	2.125E-05	2.125E-05	2.125E-05	2.125E-05	2.125E-05	2.125E-05	2.125E-05	2.125E-05	2.125E-05	2.125E-05
Reynolds Number along segment	35,658	34,532	33,407	32,282	31,158	30,036	28,914	27,792	26,672	25,552
Fanning Friction Factor	0.0065	0.0065	0.0066	0.0066	0.0066	0.0067	0.0067	0.0068	0.0068	0.0069
Churchill variable - A	7.874E+19	7.583E+19	7.290E+19	6.995E+19	6.698E+19	6.399E+19	6.098E+19	5.796E+19	5.493E+19	5.188E+19
Churchill variable - B	2.267E+00	3.789E+00	6.438E+00	1.113E+01	1.963E+01	3.531E+01	6.493E+01	1.223E+02	2.361E+02	4.690E+02
Friction loss along lateral segment (Pa)	**8.32**	**6.53**	**6.14**	**5.77**	**5.40**	**5.05**	**4.71**	**4.38**	**4.06**	**3.75**
surface area of segment (m2)	0.009	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
heat transfer coefficient (W/m2-K)	85	85	85	85	85	85	85	85	85	85
heat loss along segment (W)	42	35	35	35	35	35	35	35	35	35
Temp at end of segment (K)	353.8	353.8	353.8	353.8	353.8	353.8	353.8	353.8	353.8	353.8
Pressure at the end of the segment (Pa)	142,272	142,265	142,259	142,254	142,248	142,243	142,238	142,234	142,230	142,226
density at end of the segment (kg/m3)	1.401	1.401	1.401	1.401	1.401	1.401	1.401	1.401	1.401	1.401
Orifice flow at end of segment (m3/hr)	1.76452	1.76339	1.76226	1.76113	1.76000	1.75887	1.75775	1.75662	1.75549	1.75436

Only 1st a of finite difference calcs are included in submittal

Project: Massillon, OH

Calculation By: LGW

Date January 13, 2015

Basin: IFAS Basin

Airflow: Minimum

STEP 1: Enter design and Operating Data for Basin (Yellow Cells)

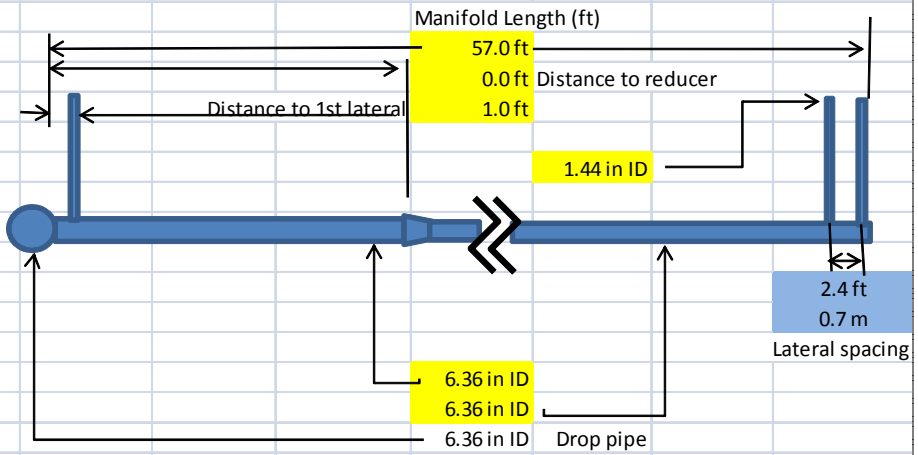
Site and Grid Data

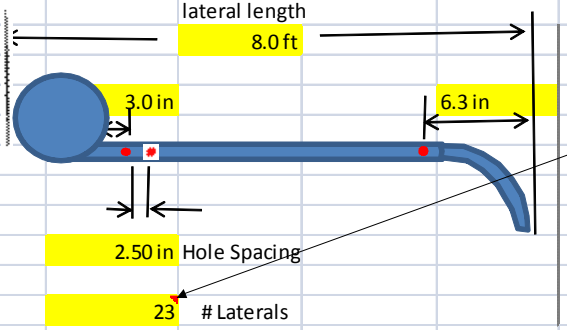
Yellow Cells - User INPUT

Air flow to basin (SCFM)	2500			
Grids/basin	13			
drop pipes / basin	13			
Safety factor on grid	**1**			
Specific Gas Constant for air	287			
Air temperature at top of Drop Pipe	180	F	355	K
Temperature of MLSS	75	F	297	K
Site Elevation	100	ft	30	m
Diffuser Depth	13	ft		
overall heat transfer coeff (U) at turbulent flow	15	BTU/hr-Ft^2-F	85	W/m2-K
Multiplier on U for transition and laminar flow	0.25			
specific heat of air			1010	j/kg-K
mass flow rate of air			1.442	kg/sec
Standard Pressure (corrected to elevation)	14.63	PSI	100,923	Pa
Internal Diameter of Drop Pipe (in)	6.36	in	0.16	m
Length of Drop Pipe	17	ft	5.18	m
Wetted length of Drop Pipe	13	ft	3.96	m
Moody Roughness Factor for pipe, ε			4.60E-05	m

Luke Wood: If balance is reasonable at peak flow then flow will be similarly balanced at lower flows.

Luke Wood:
Table 11-3 (page 11-25)
Typical Overall Heat Transfer Coefficents in Tubular Heat Exchangers
Perry's Chemical Engineers Handbook 7th ed.





Luke Wood:
Enter Total # of Laterals. Finite difference calcs accommodate up to 70 laterals per manifold and 70 holes per lateral.

PAGE 5

Basin: IFAS Basin
Airflow: Minimum

Drop Pipe Calculations

STEP 4
Enter initial guess here from Cell B46 then complete STEPs 5 and 6 and compare the calculated value with the guess. If difference within 5% no need to repeat iteration again . If difference > 5%, enter calculated value again and repeat steps 5 and 6

Yellow Cells - User INPUT

DROP PIPE ITERATION				
Totalized loses (drop pipe, orifice, manifold)	**Calculated**		**Initial Guess**	
	15.9	mm H20	16.0	mm H20
	Difference	0.4%		

Gauge Pressure at top of Drop Pipe Manifold	**5.65**	**PSI**	**38,968**	Pa
Absolute pressure at top of drop pipe	20.3	PSI	139,892	Pa
Actual Flow to basin	2,228	CFM	1.05	m3/sec
mass rate per drop pipe (inclusive of safety factor)			0.11	kg/sec
Flow per drop pipe (ACFM)	**171.41**	**ACFM**	0.08	m3/sec
Velocity	777	fpm	3.95	m/sec
Density			1.372	kg/m3
mass flux through pipe - G			5.42	kg/m2 sec
Absolute viscosity			2.13E-05	(kg/m2-s2)
Reynolds number, Nre			41,053	
Fanning Friction Factor			0.006	
Churchill variable - A			2.35505E+20	
Churchill variable - B			0.237971818	
Friction losses down drop pipe	**0.03**	**in H20**	7.8	Pa
Absolute Pressure at Bottom of Drop Pipe	20.28	PSI	139,884	Pa
Gauge Pressure at Bottom of Drop Pipe	5.65	PSI	38,961	Pa
Temp at bottom of drop pipe	168	F	349	K
Density at bottom of drop pipe			1.397	kg/m3
Actual Flow at Bottom of drop pipe	168	CFM	0.08	m3/sec
Flow into manifold	168	CFM		
averaged flow per lateral	7.3	CFM		
#holes/lateral	32			
total # holes per manifold	736			
Average flow /hole over whole grid			**0.39**	m3/hr
orifice los at average flow/hole (mm h20)			13	mm H20
			328.2	
Temp at front of manifold	168	F	349	K
Temp at end of manifold	131	F	328	K
Pressure at front of manifold			139,884	Pa
Pressure at end of manifold			139,874	Pa
Total Friction loss along manifold (Pa)			10	Pa
Total Friction loss along manifold length			1.0	mm H20

Luke Wood:
Viscosity at air temperature calculated by Sutherland's formula
(reference attached)

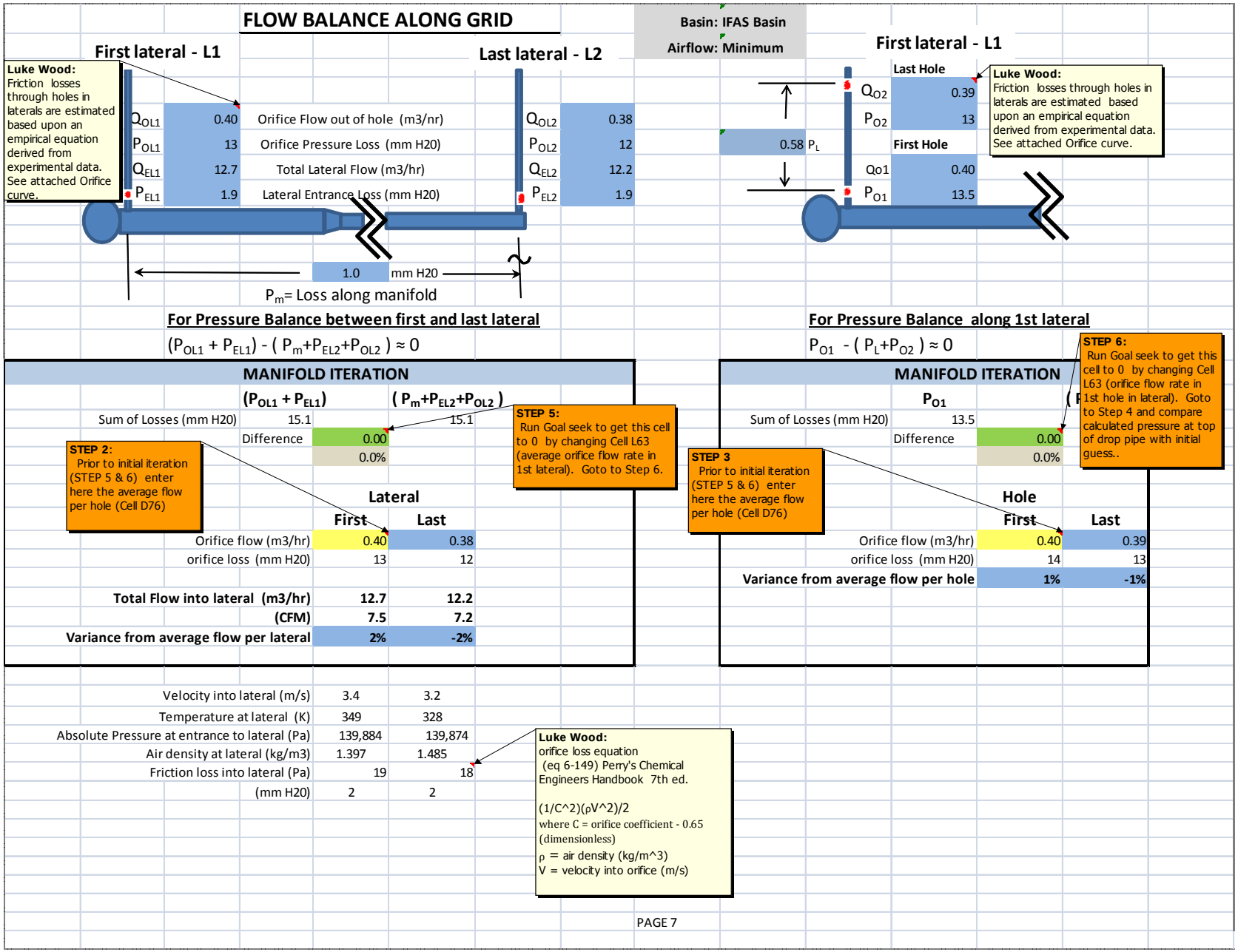
Luke Wood:
For turbulent flow, the Fanning friction factor is 1/4 of Darcy factor calculated according to Churchil's approximation,
For laminar flow (Nre < 3000), f = 16/Nre
(reference attached)

Luke Wood:
Friction Losses
$\Delta P = (4 f L G^2) / (2 d \rho)$
where
ΔP = pressure loss
f- fanning friction factor
G = mass flux in pipe
d = diameter
ρ = density

Eq 2.10-9 (page 91)
Transport Processes and Unit Operations (3rd

Luke Wood:
Change hole spacing (cell J33) until this value between 1 and 1.7 at peak design flow. Can go higher if safety factor on grid > 1

PAGE 6


FLOW BALANCE ALONG GRID
Basin: IFAS Basin
Airflow: Minimum
First lateral - L1
Last lateral - L2
Luke Wood: Friction losses through holes in laterals are estimated based upon an empirical equation derived from experimental data. See attached Orifice curve.
Q_{OL1} 0.40 Orifice Flow out of hole (m3/nr) Q_{OL2} 0.38
P_{OL1} 13 Orifice Pressure Loss (mm H20) P_{OL2} 12
Q_{EL1} 12.7 Total Lateral Flow (m3/hr) Q_{EL2} 12.2
P_{EL1} 1.9 Lateral Entrance Loss (mm H20) P_{EL2} 1.9
1.0 mm H20
P_m= Loss along manifold
For Pressure Balance between first and last lateral
$(P_{OL1} + P_{EL1}) - (P_m+P_{EL2}+P_{OL2}) \approx 0$
MANIFOLD ITERATION
$(P_{OL1} + P_{EL1})$ $(P_m+P_{EL2}+P_{OL2})$
Sum of Losses (mm H20) 15.1 15.1
Difference 0.00
0.0%
STEP 2: Prior to initial iteration (STEP 5 & 6) enter here the average flow per hole (Cell D76)
STEP 5: Run Goal seek to get this cell to 0 by changing Cell L63 (average orifice flow rate in 1st lateral). Goto to Step 6.
Lateral
First Last
Orifice flow (m3/hr) 0.40 0.38
orifice loss (mm H20) 13 12
Total Flow into lateral (m3/hr) 12.7 12.2
(CFM) 7.5 7.2
Variance from average flow per lateral 2% -2%
Velocity into lateral (m/s) 3.4 3.2
Temperature at lateral (K) 349 328
Absolute Pressure at entrance to lateral (Pa) 139,884 139,874
Air density at lateral (kg/m3) 1.397 1.485
Friction loss into lateral (Pa) 19 18
(mm H20) 2 2
Luke Wood: orifice loss equation (eq 6-149) Perry's Chemical Engineers Handbook 7th ed.
(1/C^2)(ρV^2)/2
where C = orifice coefficient - 0.65 (dimensionless)
ρ = air density (kg/m^3)
V = velocity into orifice (m/s)
First lateral - L1
Last Hole
Q_{O2} 0.39
P_{O2} 13
0.58 P_L
First Hole
Qo1 0.40
P_{O1} 13.5
Luke Wood: Friction losses through holes in laterals are estimated based upon an empirical equation derived from experimental data. See attached Orifice curve.
For Pressure Balance along 1st lateral
$P_{O1} - (P_L+P_{O2}) \approx 0$
MANIFOLD ITERATION
P_{O1}
Sum of Losses (mm H20) 13.5
Difference 0.00
0.0%
STEP 6: Run Goal seek to get this cell to 0 by changing Cell L63 (orifice flow rate in 1st hole in lateral). Goto to Step 4 and compare calculated pressure at top of drop pipe with initial guess..
STEP 3 Prior to initial iteration (STEP 5 & 6) enter here the average flow per hole (Cell D76)
Hole
First Last
Orifice flow (m3/hr) 0.40 0.39
orifice loss (mm H20) 14 13
Variance from average flow per hole 1% -1%
PAGE 7

Finite Difference Calculations

IFAS Basin Minimum

Luke Wood: Since calcs are repetative, only a portion of the finitite difference calcs for each section (drop pipe, manifold, and laterals) is provided

Heat Loss Along Drop Pipe

Luke Wood: Drop pipe is divided into 70 equal segments

wetted length	3.96	m
Length of Increment	0.05660295	m
area of segment	0.029	m2

Cumulative Depth (m)	0.1	0.11	0.17	0.23	0.28	0.34	0.40	0.45	0.51	0.57
Air Temp at top of segment (K)	355.4	355.3	355.2	355.1	355.0	354.9	354.8	354.7	354.6	354.5
heat loss along segment (watts)	142	142	141	141	141	141	141	140	140	140
Temperature at bottom of segment (K)	355.3	355.2	355.1	355.0	354.9	354.8	354.7	354.6	354.5	354.4

Luke Wood: Manifold is divided into segments equal in length to the distance between laterals. Finite Difference Calcs for friction loss, heat loss, and gas property changes (viscosity, density, etc) are completed for each segment

Heat and Friction Losses Along Grid Manifold

Manifold Segment # (also Lateral #)	1	2	3	4	5	6	7	8	9	10
manifold ID in segment between laterals (in)	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36
cross section of pipe (m2)	0.0205	0.0205	0.0205	0.0205	0.0205	0.0205	0.0205	0.0205	0.0205	0.0205
Flow at Front of Segment (m3/hr)	286	273	261	248	235	223	210	198	185	173
(m3/sec)	0.079	0.076	0.072	0.069	0.065	0.062	0.058	0.055	0.051	0.048
Velocity along segment (m/s)	3.88	3.71	3.53	3.36	3.19	3.02	2.85	2.68	2.51	2.34
Pressure at front of segment (Pa)	139,884	139,883	139,882	139,881	139,880	139,879	139,878	139,878	139,877	139,877
Temp at front of segment (K)	348.9	347.8	346.7	345.6	344.5	343.5	342.5	341.5	340.5	339.5
density at front of segment (kg/m3)	1.397	1.401	1.406	1.410	1.415	1.419	1.423	1.427	1.431	1.435
Mass Rate through segment (kg/sec)	0.111	0.106	0.102	0.097	0.092	0.088	0.083	0.078	0.074	0.069
Mass flux through segment G (kg/ m2 sec)	5.42	5.19	4.97	4.74	4.51	4.29	4.06	3.83	3.59	3.36
absolute viscosity (kg/m2-s2)	2.103E-05	2.097E-05	2.092E-05	2.087E-05	2.082E-05	2.078E-05	2.073E-05	2.068E-05	2.064E-05	2.060E-05
Reynolds Number along segment	41,606	39,990	38,354	36,697	35,020	33,324	31,609	29,876	28,124	26,355
Fanning Friction Factor	0.0057	0.0057	0.0058	0.0058	0.0059	0.0059	0.0060	0.0061	0.0061	0.0062
Churchill variable - A	2.406E+20	2.259E+20	2.112E+20	1.967E+20	1.822E+20	1.678E+20	1.536E+20	1.396E+20	1.258E+20	1.124E+20
Churchill variable - B	1.921E-01	3.620E-01	7.065E-01	1.432E+00	3.027E+00	6.698E+00	1.560E+01	3.846E+01	1.011E+02	2.859E+02
Friction loss along manifold segment (Pa)	**1.09**	**1.01**	**0.93**	**0.85**	**0.78**	**0.71**	**0.64**	**0.57**	**0.51**	**0.45**
surface area of segment (m2)	0.377	0.377	0.377	0.377	0.377	0.377	0.377	0.377	0.377	0.377
heat transfer coefficient (W/m2-K)	85	85	85	85	85	85	85	85	85	85
heat loss along segment (W)	1,656	1,620	1,584	1,550	1,516	1,482	1,450	1,418	1,387	1,357
Temp at end of segment (K)	347.8	346.7	345.6	344.5	343.5	342.5	341.5	340.5	339.5	338.6
Pressure at the end of the segment (Pa)	139,883	139,882	139,881	139,880	139,879	139,878	139,878	139,877	139,877	139,876
density at end of the segment (kg/m3)	1.401	1.406	1.410	1.415	1.419	1.423	1.427	1.431	1.435	1.439
Flow into lateral at end of segment (m3/hr)	12.67	12.65	12.63	12.61	12.59	12.56	12.54	12.52	12.50	12.48

Luke Wood: Lateral is divided into segments equal in length to the distance between holes. Calcs for friction loss, heat loss, and gas property changes (viscosity, density, etc) are completed for each segment

Heat and Friction Losses Along Lateral

Lateral segment (also hole #)	1	2	3	4	5	6	7	8	9	10
manifold ID in segment between laterals (in)	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44
cross section of pipe (m2)	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011
Flow at Front of Segment (m3/hr)	12.7	12.3	11.9	11.5	11.1	10.7	10.3	9.9	9.5	9.1
(m3/sec)	0.004	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Velocity along segment (m/s)	3.35	3.25	3.14	3.03	2.93	2.82	2.72	2.61	2.51	2.40
Pressure at front of segment (Pa)	139,884	139,883	139,883	139,882	139,882	139,882	139,881	139,881	139,881	139,880
Temp at front of segment (K)	348.9	348.9	348.9	348.9	348.8	348.8	348.8	348.8	348.7	348.7
density at front of segment (kg/m3)	1.397	1.397	1.397	1.397	1.397	1.397	1.397	1.397	1.398	1.398
Mass Rate through segment (kg/sec)	0.005	0.005	0.005	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Mass flux through segment G (kg/ m2 sec)	4.68	4.53	4.39	4.24	4.09	3.94	3.80	3.65	3.50	3.36
absolute viscosity (kg/m2-s2)	2.103E-05	2.102E-05	2.102E-05	2.102E-05	2.102E-05	2.102E-05	2.102E-05	2.102E-05	2.102E-05	2.102E-05
Reynolds Number along segment	8,146	7,889	7,633	7,376	7,120	6,864	6,608	6,352	6,096	5,841
Fanning Friction Factor	0.0087	0.0088	0.0088	0.0089	0.0090	0.0091	0.0092	0.0093	0.0093	0.0095
Churchill variable - A	7.887E+18	7.407E+18	6.939E+18	6.482E+18	6.036E+18	5.604E+18	5.183E+18	4.776E+18	4.383E+18	4.003E+18
Churchill variable - B	4.124E+10	6.880E+10	1.168E+11	2.017E+11	3.552E+11	6.383E+11	1.172E+12	2.205E+12	4.256E+12	8.445E+12
Friction loss along lateral segment (Pa)	**0.57**	**0.45**	**0.42**	**0.40**	**0.37**	**0.35**	**0.33**	**0.31**	**0.29**	**0.26**
surface area of segment (m2)	0.009	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
heat transfer coefficient (W/m2-K)	85	85	85	85	85	85	85	85	85	85
heat loss along segment (W)	39	32	32	32	32	32	32	32	32	32
Temp at end of segment (K)	348.9	348.9	348.9	348.8	348.8	348.8	348.8	348.7	348.7	348.7
Pressure at the end of the segment (Pa)	139,883	139,883	139,882	139,882	139,882	139,881	139,881	139,881	139,880	139,880
density at end of the segment (kg/m3)	1.397	1.397	1.397	1.397	1.397	1.397	1.397	1.398	1.398	1.398
Orifice flow at end of segment (m3/hr)	0.40065	0.40035	0.40006	0.39976	0.39946	0.39917	0.39887	0.39857	0.39828	0.39798

Only 1st a of finite difference calcs are included in submittal

Attachment I

Supporting Information

Sutherlands Formula

Effect of temperature on the viscosity of a gas

Sutherland's formula can be used to derive the dynamic viscosity of an ideal gas as a function of the temperature:[15]

$$\mu = \mu_0 \frac{T_0 + C}{T + C} \left(\frac{T}{T_0}\right)^{3/2}.$$

This in turn is equal to

$$\lambda \frac{T^{3/2}}{T + C}, \text{ where } \lambda = \frac{\mu_0 (T_0 + C)}{T_0^{3/2}} \text{ is a constant for the gas.}$$

in Sutherland's formula:

- μ = dynamic viscosity in (Pa·s) at input temperature T,
- μ_0 = reference viscosity in (Pa·s) at reference temperature T_0,
- T = input temperature in kelvins,
- T_0 = reference temperature in kelvins,
- C = Sutherland's constant for the gaseous material in question.

Valid for temperatures between $0 < T < 555$ K with an error due to pressure less than 10% below 3.45 MPa.

Sutherland's constant, reference values and λ values for some gases:

Gas	C [K]	T_0 [K]	μ_0 [μPa s]	λ [μPa s $K^{-1/2}$]
air	120	291.15	18.27	1.51204129
nitrogen	111	300.55	17.81	1.40673219
oxygen	127	292.25	20.18	1.69341129
carbon dioxide	240	293.15	14.8	1.57208593
carbon monoxide	118	288.15	17.2	1.42819322
hydrogen	72	293.85	8.76	0.63623656
ammonia	370	293.15	9.82	1.29744337
sulfur dioxide	416	293.65	12.54	1.76846608
helium	79.4[16]	273	19[17]	1.48438149

reference

15. ^ Alexander J. Smits, Jean-Paul Dussauge Turbulent shear layers in supersonic flow, Birkhäuser, 2006, ISBN 0-387-26140-0 p. 46

http://en.wikipedia.org/wiki/Viscosity#Effect_of_temperature_on_the_viscosity_of_a_gas

Fanning friction factor formulæ [edit]

This friction factor is one-fourth of the Darcy friction factor, so attention must be paid to note which one of these is meant in the "friction factor" chart or equation consulted. Of the two, the Fanning friction factor is the more commonly used by Chemical Engineers and those following the British convention.

