

City of Massillon, OH 2013 WWTP Improvements Project

Submittal: 43.21.13.31-001-0 VTSH Pumps

Submittal Review Comments by CTI - O'Brien & Gere Joint Venture

Shop Dwg. Log No. 43.21.13.31-001-2 **OBG Job No.** _____

Date: June 5, 2015 **Contract No.** 1b

Division 33 **Section** 43.21.13.31

- ☒ REVIEWED
- ☐ REVIEWED AND NOTED
- ☐ RESUBMIT
- ☐ REJECTED
- ☐ ACTION NOT REQUIRED

Checking of shop drawings is limited to general design and general arrangement only and is not intended to be a verification of compliance with all requirements. Review shall not relieve the Contractor from the responsibility of details of design, correct dimensions for proper fitting, coordination with other performance or any other requirement of the Contract.

CTI - O'BRIEN & GERE JOINT VENTURE

By: 



FAIRBANKS NIJHUIS™

May 1, 2015

CTI Engineers, Inc.
One Cascade Plaza, Suite 710
Akron, Ohio 44308

Attn: David Kohlmeier, P.E.

Subject:	Purchase Order Number:	Contract No. 1B
	Sales Order Number:	2670245
	Project:	Massillon WWTP, 064946

David:

The revised submittal data for the above order is attached. This revised submittal is for your review and approval prior to release for manufacturing.

We require submittal return with your review comments and/or approval to release within 35 days for production scheduling purposes. At time of release, please advise firm "on-site" requirement dates for this equipment.

Very Truly Yours,

Specifications Department
Pentair Flow Technologies

Return Submittal to: Rikki Simmons
Contract Administrator

cc: file

Enclosures: (5) sets submittal
(2) CDs

Pentair Flow Technologies
General Clarifications

1. The supply and installation of the following items are by others unless otherwise identified in this submittal.
 - Anchor bolts, nuts and washers.
 - Gauges, valves and miscellaneous fittings and adapters.
 - Connecting piping and/or supports.
 - Maintenance lubrication, lubrication piping and related equipment.
 - System control apparatus.
 - Maintenance tools and/or storage boxes.
 - Equipment tags
 - Installation or field performance testing.
2. The following items are to be installed in the field:
 - Accessory items that are shipped separately.
3. Verification and/or confirmation of the following are requested at or prior to release of this equipment.
 - Overall lengths or elevations

Fairbanks Nijhuis
Submittal Data
For
Massillion WWTP
Massillion, OH

Supplier:	City of Massillion 151 Lincoln Way East Massillon, OH 44646
Manufacturer: Pump	Fairbanks Nijhuis 3601 Fairbanks Ave. Kansas City, Kansas 66106-0906 (913) 371-5000
Project Number:	064946
Sales Order Number:	2670245
Service:	Primary Effluent
Tag:	Primary Effluent Pump No.1, Primary Effluent Pump No.2, Primary Effluent Pump No. 3
Quantity:	3
Pump Size & Model:	20" VTSH
Motor:	U S Electrical Motors P. O. Box 2345 St. Louis, MO 66112 (314) 553-2000

Fairbanks Nijhuis
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1. **Comment:** (43.21.13.31 2.2.3.B.c and d) On the "General Clarifications" Sheet some items listed to be provided "by others" are to be provided by Pentair per the contract. These include "gauges" (discharge head pressure gauges) and "valves" (air and vacuum release valve).

Response: This is the responsibility of the Contractor to supply and is outside the scope of supply for FN.

2. **Comment:** (40 05 40.30 and 43 21 13.31 2.2.3.B.d) Pressure gauges are specified and are to be supplied with the pumps.

Response: This is the responsibility of the Contractor to supply and is outside the scope of supply for FN.

3. **Comment:** (43 08 20.11, 3.3 and 3.4) Clarifications and Exceptions page: Manufacturer's representative must be present during Field Testing and Vibration Testing.

Response: Acknowledged. Manufacturer's representative is B.L. Anderson will be present during Field testing.

4. **Comment:** (43 21 13.31, 1.8) Clarifications and Exceptions page: Certain items under Delivery Storage and Handling requirements apply to FN.

Response: Items under storage and handling are the responsibility of the Contractor and are outside the scope of supply for FN.

5. **Comment:** (43 21 13.31, 1.9) Clarifications and Exceptions page: Warrantee is to be 5 years per spec ... no exceptions.

Response: Warranty will be per executed contract.

6. **Comment:** (43 21 13.31, 2.2.B.3.c) Clarifications and Exceptions page: Air Vacuum Release valve is to be supplied by pump manufacturer.

Response: FN will provide a 2"-NPT connection on the discharge head. It is the responsibility of the Contractor to supply an air vacuum release valve and is outside the scope of supply for FN.

7. **Comment:** (43 21 13.31, 2.2.B.3.d) Clarifications and Exceptions page: Pressure gauges shall be provided by FN per spec.

Response: FN will provide a ½"-NPT connection on the discharge head. It is the responsibility of the Contractor to supply a pressure gauge and is outside the scope of supply for FN.

8. **Comment:** (43 21 13.31, 2.2.B.4.a) Clarifications and Exceptions page: Please provide John Crane Safeunit Ultima or equal per spec. The submitted seal/flushing water system has no means of controlling the flow or pressure of the water to the pumps.

Response: FN will provide the Safeunit Ultima by John Crane. Please see the revised submittal.

9. **Comment:** (43 21 13.31, Part 3) Clarifications and Exceptions page: 4 hours operator training by manufacturer is required.