The formulae below may be used to obtain the Fanning friction factor for common applications.

The friction factor for laminar flow in round tubes is often taken to be:

$$f = \frac{16}{Re}$$

where Re is the Reynolds number of the flow.

For a square channel the value used is:

$$f = \frac{14.227}{Re}$$

The Darcy friction factor can also be expressed as[1]

$$f = \frac{8\tau_w}{\rho V_{avg}^2}$$

where:

- τ_w is the shear stress at the wall
- ρ is the density of the fluid
- V_{avg}^2 is the average fluid velocity

For the turbulent flow regime, the relationship between the Fanning friction factor and the Reynolds number is more complex and is governed by the Colebrook equation [2] which is implicit in f:

$$\frac{1}{\sqrt{f}} = -4.0 \log_{10}\left(\frac{\frac{\epsilon}{d}}{3.7} + \frac{1.256}{Re\sqrt{f}}\right), \text{turbulent flow}$$

Various explicit approximations of the related Darcy friction factor have been developed for turbulent flow.

Stuart W. Churchill[3] developed a fomula that covers the friction factor for both laminar and turbulent flow.

$$f = 8\left(\left(\frac{8}{Re}\right)^{12} + (A+B)^{-1.5}\right)^{\frac{1}{12}}$$

$$A = \left(2.457 \ln\left(\left(\frac{7}{Re}\right)^{0.9} + 0.27\frac{e}{D}\right)^{-1}\right)^{16}$$

$$B = \left(\frac{37530}{Re}\right)^{16}$$

The Churchill equation approximates the Darcy friction factor thus the Fanning Friction factor is computed by dividing the computed value by 4.

References [edit]

1. ^ Yunus, Cengel. Heat and Mass Transfer. New York: Mc Graw Hull, 2007.
2. ^ Colebrook, C.F. and White, C.M. 1937, "Experiments with Fluid friction roughened pipes.", *Proc. R.Soc.(A)*, **161**
3. ^ Churchill, S.W., 1977, "Friction factor equations spans all fluid-flow ranges.", *Chem. Eng.*, **91**

http://en.wikipedia.org/wiki/Fanning_friction_factor

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SECTION 5.3

HYDRAULIC CALCULATIONS

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I. Kruger, Inc.

IFAS Reactor Hydraulic Calculations

Massillon, OH WWTP

For an AnoxKaldnes™ Biofilm Technology

Hybas^{TM} Biological Treatment System

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Revision 2
May 26, 2015

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KRUGER SIEVE CALCULATIONS

Massillon OH WWTP

Sieve assemblies at the downstream of end of each IFAS reactor are designed for a maximum flow rate of 20.38 MGD [(22.9 MGD peak flow + 21.25 MGD RAS (125% ADF) + 17 MGD IMLR (100% ADF))/3 trains]. Sieve assemblies at each IMLR Box (1 per IFAS reactor) are designed for a maximum flow rate of 8.5 MGD [25.5 MGD IMLR (150% ADF)/3 trains]. Note that calculations are based on an ADF = 17 MGD (Addendum #1) and PHF = 22.9 MGD. The maximum head loss allowed is 3 inches per reactor.

Headloss is determined in two parts. 1) Headloss through the sieve surface and 2) the headloss through the opening in the dividing wall between each stage.

The headloss through the sieve surface is estimated from the following empirical equation developed from sieve loading tests in combination with media from field testing screens. An internal report generated from testing conducted at the Bury St. Edmonds facility is included in Attachment II for reference. The loading rate was determined using the mathematical curve fit in Figure 4 of the report. The equation accounts for the impact of media accumulation at the sieve surface as the hydraulic loading increases. It should be noted that the testing screens at Bury St. Edmonds were wedge-wire screens, whereas, the screens for Massillon are perforated plate screens with 5/8" diameter holes (53% open area). The wedge-wire screen produces more headloss than a 5/8" diameter perforated screen. As such, the headloss value for Massillon calculated below is a <u>conservative</u> estimate.

$$h_s = [\ 0.0303q^2 - 0.8741q\ ] / 25.4 \qquad \text{Eq 1)}$$

(See Figure 4, page 7 of Report in Appendix II)

Where

h_s = headloss through sieve surface (converted to units of inches by 25.4 mm per inch)

q = sieve loading rate (m/hr)

The headloss through the opening in the wall are calculated in accordance with the equation

$$h_o = [\ k\ V^2 / (2g)\ ] * 12 \qquad \text{Eq 2)}$$

Where

h_o = headloss through opening (converted from ft to inches)

$k = k_1 + k_2 = 1.5$, combined headloss coefficient

$k_1 = 0.5$ (entrance coefficient)

$k_2 = 1.0$ (exit coefficient)

V = velocity through opening (ft/sec)

g = gravitational constant = 32.2 (ft^2/sec)

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Headlosses through Aerated reactors

Sieve losses

The downstream end of each IFAS reactor contains twenty-two circular sieves and each IMLR Box contains 14 circular sieves. Each circular sieve is 23 inches diameter by 5 feet long providing a total screen surface area of 660 ft^2 (61.3 m^2) for the downstream end of the IFAS reactor and 360 ft^2 (33.4 m^2) for the IMLR Box.

The max applied flow rate to the downstream end of each IFAS reactor is 20.38 MGD or 3,215 m^3 /hr. The applied sieve loading rate is 3,215 / 61.3 or 52.4 m/h.

From Eq 1), the estimated headloss for the downstream end of the IFAS reactor is

$$h_s = [\ 0.0303(52.4)^2 - 0.8741(52.4)\ ] / 25.4$$

$$h_s = 1.47 \text{ inches}$$

The max applied flow rate to the IMLR box is 8.5 MGD or 1,341 m^3 /hr. The applied sieve loading rate is 1,341 / 33.4 or 40.1 m/h.

From Eq 1), the estimated headloss for the IMLR box is

$$h_s = [\ 0.0303(40.1)^2 - 0.8741(40.1)\ ] / 25.4$$

$$h_s = 0.54 \text{ inches}$$

Wall opening losses

The opening for each sieve is 23 inches diameter and the total open areas provided by the circular sieves at the downstream end of the IFAS reactor and IMLR Box are 63.5 ft^2 and 34.6 ft^2, respectively.

The wall-opening velocity for the downstream end of the IFAS basin is (20.38*1.547/63.5) or 0.5 ft/s.
From Eq 2), the estimated wall-opening headloss for the downstream end of the IFAS reactor is

$$h_o = [\ 1.5\ (0.5\ )^2 / (2*32.2)\ ] * 12$$

$$h_o = 0.07 \text{ inches}$$

The wall-opening velocity for the IMLR box is (8.5*1.547/34.6) or 0.38 ft/s.
From Eq 2), the estimated wall-opening headloss for the downstream end of the IFAS reactor is

$$h_o = [\ 1.5\ (0.38\ )^2 / (2*32.2)\ ] * 12$$

$$h_o = 0.04 \text{ inches}$$

As can be seen in calculations above, headloss at maximum flow for both the downstream end of the IFAS reactor (1.47 + 0.07 = 1.54 inches) and the IMLR box (0.54 + 0.04 = 0.58 inches) is well below the limit of 3 inches.

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Attachment II

Field Testing Report for Sieve Headloss

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Version Number:7 *Report Number:261*

Bury St Edmuds Sieve Trials Horizontal Wedgewire February 2000

Version Number: 1

Revision date: 09 March 2000

Status: Final

Author: Jonathan Strickland

Checked by: Matthew Griffiths

Classification : Restricted

Distribution:

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Introduction

The development of Sieve designs for the Kaldnes process has been ongoing since the introduction of the process to the UK in 1994. This is clear from the situation at Bury St Edmunds where three sieve designs have been installed since the plant was first commissioned. The second design - vertical box sieves were installed in March 1996, and were a replacement for the original flat sieve design. These were tested in 1996 and have been successfully in use up to 1999. At that time they were replaced with horizontal wedge wire sieves as part of a scheme to improve the performance of the aeration system which had been subject to blockage.

The refitting scheme

The aerator refitting scheme included new aerators fixed to the floor rather than the previous lift out design. These were coarse bubble designed to enhance aeration at the sieve (outlet) end of the tank i.e 30% of the aeration is in the exit quarter of the tank. No sieve aerators were included as these were suspected to have contributed to the previous aerator blockage problem as well as excessive amounts of air channelling at the outlet end of the plant causing Kaldnes to escape. This omission of sieve aerators was the main reason for replacing the sieves, with horizontal pattern wedge wire pipe sieves.

The sieves consist of three 1.2 m long 0.6 m diameter wedge wire pipes bolted to a braced stainless steel box attached to the end wall of the tank in front of the outlet weir. The sieves are supported by but not attached to struts from the floor and side of the tanks. The sieves are internally braced by a vertical stainless steel plate welded along the length of the sieve (see photograph). The sieves are at I.5 m centres and the tops are very close to the top water level. The reactors themselves have very little (for kaldnes reactors) freeboard at 500 mm.

There are two parallel reactors each of 250 m3 receiving around 10000 m3/day (115l/s) of bacteria bed effluent (including recirculation). The reactors are filled to 60% with K1 media. Aeration is provided by one variable speed blower (1200 Nm3/h max) and two fixed speed assist/standby blowers (800 Nm3/h). At the time of this trail the variable speed blower was out of action.

Trial Method

As there are three sieves in each reactor, two pumps to feed the reactor (and another reactor to split flow to), it is possible to devise a matrix of possible tests

No of pumps	Number of Sieves		
0.5	1	2	3
1	1	2	3
2	1	2	3

A method for removing sieves from service was devised after some experimentation. This consisted of a rubber faced plate jacked into position against the tank wall. Entry to the weir box to do this required a partial pumping down of the reactor. Tests were done therefore in the order one sieve, two sieves, three sieves.

One blower was operated to the reactor under test while the test was proceeding.

During each test the reactors were closely observed, and measurements of headlosses and flow rates taken. The flow system was set up such that effluent from the reactor was returned to the inlet pump wet well. By doing this the wet well was always full and the output of the inlet pumps did not vary in response to varying head. The pumped rate was also very high as the head was low compared to the operational situation.

Level in the reactor was measured in a tube designed to act as a method for emptying the reactor if required and this was useful as a still surface free of Kaldnes. Head over the outlet weir was measured using the installed ultrasonic device which was checked for zero calibration. This ultrasonic device also computed the flow over the outlet weir and these flow rates were used to determine an average output per pump. Air rate measurement was available but this appeared unreliable and so the design rate was assumed to be correct.

Results

The head loss which is desired to be measured is that due to the passage of liquid through the sieve, and any Kaldnes media accumulated around it. The calculation of this is explained in the diagram below.

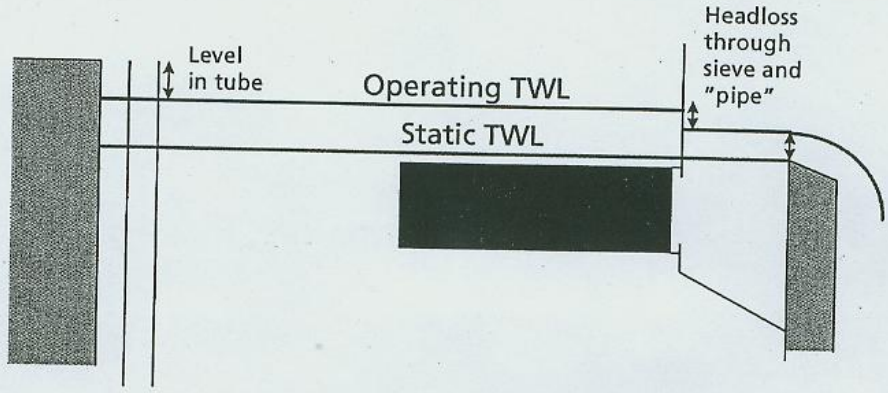


Figure 1 Headloss illustration

It is possible using this method to calculate the head loss between the reactor and the weir box -

Static level in tube - operating level in tube - Level over weir = headloss through sieve and pipe

A further calculation can be performed to calculate the head loss within the pipe sieve and through the slightly contracted (550mm) exit to the pipe sieve. In practice this is very small and can practically be ignored.

Results are tabulated overleaf in Table 1. During the trials, a variety of flow rates were obtained from the flow meters, as conditions over the outlet weirs were turbulent, and pump rates were rationalised at 100l/s per pump.

Table 1 Results

One Sieve Tests								
Flow (l/s)	Observed level in dip tube (mm)	Head between dip tube and weir crest (mm)	Head over weir (mm)	Head through sieve and exit (mm)	Calculated head sieve as pipe and exit (mm)	Head through sieve and media (mm)	Sieve loading (m/h)	Approach velocity (m/h)
50	415	90	67	23	0.5	22.5	43.1	8.6
100	295	210	80	130	2	128	86.1	17.1
200	0	505	180	325	8.6	316.4	① 172.2	34.3
Two Sieve Tests								
Flow	Observed level in dip tube (mm)	Head between dip tube and weir crest	Head over weir	Head through sieve and exit	Calculated head sieve as pipe and exit	Head through sieve and media	Sieve loading (m/h)	Approach velocity (m/h)
50	440	65	62	3	0.1	2.9	21.5	8.6
100	380	125	105	20	0.5	19.5	43.1	17.1
200	168	337	160	177	2	175	② 86.1	34.3
Three Sieve Tests								
Flow	Observed level in dip tube (mm)	Head between dip tube and weir crest	Head over weir	Head through sieve and exit	Calculated head sieve as pipe and exit	Head through sieve and media	Sieve loading (m/h)	Approach velocity (m/h)
50	455	50	59	-9	0	-9	14.4	8.6
100	410	95	80	15	0.2	14.8	28.7	17.1
200	318	187	163	24	1	23	57.4	34.3
100	409	96	97	-1	0.2	-1.2	28.7	17.1

Notes

①Test did not reach a stable result - the level was still rising and would have overflowed the reactor

② Test was run for one hour to achieve a stable result.

Aeration ratio for all tests was 3.2 $Nm^3 h^{-1}$ air/m^3 reactor, a superficial velocity of approximately 1 m/h.

Sieve loading is defined as the flow divided by the total area of the sieve, velocity through slots would be higher.

Approach velocity is the flow divided by the cross sectional area of the tank and is a measure of the forces acting to concentrate the media at the outlet end of the reactor.

These results can be represented graphically. Figure 2 includes all the results and it is clear that the result obtained at 172 m/h is an outlier and that the test had not reached stability. It is hard visually to distinguish between the results at similar sieve loadings but with different numbers of sieves operating. That is, the effect of approach velocity is not clear.

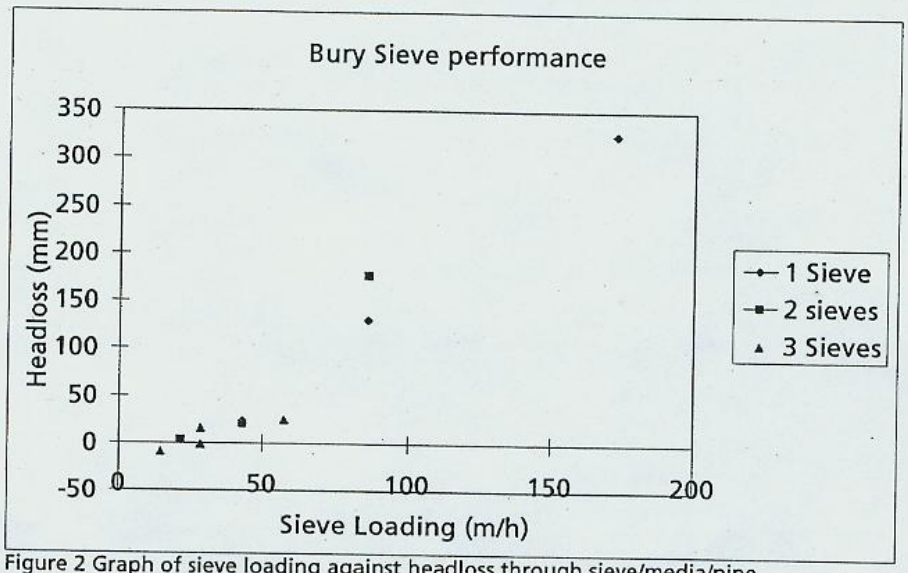


Figure 2 Graph of sieve loading against headloss through sieve/media/pipe combination.

To further investigate this, results with the same approach velocity were plotted in series together (Figure 3).

There appears to be little relationship between approach velocity and head loss at sieve loading up to 60m/h but the results at 90 m/h suggest that a higher approach velocity does have an effect.

The results up to 90 m/h have been used to derive a mathematical relationship between sieve loading and head loss (figure 4). This indicates that head loss through the sieve media combination is negligible up to 40 m/h, but thereafter rises.

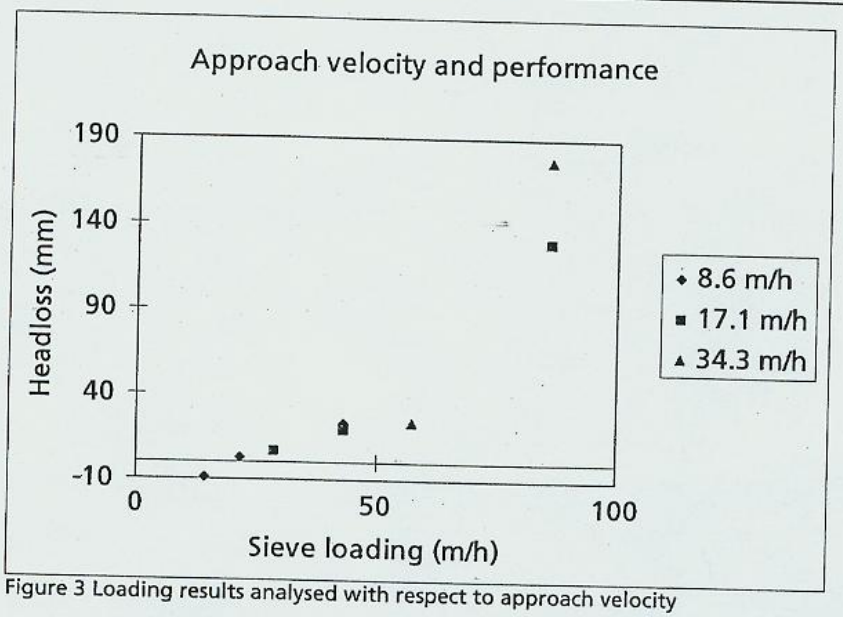


Figure 3 Loading results analysed with respect to approach velocity

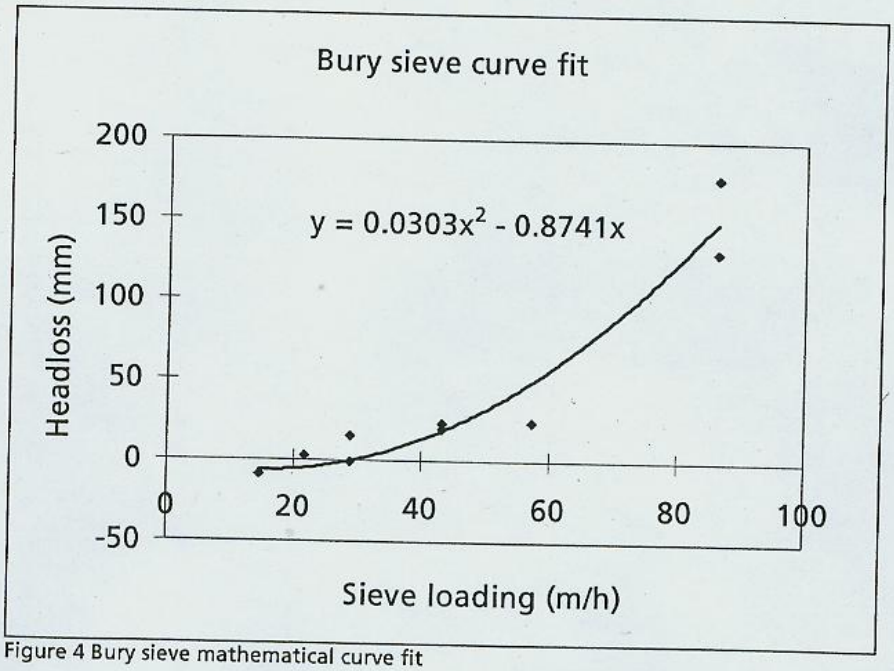


Figure 4 Bury sieve mathematical curve fit

Discussion

The sieve trials have indicated that in the configuration at Bury St Edmunds horizontal pipe sieves can safely be loaded to 60 - 70 m/h. At higher flow rates media was impeding the flow of water and creating a significant head loss. At Bury St Edmunds sieve loadings above 90 m/h would not be possible, but this is well above operational requirements.

The use of these results at different sites should be approached with care. Position of the sieves in the reactor, reactor shape, aeration velocity and aeration distribution are all significant in altering the maximum velocity possible through the sieves. Each of these will be discussed in relation to Bury St Edmunds and more general application.

Sieve position - The sieves at Bury are very close to top water level and this is not ideal as at high velocities the top surface of the sieve is not used for flow (see photographs). The sieves should not be so low as to be covered with media when the reactor is drained, so the bottom needs to be no lower than one third depth. At Bury this would be 1.1 m leaving the top surface at 0.4m of the top water level. If this were the case it is likely that higher velocities could be achieved. The sieves are relatively close together due to the narrowness of the tank, and there is clearly some interference. The Bury sieves are at 2.5 diameter centres, 4 diameter centres would be better.

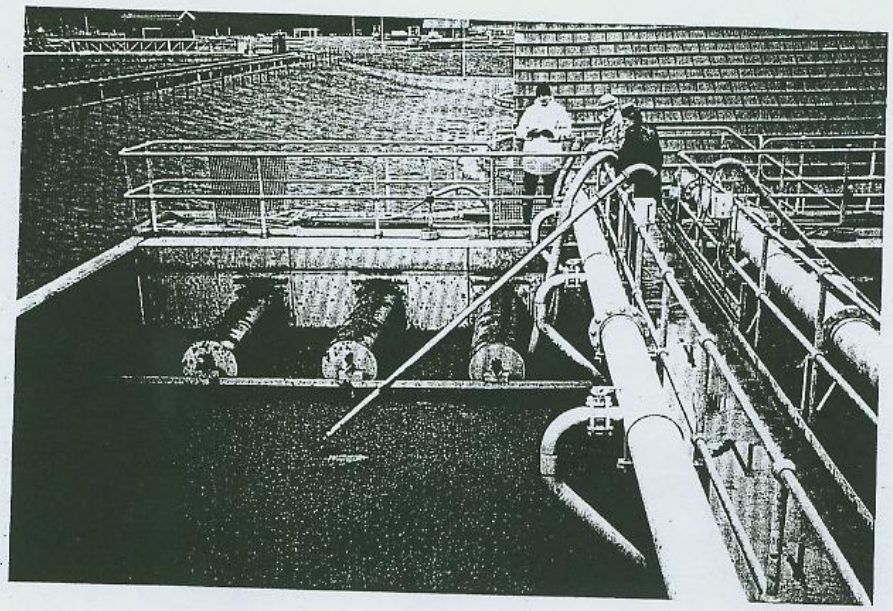
Reactor shape - The Bury reactors have a length to breadth ratio of just over 2:1 which was originally designed to encourage plug flow characteristics. However it is extremely unlikely that plug flow can be achieved in a single Kaldnes reactor and it is better to consider them as CSTRs. This ratio has the result of creating high velocities along the tank and this contributes to the accumulation of media at the outlet end of the tank. Lower length to breadth ratios in the range 1:1 - 1.5:1 would be better.

Aeration Velocity - More aeration results in better mixing and more movement of media away from the sieves. The Bury reactors are relatively lightly aerated at 3.2 Nm^3 h^{-1} air/m^3 reactor or 1m/h (during the trial - even lower in operation). Deeper tanks result in higher superficial velocities for the same air volume and therefore more mixing energy, but such tanks also need more mixing energy to transport media to the bottom of the tank, so volumetric ratio probably remains a reasonable design value. It is not acceptable to design aeration systems purely to achieve mixing, so sieves should be designed with the minimum likely aeration ratios considered. If necessary, safeguards (software, minimum blower speeds) should be used to ensure this minimum is maintained. Most plants would have process air requirements which would mean that the Bury ratios would be exceeded.

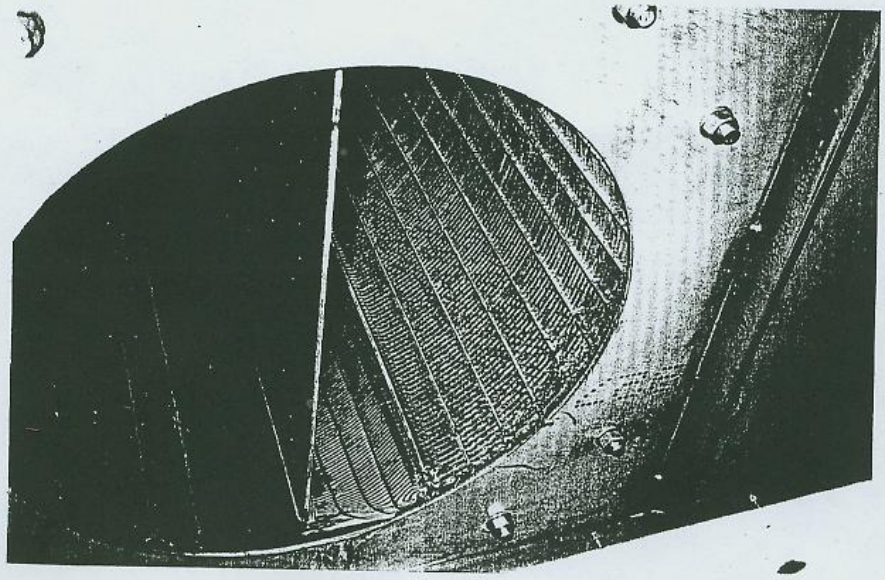
Aeration distribution - offset aeration intensity is used on Bury and all recent designs to create an outlet to inlet rolling motion in the reactor. This is effective at moving media away from the sieves. Current split (in quarters along the tank) is 20%, 25%, 25%, 30% - whether this split is ideal is unproved, but empirical evidence is good. Horizontal pipe sieves have not generally been installed with sieve aeration and do not seem to require it.

Taking all these factors into account it is likely that the Bury result represents a minimum for horizontal pipe sieve operation. If attention is given to the items discussed above it is likely that sieve velocities of 90m/h would be possible. Mechanical strength of very large sieves is an unresolved issue and large diameters/ lengths should be used with care.

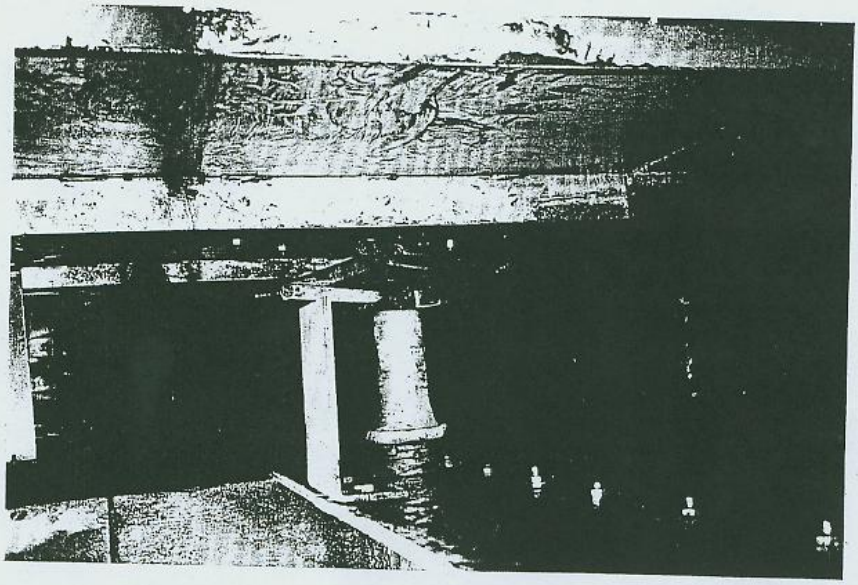
Appendix - Photographs



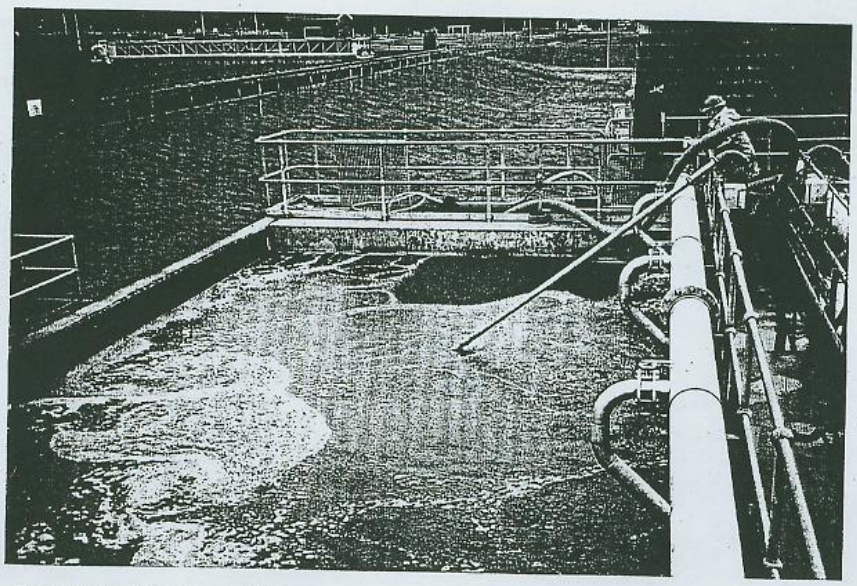
Sieve arrangement at Bury St Edmunds



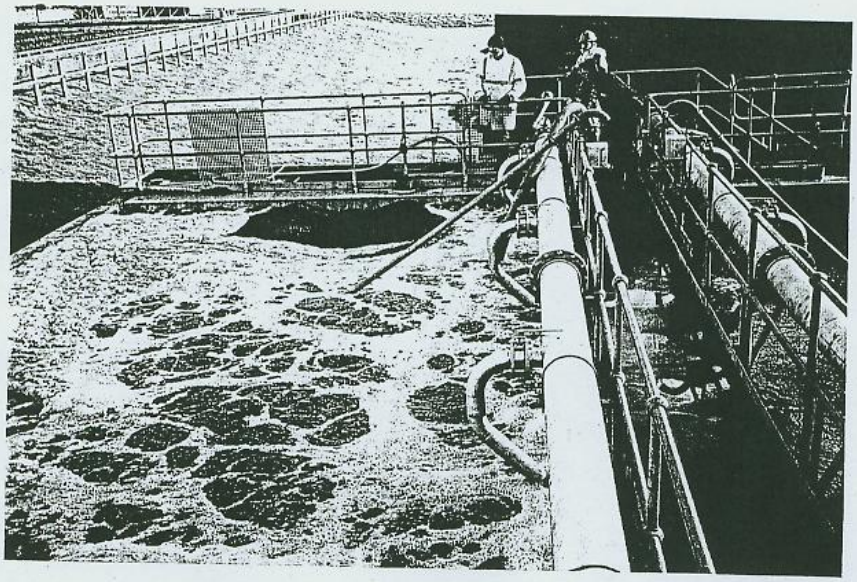
Sieve internal showing vertical stiffening plate



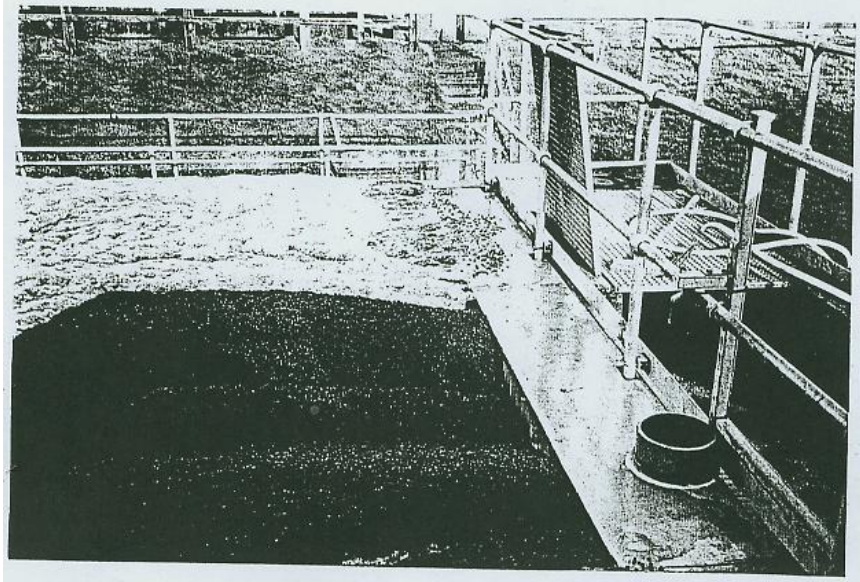
Method of sieve blockage inside weir box



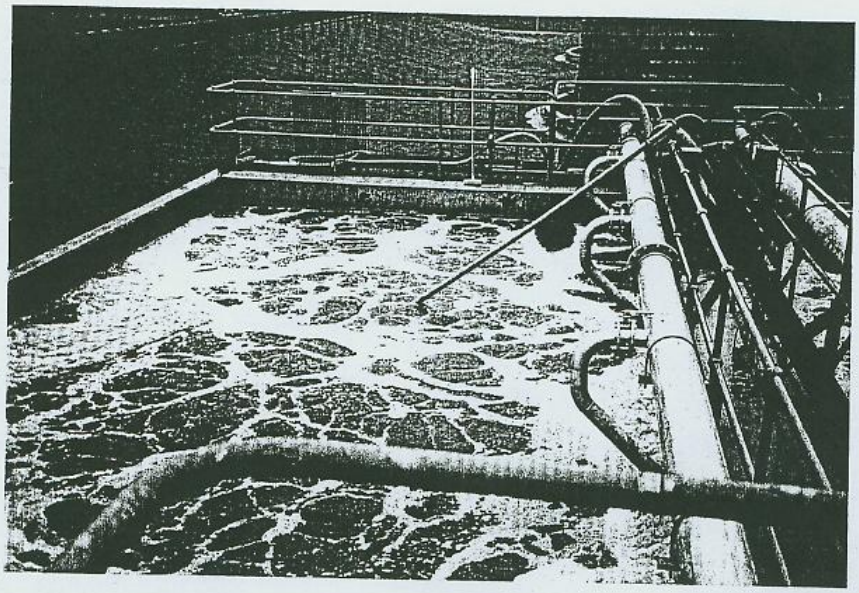
Sieve Trial - One sieve - 50l/s



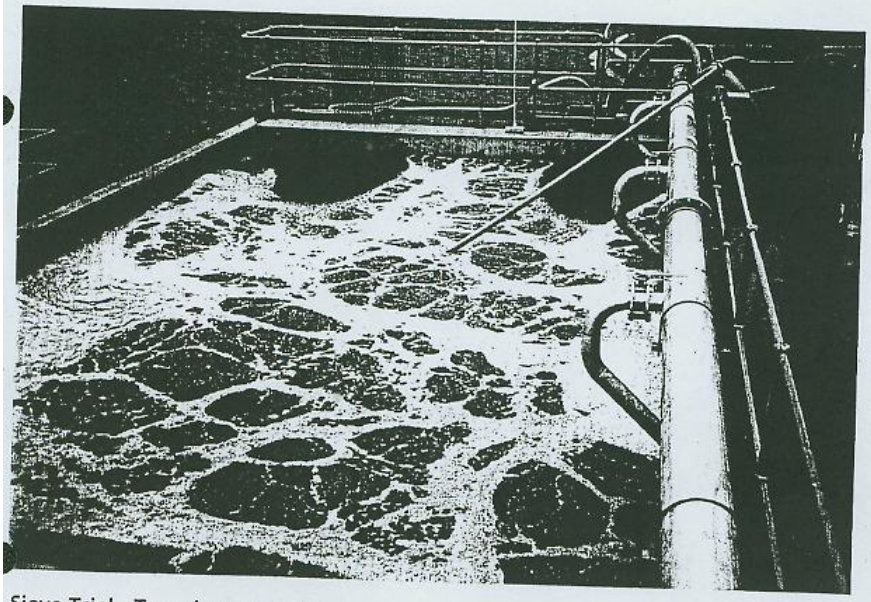
Sieve Trial - One sieve - 100 l/s



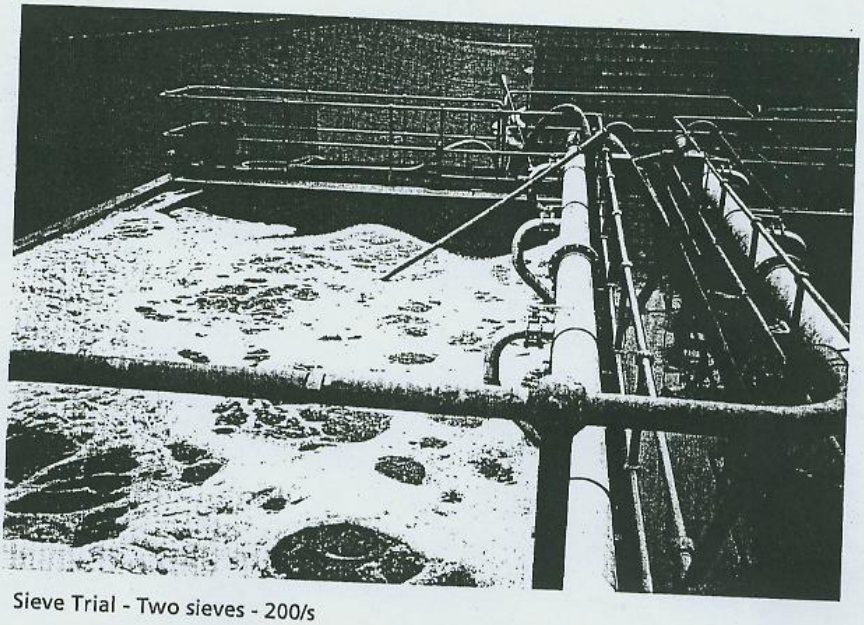
Sieve Trial - One sieve - 200l/s (trial abandoned due to overtopping!)
Note dry area above sieve indicating non utilisation of sieve top



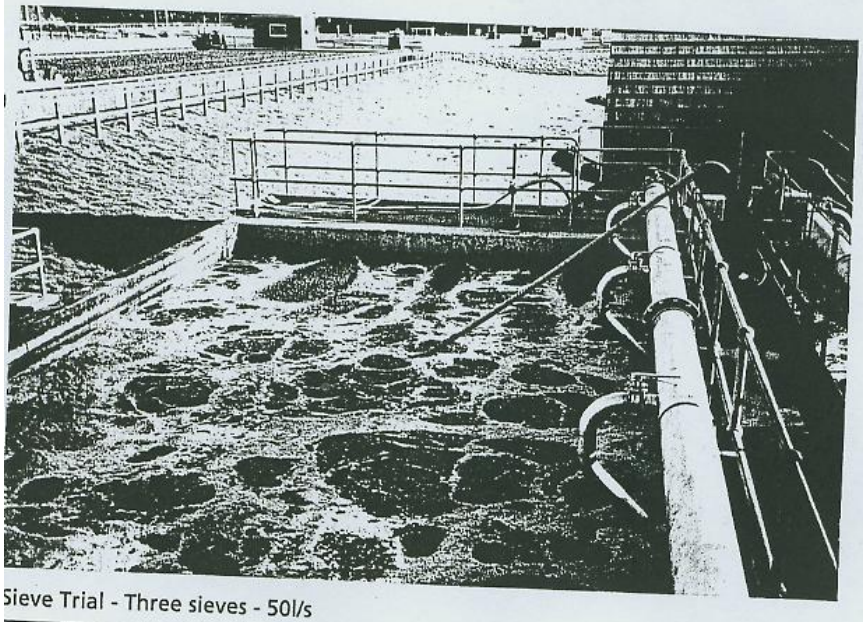
Sieve Trial - Two sieves - 50l/s



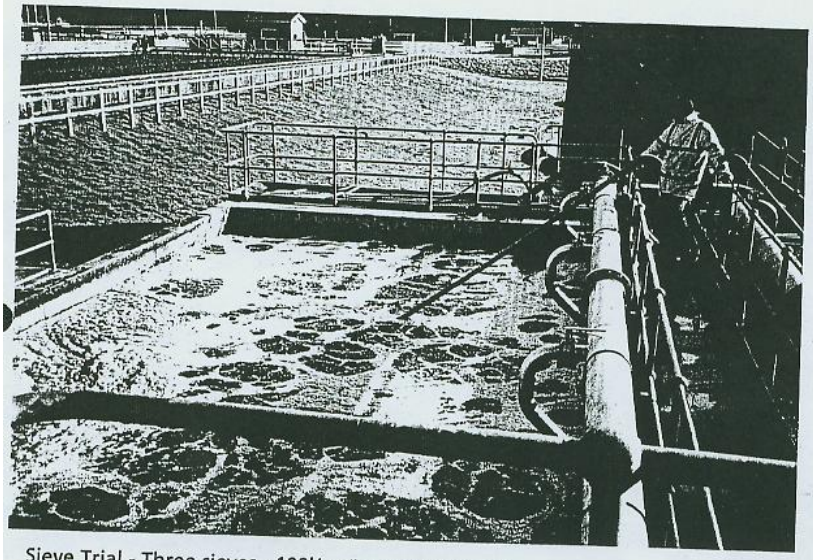
Sieve Trial - Two sieves - 100l/s



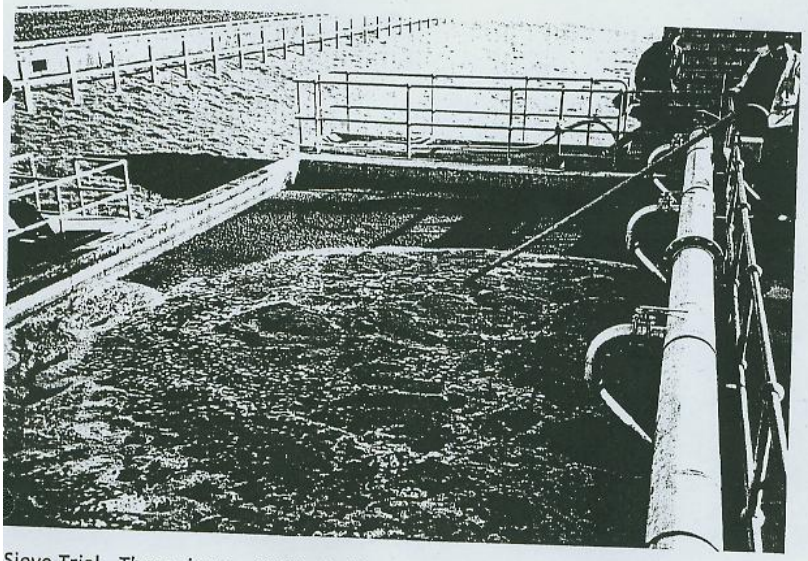
Sieve Trial - Two sieves - 200/s



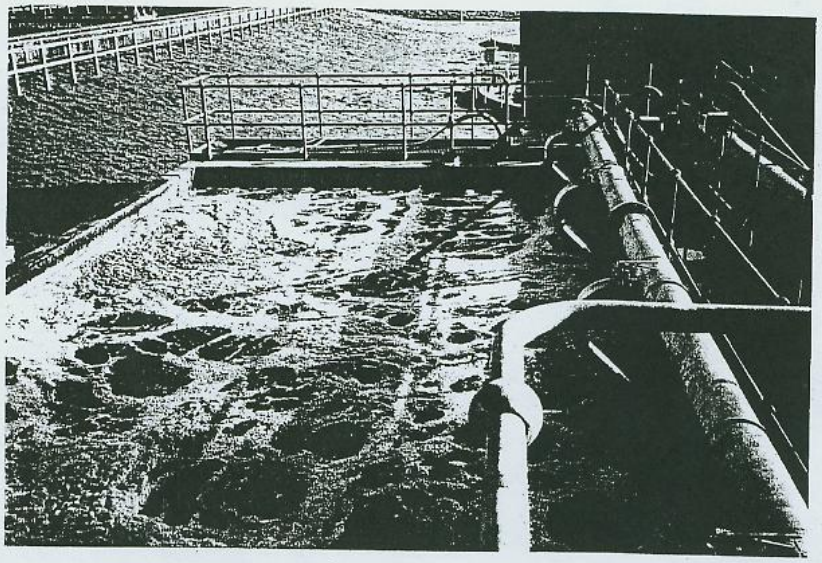
Sieve Trial - Three sieves - 50l/s



Sieve Trial - Three sieves - 100l/s - "normal" trial air



Sieve Trial - Three sieves - 100l/s - half "normal" trial air



Sieve Trial - Three sieves - 200/s

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SECTION 5.4

KRUGER STAFF QUALIFICATIONS

VEOLIA WATER
Solutions & Technologies

KRÜGER

August 2014

AnoxKaldnes™ Technology
Roster of Select Staff

Rich DiMassimo, P.E.



- Vice President of Engineering
- 16 years with Kruger, 20 years in wastewater treatment engineering
- Specialty: BNR by suspended and attached growth systems.
- Key involvement:
  - Fields Point WWTP, RI IFAS upgrade,
  - Noman Cole WWTP, VA MBBR denitrification system,
  - James River WWTP, VA IFAS demonstration study
  - James River, VA ANITA Mox System
  - South Durham, NC ANITA Mox System
  - Egan, IL ANITA Mox System

Luke Wood, P.E., MSAE



- Process Manager
- 13 years with Kruger, 19 years in wastewater treatment engineering
- Specialty: BNR by suspended and attached growth systems, high rate tertiary clarification for phosphorous removal, cloth media filtration for phosphorous removal and reuse applications
- Key involvement:
  - Mamaroneck, NY IFAS system
  - Lubbock, TX IFAS system
  - Crested Butte, CO IFAS upgrade
  - Springettsbury, PA IFAS retrofit
  - James River WWTP, VA IFAS retrofit
  - Twin Falls, ID IFAS

Michael Johns



- Senior Process Engineer
- 6 years with Kruger, 19 years in wastewater treatment engineering
- Specialty: IFAS and MBBR process design and operation for BNR and industrial applications, modeling of IFAS/MBBR systems
- Key involvement:
  - James River WWTP, VA IFAS retrofit
  - Greensboro TZ Osborne WWTP, NC IFAS demonstration
  - Fields Point WWTP, RI IFAS retrofit

Hong Zhao, Ph.D., P.E.



- Process and Technology Leader - Wastewater
- 14 years with Kruger, 23 years in wastewater treatment engineering
- Specialty: BNR by suspended and attached growth systems, MBR process design and operation, modeling of biological wastewater treatment processes
- Key involvement:
  - Development of modeling tools with AnoxKaldnes, Sweden
  - Expert comprehensive design oversight
  - James River, VA ANITA Mox System
  - South Durham, NC ANITA Mox System
  - Egan, IL ANITA Mox System

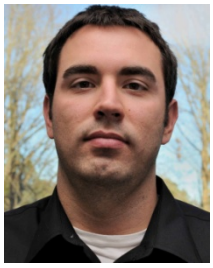
VEOLIA WATER
Solutions & Technologies

Glenn Thesing, P.E., MSEE



- Senior Process Engineers
- 16 years with Kruger, 18 years in wastewater treatment engineering
- Specialty: BNR attached growth systems (BAF, MBBR), high rate primary clarification
- Key involvement:
    - James River WWTP, VA IFAS retrofit
    - Noman Cole, VA MBBR system
    - James River, VA ANITA Mox System
    - South Durham, NC ANITA Mox System
    - Egan, IL ANITA Mox System

David Foster



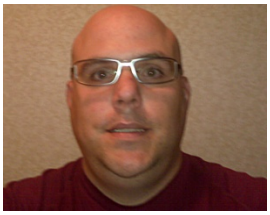
- Process Manager
- 8 years with Kruger, 8 years in wastewater treatment engineering
- Specialty: BNR attached growth systems (BAF, MBBR), high rate primary clarification
- Key involvement:
    - Flagstaff, AZ IFAS upgrade
    - Wisconsin Rapids, WI MBBR system
    - Waikoloa, HI MBBR system
    - Fairplay, CO IFAS system
    - Cocoa Beach, FL IFAS system

Chandan Satpathy



- Process Engineer
- 6 Years with Kruger, 7 Years in wastewater engineering
- Specialty: BNR by suspended and attached growth systems
- Key Involvement:
    - York, PA BNR Retrofit
    - Lower Allen Township, PA BNR Retrofit
    - Lickdale, PA IFAS WWTP
    - Dickinson, ND IFAS WWTP
    - Franklin Township, PA IFAS Retrofit
    - Twin Falls, ID IFAS

Walter Medlock, P.E.