Response: Acknowledged. B.L. Anderson will provide the operator training as FN's representative.

10. **Comment:** (26 00 20, 2.5.D and 43 21 13.31, 2.2.B.5.f) Motors shall include shaft grounding ring/ brushes and non-conductive thrust bearing carrier per 26 00 20, 2.5.D and 43 21 13.31, 2.2.B.5.f.

Response: Please see attached letter from Nidec and the revised motor submittal.

11. **Comment:** (26 00 20, 1.6.B and 2.5.D) Need Certification Letter from the Motor Manufacturer per 26 00 20, 1.6.B and 2.5.D.

Response: Please see attached letter from Nidec and the revised motor submittal.

12. **Comment:** The Kobold KAL-K shall be suitable for installation in a Class 1, Division 1 Hazardous Area.

Response: FN will provide the Safeunit Ultima by John Crane. Please see the revised submittal.

13. **Comment:** Provide motor assembly drawings with location of lubrication fittings, location of breathers and drains for totally enclosed motors.

Response: Please see attached letter from Nidec and the revised motor submittal.

14. **Comment:** (26 00 00, 1.6, C.3) Provide Inverter Duty Motor data sheets as listed in Specification 26 00 00, 1.6, C, 3.

Response: Acknowledge. Please see attached letter from Nidec and the revised motor submittal.

15. **Comment:** (26 00 00, 1.6, C.4) Provide Inverter Duty Motor data sheets as listed in Specification 26 00 00, 1.6, C, 4.

Response: Acknowledge. Please see attached letter from Nidec and the revised motor submittal.

16. **Comment:** Provide Factory Test reports.

Response: Acknowledged. FN will provide factory test reports when testing has been completed.

17. **Comment:** Provide motor shaft grounding brush(es) to drain stray rotor currents to the motor electrical equipment grounding conductor connection point.

Response: Please see attached letter from Nidec and the revised motor submittal.

18. **Comment:** Under "Test Procedure" page 2 of 2, "SPECIFIC REMARKS" indicates that pumps will be tested without mechanical seals and using the same motor for all 3 pumps. Why aren't we testing each pump with motor, pump and mechanical seal together?

Response: FN will test the pumps with the individual motors. Please see the revised test procedure. FN's standard operating procedure is to factory test the pumps with packing to minimize damage to the mechanical seals. The mechanical seals are installed in the field.

19. **Comment:** Stainless steel is desired for all piping 2" and under and bolts including and air release valve and gauge piping, petcocks, nipples, unions etc. along with appropriate electrical insulators to prevent galvanic corrosion between differential metals.

Response: FN will provide 304 stainless steel bolting on the pump. FN will not be providing electrical insulators as they are not required by specifications.

20. **Comment:** Submit 2 Paper Copies and 1 electronic copy of all O&M manual information to the City.

Response: Acknowledge. O & M manuals are prepared specifically for the project and are not done until the project is approved or released so that FN can include As-Built drawings. Final manuals will be supplied after pumps are tested so that FN can include the test curves.

21. **Comment:** Stainless steel mounting hardware is desired for all nuts, bolts, fasteners, etc. along with appropriate electrical insulators to prevent galvanic corrosion between differential metals.

Response: Stainless steel mounting hardware (anchor bolts) are outside the scope of supply for FN and shall be provided by others. FN will not be providing electrical insulators.

22. **Comment:** (43 21 13.301 Part 2.5.A) The owner is considering purchasing additional spare parts for the VTSH pumps. Please provide itemized pricing for 1 spare KAL-K Part 2.5.A flow sensor along with other spare parts specified in 2.5.A.

Response: FN will be providing the Safeunit Ultima. Itemized pricing for additional spares can be provided under separate cover.

23. **Comment:** Reference drawing Nos. 064946AB and 064946AP. The City would prefer the following pump parts be fabricated of stainless steel if that option is available: Item nos. 9, 9A, 18, 28, 51A, 51B and 102.

Response: Pump parts 9, 9A, 28, 51A, 51B and 102 are available in stainless steel for an additional charge. FN does not recommend a stainless steel soleplate (18).

24. **Comment:** (43 08 20.11 Part 3.4) Field Vibration Testing report should include a diagram showing the precise location of vibration sensors so City can monitor and repeat for future tests.

Response: This is the responsibility of Others to provide.

25. **Comment:** (43 21 13.31 Part 1.8.C) Perform one megger test on each motor (3 total) upon (or prior to) delivery and provide documentation/report of megger test results to the City for use as base line data in determining motor winding deterioration over time.

Response: Per the specification, it is the responsibility of Contractor to perform the megger test during storage. This specification does not require a megger test prior to or upon delivery of the motor.



James Slaughter
Territory Manager

April 30, 2015

Pentair Flow Technologies
Attn: Rikki Simmons
Division of Pentair Water
3601 Fairbanks Avenue
Kansas City, Kansas 66110

Subject: Purchase Order 2707293, Job 064946A01
US Motors Factory Order Number 20142830
City of Massillon, Ohio 2013 WWTP Improvements Project

Rikki:

US Motors has completed their review of the submittal review comments as generated by Dave Kohlmeier of Process Mechanical and provided to this office on the motors proposed for the above subject project. US Motors response, by Comment No. is as follows.

Comment No. 10: Motors shall include shaft grounding ring/brushes and nonconductive thrust bearing carrier per 26 00 20, 2.5.D and 43 21 13.31, 2.2.B.5.f. **US Motors Response – Motors will be provided with Inpro MGS Ground Seal and Belzona Insulated Bearings. Product cut sheets are attached.**

Comment No. 11: Need Certification Letter from the Motor Manufacturer per 26 00 20, 1.6.B and 2.5.D. **US Motors Response – Proposed motors are TEFC and not rated for hazardous duty. Motors will be rated for use with variable frequency controls (VFD) and comply to spec section 26 00 20, 2.5.D. Inverter duty motors have 40°C ambient, 1.0 SF on Inverter Power, 3300 ft. max altitude, 10:1 speed range on Variable Torque and Class F Insulation. US Motors INVERTER GRADE® insulated motors exceeded NEMA®† MG-1 Part 30 & 31 before the standards were established. We are a leader in the development of electric motors to withstand pulse width modulated (PWM) drives evolution from power transistors to higher switching frequency insulated gate bipolar transistors (IGBTs). NOTE – specific brand/make of drive has not been determined.**

Comment No. 13: Provide motor assembly drawings with location of lubrication fittings, location of breathers and drains for totally enclosed motors. **US Motors Response – Motor assembly drawing is attached showing locations of oil and grease fittings. Location of drains & breathers is not available. They will however be located on the lower bracket.**

Comment No. 14: Provide Inverter Duty Motor data sheets as listed in Specification 26 00 00, 1.6.C.3. **US Motors Response – See submittal.**

Comment No. 15: Provide Inverter Duty Motor data sheets as listed in Specification 26 00 00, 1.6.C.4. **US Motors Response – See Submittal.**

NIDEC MOTOR CORPORATION

U.S. ELECTRICAL MOTORS: 5000 West 66th Street, P.V., KS 66208
PHONE: (913) 236-5000 FAX: (913) 236-5501 EMAIL: james.slaughter@nidec-motor.com



James Slaughter
Territory Manager

Continued...

Comment No. 16: Provide Factory test reports. **US Motors Response** – Test reports will be provided after manufacture and testing. Motors are presently on hold for approval.

Comment No. 17: Provide motor shaft grounding brush(es) to drain stray rotor currents to the motor electrical equipment grounding conductor connection point. **US Motors Response** – Grounding brushes are not available. US Motors providing Inpro MGS Shaft Ground Seal to drain stray shaft currents. See attached data sheet.

If you should have any other questions, or if I can help in any other way, please do not hesitate to contact me.

Best regards.

James Slaughter
Territory Manager
U.S. Electrical Motor

NIDEC MOTOR CORPORATION

U.S. ELECTRICAL MOTORS: 5000 West 66th Street, P.V., KS 66208
PHONE: (913) 236-5000 FAX: (913) 236-5501 EMAIL: james.slaughter@nidec-motor.com



CERTIFICATE OF REGISTRATION

This is to certify that

PENTAIR WATER

Kansas City Operations

3601 Fairbanks Avenue, Kansas City, Kansas 66106-0999 USA

operates a

Quality Management System

which complies with the requirements of

ISO 9001:2008

for the following scope of registration

The design/development, manufacture and servicing of water, wastewater, fire protection, agricultural and industrial pumps.

Certificate No.: CERT-0066429
File No.: 006845
Issue Date: October 25, 2012

Original Certification Date: February 11, 1997
Current Certification Date: November 24, 2012
Certificate Expiry Date: November 23, 2015

Chris Jouppi
President,
QMI-SAI Canada Limited

Guillaume Gignac, ing.f
Vice President, Corporate Operations, Accreditation & Quality
QMI-SAI Canada Limited



ISO 9001



Registered by:

SAI Global Certification Services Pty Ltd, 286 Sussex Street, Sydney NSW 2000 Australia with QMI-SAI Canada Limited, 20 Carlson Court, Suite 200, Toronto, Ontario M9W 7K6 Canada (SAI GLOBAL). This registration is subject to the SAI Global Terms and Conditions for Certification. While all due care and skill was exercised in carrying out this assessment, SAI Global accepts responsibility only for proven negligence. This certificate remains the property of SAI Global and must be returned to them upon request.

To verify that this certificate is current, please refer to the SAI Global On-Line Certification Register: www.qmi-saiglobal.com/qmi_companies/



SAI GLOBAL

INFORM. INSPIRE. IMPROVE.

Fairbanks Nijhuis
Included Features

- Pump Shipped Assembled
- Variable Speed Pump
- Dynamically Balanced Impeller
- Hydrocone
- Stainless Steel Impeller Wear Ring – 300-350 BHN
- Stainless Steel Bowl Wear Ring – 410-484 BHN
- Bronze Backed Rubber Bowl Bearings
- 20" Flanged Column with 2-7/16" Line Shaft and 3-1/2" Enclosing Tube
- 20" x 20" Type "F" Discharge Head
- 2" NPT Connection for Air Release Valve
- Chesterton 442 Mechanical Seal
- Metastream Coupling
- Sole Plate – Will be attached to the discharge head for shipment unless requested otherwise.
- Full Data Nameplate
- Stainless Steel Bolting on Bowl, Column and Discharge Head
- Certified Witness Performance Test
- Certified Non-Witness Hydro Test at 150 PSI
- Curve Approval Required Prior to Shipment
- 2 Week Notice Prior to Witness Testing
- Lot of Spare Parts
- 125HP, 900RPM, 3/60/460V, Inverter Duty Motors

EXCEPTION, and CLARIFICATION for CHECK MARKED SPECIFICATION

064946 (20"-VTSH) REVISION 1

Specification Dated: 04/14

General Clarification

VTSH pumps are designed with external water flushed pump and lineshaft bearings. Fairbanks Nijhuis recommends the lubrication system be adequate to provide a continuous supply of flushing water to the bearings. If a continuous supply is not possible, then a timer must be installed to start the lubricating water system at least five (5) minutes before starting the pump. Flushing water flow and pressure requirements for the pump are listed below. Refer to the *Seal Water Schematic & Specifications* page contained in this submittal for additional details.