- Senior Process Engineer
- 4 years with Kruger, 13 years in wastewater treatment engineering
- Specialty: BNR by suspended and attached growth systems, field oxygen transfer testing
- Key involvement:
    - Lubbock, TX IFAS upgrade
    - Crested Butte, CO IFAS system
    - Crow Creek WWTP, WY MBBR system
    - Broomfield, CO IFAS system
    - Marbleton, WY MBBR system

John He, MSEE, PE, BCEE



- Process Engineer
- 5 Years with Kruger Inc., 18 years in water and wastewater treatment engineering
- Specialty: Process design and mathematical modeling of biological processes to the biodegradation of organic chemicals and biological nutrient removal in biological wastewater treatment system; hydraulic analysis and modeling; civil, mechanical, and process design for water, wastewater, and reclaimed water treatment facilities; industrial wastewater treatment
- Key involvement:
    - Cocoa Beach, FL Five Stage IFAS BNR plant
    - Norwich, CT Five Stage IFAS BNR plant
    - Camp Ashland, NE Carbon Removal and Nitrification MBBR Plant
    - Ducworth, SC MBBR Carbon Removal and Nitrification Plant
    - Pelican Rapids, WI Carbon Removal MBBR Plant

Charlie Guthrie



- Mechanical Engineering Manager
- 7 years with Kruger, 33 years in mechanical engineering
- Specialty: manufacturing automation, materials of construction
- Key involvement:
    - Grand Chute, WI IFAS retrofit
    - Crow Creek WWTP, WY MBBR system
    - Lubbock, TX IFAS system

Jeff Mocock



- Mechanical Applications Engineer
- 11 years with Kruger, 11 years in wastewater treatment
- Specialty: mechanical design, fabrication, installation
- Key involvement:
    - Noman Cole WWTP, VA MBBR system
    - James River, VA ANITA Mox System
    - South Durham, NC ANITA Mox System
    - Egan, IL ANITA Mox System

Karsten Andersen



- Project Manager
- 8 years with Kruger, 18 years in project management
- Specialty: CO2 production, water and wastewater construction projects, tobacco processing
- Key involvement:
    - Broomfield, CO IFAS expansion
    - Waikoloa, HI MBBR system
    - Grand Chute, WI IFAS retrofit
    - Hookset, NH IFAS retrofit
    - Egan, IL ANITA Mox System

Pete Shelley, P.E.

- Sr. Project Manager
- 19 years with Kruger, 20+ years in wastewater construction projects
- Specialty: biological wastewater treatment systems
- Key involvement:
    - Fields Point WWTP, RI IFAS retrofit
    - Noman Cole WWTP, VA MBBR system
    - Springettsbury, PA IFAS retrofit



Tim Platt, PMP

- Projects Department Manager
- 16 years with Kruger, 22 years in wastewater construction projects
- Specialty: water and wastewater construction projects, aeration devices for biological treatment
- Key involvement:
    - Mamaroneck, NY IFAS retrofit



Mike Baker

- Instrumentation and Controls Manager
- 10 years with Kruger, 17 years in wastewater treatment
- Specialty: PLC programming water and wastewater treatment systems, HMI, field process instrumentation
- Key involvement:
    - Fields Point WWTP, RI IFAS retrofit
    - Shepherdsville, KY IFAS system
    - Springettsbury, PA IFAS retrofit



Mark Oborne

- Project Engineer – Instrumentation and Controls
- 8 years with Kruger, 8 years in wastewater treatment
- Specialty: control panel design, field process instrumentation
- Key involvement:
    - Fields Point WWTP, RI IFAS retrofit
    - Shepherdsville, KY IFAS system
    - Springettsbury, PA IFAS retrofit



Todd Casey

- Application Engineer – Instrumentation and Controls
- 17 years with Kruger, 24 years in water / wastewater
- Specialty: Instrumentation, PLC, SCADA
- Key involvement:
    - Noman Cole WWTP, VA MBBR system
    - James River, VA ANITA Mox System
    - South Durham, NC ANITA Mox System
    - Egan, IL ANITA Mox System



Chris Thomson, P.E.



- Product Manager - AnoxKaldnes
- 1 year with Kruger, 14 years in water and wastewater treatment engineering
- Specialty: Water Treatment, Collection and Distribution, Secondary and BNR wastewater treatment, AnoxKaldnes
- Key involvement:
    - Birchwood, WI MBBR System
    - Norwich, CT IFAS retrofit
    - Egan, IL ANITA Mox System

Andy Szekeress



- Regional Sales Manager – Biological Systems
- 12 years with Kruger, 17 years in wastewater treatment
- Specialty: AnoxKaldnes, Tertiary Filtration, Chemically Enhanced Settling
- Key involvement:
    - Chicago, IL, MWRD Egan WRP ANITA Mox system
    - Pelican Rapids, MN MBBR retrofit
    - 26 ACTIFLO facilities
    - 21 Discfilter facilities

Ken Krupa, P.E., MSEE



- Regional Biological Sales Manager
- 9 years with Kruger, 37 years in wastewater treatment
- Specialty: Biological Aerated Filters, IFAS, MBBRs, Oxidation Ditches
- Key involvement:
    - Springettsbury, PA IFAS Retrofit
    - Fairfax County, VA DN MBBR
    - Norwich, CT – IFAS Retrofit
    - James River Treatment Plant, VA, ANITA Mox (Anammox MBBR)

KRÜGER

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Richard W. DiMassimo, P.E.

EDUCATION

B.S. Chemical Engineering, North Carolina State University, North Carolina 1985
B.S. Textile Chemistry, North Carolina State University, North Carolina 1985

EXPERIENCE

VICE PRESIDENT ENGINEERING – I. KRUGER INC., CARY, NC (2008-PRESENT)

- Management/ supervision of process engineering staff and pilot testing departments in support of wastewater, drinking water and biosolids treatment technologies
- Management/ supervision of final technical risk assessments
- Management/ supervision of new technology assessment including test protocol development and implementation for pilot and full scale
- Management/ supervision of coordination and direction for R&D

MBR PROCESS ENGINEER AND GROUP MANAGER, I. KRUGER INC., CARY, NC (2006-2008)

- Responsible for product development
- Preliminary and detailed design of flat sheet MBR systems including equipment and instrumentation selection
- Full scale plant commissioning
- Design, coordination and on site testing of Title XXII MBR Pilot

PRODUCT MANAGER/ PROCESS GROUP MANAGER/ PROCESS ENGINEER – BIOLOGICAL TREATMENT SYSTEMS, I. KRUGER INC., CARY, NC (1998-2006)

- Responsible for product development and sales
- Preliminary and detailed design of flat sheet MBR systems including equipment sizing and instrumentation selection
- Perform hydraulic calculations
- Plant start-ups and commissioning
- On site performance testing
- BioWin and in-house modeling tools, specification development, bid specification and plans review, design tool development

PROFESSIONAL REGISTRATIONS

- Holds 3 U.S. Patents in the field of wastewater treatments

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Luke Wood

EDUCATION:

B.S., Agricultural Engineering, North Carolina State University, 1987
M.S., Agricultural Engineering, Virginia Polytechnic Institute and State University, 1991

PROFESSIONAL REGISTRATION

Professional Engineer,
North Carolina - 1994

PUBLICATIONS / PRESENTATIONS / PATENTS

"Improving Effluent Total Nitrogen With Dynamic Control of Aerobic/Anoxic Phasing", WEFTEC Annual Conference 2011, Los Angeles, CA, October 2011

"Improving Nitrogen Removal by RAS addition to the Secondary Anoxic Zone: Results of Full-Scale Implementation", WEFTEC Annual Conference 2007, San Francisco, CA, October 16, 2007

"Assessment of Biological Phosphorus Removal in an Oxidation Ditch", Nutrient Removal 2007, WEF Specialty Conference, Baltimore, MD, March 4, 2007

"Dynamic Phase Control For Increased Nitrogen Removal using On-line Nutrient Analyzers", 60th Annual KWEA Conference, Topeka, KS, April 13, 2005

"Microsand Ballasted Flocculation and Clarification: Effects on Removal of TSS, Oil & Grease, and Metals from a Steel Mill Waste Stream", WEFTEC Annual Conference 2002,

"Use of Phased Isolation Ditch Technology to Minimize Secondary Clarifier Solids Loading During Peak Hydraulic Flows", Indiana Water Pollution Control Association 63rd Annual Conference. November 15, 1999

"Modeling Gas Transfer and Biological Respiration in a Recirculating Aquaculture System", Aquacultural Engineering, Vol. 15, No. 5, 1996

US Patent, Method and System for Nitrifying and Denitrifying Wastewater, Process uses Oxic/Anoxic Phasing coupled with Membrane Treatment

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Luke Wood

EXPERIENCE

Process Group Manager, I Kruger Inc. **2002- Present**

- Managed process engineering group responsible for project design, commissioning, and technical support for IFAS/MBBR, conventional activated sludge, tertiary phosphorous removal. Likewise responsible for project assignment, completion and delivery, QA/QC reviews.
- Process Lead and/or oversight of others in process lead role responsible for design, facility start-up, process troubleshooting, operator training, etc.
  - Mamaroneck, NY, 23 MGD IFAS Process
  - James River, VA, 20 MGD IFAS Process
  - Lubbock, TX 18 MGD IFAS Process
  - Lancaster, PA, 32 MGD Pure Oxygen Process
  - Durham, NC, 12-MGD A2/O EBNR Process (TN < 2.8, TP < 0.28)
  - State College, PA, 9-MGD A2/O Process
  - Derry, PA, 6.3 MGD A2/O Process
  - Cary, NC, 12 MGD BioDenipho Process
- Process development and pilot testing for tertiary phosphorus removal applications to low concentrations (<0.1 mg/l) with cloth media filters and <0.05 mg/L with ballasted coagulation/flocculation. Currently supporting implementation of full scale projects.

Senior Process Engineer- ACTIFLO Process, I. Kruger Inc. **2000 - 2002**

- QA/QC reviews and Technical Support on Projects, Process design and engineering on special projects, start-up of water treatment facilities, troubleshooting, Operator training
- Bethlehem Steel, MD: 116-MGD Wastewater Treatment Facility, Principal Process Design Engineer:
- Hillsborough-Tampa, FL: 40-MGD ACTIFLO Water Treatment Process, Startup and Operator Training, Troubleshooting
- Fort Worth, TX: 58-MGD CSO Treatment Facility, Process Design Engineer
- Process Design/Startup for ACTIFLO Projects in CA, MO, TX, OR, KY, KS

Process Engineer, Biological Systems, I. Kruger Inc. **1998 - 2000**

- Process design, Start-up, Operator training for Aerobic Thermophillic Digestion (ATAD) Systems and Biosolids Pasturization
- Process design, start-up, and operator training for Biological Nutrient Removal Systems
  - Gastonia , NC: 16-MGD A^2/O Process,
  - Elizabethtown, PA: 5.6-MGD BioDenipho Process
  - La Grange, IN: 1.5 MGD A/O Process

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Luke Wood

Consulting Engineer, Triangle Environmental, Inc. **1991 - 1998**

- Project Engineer and Staff Engineering Support: Industrial Wastewater Projects, Groundwater treatment, Land Application of Sludge
- Permitting and Regulatory Assessment. NPDES Permit Applications, Pretreatment Permits, Title 5 Air Quality Permit Preparations, Air Emissions Inventories, Hazardous Waste Reporting, Storm water Prevention Plans, SPCC Plans

N.A. WATER SYSTEMS

N. A. Water Systems
250 Airside Drive
Moon Township, PA 15108

Telephone: 412.809.6000
Mobile: 401.339.5558

Michael R. Johns

EDUCATION

Bachelor of Science in Chemical Engineering, Pontificia Universidade Catolica of Rio de Janeiro, Brazil

Masters of Business Administration, Universidade Estadual of Rio de Janeiro, Brazil

BACKGROUND

Mr. Johns is a chemical engineer with extensive understanding of wastewater treatment, specifically, with over 10 years of experience with the popular Moving Bed Biofilm Reactor wastewater technology. Now as part of Veolia Water, Mr. Johns' considerable expertise is a valuable asset to the continued success of the Moving Bed Biofilm Technology within the company. Fluent in Portuguese and Spanish, Mr. Johns provides technical support to Veolia business units throughout North and South America.

EXPERIENCE

PROJECT ENGINEER, VEOLIA WATER (2010-PRESENT)

- Provides process and technical guidance with regards to all AnoxKaldnes biological wastewater treatment products including process and associated equipment design, start-up and training

PROJECT MANAGER, ANOXKALDNES, INC. (2007-2009)

- Acted as the point of contact and liaison between the company and its clients
- Prepared submittal documents, monitored the project scope, tracked budgets and schedules
- Responsible for timely delivery for all project documents, equipment and services
- Provided field inspections and training
- Reviewed all engineering work products prior to delivery to the client

DIRECTOR OF SALES, HYDROXYL SYSTEMS, INC. (2004-2007)

- Responsible for directing the company's sales strategies in addition to managing companywide process engineering
- Responsible for preparing process designs, cost estimates and all proposals

N. A. Water Systems
250 Airside Drive
Moon Township, PA 15108

Telephone: 412.809.6000
Mobile: 401.339.5558

Michael R. Johns

- Played a key role in communicating with the client and representing the company prior to a sale
- Identified new products, processes and procedures to improve the company's competitive edge

PROCESS ENGINEERING MANAGER, HYDROXYL SYSTEMS INC. (1999-2004)

- Responsible for preparation of all process designs, cost estimates, pricing and proposals and ensure that a quality bid was delivered on time and according to specifications
- Provided guidance on R&D activities
- Kept abreast of marketing trends, new competitors, old competitors and their impact on the company

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Hong W. Zhao, Ph.D., P.E., BCCE

EDUCATION

Ph.D., Environmental Engineering, University of British Columbia, Vancouver, BC, Canada, 1998

M.Sc., Environmental Engineering, University of Regina, Regina, Sask, Canada, 1993

B.S., Civil Engineering, Tsinghua University, Beijing, China 1987

EXPERIENCE

PROCESS & TECHNOLOGY LEADER – WASTEWATER, I. KRUGER INC., CARY, NC (2010-PRESENT)

- Technical assessments and performance validations of new wastewater technologies, including MBBR, IFAS, MBR, BAF, anammox processes and activated sludge
- Model development and validation
- Improving advanced controls strategies for Kruger's existing processes

MBR PROCESS ENGINEER AND GROUP MANAGER, I. KRUGER INC., CARY, NC (2006-2010)

- Process design and engineering for municipal wastewater treatment facilities utilizing MBR technology start-up/commissioning of pilot scale MBR facilities, QA/QC technical review
- Process Design Engineer for 0.6 MGD and 2.0 MBR BNR and retrofit projects
- Designed 25,000 gpd MBR nutrient removal test plant used for internal testing and research and Title 22 certification
- Process design for MBR package plants

SR. PROCESS ENGINEER, BIOLOGICAL SYSTEMS, BAF TECHNOLOGY, I. KRUGER INC., CARY, NC (2003-2006)

- Process design, star-up and operator training for Kruger's BAF – Biostyr®
    - Onondaga, NY 80 MGD tertiary nitrification
    - Northfield, MN secondary nitrification
    - St. Peter, MN secondary nitrification
    - Cheshire, CT 3.5 MGD tertiary denitrification
    - Tahoe Truck 8 MGD tertiary nitrification and denitrification.

SR. PROCESS ENGINEER, BIOLOGICAL SYSTEMS, ATAD/OXIDATION DITCH, I. KRUGER INC., CARY, NC (2000-2003)

- Process design, star-up, and operator training for Aerobic Thermophillic Digestion (ATAD) Systems
    - Pacifica, CA
    - Surprise, AZ

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Hong W. Zhao, Ph.D., P.E., BCCE

- Process design, start-up, and operator training for Biological Nutrient Removal Systems – Oxidation Ditches
    - Toole, UT
    - New Hanover, PA
    - Conway, SC
    - Brunswick County, NC
    - North Cary, NC WWTP Expansion

PROFESSIONAL REGISTRATIONS

- Registered Professional Engineer (PE) in Environmental Engineering, State of Ohio
- Board Certified Environmental Engineer (BCEE or DEE) in Water and Wastewater Treatment, American Academy of Environmental Engineers

RELEVANT PUBLICATIONS

1. Zhao H. W., Mavinic D. S., Oldham W. K. and Koch F. A. (1999). **Controlling factors for simultaneous nitrification and denitrification in a two-stage intermittent aeration process treating domestic sewage.** *Water Research*. Vol. 33, No. 4, pp. 961-970.
2. Zhao H. W., Mavinic D. S., Oldham W. K. and Koch F. A. (1997). **Bench-scale evaluation of a two-stage biological nutrient removal process**. *Proceedings of Joint CSCE-ASCE Environmental Engineering Conference,* Edmonton, Canada, July 22-26, 1997, 763-774.
3. Zhao H. W., Mavinic D. S., Oldham W. K. and Koch F. A. (1998). **Factors affecting phosphorus removal in a two-stage intermittent aeration process treating domestic sewage**. *Proceedings of WQI'98, International Association on Water Quality 19th Biennial International Conference,* Vancouver, Canada, 21-26 June 1998.
4. Zhao H. W., Mavinic D. S., Oldham W. K. and Koch F. A. (1998). **Pre-denitrification with methanol in single-sludge biological nutrient removal processes treating domestic sewage.** *Proceedings of WEFTEC'98*, *Water Environment Federation 71st Annual Conference & Exposition,* Orlando, Florida, USA., October 3-7, 1998, 109-128.
5. Zhao H. W., Mah, T, Mavinic D. S., Oldham W. K. and Koch F. A. (2002). **Technique to determine the simultaneous nitrification and denitrification rates in an intermittent aeration tank.** Proceedings of WEFTEC'02, *Water Environment Federation Annual Conference & Exposition,* Chicago, Il, USA., Sept 28 – Oct. 3, 2002.
6. Zhao H. W., DiMassimo R. W., and Hong S. N. (2001). **Evaluation of the Amount of Nitrogen Removal Due to Simultaneous Nitrification and Denitrification in A/O Type BNR Processes.** Proceedings of 76th Annual Florida Water Resources Conference. Jacksonville, FL.

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Hong W. Zhao, Ph.D., P.E., BCCE

7. Zhao H.W., Freed T., DiMassimo R., and Hong S. (2003). **Determination of Phase Length of BioDenipho Process Using Ammonia and Nitrate On-line Analyzers.** 2003 CWEA Annual Conference, Ontario, CA.

8. Viraraghavan T., **Zhao H. W**. and Tanjore S. (1993). **Low-temperature performance of biological wastewater treatment systems.** *Presented in Joint CSCE-ASCE Conference,* Montreal, Canada, July, 1993.

9. Viraraghavan T., **Zhao H. W**. and Singh K. S. (1999). **Enhanced Primary Sedimentation of Wastewater – A Plant Study.** Fluid/Particle Separation Journal, Vol. 12, No. 1, pp. 54-59.

10. Zhao H. W., Freed T., DiMassimo R., Hong S., Bundgaard E., and Thomsen H. (2004). **Demonstration Of Phase Length Control Of Biodenipho® Process Using On-Line Ammonia And Nitrate Analyzers At Three Full-Scale Wastewater Treatment Plants.** Proceedings of WEFTEC'04, *Water Environment Federation Annual Conference & Exposition,* New Orleans, LA, USA., Oct. 2 – Oct. 6, 2004.

11. Zhao H. W., Mavinic D. S., Oldham W. K. and Koch F. A. (1998). **Factors affecting phosphorus removal in a two-stage intermittent aeration process treating domestic sewage**. *Water Sci. Technol.,* **38**, 115-122.

12. Zhao H. W., Woods C., Parker J., and Hong S-N (2006). **Pilot Evaluation of Floating Media Biological Aerated Filters (BAFs) to Achieve Stringent Effluent Nutrient Discharge Requirements.** *Proceedings of IWA2006,* International Water Association Biennial Conference in Beijing 2006.

13. Zhao H. W., Michael T. Sparks, Chinh Hoang and Rich DiMassimo (2008). **Phasing the Biological Nutrient Removal Process to Reduce Operating Cost and Improve Denitrification for a Membrane Bioreactor System**. 2008 South Carolina Water Profession Annual Conference, SC.

KRÜGER

I. Kruger Inc.
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Facsimile: 919.677.0082

Karsten Andersen

EDUCATION

B.S. Mechanical Engineering, Odense Technical College, Denmark 1978

EXPERIENCE

SENIOR PROJECT MANAGER, I. KURGER INC., CARY, NC (2009-PRESENT)

- Responsible for executing a variety of water and wastewater systems projects including 11 different AnoxKaldnes, MBBR and IFAS projects

PROJECT MANAGER, I. KURGER INC., CARY, NC (2005-2009)

- Responsible for executing a variety of water and wastewater systems projects including 11 AnoxKaldnes projects

ADVANCED PROCESS ENGINEER, COLLINS & AIKMAN, ROXBORO, NC (1999-2005)

- Responsible for process operations of fabric production plant

PROCESS ENGINEER, DAY & ZIMMERMAN INTERNATIONAL, GREENVILLE, SC (1995-1999)

- Developed P&ID's and PFD's for new brake pad plant including wastewater facility

PROJECT MANAGER, BOC GASSES, MURRAY HILL, NJ (1989-1995)

- Responsible for execution of Dry Ice Expanded Tobacco systems in the tobacco industry

TECHNICAL DIRECTOR, HYDROGAS DANMARK, FREDERICIA, DENMARK (1986-1989)

- Supervised a staff of 45 associates in the engineering department and workshop responsible for producing CO2 production and recovery systems

MECHANICAL DESIGN, QUITZAU INDUSTRY, SOENDERBORG, DENMARK (1979-1981)

- Designed heat exchangers for exhaust gasses from boilers and engines

SALES ENGINEER, HAVEMANN, COPENHAGEN, DNEMARK (1978-1979)

- Sold lighting systems and electric heating

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Christopher L. Evans

EXPERIENCE

FIELD SERVICE ENGINEER, I. KRUGER INC., CARY, NC (2007-PRESENT)

- Oversees the commissioning of Disc filters and Drum filters
- Responsible for equipment inspections: Disc filters, Drum filters, MBBR/IFAS, MBR, ACTIFLO®, Oxidation Ditches for start-up

SUMMARY OF RELATED EXPERIENCE

ANOXKALDNES (MBBR/IFAS) EQUIPMENT INSPECTIONS

- Wisconsin Rapids, WI
- Grand Chute, WI
- Broomfield, CO
- Crested Butte, CO
- Georgetown, CO
- New Castle, CO
- Crow Creek, WY
- Cascade Shores, CA
- Waikoloa, HI
- Shepherdsville, KY
- James River WWTP, Newport News, VA
- Noman Cole WWTP, Fairfax, VA
- Hooksett, NH
- Mamaroneck, NY

ACTIFLO® EQUIPMENT INSPECTIONS

- Port Angeles, WA – DW
- Salem, OR – CSO
- Fairfield, CA – WWTP
- Jaffrey, NH – WWTP
- Papillion, NB – WWTP
- Webster, NH – WWTP
- Nashua, NH – WWTP

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MBR EQUIPMENT INSPECTIONS

- WEDCO, Bermuda
- Monterrey Shores, NC
- Wappinger, NY
- Plymouth, MA (MCI)
- Crestview, FL
- Bergen, NY
- Wanchese, NC

OXIDATION DITCH EQUIPMENT INSPECTIONS

- Cabra, OK
- Wildwood, FL
- Pottsville, PA
- South Hill, VA

DRUMFILTERS AND DISCFILTERS EQUIPMENT INSTALLATION

- Salamanca, NY
- Litiz, PA
- Mt. Holly, NJ
- Selbyville, DE
- Simcoe, ON, CA
- Banif, AB, CA
- Hertford, NC
- Sneads Ferry, NC
- Surf City, NC
- Whiteville, NC
- Lowesville, NC
- Thomasville, NC
- Killian Creek, NC
- Whittier, NC
- York, SC
- Winder, GA
- Holy Hill, FL
- Stuart, FL
- Lady Lake, FL
- House Springs, MO
- Hackberry, TX

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Christopher L. Evans

- Humble, TX
- Santa Fe, NM
- Isleta, NM
- Heyburn, ID
- Colfax, CA
- Belvidere, IL

RELATED FIELDWORK

- South Adams, Co WWTP – Pilot ACTIFLO®
- Knoxville, TN WWTP – Pilot ACTIFLO®
- Ft. Myers, FL WWTP – MBBR Pilot
- Brownsville, TX – Membrane Filtration Pilot

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Barry D. Law

EDUCATION

Graduated St. Joseph Academy 1965
United States Marine Corps 1966-1970
State of Florida Teachers Certificate (STA Engineer)
Class A- Florida Wastewater Treatment Plant Operator - License Number 0002175
Class C- Florida Water Treatment Plant Operator- License Number 0007610C
Class A-Certificate in Collection
Class A-Certificate in Reuse

EXPERIENCE

FIELD SERVICES, I. KRUGER, INC., CARY, NC (1994-PRESENT)

- Ensure that all Kruger equipment has been properly installed
- Provide mechanical check out prior to start up on all equipment
- Equipment start up on all Kruger equipment to ensure proper operation
- Provide start up and scheduled maintenance training to owners on all equipment
- Process pilot testing, data collection, and report preparation for the Disc Filters
- Mechanical troubleshooting for equipment for all Kruger processes
- Prepare in-house documentation on start up procedures
- Supply technical support for all Kruger processes