Flow Rate (GPM)	Pressure (PSI)
1.0	54

SECTION: 43 28 20.11 TESTING ON PUMPING EQUIPMENT

- 1.3_A.1. Clarification: field test is to be by contractor or others.
- 1.3_A.4. Clarification: field test is to be by contractor or others; field test result is to follow.
- 3.2_A.2. Clarification: this appears to be a requirement for a pump with a submersible motor which would not be applicable to the Vertical Turbine Solid Handling (VTSH) pump.
- 3.2_A.6. Clarification: this appears to be a requirement for a pump with a submersible motor which would not be applicable to the Vertical Turbine Solid Handling (VTSH) pump.
- 3.2_A.7. Clarification: this appears to be a requirement for a pump with a submersible motor which would not be applicable to the Vertical Turbine Solid Handling (VTSH) pump.
- 3.2_B. Clarification: pump control components are to be by contractor or others.
- 3.2_C. Not applicable
- 3.2_D.4. Exception: Net Positive Suction Head Required (NPSHR) test is not within the scope of supply.
- 3.3 Clarification: FIELD RUNNING AND PERFORMANCE TESTTING to be by contractor or others.
- 3.4 Clarification: FIELD VIBRATION TESTTING to be by contractor or others.
Exception: to "The "Overall (OA)" or total broad band unfiltered reading shall be no more than 0.25 inches/second peak vibration velocity." Fairbanks Nijhuis (FN) guaranteed Pump Field Vibration per ANSI/HI 9.6.4-2000. Per Figure 9.6.4.10, guaranteed value is: 0.34 inches / sec RMS Overall Vibration Velocity.
- 3.5 Clarification: ACCEPTANCE to be by contractor or others, except Fairbanks Nijhuis Authorized Representative (FNAR) will be present during the installation, start-up and commissioning process as required to fulfill certification of proper installation.
- 3.6 Clarification: FINAL ALIGNMENT is to be by contractor or others.

SECTION: 43 21 13.31 VERTICAL TURBINE SOLID HANDLING PUMPS

- 1.8 Clarification: STORAGE AND HANDLING are to be by contractor or others.
- 1.9 Exception: The warranty for the pumps will be 36 months from start-up or 42 months from shipment, whichever occurs first.
- 2.2_B.3.b. Clarification: "two-piece top shaft" is not necessary when the driver is Vertical Solid Shaft Electric Motor.
- 2.2_B.3.c. Clarification: there will be a 2"-NPT connection on discharge head for air and vacuum release purpose. Air and Vacuum release valve is to be by contractor or others.

2.2_B.3.d. Exception: there will be a ½”-NPT connection on discharge head for gauge purpose. Gauge is to be by contractor or others.

Part 3 Clarification: EXECUTION is to be by contractor or others, except FNAR will be present during the installation, start-up and commissioning process as required to fulfill the certification of proper installation

TEST PROCEDURE FOR
VERTICAL-TURBINE-SOLID-HANDLING TYPE PUMPS

Revision **1**

Order:	064946	Model:	20"-VTSH	Qty. Tested:	3
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The pump unit(s) will be tested in accordance with the Hydraulic Institute's current published test procedures and the job specifications.

Test will be conducted to assure pumps(s) performance meets the requirements of sold conditions, as shown on the Fairbanks Nijhuis submittal curve.

Test conducted at Fairbanks Nijhuis Pump's factory, located in Kansas City, Kansas.

Sufficient test points (at least 8) will be taken to assure the pump(s) performance is established. A certified pump performance curve, based on the actual pump tested will be plotted on an 8-1/2" x 11" sheet of graph paper.

Measurements will be taken using calibrated equipment and the values of each measurement will be determined as follows.

Total Head (H):

The total head will be the summation of the discharge pressure transducer reading, plus or minus the suction pressure transducer (or suction manometer) reading, plus or minus the vertical distance between the gauge zero reference points and any velocity head correction when gauge taps are located on different pipe inside diameters.

Rate of Flow (GPM)

The rate of flow will be measured with a Venturi Meter. The differential head measured with a differential pressure transducer, and the GPM will be derived by using the Venturi Meter calibration data.

RPM:

The RPM will be determined by means of a calibrated Photoelectric Speed Counter.

Horsepower (BHP)

The horsepower input to the pump will be determined by using Job motors. The input wattmeter kW reading will be converted to horsepower from the Job motor guaranteed efficiency, for each test point.

Pump Efficiency:

From the values of input horsepower, total head, and rate of flow, the pump efficiency will be calculated for each individual test point.

EQUIPMENT LIST:

Discharge Gauge: Differential pressure transducer, calibrated once every 4 months using a dead weight tester.

Venturi Gauge: Differential pressure transducer, calibrated once every 4 months using a dead weight tester.

Venturi Meter: To be determined.

Watts/Amps/Volts/P.F.: To be determined.

RPM Counter: To be determined.