SUMMARY OF RELATED EXPERIENCE

- Plant Manager for wastewater, water, collections and reuse for 25 years
- Managed plant operations and maintenance for plants ranging from 0.1 MGD to 70 MGD
- Managed wastewater, water and powerhouse for Miller Brewing Co. 1979-1986
- Managed wastewater plant construction, startups and operator and equipment training
- Involved in operator and maintenance training for US Filter/Kruger and performed training on all Kruger processes (1994-Present)

SUMMARY OF PROJECT START UPS

- Middletown, PA – Dry and wet check of Anaerobic Process
- Erie, CO – Disc Filter and IFAS
- Springettsbury, PA – IFAS
- Manheim, PA – Waster Water start-up
- Highspire, PA – Ditch start-up
- Panther Creek, TX – Filter and start-up training

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Barry D. Law

- Orbisona, PA – Ditch, start-up training
- Live Oak, FL – Filters start-up and operator training
- Ft. Smith, AK – ACTIFLO® start-up and training
- Crestview, FL NEOSEP® MBR start-up and training
- Grand Rapids, WI – MBBR
- Tampa Bay, FL – ACTIFLO® start-up and training
- Umatilla, FL – Filters start-up and troubleshooting
- Oak Rum, FL – Filters
- Baldwin, FL – Disc Filter
- Wildwood, FL – Ditch
- Reedy Creek, FL – Weir
- Okaloosa, FL – Disc Filter
- Ozark, MO – Ditch and Filters
- Tampa, FL – ACTIFLO® start-up Hillsborough River WTP – Tampa, FL – 40MGD – DW
- Stuart, FL – Disc Filter
- Baldwin, FL – Disc Filter
- Georgetown, CO – IFAS
- Westborough, MA – ACTIFLO® and Ditch
- York, PA – Ditch
- Springettsbury, PA – IFAS
- Woodbridge, NY – Disc Filter
- Santa Fe, NM – Discfilter
- Manheim, PA – Ditch
- Las Marais, PR – ACTIFLO®
- Mamaroneck, NY – IFAS
- Seminole County, FL – ACTIFLO®
- St. Bernard Parrish, LA – ACTIFLO®

This is an abbreviated list of complete projects

ANOXKALDNES

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Thomas Welander

EDUCATION

Appointed Associate Processor in Biotechnology, Lund University, Sweden 1995

Doctor of Philosophy in Applied Microbiology, Lund University, Sweden 1983-1989

M.Sc. in Chemical Engineering, Chalmers Technical University, Gothenburg, Sweden 1981

EXPERIENCE

CHIEF VISIONALRY OFFICER – 100% SINCE 2010 (CEO PRIOR), ANOXKALDNES AB, LUND SWEDEN (1998-PRESENT)

GROUP LEADER IN ENVIRONMENTAL BIOTECHNOLOGY (50%) MANAGING DIRECTOR, ANOX AB (50%), DEPARTMENT OF BIOTECHNOLOGY, LUND UNIVERSITY (1996-1997)

GROUP LEADER IN ENVIRONMENTAL BIOTECHNOLOGY (50%) R&D MANAGER, ANOX AB (50%), DEPARTMENT OF APPLIED MICROBIOLOGY, LUND UNIVERISTY (1992-1995)

RESEARCH ASSISTANT (50%) R&D MANAGER, ANOX AB (50%), DEPARTMENT OF APPLIED MICROBIOLOGY, LUND UNIVERISTY (1990-1991)

RESEARCH ASSISTANT, DEPARTMENT OF APPLIED MICROBIOLOGY (1982-1989)

OTHER APPOINTMENTS

NORDIC INDUSTRIAL FUND (1990-1994)

- Project leader of the Nordic project for treatment of pulp and paper industry wastewaters within the environmental biotechnology program

CHINA, MINISTRY OF FORESTRY (1993, 1995)

- Consultant for the FAO and P.R. China, Ministry of Forestry concerning treatment of pulp and paper industry effluents in China

EU CLOSED CYCLE PROJECT (1999-PRESENT)

- Coordinator of EU CLOSED CYCLE project concerning treatment and reuse of paper mill process water

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Thomas Welander

AWARDS/ PATENTS

- Received the AF Research Foundation from the hand of the Swedish King (1995)
- Inventor of seven granted patents

RELEVANT PUBLICATIONS

1. Looner, C., Welander, T., Molin, N., Dostalek, M. and Blickstad, E. (1986). The microflora in a sour dough started spontaneously on typical Swedish rye meal. Food Microbiology, 3, 3-12.

2. Welander, T and Andersson, P-E. (1985). Anaerobic treatment of wastewater from the production of chemi-thermomechanical pulp. Water Science and Technology, 17:1, 103-111.

3. Andersson, P-E., Gunnarsson, L., Olsson, G., Welander, T. and Wikstrom, A. (1987). Anaerobic treatment of CTMP effluent. Pulp & Paper Canada, 88:7, T233-T236.

4. Welander, T. (1988). An anaerobic process for treatment of CTMP effluent, Water Science and Technology, 20:1, 143-147.

5. Malmqvist, A., Welander, T. (1992) Anaerobic removal of chlorate from bleach effluents. Water Science and Technology, 25 (7), 237-242.

6. Malmqvist, Å., Gunnarsson, L., Welander, T., Nystrom, M., Herstad-Svard, S., Mylen, B. and Dalentoft, E. (1993) Biological removal of chlorate from kraft bleach effluent – a pilot plant study. Nordic Pulp and Paper Res. J. 8(3), 302-306,337.

7. Yu, P. and Welander, T. (1993). A comparison of biological and thermo-alkaline treatment for the removal of chlorinated organic matter from kraft bleach plant effluent. Nordic Pulp and Paper Res. J. 8(4), 360-364,404.

8. Welander, U., Henrysson, T. and Welander, T. (1997). Nitrification of landfill leachate using suspended carrier biofilm technology. *Wat. Res*. 31(9),

9. Christensson, M., Lie, E., Jönsson, K., Johansson, P. and Welander, T. (1998). Increasing substrate for polyphosphate accumulating bacteria in municipal wastewater through hydrolysis and fermentation of sludge in primary clarifiers. *Wat. Env. Res*. 70(2), 138-145

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10. Lie, E., Christensson, M., Jönsson, K., Johansson, P. and Welander, T. (1998). Carbon and phosphorus transformations in a full-scale enhanced biological phosphorus removal process. *Wat. Res.* 31:2719-2726

11. Welander, T., Alexandersson, T., Ericsson, T., Gunnarsson, L. and Storlie, A. (2000). Reducing sludge production in biological effluent treatment by applying the LSP process. Proc. 2000 TAPPI Int. Envir. Conf. Exhibit, 6-10 May, 2000, Denver, Book 2, pp 757-764.

12. Welander, T., Olsson, L.-E. and Fasth, C. (2002). Nutrient limited biofilm pretreatment – an efficient way of upgrading activated sludge plants for lower sludge production and improved sludge separability. TAPPI Journal (in press).

Author of over 29 other publications from 1993 to present

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Magnus Christensson

EDUCATION

Postdoctoral Fellow, Massey University, New Zealand 1998-2000

Ph.D. in Biotechnology, Lund University, Sweden 1997

Master of Science in Chemical Engineering, Lund University, Sweden 1992

EXPERIENCE

MANAGER OF MUNICIPAL RESEARCH AND DEVELOPMENT, ANOXKALDNES AB, LUND SWEDEN (2000-PRESENT)

- Responsible for coordinating the technology research and development work
- Responsible for the research activities in the following projects:
  - Bioplastic (polyhydroxylalkanoates) from sludge
  - Characterization of the microorganisms within the biological processes (including molecular methods)
  - Development of the new media
  - Upgrading municipal activated sludge processes to the Hybrid IFAS system including biological nitrogen and enhanced phosphorus removal
- Design engineering for the Hybrid IFAS process
- Lecturer at AnoxKaldnes courses (national and international), regular guest lecturer at Lund University seminars

POSTDOCTORAL FELLOW AT THE INSTITUTE OF TECHNOLOGY, MASSEY UNIVERSITY, PALMERSTON NORTH, NEW ZEALAND (1998-2000)

- Research on Enhanced Biological Phosphorus Removal from dairy wastewater
- Research activity included:
  - Operation of lab-scale SBR's and lab-scale perfermentor
  - Characterization of treatment efficiency and sludge composition (PHA, glycogen, P, metals, etc)
  - Studies of pure cultures isolated from activated sludge
- Lecturing (Environmental Management, Microorganisms in soil)
- Research advisor of 4th year projects of Bachelor of Technology
- Examinator of Master of Science thesis

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Magnus Christensson

PUBLICATIONS

1. Christensson, M., Lie, E. and Welander, T. (1994). A comparison between ethanol and methanol as carbon sources for denitrification. Water Science and Technology, 30:83-90

2. Christensson, M., Blackall, L.L., Keller, J and Welander, T. (1996). The influence of sludge retention time on the biological nutrient removal and changes in sludge community in activated sludge sequencing batch reactors. First IAWQ Specialized Conference on Sequencing Batch Reactors, Munich, 413-418.

3. Jonsson, K., Johansson, P., Christensson, M., Lee, N., Lie, E. and Welander, T. (1996). Operational factors affecting enhanced biological phosphorus removal at the waste water treatment plant in Helsingborg, Sweden. Water Science and Technology, 34:67-74.

4. Lie, E., Christensson, M., Jonsson, K., Ostgaard, K., Johansson, P. and Welendar, T. (1997). Carbon and phosphorus transformations in a full scale enhanced biological phosphorus removal process. Water Research, 31:2693-2698.

5. Ostgaard, K., Christensson, M., Lie, E., Jonsson, K. and Welander, T (1997). Anoxic biological phosphorus removal in a full scale UCT process. Water Research, 31:2719-2726.

6. Christensson, M. (1997). Enhanced Biological Phosphorus Removal – Carbon sources, Nitrate as Electron acceptor and Characterization of the Sludge Community. PhD. Thesis. Department of Biotechnology. Lund University, Sweden.

7. Christensson, M., Blackall, L. and Welander, T. (1998). Increasing substrate for polyphosphate accumulating bacteria in municipal wastewater through hydrolysis and fermentation of sludge in primary clarifiers. Water Environment Research 70 (2), 138-145.

8. Blackall, L.L, Bond, Crocetti, G.C. and Christensson, M. (1998). The microbial diversity of complex consortia in waste treatment processes: Correlation between process performance and microbial composition. Conference proceeding, The COE Symposium on “Microbial Community Structure and Functions of Biological Wastewater Treatment Processes”. Tokyo. P 94-101.

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Marius Haegh

EDUCATION

Master of Science, Environmental Engineering, Aalborg University, Aalborg, Denmark 1994-1996

Bachelor of Science, Environmental Planning and Engineering, NKI College of Engineering, Trondheim, Trondheim Norway 1991-1994

EXPERIENCE

REGIONAL SALES MANAGER, ANOXKKALDNES AB (2002-PRESENT)

- Manager of regional sales and marketing for the AnoxKaldnes MBBR process
- Process design and engineering for MBBR process
- Leader of MBBR aquaculture systems engineering and sales
- Conduct pilot studies using AnoxKaldnes mobile test units

PROJECT MANAGER/PROCESS ENGIENER, NORCONSULT AS, WATER, WASTE AND ENVIRONMENT DIVISION, SANDVIKA, NORWAY (2000-2002)

- Group leader for O&M Project Management for water and wastewater
- Preliminary design for water and wastewater
- Design for full scale treatment plants for water and wastewater
- Project management for full scale system design and delivery
- Quality control of preliminary and full scale system design

PROJECT MANAGER/PROCESS ENGINEER, NORCONSULT AS, WATER, WASTE AND ENVIRONMENT DIVISION, LILLEHAMMER, NORWAY (1997-2000)

- Head manager of Norconsult's Unit for technical operational support (NSU) to wastewater treatment plants and water supplies. (NSU provides technical assistance, competence training, reporting etc. for approximately 170 waterworks and wastewater treatment plans in Oppland county, Norway)
- Design of full scale treatment plants for water and wastewater
- Project management of full scale system design and delivery
- Quality control of preliminary and full scale system design

DESIGN ENGINEER AND ENVIRONMENTAL PLANNER, NARVIK MUNICIPALITY, NARVIK CITY, NORWAY (1996-1997)

- Design of full scale distribution networks for water and wastewater
- Assistant for the making of master plans for water and wastewater in Narvik municipality
- Project manager of full scale deliveries

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Marius Haegh

PRESENTATIONS

1. The upgrading of Jevnaker WWTP. Increasing capacity of existing reactors with the Kaldnes MBBR process", Norwegian Water and Wastewater Association", Gardermoen, Norway – June 2002.

2. "Working Environment in wastewater treatment plants – risks, assessment and actions", Norwegian Society of Chartered Engineers – Gol, Norway, April 2001.

3. "Water supply in rural areas, vulnerability and preparedness to unforeseen incidents", Association for Water Conservation and Water Hygiene, Oslo, Norway October, 2000

4. "Upgrading wastewater treatment plants by the use of biofilm carriers, oxygen addition and pre-treatment in the sewer network", SINTEF, Trondheim, June 1996

PUBLICATIONS

1. Upgrading wastewater treatment plants by the use of biofilm carriers, oxygen addition and pre-treatment in the sewer network". Wat.Sci. Tech. Vol 37, No. 9, pp 159-166, 1998.

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Håvard Stenersen

EDUCATION

Malmø Technical Institute, Mechanical Engineering 1973

Rjukan Vocation School, Power Station Engineer 1970

Valdres Vocational School, Electrical Study 1969

COURSES

Computer Aided Design (CAD), Renishaw MAE 1988
CAD-course in Autofit/Isomet (Shipping Research Services) 1983
Courses in design of hydraulic systems 1982
Courses in noise-and vibration measurement 1980

EXPERIENCE

SENIOR ENGINEER, KRUGER KALDNES AS, TØNSBERG, NORWAY (1995-PRESENT)

- Project: Breiskallen R.A.,
  Client: Vestre Toten Kommune
  - Project manager for upgrading of existing chemical wastewater treatment plant
  - Responsible for detailed design, documentation and procurement

- Project: DEJÁR Wastewater treatment plant, Hungary
  Client: Intercounsult, Hungary
  - Project manager for construction of the new municipal wastewater treatment plant for Dejtár. Size 3000 p.e. with N-removal, pre-denitrification

- Project: Østlandesmeieriet Lom & Skjåk
  Client: Tine Norske Meierier
  - Project manager for construction of diary wastewater treatment plant for BOD-removal with capacity 250kg BOD/d

- Project: Gjøvik Potetindustrier AS
  Client: Gjøvik Potetindustrier AS, HOFF
  - Project manager responsible for design of piping and process equipment. Wastewater treatment plant for potato industry, BOD-removal with capacity 1000kg BOD/d

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Håvard Stenersen

PROJECT ENGINEER, ALLUM ENGINEERING AS (FRAMNÆS ENGINEERING AS), SANDEFJORD (1991-1994)

- Project: Grycksbo, Sweden
  Client: Kaldnes Miljøteknologi AS/STORA Papyrus Grycksbo
  - Responsible for design and detailed engineering of new treatment plant. Fine paper mill, BOD removal with capacity 700 kg BOD/d

- Project: Several
  Client: Kaldnes Miljøteknologi AS
  - Design and calculation of several minor plants for municipal and industrial wastewater

- Project: Bekkelaget Renseanlegg, Oslo
  Client: Oslo Vann-og Avløpsvesen
  - Responsible for construction of test plant for full scale N-removal, with post-denitrification process. Capacity 15.000 p.e.

SENIOR ENGINEER, KEFTECH AS, TØNSBERG (1989-1991)

- Project: "Snorre" Field Development Project, MEC,
  Client: S aga Petroleum A/S/Kaldnes de Groot A/S
  - Isometric piping drawings and supports for fabrication and installation in Separator, Pig Trap, and for Water Injection Preassemblies
  - As-built drawings for Separator and Pig Trap modules

- Project: "Veslefrikk A and B" Oil Field
  Client: Moss Rosenberg Verft, Stavanger
  - Conversion of "West Vision" Field Engineer – Accommodation and HVAC

- Project: Fertilizer factory No. 3, Norsk Hydro, Porsgrunn
  Client: Allum Engineering A/S
  - Detail engineering on extract system on equipment.
  - Arrangement drawings

- Project: Magnesium Plant, Becancour, Canada
  Client: Norsk Hydro, Vækerø
  - Design of pipe support

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Håvard Stenersen

FRAMTEC A/S, SANDEFJORD (1988)

- Project: "Heidrun" Oil Field, early production
  Client: Kaldnes A/S Keftech A/S
  - Estimation and bid specification for conversion of D/B
  - "Norjarl" HVAC, fire protection and corrosion protection

SENIOR ENGINEER, OUTFITTING AND ARCHITECH DEPARTMENT (1986-1987)

- Project: NPK 84, Fertilizer factory No. 4 Norsk Hydro, Porsgrunn
  Client: Allum Engineering A/S/ Norsk Hydro
  - Design and arrangement of sanitary system and piping in the new service building for fertilizer storage
  - Arrangement of ventilation and dehumidification system and ducting in fertilizer storage as well as ventilation in the service building
  - Arranging of sprinkler system and vacuum cleaning system and piping in above mentioned storage
  - Design and arrangement for Aminol system
  - Design and arrangement for steam piping
  - Heat tracing on different pipe systems
  - Design and arrangement of various minor tasks as platforms, stairways, ladders, supporting of pipes and components and foundation for miscellaneous equipment in the factory

ENGINEER, OUTFITTING AND ARCHITECT DEPARTMENT, A/S FRAMNÆS MEK, VÆRKSTED, SANDEFJORD (1977-1986)

- Project: "Safe Supporter" semisubmersible offshore accom. unit
  Client: Safe Offshore AB, Gothenburg
  - Isometric piping drawings for installation of sprinklers in accommodation

- Project: M/T "Petroskald"
  Client: Golar-Nor Offshore A/S
  - Design of hydraulic arrangement and piping for deck machinery on forecastle, including additional firefighting equipment

- Project: "West Vanguard" semisubmersible drilling platform
  Client: A/S Smedvig Drilling Co.
  - High pressure cleaning system, hydraulically operated doors and various outfitting drawings
  - Layouts, design, documentation and procurement

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Håvard Stenersen

- Project: "Seaway Pelican" new building, diving and support vessel
  Client: Stolt-Nielsen Seaway A/S
  - Design of life saving arrangement, load line arrangement, marks on hull/superstructure and also general arrangement for the vessel
- Project: Diving, service and support semisubmersible new building project
  Client: Mascot Drive
  - Drawing of General Arrangement

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Flemming Gauti Wessman

EDUCATION

Post Graduate Diploma in "high rate floating media filtration" 1997

The Norwegian Institute of Technology (NTH), University of Trondheim Norway. M.Sc. in Civil Engineering, Department of Hydraulic and Environmental Engineering, Faculty of Civil Engineering 1992-1997

EXPERIENCE

MANAGING DIRECTOR OF PROCESS DESIGN AND SUPPORT, KRUGER KALDNES AS, TØNSBERG, NORWAY (1997-PRESENT)

- Process design of municipal and industrial wastewater treatment plants in the national and international market
- Research & development work on the AnoxKaldnes MBBR process
- Support and training to international licensee companies
- Commissioning of municipal and industrial wastewater treatment plants, training of operating personnel

CSIRO, MELBOURNE AUSTRALIA (1997)

- Research on high rate floating media filtration
- Responsible for operation of pilot plant
- Responsible for laboratory analysis

PUBLICATIONS

1. Bjørn Rusten, Jon G. Siljudalen, Flemming G. Wessman, Asgeir Wien and Ingar Tranum: Treatment of wastewater from the new Oslo Airport and surrounding communities using Moving Bed Biofilm Reactors and Chemical Precipitation.

2. Wessman, Flemming Gauti: "High rate floating media filtration". Department of Hydraulic and Environmental Engineering, NTNU, 1997.

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Alan Werker

EDUCATION

Ph.D. Civil (Environmental) Engineering, University of British Columbia 1999
Thesis: The effect of pH on microbial activity and community structure in the biological removal of resin acids from wastewater. Supervisor: Professor Eric Hall

Masters in Engineering, Mechanical Engineering, University of Toronto 1998

B.A.Sc. Mechanical Engineering, University of Waterloo 1985

EXPERIENCE

PROJECT ENGINEER AND R&D MANAGER, ANOXKALDNES AB, LUND, SWEDEN (2003-PRESENT)

ASSISTANT PROFESSOR, DEPARTMENT OF CIVIL ENGINEERING, UNIVERSITY OF WATERLOO, ONTARIO, CANADA (1999-2002)

- Ongoing research initiatives include 1) applied microbial ecology for monitoring and optimizing biological wastewater treatment systems, 2) devising methodology for better engineering of constructed wetland wastewater treatment systems and 3) community based waste management strategies
- Courses taught: ENVE 330 – Environmental sampling and analysis, ENVE 431 – engineering, CIVE/ENVE 472 – Wastewater treatment, CIVE/ENVE 375 – Water quality engineering, CIVE/ENVE 472 – Wastewater treatment, CIVE 670 – Water and Wastewater treatment, CIVE 771 – Biological wastewater treatment: Theory and Practice, CIVE 775 – Principles of Ecological Engineering
- Other development work within chemicals and gases for treatment of water and wastewater

CONSULTANT, BOOJUM TECHNOLOGIES LIMITED, TORONTO, ONTARIO CANADA (2000-2002)

- Titrimetric analysis of metals in acid mine drainages samples

CONSULTANT, REGIONAL MUNICIPALITY OF OTTAWA, CARLOTON, ONTARIO, CANADA (2000-2002)

- Thermodynamic modeling to investigate condensation and corrosion in a gravity sewer

CONSULTANT, SKF ENGINEERING & RESEARCH CENTRE B.V. UTRECH, THE NETHERLANDS (1998)

- Modifications of Residual Stress Analysis Software

ANOXKALDNES

AnoxKaldnes AB
Klosterängsvägen 11 A
Lund Sweden 226 47

Telephone: +46 46 18 21 57
Facsimile: +46 46 13 32 01

Alan Werker

CONSULTANT, CAPITAL REGION DISTRICT, VICTORIA, BRITISH COLUMBIA, CANADA (1997)

- Preliminary assessment and trouble-shooting the performance of an MBR treatment system

CONSULTANT, AVANI MARKETING CORPORATION COQUITLAM, BRITISH COLUMBIA, CANADA (1996)

- Investigating the surface tension of water samples

CONSULTANT, SKF ENGINEERING & RESEARCH CENTRE B.V., VANCOUVER, BC, CANADA

- Commissioned by the S.K.F. Engineering & Research Centre to develop analytical software for the processing and interpretation of X-ray diffraction data for the purpose of metallurgical characterization in fatigue research.
- Created a graphically interactive and menu-driven program employing object orientated programming in Turbo Pascal facilitating advanced X-ray line profile analysis.
- Analyzed research data from Internal Fraction experiments performed at the S.K. F. Research Centre in the Netherlands

MATERIAL ENGINEER, S.K.F. ENGINEERING & RESEARCH CENTRE, UTRECHT, THE NETHERLANDS (1988-1991)

- Project leader for two Corporate Research investigations in bearing fatigue. Project were a balance of literature review, theoretical analysis, experimentation, analytical software development, administration, reporting and seminar presentation.
- Researched the driving forces for microstructural change in rolling bearing as influenced by time, temperature and loading in relation to the material condition.
- Advanced techniques in X-ray diffraction analysis of residual stress and peak line profile to better characterize the state and response of bearing stability.
- Explored the technique of thermometric measurements during cyclic loading to follow microstructural change and the fatigue process.
- Presented results to S.K.F. companies in Italy, Germany and the United States.

ACADEMIC DISTINCTIONS

- Adjunct Assistant Professor, Department of Civil Engineering, University of Waterloo (2003)
- Cross appointed to the Department of Chemical Engineering, University of Waterloo (2000-2002)
- CAWQ winner in the student paper competition at the 1998 IA WQ Biennial Conference (1998)
- PAPRICAN Studentship, Pulp and Paper Research Institute of Canada (1994-1996)

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Alan Werker

- British Columbia Water and Waste Association Academic Achievement Award (1994)
- First Prize – University of British Columbia's Patent Office Make it Green Contest (1994)
- Natural Sciences and Engineering Research Council of Canada Postgraduate Scholarship (1992-1994)
- Ontario Graduate Scholarship (1987)
- University of Toronto Open Master's Fellowship (1987)
- Dean's Honour List, University of Waterloo (1980-1985)

RELEVANT PUBLICATIONS

1. Werker, A.G., Becker, J. and Huitema, C. (2002). Assessment of activated sludge microbial community analysis in full scale biological wastewater treatment plants using patterns of fatty acid isopropyl esters (FAPES), Water Research, accepted November 2002.
2. Werker, A.G., Dougherty, J.M., McHenry, J.L. and Van Loon, W.A. (2002). The need for understanding treatment variability for improved wetland wastewater treatment design, Ecological Engineering, 19 (1): 1-11.