SPECIFIC REMARKS:

1. Witness Certified Factory Performance Test per ANSI/HI.
2. Test pump complete build up with Job motor, and except using packing in lieu of job Mechanical Seal.
 - For reduced speeds test all pumps with Job motors and factory Test VFD.
 - Each pump, test one (1) full speed and two (2) reduced speeds, as shown on submittal curve.
3. Allowable test tolerance at the rated point per ANSI/HI 14.6 Grade 1U is:
 - +6% head
 - or +10% on rate of flow
 - +10% on power
 - No negative tolerance will be allowed on efficiency.

PUMP TEST STANDARDS:

Pump tests conducted by Fairbanks Nijhuis meet the following standards:

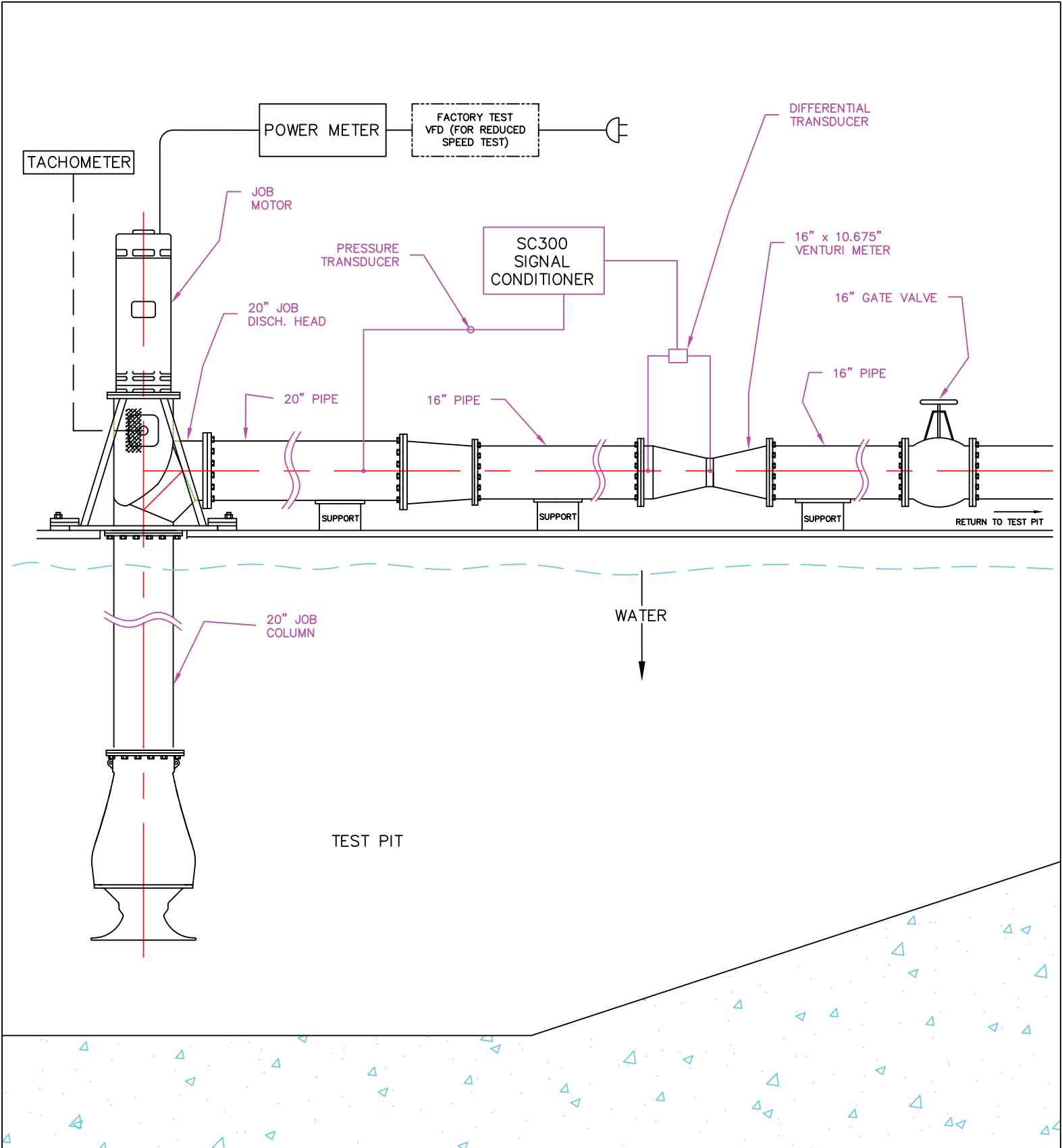
Hydraulic Performance Acceptance Tests Standard, ANSI/HI 14.6-2011