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SECTION 5.5

THERMAL EXPANSION/CONTRACTION CALCULATIONS

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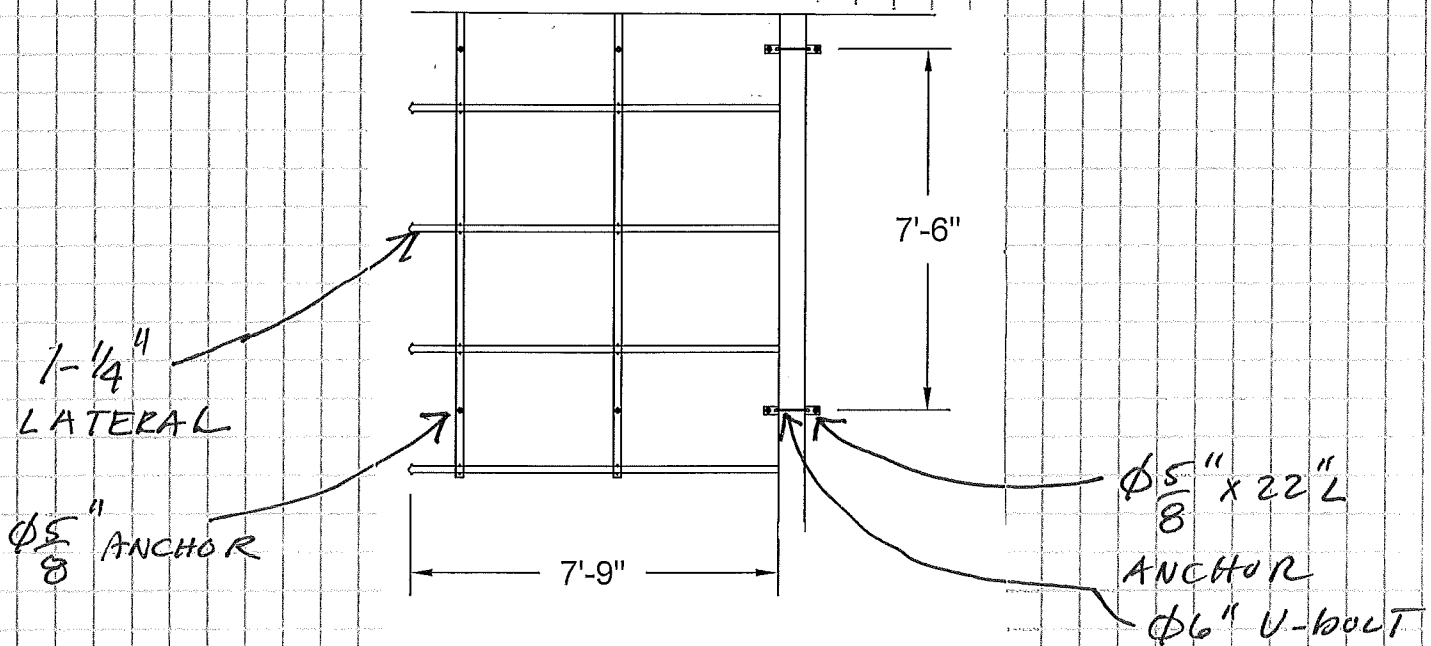
Project: Massillon, OH

Name: CHRIS PETERS

Date: 3-30-15

Sheet: 1 of 4

PART 1 - CALCULATE Buoyancy FORCES ON ANCHORS/SUPPORTS



PLAN VIEW

PARTIAL SECTION OF AIRGRID

Total Buoyancy force on AIRGRID SECTION EQUALS FORCE ON 6" PIPE (F_6) plus force on 1-1/4" LATERALS (F_1).

D = PIPE DIA. (FT.)
S_w = water density
L = LENGTH OF PIPE (FT.)

$$F_B = \frac{\pi}{4}(D)^2 S_w L$$

$$F_6 = \frac{\pi}{4}\left(\frac{6.625}{12}\right)^2\left(62.4\frac{lb}{ft^3}\right)(7.5\ FT) = 112\ lbF$$

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Date: 3-30-15 Sheet: 2 of 4

and F_1 = 2916F (FOR 4 LATERALS)

F_B = 11216F + 2916F = 14116F.

TOTAL WEIGHT OF PIPES/ANGLE = 14216F

∴ NO SIGNIFICANT LOAD ON ANCHORS/U-BOLTS

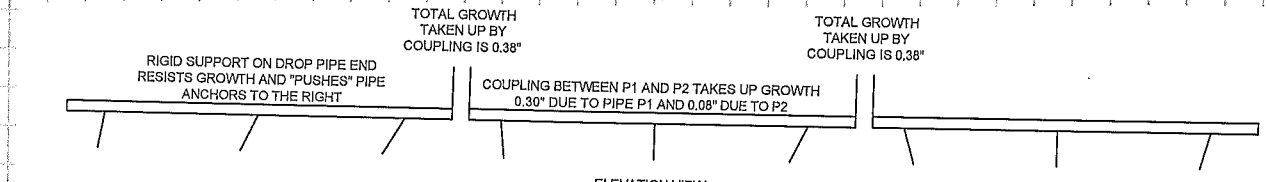
PART 2 - Calculate THERMAL GROWTH IN MANIFOLD AND STRESS IMPARTED TO ANCHORS.

TOTAL EXPANSION IN PIPE (D_T) = $\Delta T \alpha_{ss} L$

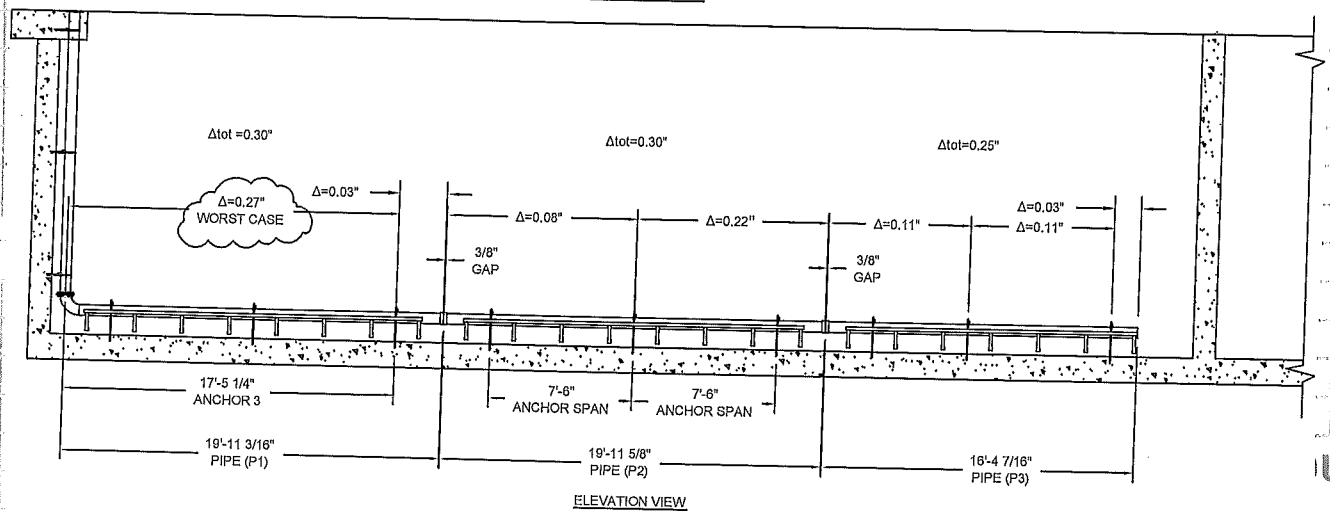
ΔT = temperature RANGE (115°F PER SPEC.)

α_{ss} = THERMAL expansion coefficient

L = Length OF PIPE



ELEVATION VIEW



ELEVATION VIEW

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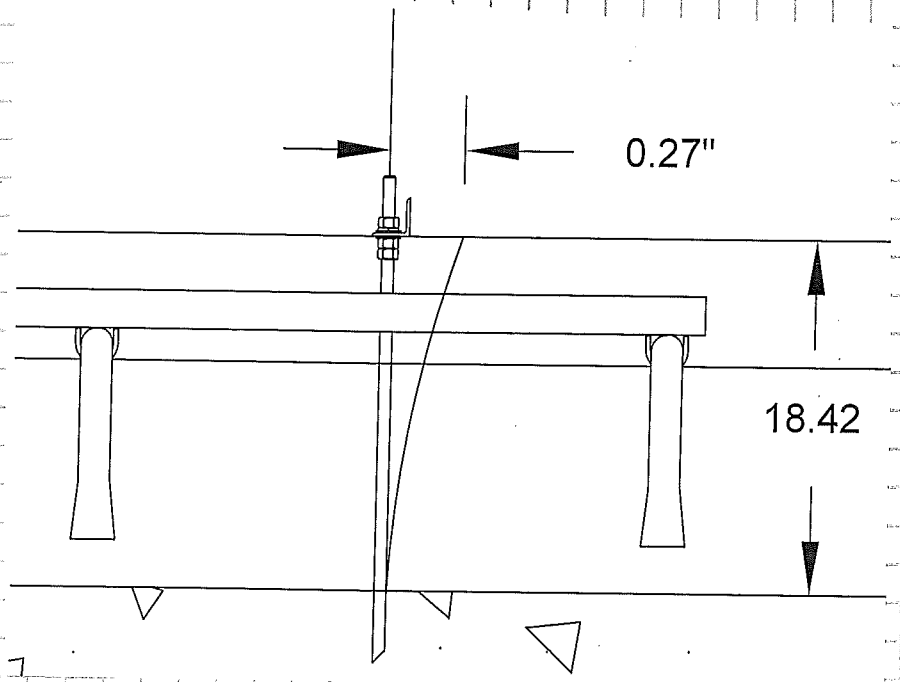
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Date: 3-30-15 Sheet: 3 of 4

Worst Case bending occurs at the last anchor of pipe P1:

$D_T = (115°F)(11 \times 10^{-6}\ in/in\ °F)(209.25\ in) \cong 0.27\ in$



Treat anchor as a cantilever beam with displacement = 0.27". Calculate maximum bending stress at base of anchor.

FOR ϕ5/8" S.S. Threaded ROD:

$F_u = 100{,}000\ psi$, $A = 0.226\ in^2$, $Z = 0.152\ in^3$

$F_y = 65{,}000\ psi$, $I = 0.041\ in^4$

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Date: 3-30-15 Sheet: 4 of 4

Allowable Bending stress, $\sigma_A = 0.6\ F_y$

$= 0.6\ (65{,}000\ psi) = 39{,}000\ psi$

$$\delta_{MAX} = \frac{PL^3}{3EI} = 0.27\ in$$

SOLVING FOR P,

$$P = \frac{(0.27\ in)(3)(28.5 \times 10^6\ \frac{lb}{in^2})(0.0041\ in^4)}{(18.42\ in)^3}$$

$$P = 15.1\ lbf$$

$$\therefore \quad \sigma_{MAX} = \frac{PL}{Z} = \frac{(15.1\ lbf)(18.42\ in)}{0.0152\ in^3} = 18{,}350\ psi$$

$18{,}350 < 39{,}000$ so deflection is acceptable.

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City of Massillon, OH 2013 WWTP Improvements Project

Submittal: 46 53 33-001-1 IFAS Submittal (Rev-0, Revised)

Submittal Review Comments by CTI - O'Brien & Gere Joint Venture

NO.	COMMENT	RELATED SPEC PARA.
18	Confirm all pipe support systems shall have a factor of safety of 4 or greater against calculated buoyant forces when installed. Confirm all anchor bolts shall have a factor of safety of 10 or greater against calculated buoyant forces when installed.	2.3.E
19	Please confirm the air requirements at both average and peak flow in the basin. Page 523/577 shows a total process demand of 20,100 SCFM while page 527/577 shows a possible process demand of 22,200 SCFM (2 basins at peak design flow of 11,100 SCFM). Which process demand will blowers be required to meet? Please note that bid documents show a total process air requirement at peak (all reactors, all trains) of 19,500 SCFM.	

Reviewer: John Callahan
Discipline: Electrical

NO.	COMMENT	RELATED SPEC PARA.
1	On page 10 of 577, the Air Scour Blower list under Additional Information that Blower Operation is Variable Speed, These blowers are constant speed.	
2	Please provide inverter duty rated mixer motors for variable frequency drive operation.	
3	Please modify mixer controls (and associated wiring diagram) such that the mixer will shutdown when seal leak is detected.	
4	Provide wiring diagram for the Instrument Surge Protection device.	
5	Per specification 40 92 13.13 Electrically Operated Primary Control Valves, Shop drawings shall include manufacturers standard wiring diagrams including all available terminal connections, project specific wiring interconnection diagrams showing all field termination points to remote equipment. Provide factory performance test report.	40 92 13.13
6	Per Specification 26 05 13 Electric Motors, provide motor assembly drawings with information as listed in Section 1.6,C.1 and 2., Provide factory test reports.	26 05 13

PART 2 PRODUCTS

2.1 GENERAL

A. All equipment shall be supplied complete. Parts shall be proportioned to have liberal strength, stability and stiffness and shall be especially adapted for the intended service. Ample room and facilities shall be provided for inspection, repairs and adjustments.

B. All equipment furnished herein is intended to be submerged in wastewater. No part shall be of any material other than Type 304L or 316L stainless steel, or gasket material.

C. All equipment that will come in contact with the compressed air shall be suitable for operation with compressed air at temperatures resulting from the service conditions described in Paragraph 1.060 above when said equipment is submerged in water or wastewater.

2.2 STAINLESS STEEL MATERIALS AND FABRICATION

A. All welded parts and assemblies shall be fabricated from sheets and plates of Type 304L stainless steel with a 2D finish conforming to AISI 304L and ASTM A240.

B. All non-welded parts and pieces shall be fabricated from sheets and plates of Type 304 stainless steel conforming to ANSI 304 and ASTM A240.

C. All nuts, bolts and washers, including anchor bolts shall be furnished in Type 316 series stainless steel.

2.3 PIPING

A. Furnish connections to stainless steel drop legs 3-ft above water surface elevation. Drop leg supports shall be supplied and be anchored to the concrete tank wall. All interconnecting hardware required to secure the pipe shall be provided. Field welding shall not be allowed.

B. All piping shall be suitable for use in wastewater. Drop leg connections and air manifolds shall be Type 304/304L stainless steel. Lateral pipe, pickled and passivated, shall be ASTM-A778 Type 304L and shall be supplied with a minimum nominal wall thickness of Schedule 5S for nominal pipe size up to 8. Lateral pipe lengths shall not exceed 20-ft.

C. Drop leg connections and manifolds shall be supplied with flexible couplings, expansion joints, pipe supports, etc, as required by the manufacturer for alignment of the system and to meet the expansion/contraction requirements as specified in Paragraph 1.060 above.

D. Type 304/304L stainless steel aeration grids shall be provided for the each of the aeration zones. Each grid shall be comprised of an aeration grid manifold with laterals uniformly spaced along the length of the manifold. Each lateral shall have a series of uniformly spaced holes along the bottom. The lateral pipe shall include a means of drainage while preventing media from entry.

E. All pipe support systems shall have a factor of safety of 4 or greater against calculated buoyant forces when installed. All anchor bolts shall have a factor of safety of 10 or greater against calculated buoyant forces when installed.

F. The aeration grids shall be level to plus or minus 1/4-in. All piping and grids shall be capable of being leveled to this tolerance and remaining level under all conditions of operation whether the aeration tanks are full, partially full, or empty.

G. Lateral piping shall include an expansion-contraction system consisting of fixed joints and guide supports. Guide supports shall allow longitudinal movement for expansion-contraction of the lateral piping. Straub

non-stamped thermal calculations for air grids/manifolds

I. Complete calculations and drawings demonstrating that the entire system, including the manifolds, laterals and drain lines meet requirements for expansion and contraction as specified in Paragraph 1.060 below.

1.6

1. Drawings and calculations shall show how the system will expand/contract under the range of conditions specified and demonstrate that manifold headers, lateral pipes, pipe fittings, expansion joints, piping supports, etc, for the entire system supplied comply with requirements specified in Paragraph 1.060 below. If deflection of piping at joints is allowed, calculate the maximum amount of deflection that will occur and compare the deflection to the maximum allowable for the type of joint used and confirm that the joints will not leak and that the expansion and contraction are acceptable for the specified condition.

1.6 DESCRIPTION OF SYSTEM

A. All of the equipment specified herein is intended to be standard aeration equipment capable of transferring atmospheric oxygen into the integrated fixed-film activated sludge reactors and to create adequate mixing to keep the IFAS media in suspension, well-dispersed and to prevent media bulking. The aeration system consists of three individual trains. Each train consists of a pre-anaerobic, pre-anoxic, and aeration zone. The aeration zone shall require the installation of an aeration system as specified herein.

B. System Responsibility

1. All equipment specified under this Section shall be furnished by the IFAS supplier who shall have sole responsibility for designing and furnishing all the parts and components required for a complete and operable system; however, all equipment need not be manufactured by a single manufacturer. The equipment shall be manufactured and installed in accordance with the best practices and methods.

C. Performance Requirements

1. The aeration basins are used to reduce the biochemical oxygen demand (BOD) and to provide for nitrification. The required total field oxygen transferred into the mixed liquor shall be as determined by the IFAS supplier and calculations shall be approved by engineer. The aeration system is to provide full floor aeration in a pattern selected by the IFAS supplier and approved by the Engineer to provide adequate mixing and media migration control. The aeration system shall operate within the manufacturer's design range at full capacity and at lower air flow ranges required to meet mixing limited conditions per ASCE/WEF. Minimum air flow in all grids at average air flow rate shall not be less than 0.12 scfm/sq ft of aeration tank surface area.

2. The minimum transfer of dissolved oxygen into clean water, corrected to 20 degrees and sea level shall be determined by the IFAS manufacturer's design calculations based on the flows and loads specified in Section 46 53 33.

3. Clean water oxygen transfer efficiencies shall be measured at Standard Conditions, at the specified average diffuser submergence, and by test procedures and conditions as specified in Paragraph 3.0I below. Standard Conditions are defined as 14.7 psi, 68 degrees F, and 36 percent relative humidity.

4. The required air pressure at the top of each drop leg shall be provided by supplier. Manifolds and laterals shall be designed to carry at least the peak hour demand or 200 percent of the specified average daily flow, whichever is greater.

D. The entire system, including the manifold and laterals shall allow for expansion and contraction under the following conditions:

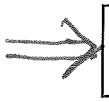
1. Winter conditions, empty aeration tanks (minus 30 degrees F).

2. Summer conditions, empty aeration tanks (105 degrees F with 120 degrees F aeration grid).

3. Operation with air supply as 225 degrees F and aeration tanks full.

4. Operation with air supply at 225 degrees F and water level in aeration tanks 2-ft above diffusers.

5. Typical installation temperature range is 40 degrees F to 85 degrees F.



6. Temperature variation for the aeration grid occurs between coldest temperature and the highest installation temperature (-30 degrees F to 85 degrees F) for a temperature difference of 115 degrees F

1.7 DELIVERY, STORAGE AND HANDLING

A. Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components. No shipment shall be made until approved by the Engineer in writing.

1. At the time of shipment, the shipping list, original bill of loading, shipping memorandum and invoice shall be delivered in triplicate to the Engineer. Each shipping list shall give the description and net weight of each item, and gross weight of the shipment. Shipment will not be accepted until the list has been received. Demurrage or other charges resulting from failure to furnish these lists shall be absorbed by the Contractor.

B. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended. Each box or package shall be legibly marked to show its net weight.

C. All components shall be properly protected so that no damage or deterioration will occur during a prolonged delay between time of shipment and installation, including any prolonged period at the site.

D. The finished surfaces of all exposed flanges shall be protected by wooden blank flanges or plastic inserts, strongly built and securely bolted thereto.

E. Piping shall be arranged and clearly marked for the tank and grid for which they are intended.

1.8 SPARE TOOLS AND SPARE PARTS

A. Provide one set of special tools that are required for normal operation and maintenance. Tools shall be packaged in a steel case, clearly and indelibly marked on the exterior to indicate equipment for which tools are intended.

B. Provide the following spare parts:

1. Sufficient material to repair 10 percent of all expansion joints supplied under this Contract.

2. Sufficient material to replace 5 percent of pipe supports, including nuts and bolts.

C. All spare parts shall be packed in containers which are clearly and indelibly identified as to their contents. All items shall be suitably packed and protected for long periods of storage.

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SECTION 5.6

CONTROL DESCRIPTION

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CONTROL DESCRIPTION
FOR
IFAS SYSTEM PROTECION

FOR

WWTP IMPROVEMENTS PROJECT
MASSILLON, OH
INTEGRATED FIXED-FILM ACTIVATED SLUDGE SYSTEM

PREPARED BY

Kruger Inc.
Cary, North Carolina
(919) 677-8310
(919) 677-0082 (Fax)
Project Number: 5700235402

September 10, 2015

VEOLIA WATER
Solutions & Technologies

Massillon, OH WWTP
Control Description for IFAS System Protection

Process Blower Surge Function

Purpose: Process blower surge function periodically increases process blower output to in order to temporarily increase the air delivered to the IFAS reactor air grids for the purpose of mixing and/or reconstituting floating media. The function initiates a blower surge event based on a frequency and duration. The PLC allows the operator to manually initiate an event via a toggle switch at the PLC HMI. A countdown to the next event and an indication of whether an event is currently in progress is displayed at the PLC HMI. Each time an event is initiated (manually or automatically) the duration and interval timers are reset to the currently entered setpoints and restarted.

Operator Inputs

Input	Range	Default	Comment/Definition
Interval	2 to 48 Hrs	24	
Duration	5 to 30 minutes	15	
Blower Count	1 or 2	1	Minimum number of Blowers to bring into operation for surge. IF current # of blowers in operation exceeds count value, the use current value.
Blower Speed	30 to 60 Hz	60	Blower speed may be shown in % instead of Hz.
Toggle	ON or OFF	OFF	Toggles the surge function ON or OFF.
Start			Start Button allow Operator to implement a single surge event immediately regardless of the status of either the duration timer or the Toggle.

High Water Level Detection in IFAS Tank

Purpose: A guided wave radar level probe shall be installed in each IFAS reactor to monitor the water level. If the water level is at or above the high level setpoint for at least 30 seconds, the following actions shall be implemented:

Alarm: A high level alarm shall be displayed on the PLC HMI / SCADA and relayed to the Plant System Auto Dialer as a critical alarm requiring immediate operator response. The PLC shall display the following message on the main control screen, blower control

screen, and IMLR pump control screen: ”Normal Control Suspended Due to High Level”. A high-high level alarm shall also be established at the PLC (and displayed on the PLC HMI / SCADA and relayed to the Plant System Auto Dialer as a critical alarm) to indicate that the activation of the system protection routines did not stop the rise in water level and an overflow event is imminent.

Internal Recycle Pumps: All internal recycle pumps in “Auto” shall be shut down. To restart the pumps, the operator must have acknowledged the alarm, the high water level condition must no longer exist, and the operator must activate the “Resume Normal Control” switch at the PLC HMI. This switch shall be available on the main control screen, process blower control screen, air sparge blower control screen, and IMLR pump control screens.

Process Blowers: All blowers in “Auto” that serve the IFAS zone shall be set to maximum speed. To resume normal blower control; the operator must have acknowledged the alarm, the high water level condition must no longer exist, and the operator must activate the “Resume Normal Control” switch at the PLC HMI. This switch shall be available on main control screen, process blower control screen, air sparge blower control screen, and IMLR pump control screens.

Air Sparge Blowers: The duty air sparge blower will normally operate intermittently according to on/off time. If high water level condition occurs, the duty air sparge blower shall exit intermittent timer operation and run continuously. To resume normal air sparge blower control; the operator must have acknowledged the alarm, the high water level condition must no longer exist, and the operator must activate the “Resume Normal Control” switch at the PLC HMI. This switch shall be available on main control screen, process blower control screen, air sparge blower control screen, and IMLR pump control screens.

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SECTION 6

SCOPE OF SUPPLY

VEOLIA WATER Solutions & Technologies

SECTION 3

AnoxKaldnes Hybas™ Equipment Scope of Supply

3.1 GENERAL:

Kruger will supply the following equipment as described below:

a. Biofilm Carrier Elements
b. Aeration System
c. Screen Assemblies
d. Supports
e. Submersible Mixers
f. Sparging Blowers
g. Valves
h. Instrumentation and Control

3.2 PROCESS DESCRIPTION:

The core principle of the Hybas process is to have a continuously operating, non-clogging biofilm reactor with no need for backwashing, with low head-loss and a high specific biofilm surface area. The biomass grows on small carrier elements that move along with the water in the reactor. The movement within the reactor is produced by an engineered aeration system while the media are retained within the reactor using stainless steel retention screens. The biofilm carrier elements are made of high density polyethylene and have a specific gravity of 0.96. The AnoxKaldnes Hybas process does not require backwashing.