Certified By: _____

 3/6/15.
Max Du

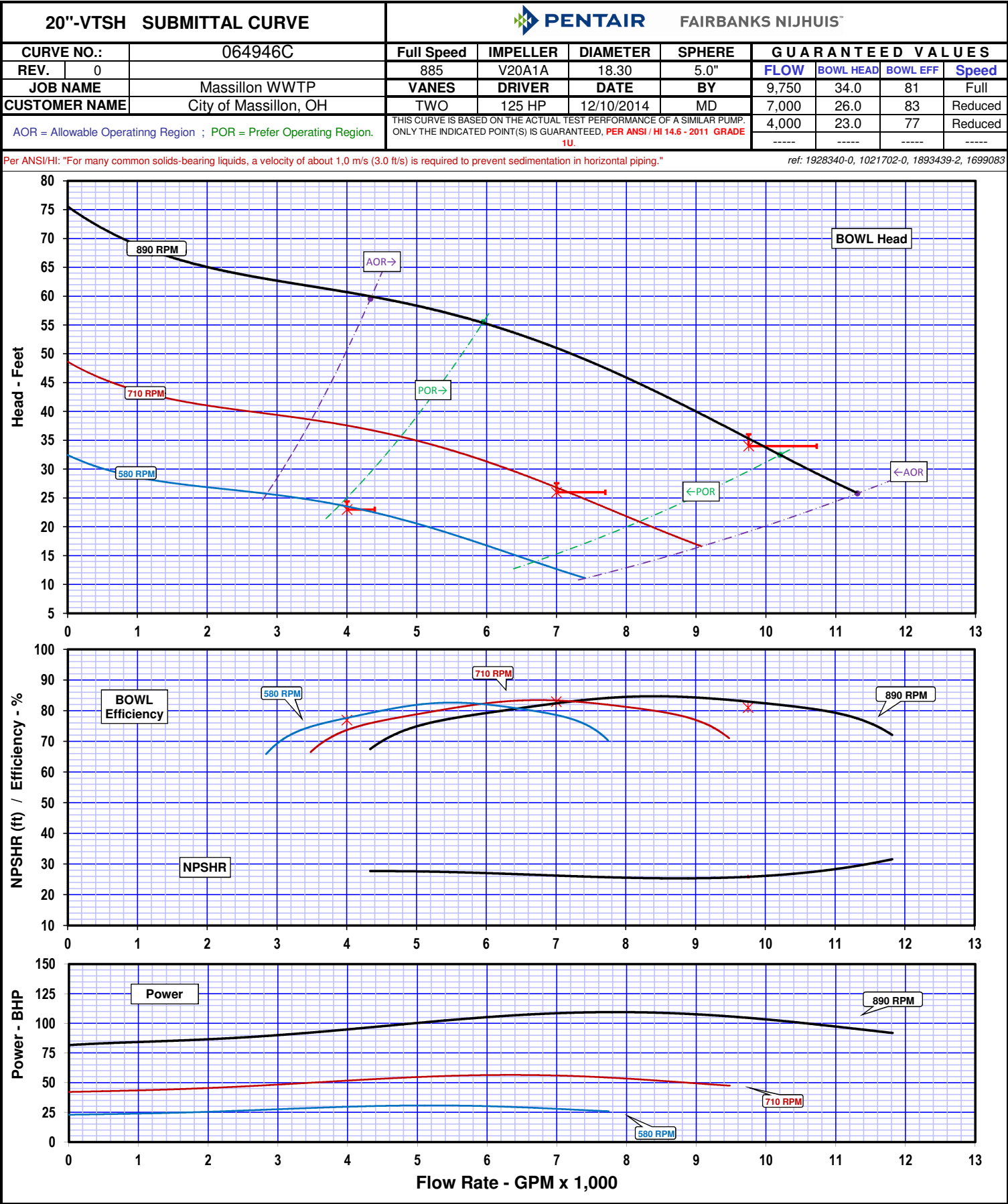
Product Engineer

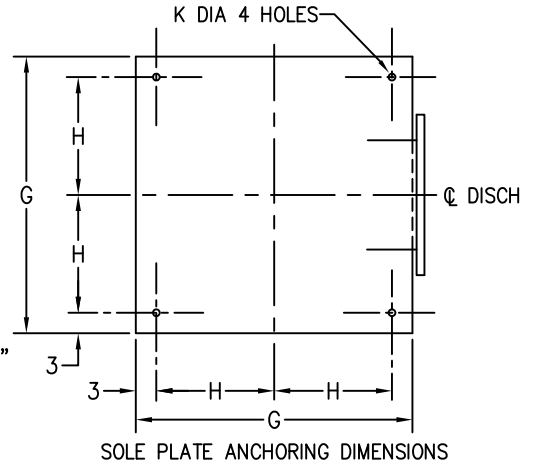
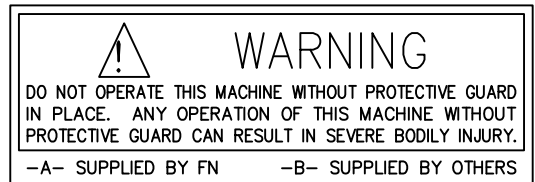
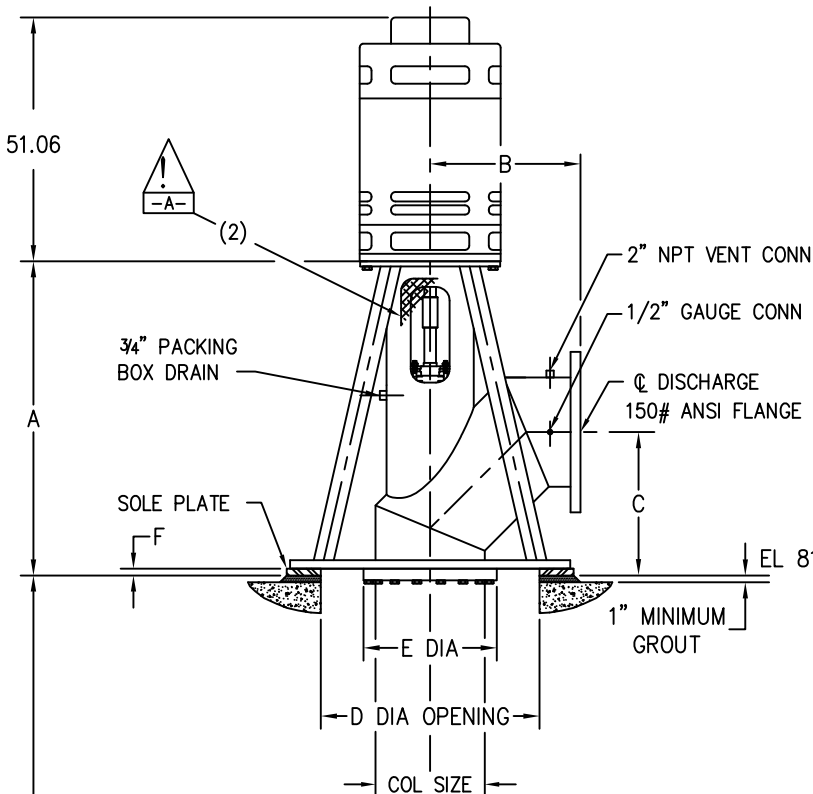
Pentair Flow Technologies



NOTES:
1. GAUGE LOCATIONS AND PIPE DISTANCES BEFORE THE VENTURI METER ARE PER HYDRAULIC INSTITUTE STANDARDS LATEST EDITION.

RELEASE NUMBER	XX	REV NO	1
064946 TEST SET UP			
DWG. NO.	064946TS		

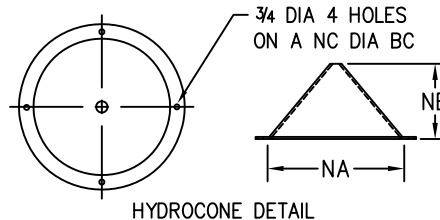




PUMP	DISCH	COL.	A					B	C	D
			MOTOR BASE DIAMETER							
			20							
20	20	20	56					27	31	42

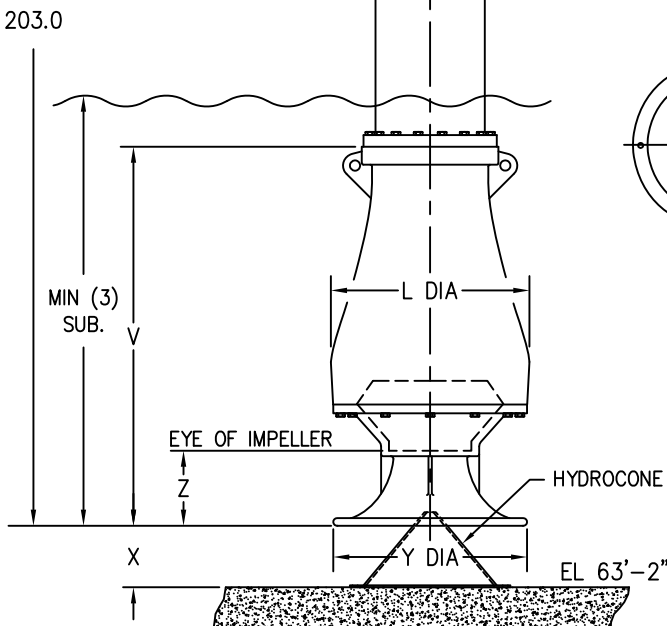
PUMP	E	F	G	H	K	L	V	X	Y	Z
20	23 3/4	1	52	23	1	37 3/4	73 5/8	12	37 5/8	14 1/2

PUMP	NA	NB	NC
20	28	15	30



NOTES:

- (1) ALL DIMENSIONS ARE IN INCHES UNLESS NOTED.
- (2) GUARD FURNISHED WHEN FLANGED COUPLING IS USED.
- (3) REFER TO SUBMERGENCE CHART FOR MIN. SUBMERGENCE.
- (4) SOLEPLATE TO HAVE FULL CONTACT WITH GROUT.
- (5) NOT FOR CONSTRUCTION, INSTALLATION, OR APPLICATION PURPOSES UNLESS CERTIFIED. DIMENSIONS SHOWN MAY VARY DUE TO NORMAL MANUFACTURING TOLERANCES.



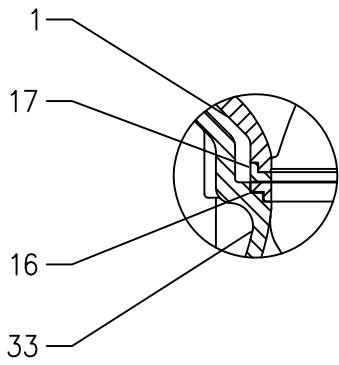
REV 1-ADDED 2" NPT VENT CONN AND 1/2" GAUGE CONN 4/29/15 SMF

CUSTOMER					P.O. NO.			
CITY OF MASSILLON, OHIO					CONTRACT # 1B			
JOB NAME					TAG NAME		SETTING PLAN VERTICAL TURBINE SOLIDS HANDLING ABOVE GROUND DISCH	
MASSILLON WWTP					PRIMARY EFFLUENT PUMP #1, #2, #3			
PUMP SIZE AND MODEL		GPM	TDH	RPM	ROTATION			
20" VTSH		9750	34	885	CCW			
MOTOR	HP	FRAME	PHASE	HERTZ	VOLTS	ENCLOSURE		
USEM	125	447VP	3	60	460	EXPLOSION PROOF		
CERTIFIED FOR			CERTIFIED BY		DATE		DWG NO	
PROJECT # 064946			SMF		DECEMBER 2014		064946SP	
							REV NO 1	