Our Hybas system design is based on surface area loading rates (SALR) with respect to BOD_5 and NH_3-N. Our experiences with other municipal facilities with both pilot test data and full scale data have provided the design basis for the selection of the SALR for this facility.
The calculation for the amount of biofilm carrier elements required is based upon the SALR selected & the effective surface area of biofilm carrier elements in the basin. The effective surface area of AnoxKaldnes K5 carriers for biomass growth is 800 m^2/m^3 (244.9 ft^2/ft^3).

3.3 SCOPE OF SUPPLY:

AnoxKaldnes IFAS System Equipment – Limited to In-Basin Equipment Only

Process and Mechanical Equipment Items	Qty	Description
AnoxKaldnes K5 Media, (ft^3)	108,760	• AnoxKaldnes K5 carrier elements, providing additional effective surface area for biological growth. • Carrier elements will be delivered, FOB Jobsite included in this scope of supply, to the City of Massillon, OH. • Media will be delivered in a total of sixty-nine (69) covered or flatbed trailers, each containing up to 45 bags. If alternate shipping methods are requested by the Buyer, additional charges may apply. • For reference, Contractors at other projects have typically installed three (3) trailers per day. The fastest installation rate observed was five (5) trucks per day. • Neither on site storage nor near-site storage of media by the Contractor is necessary. Within limits described in this Scope of Supply, media can be delivered to the site as the Contractor is able to install it in the basins. • Each bag is approximately 3.5 ft x 3.5 ft x 3.0 ft, or 35 ft^3 per bag (1.0 m^3) and has at least two (2) handles on the top side, which can be used to remove the bags from the trailers. Bags weigh approximately 270 lbs each. • Media bags will be shipped individually or shrink-wrapped 2-3 to a pallet • The bags will require removal from trailers and field placement or storage by the Contractor. The Contractor will have 2 hours to unload each container, after it arrives on site, before demurrage charges are assessed. The Contractor shall be responsible for any demurrage charges. Storage: • The media bags can be stored outside for long periods of time however they need to be covered to minimize any degradation of the bag itself due to sunlight. • The media bags can be stored in a pyramid style using 3 - 4 bags as the height of the pyramid. UV-resistant tarps can be used to cover the bags of media until such time they are loaded into the reactor. Pictures below show storage of the bags prior to being covered with tarps. • The Contractor shall be responsible for supply, installation, maintenance, and repair of protective tarps or covers.

Process and Mechanical Equipment Items	Qty	Description
AnoxKaldnes IFAS Aeration System	39	• For each of the three (3) Hybas tanks there will be installed thirteen (13) air grid modules. Each grid will have an 8" diameter Schedule 10s drop pipe, 8" diameter Schedule 10s central manifold, and will be broken down as follows: - Ten (10) Air Grid Modules with twenty three (23) diffuser lateral pairs of 1.5" diameter and Schedule 5s. - Two (2) Air Grid Modules with seventeen (17) diffuser lateral pairs of 1.5" diameter and Schedule 5s. - One (1) Air Grid Module with sixteen (16) diffuser lateral pairs of 1.5" diameter and Schedule 5s. Approximate module dimensions are 8 ft wide x 57 ft long for the aeration grids • Laterals with 4 mm holes drilled at equally spaced intervals are designed for a turndown of 50% of the design airflow without loss of equal distribution of air to each lateral • All piping and supports will be of 304 or 304L stainless steel. • All interconnecting hardware provided by Kruger, with the exceptions listed below. Hardware will be of 304 stainless steel or higher grade. • The aeration system & supports will require unloading & field erection by others. • AERATION GRID FLANGE BOLTS, NUTS AND GASKETS AT THE KRUGER / CONTRACTOR INTERFACE ARE **NOT PROVIDED.** ALL OTHER HARDWARE FOR THE SUPPORTS AND IN BASIN FLANGE CONNECTIONS **ARE PROVIDED** BY KRUGER. • Please note that all connecting materials provided by Contractor must be of compatible material to the AnoxKaldnes system. If not compatible, insulated pipe must be provided. • Kruger shall provide all anchor bolts, nuts and washers. Contractor shall provide epoxy anchor chemicals and applicators. All hardware shall be 304 stainless or higher grade. Kruger recommends Hilti H-150 MAX SD adhesive or similar epoxy anchor product.
De-Ox Air Mixing	3	• For each of the three (3) De-Ox tanks there will be installed one (1) aeration pipe for pulse mixing for the purposes of keeping the solids suspended.

Process and Mechanical Equipment Items	Qty	Description
Cylindrical Screen Assemblies	108	• A total of sixty-six (66) screen assemblies for effluent screening, each 5 feet long, 22-7/8 inch diameter. Twenty-two (22) screens shall be installed in each IFAS reactor. • A total of forty-two (42) screen assemblies for IMLR Box screening, each 5 feet long, 22-7/8 inch diameter. Fourteen (14) screens shall be installed in each IMLR Box. • Air sparging valves and piping for the top eleven (11) screens in the effluent of each IFAS reactor will be provided by Kruger and installed by the Contractor. Sparge pipes shall be connected to the process air headers for each train. There will be one (1) sparge pipe connection per train for continuous air flow of 133 SCFM per reactor. Kruger will provide one (1) manual valve for each sparge pipe, for a total of three (3) manual valves. • Screen and air sparging piping for the screen assemblies shall be 304/304L stainless steel. • Minimum of 50% open area in screens. • The cylindrical screen shall be constructed of a minimum schedule 10 pipe and perforated plate. • Maintain a maximum headloss of 3 inches through each reactor at peak hydraulic flows. • The screens and supports will require unloading & field erection by others. • Kruger shall provide all anchor bolts, nuts, and washers. Contractor shall provide epoxy anchor chemicals and applicators. Kruger recommends Hilti H-150 MAX SD adhesive or similar epoxy anchor product. • Wall inserts are not necessary and shall not be provided. • All hardware will be 18-8 stainless or higher grade. 4
Flat Screen Assemblies	12	• Wall inserts are not necessary and shall not be provided. • A total of twelve (12) flat perforated plate screen assemblies, each 5 feet wide by 2 feet tall. Four (4) screens shall be installed in each IFAS reactor. • Screens and screen supports for the screen assemblies shall be 304/304L stainless steel. • Flat screens shall be placed over ports at the water surface in each reactor to facilitate foam movement to the downstream reactors. Kruger will provide screens and hardware. • Kruger shall provide all anchor bolts, nuts, and washers. Contractor shall provide epoxy anchor chemicals and applicators. Kruger recommends Hilti H-150 MAX SD adhesive or similar epoxy anchor product.

Process and Mechanical Equipment Items	Qty	Description
Submersible Mixers	9	• One (1) for each Anaerobic reactor. • One (1) for each Pre-Anoxic Reactor. • Includes: Submersible Propeller Mixer, submersible power cable, 304SS guide rails, receiving bracket, hoist base, lifting cable, power cable support cable, and one hoist with manual winch per 3 mixers. • Contractor shall provide all anchor bolts, nuts, washers, epoxy anchor chemicals, and applicators. All hardware shall be 304 stainless or higher grade. Kruger recommends Hilti H-150 MAX SD adhesive or similar epoxy anchor product. Spare Parts: • Spare mixer • Mechanical seal set • O-ring set.
Regenerative Blowers	2	• Regenerative blowers for screen air sparging. Each blower will be rated for 400 SCFM and 20 NPHP. • One (1) duty plus one (1) standby.
Modulating Airflow Control Valves	3	• A total of three (3) modulating butterfly valves (one (1) per train) shall be provided. One (1) modulating butterfly valve shall be installed in the air pipe header for the Hybas reactor. Size: 8-inch diameter, 1 per train (3 total) • A total of three (3) solenoid valves (one (1) per train) shall be provided. One (1) solenoid valve shall be installed in the air pipe header for De-Ox Reactor mixing. Size: 2-inch diameter, 1 per train (3 total)

12-inch

Submitting with 2" butterfly valves with electronic actuators as solenoids we not available with given pressure differential.

Equipment Control

Kruger shall supply an Allen-Bradley Control Logix PLC processor based control panel as described herein to control the Kruger IFAS system based on operator set points. All I/O will be wired to field terminations as required. The control panel will be completely assembled, tested, and programmed for the required functionality. The U.L. labeled panel will be comprised of the following:

IFAS Control Panel

Qty	Description	Manufacturer
1	NEMA 12 Painted Steel 72"H x 72"W x 24"D Freestanding 2-Door Panel (SCE727224FSD) *Must be located indoors in a climate controlled environment	Saginaw
1	Back Panel for Control Panel 60"Hx68"W (SCE72P72F1)	Saginaw
1	12" Color Touchscreen Operator Interface Panelview Plus 6 (2711P-TC12C4A8)	Allen Bradley
1	PLC Processor (1756-L75) Control Logix Processor	Allen Bradley
2	PLC Ethernet Module (1756-EN2T) Control Logix	Allen Bradley
2	PLC 10 Slot Chassis (1756-A10) Control Logix	Allen Bradley

2	PLC Power Supply (1756-PA72) Control Logix	Allen Bradley
7	PLC Digital Input Module 16PT 120VAC (1756-IA16) Control Logix	Allen Bradley
2	PLC Digital Output Module 16PT 120VAC (1756-OA16I) Control Logix	Allen Bradley
3	PLC Analog Input Module 16PT 4-20mA (1756-IF16)	Allen Bradley
2	PLC Analog Output Module 8PT 4-20mA (1756-OF8)	Allen Bradley
1	120 VAC Surge Protector (SFP 120 2856702)	Phoenix Contact
AR	Circuit Breakers	Square D or Equivalent
2	24VDC 5A Power Supply (QUINT-PS-100-240AC/24DC/5)	Phoenix Contact
48	4-20mA to 4-20mA Analog Isolator (28 64 40 6)	Phoenix Contact
64	4-20mA Analog Surge Arrestor (PT2x2 24DC ST)	Phoenix Contact
64	4-20mA Analog Surge Arrestor Base Element (PT2x2 24DC BE)	Phoenix Contact
144	Double Level Field Terminal Block Screw Connection (UTTB4)	Phoenix Contact
32	Interposing Relay w/Base for Digital Outputs	Allen Bradley
1	Ethernet Switch 6 Port 10/100 Base T/ 2 SC Multimode Fiber Optic Ports Industrial Ethernet Switch (SFN 6TX 2FX 2891314)	Phoenix Contact
1	Cabinet Light & Convenience Outlet	Leviton or Equal
1	1500VA 120VAC Input/120VAC Output UPS S1K1500	Sola
AR	Misc. Wire and Panduit	
1	Allen Bradley RSLogix 5000 (PLC Programming Software)	Allen Bradley/Rockwell
1	Allen Bradley Factory Talk View Studio Machine Edition (Operator Interface Programming Software)	Allen Bradley/Rockwell
1	Completed Panel Shop Tested and UL Labeled	Kruger
1	PLC / Operator Interface Programming	Kruger

NOTE: AR means As Required. The quantity of these items will be determined at the time of panel construction.

Each PLC Control Panel will include the necessary input/output plus twenty percent (20%) “Live” spare wired signals for future or additional signal interface.

All PLC and Operator Interface programming is based on Kruger standards, any requests or requirements that would deviate from this standard will result in additional costs. Kruger will be providing PLC/ Operator Interface programming only for the Kruger supplied PLC Control Panel.

The PLC Program and Operator Interface Program and its associated Graphic screens developed by Kruger, are for use on the Kruger supplied PLC and Operator Interface only. The Kruger supplied PLC Program and Operator Interface Program and its associated Graphic screens cannot be used, whole or any part for other uses.

Kruger will use Allen Bradley development software for PLC Programming and Operator Interface Programming; the development software is licensed to Kruger and will not be provided as part of this scope. Kruger will not be providing any PLC, Network, Operator Interface, or Alarm Notification software.

Kruger will supply copies of the completed PLC and Operator Interface programs at job completion. Prior to supplying completed PLC and Operator Interface programs, Kruger requests that a non-disclosure agreement be signed and returned to Kruger.

Factory testing of the Kruger PLC Control Panel will be conducted by Kruger personnel at a Kruger selected Panel Facility. Kruger reserves the right to conduct this testing when it is deemed

appropriate in regards to Kruger personnel. Kruger has an established Panel testing criteria and will conduct all Panel and Software testing per Kruger standards. When said Panel/Software testing is complete a Test Report will be generated per Kruger standards. Other party's are welcome to witness panel testing at no expense to Kruger, testing can be witnessed at an agreed upon date that does not impact delivery or start-up schedules.

No other Instruments, Control Panel Components (PLC or other components) will be supplied unless they are explicitly listed in this Scope of Supply.

INSTRUMENTATION:

Kruger shall supply the field instruments as detailed herein.

Field Instruments

Qty	Description	Manufacturer
3	pH Sensor w/ SC200 LXV401.52.00002 SC200 Controller w/Temperature 4-20mA DPD1P1 Differential Digital Sensor (Train 1, Train 2, Train 3)	Hach
3	Dissolved Oxygen Analyzer LXV401.52.00002 SC200 w/ Dissolved Oxygen Probe 57900-00 LDO (Train 1, Train 2, Train 3)	Hach
3	Guided Radar Level Magnetrol Eclipse 760 (TRAIN 1, TRAIN 2, TRAIN 3)	Magnetrol
3	8" Thermal Mass Flowmeter FCI ST50 (Train 1 C-Stage, Train 2 C-Stage, Train 3 C-Stage,) *Please note Thermal Mass Flowmeter's require 20 Pipe ID's upstream and 10 Pipe ID's downstream, without obstructions for accurate reading.	FCI
3	Float Level Switch Eco-Float (Train 1, Train 2, Train 3)	Anchor Scientific
15	Field Instrument 120VAC/4-20mA Surge Protection Boxtrab BXT-N4X-4-Wire	Phoenix Contact
1	Instrument Start-Up and Calibration	Kruger

Kruger will calibrate and start-up Instruments supplied by Kruger. Instruments supplied by others will require calibration and start-up by others.

IMPORTANT NOTE: NO ADDITIONAL TOOLS AND/OR SPARE PARTS OTHER THAN LISTED ABOVE WILL BE PROVIDED AS PART OF KRUGER'S SCOPE OF SUPPLY. FURTHERMORE, THERE ARE NO PREVENTATIVE MAINTENANCE REQUIREMENTS OR REPLACEMENT PARTS NECESSARY DUE TO THE MEDIA, AERATION SYSTEM, AND SCREENS BEING MAINTAINANCE FREE COMPONENTS.

Notes Regarding System Design and Installation

- For any MBBR or IFAS system, regardless of manufacturer, the quality and finish of reactor surfaces is important for the long-term longevity of the system. AnoxKaldnes has years of experience in the design and manufacture of MBBR and IFAS systems, with the quality and texture of the finished reactor walls is important. It is particularly important to prevent chipping, holidays, or rough areas that would leave open any annular spaces around media retention screens.

KRÜGER

SECTION 7

SHIPPING, HANDLING & STORAGE INSTRUCTIONS

VEOLIA WATER
Solutions & Technologies

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Cary, NC 27513
Phone (919) 677-8310
Fax (919) 677-0082

I. Krüger Inc. Shipping, Handling, and Storage Instructions

SHIPPING

Most of the material for this project will be dropped shipped from an I. Krüger Inc. authorized supplier and delivered directly to the site. The authorized supplier has been informed to follow the following instructions:

- All items delivered will be clearly identified with I. Krüger Inc.'s name, I. Krüger Inc.'s project name and project number, and I. Krüger Inc.'s purchase order number.
- All shipments will have a clear Packing List identifying all parts in the shipment. There should be no Packing List with "1 lot Machine Parts". The Packing List description will be descriptive.
- All boxes will be identified with a Packing List clearly identifying the contents of each box.
- All equipment will be tagged with the corresponding tag numbers shown on the design drawings (if applicable).
- The shipper is required to call the jobsite 48 hours in advance of delivery, and make arrangements with the contractor for receipt of material.

If there are more stringent requirements in the contract documents then they will take precedence over the above. If any of these requirements are not being following, please notify the I. Krüger Inc. Project Manager immediately. The project manager will work with our suppliers to ensure the problem does not continue.

RECEIVING EQUIPMENT

After arriving at the site, all materials and equipment shall be examined by the receiver and any discrepancies, overages or shortages noted on the receiving report. All visible damage should be documented as follows, before off loading and formal receiving.

- Receiver shall review all cartons, crates, boxes, equipment, skidded/palletized material, etc., for any sign of physical damage. All noted damage MUST be addressed as follows before off loading or receiving: (1) Receiver shall not off load or sign for the goods "as delivered" until all issues have been addressed with freight carrier. (2) DO NOT OFF LOAD. Receiver must take photograph of damaged item(s) (3) Receiver then must call I. Krüger Inc.'s project manager and provide the name of the freight carrier, bill of lading number, description and a copy of the photograph for record. (4) I. Krüger Inc.'s project manager shall contact both the supplier and the freight carrier to request a formal release based on "accept as noted," with the Trade Contractor noting the specific damage on the bill of lading, before signing for receipt of said goods. If there is substantial damage, please report as described above, but also refuse to unload the goods.
- If the freight carrier refuses to give the I. Krüger Inc.'s project manager an "accept as noted" release, based on said noted damage, I. Krüger Inc.'s project manager shall notify the receiver to reject said shipment in full. I. Krüger Inc. shall notify both the supplier and the freight carrier to have the

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material returned to nearest carrier terminal for inspection by carrier's freight inspector. Acceptance of material damaged in transit, subject to exceptions properly taken, does not jeopardize the successful prosecution of a claim against the freight carrier at a later date.

- Receiver shall report concealed damage to both the freight carrier and I. Krüger Inc. immediately upon discovery but preferably within five 5 days after receipt of material. As soon as the concealed damage is apparent, receiver shall stop unpacking, take photographs and notify the I. Krüger Inc. project manager of the damage.
- Receiver must submit all required documentation, bill of lading, inclusive of a full accounting of all of the details to I. Krüger Inc.'s project manager as soon as possible, in order for I. Krüger Inc. to file a formal claim with the freight carrier.
- Failure of the receiver to follow all of the above "Damage Goods" procedures, giving cause for Kruger or its suppliers to loose all rights to collect damages and make claims from the freight carrier, will cause all related costs to be born by the receiver and paid to the damaged party in full as documented.

STORING EQUIPMENT

Once the equipment has been checked for any damage that might have occurred in transit, use the following guideline if it is intended to store the equipment. Preferably, all equipment should be warehoused to protect the equipment against inclement weather, dust or damage by vehicles. **Spare parts should also be warehoused until used.** When indoor storage is not available then outdoor storage is acceptable. In either case, the following procedure should be followed:

- All fabricated steel components should be stored in a clean and dry area that provides adequate ventilation. All equipment must be stored with adequate support underneath to prevent distortion and to raise equipment above any undesirable ground or floor conditions. Any tenting or tarpaulins must be well supported so as to provide adequate ventilation.
- Mechanical equipment with rotating components i.e. motors, pumps, etc. must have the component shafts hand rotated several times on a regular basis. It is highly recommended to log those events with date and name of person performing the operation.
- The contractor should recoat any parts with paint, primer or grease, which may have been scratched or wiped, clean of their protective coating in shipment. Periodic checking is necessary to remove any accumulated condensation or rust, and recoat as necessary.
- Painted and plastic surfaces are affected by long exposure to direct sunlight and should be shielded from the sun. Similarly, bitumastic coatings tend to become brittle and will chip. In general, exposure to direct sunlight and subsequent cooling is conducive to condensation of moisture and should be avoided. Check periodically for accumulations of moisture and/or surface rusting. If rusting is present, prepare the surface and recoat with proper material. Increase ventilation and reduce humidity.
- Instrumentation, control panels and alike should always be in a climate controlled warehouse until

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installation. Equipment containing PVC parts such as chemical feed equipment etc. should always be in a climate controlled warehouse until installation. Tarps etc. shall be supported to prevent damage from long term pressure to the equipment stored underneath

- Caution should be taken to prevent any carbon steel products or SS from the 400 series to be in contact with our stainless steel parts. If our components are stored outside, there **should not be** any carbon steel products or SS from the 400 series, stored above, due to contamination and staining from rain water runoff.
- For equipment **not** manufactured by **I. Krüger Inc.** refer to the appropriate section in the Installation, Operation, and Maintenance Manual to determine the manufacturer's storage requirements.

UN-LOADING, STORAGE AND HANDLING OF MEDIA

The carrier elements are typically delivered in 1.0 cubic meter bags. The K5 bags weigh approximately 270 lbs. each. The bags can be lifted by their two ears located on the top of each bag by using a fork lift. The bags should be lifted over the side of the tank and media discharged into the reactors. The picture below shows what the 1.0 cubic meter media bags look like.

The media will be delivered in semi box-trailer containing 40 to 48 bags, palletized with 2 bags per pallet.



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Delivery of the media will typically occur with 3 trucks arriving on site each day during each week, unless other arrangements have been arranged with Krüger's project manager. Media must be offloaded immediately otherwise demurrage charges will occur. The client will be responsible for any demurrage charges.

For reference, Contractors at other projects have typically unloaded three (3) trailers per day. The fastest off-loading rate observed was five (5) trailers per day

The media bags can be stored outside for long periods of time however, they need to be covered to minimize any degradation of the bag itself due to sunlight. The media bags can be stored in a pyramid style using 3 - 4 bags as the height of the pyramid. For short term coverage, blue tarps can be used to cover the bags of media until such time they are loaded into the reactor. For longer term coverage, we recommend the use of UV reflective tarps. Pictures below show storage of the bags prior to being covered with tarps.

This type of tarp is sufficient to cover the media, but for short term only:
The tarp should be inspected regularly and replaced as needed to maintain protection.

BLUE POLY TARPS

Blue economy poly Tarps are manufactured from tough low density polyethylene, laminated on both sides with high density polyethylene which makes economy Tarpaulins strong, tear resistant and 100% water proof. Our Tarps are lightweight, easy to handle, rot proof, shrink proof, UV protected and flexible to Artic temperature. Our low priced blue Tarps are widely used in the construction, agriculture, boating, camping, industry, landscaping and much more. We recommend for outdoor use to securely tie down the Tarp to gain maximum life span of the cover and your assets.

- Grommets approx every yard
- 3 oz per square yard
- 900 denier, 8 x 10 weave count
- Finished Blue Tarp Size is 4" or up to 2% smaller
- Sold as single or case
- 100% Water proof
- Mildew resistant
- Tear resistant
- Acid resistant
- UV Treated

Actual finished Blue Tarp Size is approx 4" to 6" or 2% smaller.

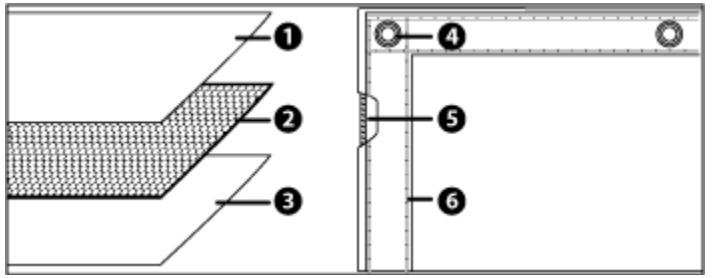
This type of tarps is better to cover the media for longer term.
The tarp should be inspected regularly and replaced as needed to maintain protection





SILVER/BLACK SUNSHIELD™ POLY TARPS

SUPER-HEAVY DUTY
SILVER
POLY TARPS



1. UV Resistant Top Coating (Weather resistant polyethylene coating)
2. High Density Polyethylene Weave (14 strands vertical, 14 strands horizontal per sq. in.)
3. UV Resistant Bottom Coating (Weather resistant polyethylene coating)
4. Plastic reinforced corners and grommets every 18"
5. Poly Roping in Hem all around
6. Double-Stitched or Heat Sealed Hems

14x14 square inch cross weave count, 12 mil. construction, 1000 Denier

POLYTUF® SILVER/BLACK SUNSHIELD™-UVI Poly Tarps are very rugged and designed for use under continuous outdoor exposure. Sunshield is made with Black High Density Woven Fabric along with UV Treated Coatings on both sides to provide extended life in the sunlight. In addition, using Sunshield with Reflective Silver Side up will divert both heat and ultraviolet light, while using the Black Side up will absorbe heat and divert ultraviolet light. Both sides are Heat and Cold Resistant.

With 6.0 oz. per square yard material weight and 14 x 14 square inch cross weave count. UV Resistant Top and Bottom Coating (weather resistant polyethylene coating) with a High Density Black Polyethylene Weave center layer.

Features include:
12 mil. thickness, UV Resistant, heat sealed seams, 3/16" poly rope in hem with Heavy Duty Molded Plastic Reinforced Corners and aluminum grommets at each corner and about every 18" around the hem.
Silver one side, Black one side.

KRÜGER

SECTION 8

PERFORMANCE TESTING PROTOCOL

VEOLIA WATER
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PERFORMANCE TEST PROTOCOL

FOR

WWTP IMPROVEMENTS PROJECT
MASSILLON, OH
INTEGRATED FIXED-FILM ACTIVATED SLUDGE SYSTEM

PREPARED BY

Kruger Inc.
Cary, North Carolina
(919) 677-8310
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Project #5700235402

September 2, 2015

VEOLIA WATER
Solutions & Technologies

Introduction

Process Performance Tests of the IFAS system at the Massillon OH WWTP will be conducted after the system is fully acclimated / approved for beneficial use and has been operating at the test conditions for a minimum of 30 days. The purpose of this document is to establish the procedures of the IFAS Process Performance Test.

Description

The Process Performance Test shall be conducted over one (1) 90 consecutive day period of which at least 30 days must be at an average water temperature equal to or less than the design temperature of 15.7 C. The primary objective of the test is to demonstrate the IFAS system is capable of achieving the specified design requirements. The Process Performance Test shall be considered successful if the effluent concentrations from the system meet the criteria listed in Table 1 during the test period.

Table 1: IFAS Effluent Criteria

Parameter	30-Day Average
BOD_5:	≤ 10 mg/L
TN:	≤ 10 mg/L
NH_4-N:	≤ 1.3 mg/L* ≤ 2.9 mg/L*
OP:	≤ 0.5 mg/L**

* If 30-day average temperature is ≥ 15.7 C, the ammonia limit shall be ≤ 1.3 mg/L. If the 30-day average temperature is < 15.7 C, the ammonia limit shall be ≤ 2.9 mg/L.

** Chemical trim may be required to meet limit of 0.9 mg/L during performance test.

According to the specs, the system influent flow and loads shall be within 10 percent of the specified design maximum-month values. Kruger will attempt to keep the loading within this range, but it can't be guaranteed. Each of the test trains (one or two) will be set near their max month flow rating thru proper flow distribution assuming that it does not exceed the design loading of the test basins. Since the pollutant concentrations can't be controlled, it may not be possible to load the test basins near their design capacity.

In general, the Owner will operate and maintain the plant, collect the necessary samples and analyze them, and provide Kruger with all standard operational data (flow rate, online instrument, water temperature trends, etc). The Owner shall also provide duplicate samples that will be retrieved and analyzed by an independent certified lab provided by Contractor. Kruger will work with the Owner to determine process operating parameters and provide technical support before and during the test. The Contractor shall furnish all power, facilities, labor, materials, supplies and test instruments required to conduct the performance test. The method of IFAS operation is presented later in this document.

Sample Collection and Analysis

General procedures and requirements for field acceptance testing are provided in the project Specifications and Contract Documents (See Attachments).

During the test, the Owner will collect 24-hour composite / grab samples each day for a period of 90 consecutive days and grab samples per the specifications. The Contractor shall an agreed upon independent certified lab to analyze the samples. Programmable auto samplers (provided and operated by the Owner) shall be set to obtain samples at the following locations:

- IFAS system influent (primary effluent)
- IFAS system effluent (clarifier effluent)

The following analytical tests will be performed during the performance test.

Table 2: Sampling Analysis

Test Parameter	Sample Location					
	Primary Effluent	Anoxic Effluent	Oxic Effluent	Oxic Recycle	RAS	Effluent Channel*
$CBOD_5$	1-A					1-A
COD	1-A					1-A
sCOD	1-A	2-A	2-A			1-A
TSS	1-A	2-A		2-A	2-A	1-A
TKN	1-C					1-C
NH_3-N	1-A	2-B	2-B			1-A
NO_3-N	1-A	2-B	2-B			1-A
NO_2-N	1-A	2-B	2-B			1-A
OP	1-A					1-A
TP	1-A					1-A
Alkalinity	1-A		2-C			1-A
DO		2-B	2-B	2-B		
Temp		2-B	2-B			

* Raw samples from common effluent channel will require 30 minutes of settling followed by decant of the supernatant into the final sample collection bottle. Since all three trains will be in operation during the performance test, it is important that effluent channel samples be taken at a location that does not include effluent from the basins not included in the performance test.
Sample Type:
1 - 24-hour Composite
2 – Grab**
A – Daily (Mon – Fri)
B – 3 times per day (3 individual samples)
C – 3 times per week (Mon, Wed, Fri)
** Grab samples collected will be immediately immersed in an ice bath at the basins. In the lab, the sample will be filtered (as necessary) and stored in the refrigerator until transferred to the external lab.

Additionally the flow, return activated sludge flow, oxic recycle flow, and air flow to the diffuser system in the test treatment train will need to be recorded daily.

All wastewater sample, collection, preservation, holding, analytical techniques and analysis shall be in accordance with the most recent edition of "Standard Methods for the Examination of Water and Wastewater" and EPA 40 CFR 136. Results of the laboratory analyses will be provided to Kruger as soon as they are available and no longer than 3 business days after the date of sample collection for all tests except $CBOD_5$.

Process Design Summary

Water characteristics are defined in the project specifications and in Table 3 below.

Table 3: IFAS Influent Design Basis

Parameter	Units	Values
Flow, Annual Average (Design)	MGD	17.0
Flow, Peak Hourly	MGD	22.90
BOD_5, Design Flow	mg/L	167
TSS, Design Flow	mg/L	110
TKN, Design Flow	mg/L	36.6
TP, Design Flow	mg/L	5.4
RAS	%	50 -100
IMLR Total	%	250
MLSS	mg/L	3500 - 4000
Elevation	ft	75
Min/Average Temperature	°C	10/15.7

Plant Operation and Control

During the process performance test, the Owner will provide staff to operate and maintain the facility. The IFAS system will be operated normally during the test, as recommended in the process O&M manuals and process training documents and with process advice from Kruger.

Prior to starting the test, Kruger will work with the Owner to review the operation of the plant and suggest changes if warranted.

If during the performance test it appears that the process guarantees are not being met, Kruger shall have the right to have the plant operated at such reasonable conditions as it may deem necessary or advisable for the purpose of determining the nature or cause of the failure of the plant to meet such guarantee, provided such operating conditions are in accordance with good engineering practice within the Owner's operating rules enforced at the plant site, provided that the changed operations do not cause other plant unit processes to lose efficiencies or cause effluent violations of other parameters not covered by the performance warranty. Thereafter, Kruger shall have the right to make or have made such adjustments in order to meet such guarantee and the right to correct deficiencies in the process design basis as it deems necessary or advisable. Such alterations or modifications shall be subject to review and approval by an appropriate State Agency, Engineer, and the Owner.

Schedule

The Process Performance test shall be conducted during one (1) 90 day period. Upon completion of system start-up, the date of commencement for the Process Performance Test shall be mutually agreed upon by the Owner, Kruger, O'Brien & Gere. The test shall be initially conducted within twelve (12) months of process startup.

Provisions for Retest

The Process Performance Test will be deemed complete if the process objectives are met for the test period.

In the event the IFAS system does not meet the requirements of the specifications during the performance test, Kruger will be permitted to make changes to the equipment and methods of operation at Kruger's sole expense. The readjustments shall be made as soon as practicable. Following the readjustments, Kruger in conjunction with the contractor shall make a second test run for the 30-day period that did not meet the specified limits. Additional testing of any equipment that has been repaired, modified, or replaced shall be conducted in accordance with the procedure for initial acceptance testing. Conformance with the performance requirements must be achieved before the IFAS system will be deemed acceptable.

The Owner shall have the right to use the IFAS system as needed to treat wastewater until an accepted or, if rejected, until acceptable replacement goods, equipment, or treatment system is available for use.

Reporting

Upon completion of the Process Performance Test, Kruger shall prepare and submit a written report. The report shall be submitted to the Engineer and shall include pertinent details regarding the test as well as test results to demonstrate that the IFAS system complies with the specified performance requirements.

Attachment A

3.4 FIELD TESTING

A. Preliminary field testing, inspection and mechanical checkout of the entire IFAS system shall be performed by a qualified representative of the IFAS system supplier. The IFAS process basin(s) shall be filled with plant effluent water to perform wet system checkout. Sufficient tests shall be conducted to demonstrate to the Engineer that:

1. All system mechanical components are fully operational. Testing and performance requirements shall be in accordance with the applicable equipment specifications.

2. All connecting piping is leakproof and properly anchored in accordance with the applicable mechanical specifications.

3. The entire system is ready for continuous safe operation.

4. The purpose of the checkout shall be to ensure that each individual system component has been correctly installed, shall operate fully in the manner intended, and is ready to perform its function as part of an integrated system when placed in continuous operation.

5. Functional testing shall include proof of the communication interface and memory map data transfer between the MCP and the plant Process Control System (PCS). The manufacturer shall require the presence of the Contractor and the Applications Engineer System Supplier (AESS) during the interface test.

6. Testing shall include coordination with Contractor in the Provision of Loop Test Sheets that document that each physical signal in accordance with the P&IDs and Electrical Drawings has been correctly landed and each control loop is tested as being programmed in accordance with requirements herein.

B. When all preceding equipment tests have been satisfactorily performed and when process influent is available and can be suitably handled through the IFAS system and when so authorized by the Engineer, the IFAS system basin(s) shall be placed into service with no IFAS media installed within the basin. Provide the IFAS system suppliers' representative to advise the Owner's operating personnel during the start-up period. Start-up operations shall be continued until it is satisfactorily demonstrated that the IFAS system equipment and other systems are suitable for continuous online service, or a minimum of 30 days. The Contractor will utilize plant effluent for this test.

C. At the successful conclusion of the 30 day initial startup period, the IFAS media shall be installed in accordance with the IFAS system supplier's recommendations. Continue to provide the IFAS system suppliers' representative to advise the Owner's operating personnel for a second 30-day period. At the successful conclusion of this second 30-day period, the IFAS system shallbe considered substantially complete and shall be accepted by the Owner. The Contractor will utilize primary effluent for this test, and the test period will not commence until biofilm growth is established on the media – as determined by the Engineer.

D. A performance test shall be initiated after beneficial use as part of overall plant performance evaluation during General Construction. The Contractor shall furnish all power, facilities, labor, materials, supplies and test instruments required to conduct the performance test. Furnish the services of an independent, certified testing laboratory for sample analysis. Owner will collect and analyze samples during the 90 day test.The IFAS supplier may also collect and send samples to laboratory. Primary effluent will be routed to the IFAS system for this test. The field test shall be performed as follows:

1. During the performance testing period, the system influent flow and loads shall be within 10 percent of the design maximum-month values specified herein. If necessary due to actual plant flows and loads at the time of the performance test, performance testing may be performed on fewer process trains than the entire IFAS system.

2. The performance test shall run for a minimum of 90 days, during which at least 30 of the 90 days shall incorporate the design wastewater temperature specified herein. The performance test shall be completed before 12/31/2015 and may be performed during colder minimum temperature conditions.

3. The performance testing shall be considered successful if the effluent from the IFAS process train(s) complies with the performance requirements specified herein.

4. Upon completion of the performance test, submit a total of five copies of a test report to the Owner and Engineer. The report shall include an operational data summary including influent loading, operational parameters and effluent performance during the test period, comparing these with the performance requirements specified herein.

5. In the event that the IFAS system does not comply with the performance requirements as specified herein, the IFAS system supplier shall note this in the test report.

    a. The IFAS system supplier shall determine the reason(s), shall propose measures necessary to bring the system into conformance, and shall propose an implementation schedule to complete the necessary measures.

    b. The measures necessary to bring the system into conformance that are a change from the IFAS system supplier's submitted design shall be at the cost of the IFAS system supplier.

c. The performance test as specified herein shall then be repeated at no additional cost to the Owner.

KRÜGER

SECTION 9

WARRANTY & PROCESS PERFORMANCE GUARANTEE

VEOLIA WATER Solutions & Technologies

KRÜGER

I. KRUGER INC. WARRANTY

Installation Site:	_____	Equipment Delivery:	_____
Equipment Type:	_____	Warranty Begins:	_____
Owner:	_____	Warranty Ends:	_____

Length of Warranty: The system is warranted against defects in material and workmanship for one (1) year from beneficial use, unless stated otherwise in the contract documents.

Warranty Coverage: Kruger's sole obligation under this warranty is limited to repairing or replacing, at its option, any item covered under this warranty. All equipment or parts covered by this warranty are guaranteed to be free from defective material and workmanship, under normal use and service and maintained in accordance with I. Kruger Inc. instructions. This guarantee does not cover failure of normal wearing parts unless failure of such part has resulted from defective material and workmanship. The warranty also does not apply to parts or equipment damaged from improper operation or misuse, neglect, accident, improper wiring or installation, or alterations and repairs made by any one other than I. Kruger Inc. or its authorized representative.

No Implied Warranties: ALL OTHER WARRANTIES EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE EXCLUDED.

Conditions: In the event of any defects developing within the warranty period, under normal and proper use, Kruger, Inc. is to be notified promptly in writing within 30 days of when the defect was discovered or should have been discovered. Kruger, Inc. must be given prompt and reasonable opportunity to inspect the defective equipment or parts and be given access to the Owner's logs and records to establish proper operation and maintenance. Kruger, Inc. will make all repairs at the manufacture's facility when practical. It is the owner's responsibility for all removal, outward-bound shipping, and re-installation charges.

Claims: Kruger Inc. does not accept liability for any corrective or other work or expenditures of any kind that have not been authorized by Kruger, Inc. in writing prior to the commencement of such work. Service calls, when requested and where no evidence of defective material or workmanship is found, will be at the expense of the Purchaser. In no event shall Kruger, Inc. be liable for special, indirect, incidental or consequential damages, including but not limited to, loss of profits or revenue, loss of use of equipment or any associated equipment, cost of capital, cost of substitute equipment, facilities or services, down time cost, or claims of customers of the Purchaser for such other damages. Kruger, Inc. will only be responsible for damages from proven negligent acts of its direct employees only.

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Web site: www.krugerusa.com

VEOLIA WATER
Solutions & Technologies

KRÜGER

Process Performance Guarantee

AnoxKaldnes Hybas System

City of Massillon, OH
WWTP Improvements Project
Contract No. 1A

9/14/2015

VEOLIA WATER
Solutions & Technologies

PROCESS PERFORMANCE GUARANTEE
AnoxKaldnes Hybas System
City of Massillon, OH
WWTP Improvements Project
Contract No. 1A
September 14, 2015

GENERAL

This Process Performance Guarantee is made to the City of Massillon ("Owner") by the AnoxKaldnes Hybas SYSTEM SUPPLIER ("KRUGER") in connection with the AnoxKaldnes Hybas System.

PROCESS PERFORMANCE GUARANTEE

Table 1: Process Performance Summary

Parameter	Primary Effluent	Final Effluent
Flow (MGD)	17.9	--
NH3-N[a] (mg/L)	--	≤ 1.0 / ≤ 2.9
TKN (mg/L)	36.6	--
Total Nitrogen (TN)[b] (mg/L)	--	≤ 10
TP (mg/L)	5.4	--
PO4-P (mg/L)		≤ 0.5
cBOD5 (mg/L)	167	
Temperature[c] (°C)	10/23	

a. Effluent values represent the monthly average value for summer/winter periods respectively. The winter period constitutes the days between and including November 1 to April 30. The summer period constitutes the days between and including May 1 and October 31.
b. The effluent values represent the six month average either the winter or summer period.
c. Minimum and maximum temperature.

A. The effluent quality performance of the AnoxKaldnes Hybas system will be demonstrated via one (1) ninety day performance test period during the first twelve (12) months of operation, following stabilization of the process. The performance test will demonstrate that KRUGER has complied with the effluent quality criteria specified herein.

B. Guaranteed Performance is based upon a process designed in accordance with the influent and effluent wastewater criteria from Table 1 above. Additionally, the following conditions shall be met:

1. There will be sufficient alkalinity, either present in the wastewater or by means of chemical addition by others, to maintain a pH in the range of 6.7 - 8.0 in the process tanks.

2. With the exception of temperature, all values listed are maximum values and include contributions of all recycle streams flows from return activated sludge and internal mixed liquor recycle.
3. The average influent temperature of the flow to the biological treatment system for the winter period (November 1 to April 30) shall be ≥13.2 °C and the minimum temperature shall be ≥ 10 °C. The average influent temperature of the flow to the biological treatment system for the summer period (April 1 to October 31) shall be ≥ 18 °C.
4. The wastewater must be biodegradable with no inhibitory concentrations of toxic compounds present.
5. The effluent refractory organic nitrogen after secondary clarification shall not exceed 1.0 mg/L.
6. The influent to the biological treatment system shall have a volatile fatty acid to total phosphorous (VFA/TP) ratio > 8:1.
7. The influent to the biological treatment system shall have readily biodegradable COD to total nitrogen (rbCOD/TN) ratio > 3.7:1

C. Process Performance Testing.

1. The OWNER shall be responsible for operating the AnoxKaldnes Hybas system, collecting all samples, carrying out all laboratory tests and keeping such detailed records as may be necessary for determining whether the performance guarantees have been met. KRUGER shall advise the Owner on process operation of the Hybas System. Records shall be retained until the performance guarantee has been satisfied or until expiration of the period during which the performance test is to be performed whichever occurs earlier, and such records shall include all daily log sheets, operator notes, sample inspections, and instrument charts produced in operation of the plant. The OWNER shall provide one copy of such records to the SUPPLIER free of charge and upon KRUGER'S request. The OWNER shall make copies of such records available to KRUGER for inspection and for further copying at KRUGER'S expense.

2. The performance test shall be subject to the following general conditions:

    a. All volumes specified shall be measured by tank gauges or calibrated meters acceptable to the Process Supplier and corrected to 60 °F (15.6 °C).

    b. All analyses, data reduction or tests not otherwise specified shall be carried out by procedures furnished or approved by the Process Supplier, (The publication, Standard Methods for Examination of Water and Wastewater, most recent edition; shall be the primary procedure source unless a different source is agreed upon by OWNER and KRUGER.)

    c. Determination of VFA and/or readily biodegradable COD (rbCOD) shall be determined at KRUGER'S discretion and expense. rbCOD shall be determined by the rapid physical-chemical method (Mamais, D., D. Jenkins, and P. Pitt. 1993. A rapid physical-chemical method for determination of

readily biodegradable COD in municipal wastewater. Water Res. 27(1):195-197). VFA content shall be determined by gas chromatography.

d. The OWNER shall furnish all materials, utilities, services and personnel as are required to operate the plant during the performance tests.

e. The OWNER shall promptly notify KRUGER in writing of start-up date. The OWNER will also notify KRUGER in writing at least thirty (30) days in advance of beginning the ninety (90) day performance test.

3. The following are specific responsibilities of KRUGER and OWNER with respect to the performance test and guarantees:

a. OWNER shall be obligated during a performance period comprising twelve (12) calendar months, following successful process start-up and stabilization of the MBBR system, to carry out the ninety (90) day performance test at such conditions and at such time as KRUGER may reasonably request for purposes of determining whether guarantees are met. The time within which the performance test is to be carried out may be extended by the length of any period of down time required for correcting any failure or deficient performance.

b. Within the performance period, one (1) ninety (90) day performance test shall be conducted at a time to be chosen by the OWNER to demonstrate and document the effluent quality for purposes of determining whether the effluent quality guarantees have been satisfied. When the KRUGER'S guarantees have met all of the performance standards set forth in the process guarantees, KRUGER'S total liability, with the exception of equipment warranties, under this Agreement shall be discharged. The OWNER shall provide the labor required to obtain samples and required measurements and shall pay for all laboratory analyses of the samples.

c. If during the performance test it appears that the process guarantees are not being met, KRUGER shall have the right to have the plant operated at such reasonable conditions as it may deem necessary or advisable for the purpose of determining the nature or cause of the failure of the plant to meet such guarantee, provided such operating conditions are in accordance with good engineering practice and OWNER'S operating rules enforced at the plant site. Thereafter, KRUGER shall have the right to make or have made such adjustments in order to meet such guarantee and the right to make or have made such alterations or modifications to the plant necessary to correct deficiencies in the process design basis as it deems necessary or advisable. Such alterations or modifications shall be subject to review and approval by an appropriate Stage Agency and the OWNER.

d. The following recordings and samples shall be taken and/or analyzed. The samples shall be taken at the anaerobic tank influent, the anoxic tanks effluent, and the secondary clarifier effluent, unless noted otherwise. The following are the minimum samples and recording parameters:

1. Flow (MGD)
2. TSS (mg/l)
3. BOD (mg/l)
4. TKN (mg/l)
5. NH4-N (mg/l)
6. NO3-N
7. NO2-N
8. PO4-P
9. Alkalinity (mg/l) (only during the first week of testing)
10. Temperature
11. pH

4. KRUGER and OWNER will jointly review performance of the process system to determine compliance with performance guarantees. Review will include, but not be limited to, a comparison of influent and process design basis with the actual performance results. The OWNER will promptly notify KRUGER of the failure to meet any process guarantee and specify the respect in which such guarantee has not been met. If the SUPPLIER disputes any claimed failure, notice of such dispute shall be furnished promptly to OWNER. KRUGER shall not be responsible in any way for nonfulfillment of guarantees or the cost of alterations or modifications to the plant due to deficiencies in the plant beyond KRUGER'S control, such as the design by the ENGINEERS, materials or equipment, workmanship (other than that of KRUGER) or services beyond the control of KRUGER, including, but not limited to:

a. Defective materials or mechanical conditions or deficient performance of equipment utilized in parts auxiliary to the Technology not supplied by KRUGER.

b. Noncompliance with the process design basis for said plant and/or noncompliance with operating instructions, or reasonable revisions of either of these consistent with the Specifications, furnished or approved in writing by KRUGER to OWNER or defective conditions or performance of any materials, equipment or work supplied by or contracted for by OWNER, other than those provided or supplied by KRUGER, provided that KRUGER has given OWNER notice of such noncompliance or defective conditions or performance promptly upon discovery of the same.

c. Failure of OWNER to furnish adequate utilities such as, but not limited to electricity, air, water, etc., as set forth in the O & M Manual supplied by KRUGER, as well as an adequate operating force or mechanical failure of

any of the equipment of component parts thereof due to ordinary wear and tear.

d. Failure of OWNER to perform any of the responsibilities and obligations assumed by it in accordance with the provisions hereof.

e. The failure or refusal of the OWNER substantially to comply with any or all of the foregoing conditions which impairs KRUGER'S ability to satisfy its guarantee shall constitute a waiver of the requirement of performance test to which such conditions are applicable and thereupon KRUGER guarantees relating to such tests shall be deemed to have been met.

D. Performance Standards.

1. KRUGER shall guarantee the performance of the Hybas system, based on the specified criteria.

2. In the event that the Hybas system does not achieve the required level of performance during the test periods, KRUGER shall be given the opportunity to modify the process and/or operation of the plant as necessary, with the assistance of the plant operating staff, to produce the required effluent quality. KRUGER shall be allowed to conduct two additional tests to meet the specified process guarantee criteria.

    a. Failure to Meet Effluent Quality Performance Standards. If the biological treatment system fails to achieve the required effluent quality during the performance test period and fails both additional tests, testing shall be done at KRUGER's expense to determine that the wastewater is biodegradable. If the wastewater characteristics, including all side streams, are less than or equal to the design criteria, KRUGER shall pay for modifications to improve effluent quality. If the testing indicates that the wastewater is not completely biodegradable to the level required to meet effluent limits, it shall constitute a waiver of the requirement of the performance test to which such conditions are applicable and thereupon KRUGER'S guarantees relating to such tests shall be deemed to have been met.

3. The value of Kruger's maximum cumulative obligation under the Agreement shall be limited to 100% of the original purchase price of the equipment supplied.

4. Upon successful completion of the specified testing requirements, KRUGER'S total liability under the terms of these specifications shall be discharged.

EQUIPMENT WARRANTY

KRUGER warrants its equipment will be free from defects in materials and workmanship for a period of 3 years after beneficial use or 42 months after delivery (whichever occurs first) for non-moving parts (including the IFAS media, air grids, cylindrical screens, and flat screens) and

a period of 1 year after beneficial use or 18 months after delivery (whichever occurs first) for all other parts. Supplier's warranty does not cover damage caused by chemical action or abrasive material, misuse or improper installation (unless installed by Supplier). Supplier's warranty is conditioned on Owner's (a) operating and maintaining the equipment in accordance with Supplier's instructions; (b) not making any unauthorized repairs or alterations, and (c) not being in default of any payment obligation to System Supplier. The warranties set forth in the Instructions to Bidders/General Conditions and Special Conditions are System Supplier’s sole and exclusive warranties and are subject to System Supplier's aggregate limit of liability of one times the price paid for the equipment. System Supplier makes no other warranties of any kind, express or implied, including without limitation, any warrant of merchantability or fitness for purpose.