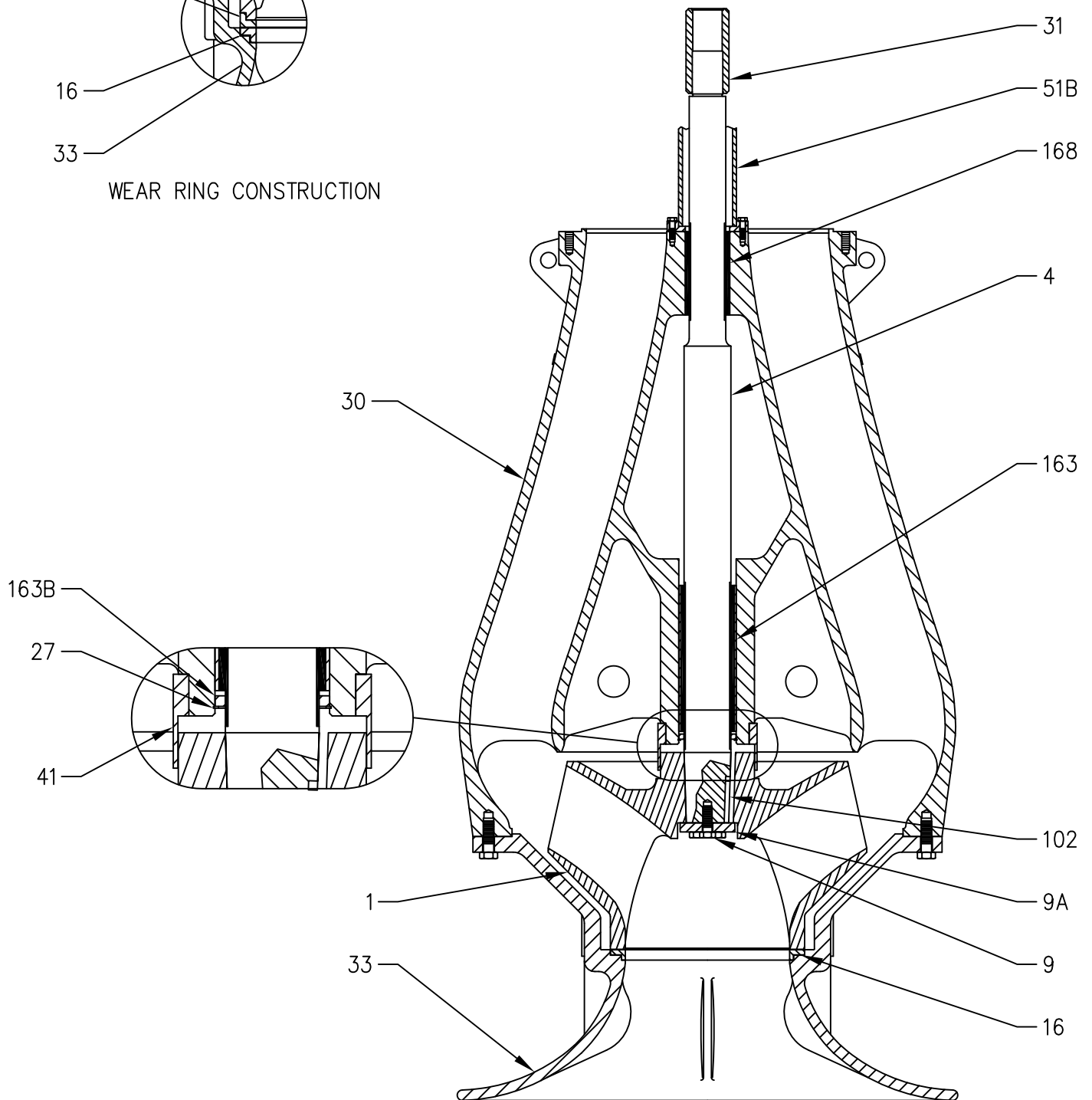
Fairbanks Nijhuis
Material Specifications

<u>Item</u>	<u>Description</u>	<u>Material</u>	<u>Specification¹</u>
1	Impeller	Cast Iron	A48 Class 30
4	Pump Shaft	Stainless Steel	A582 S41600
7	Discharge Head	Steel	A36 & A53
9	Impeller Capscrew	Steel	SAE J429 Grade 8
9A	Impeller Washer	Steel	A108 12L14
13	Top Shaft Sleeve	Stainless Steel	AISI 304
16	Bell Wearing Ring	Stainless Steel	A743 Gr CA40 (410-484 BHN)
17	Impeller Wear Ring	Stainless Steel	A743 Gr CA40 (300-350 BHN)
18	Soleplate	Steel	A36
19A	Drive Shaft	Steel	AISI 1045
19B	Top Shaft	Stainless Steel	A582 S41600
23	Lineshaft	Stainless Steel	A582 S41600
27	Ring, Retainer	Stainless Steel	AISI 302
28	Flanged Column Pipe	Steel	A36 & A53
28A	Head Gasket	Tag Board	D1170 Grade 3111
30	Diffuser Bowl	Cast Iron	A48 Class 30
31	Shaft Coupling	Stainless Steel	A582 S41600
33	Suction Bell	Cast Iron	A48 Class 30
41	Throttle Ring, Bowl	Stainless Steel	A743 Gr CA40 (300-350 BHN)
50	Connector Bearing	Bronze	B505 C93200
51	Enclosing Tube	Steel	A53
51A	Top Enclosing Tube	Steel	A53
51B	Enclosing Tube, Bottom	Steel	A53
63	Packing Box	Cast Iron	A48 Class 30
63A	Packing Box Gasket	Copper	B152 Alloy 110
63B	Packing Box Bearing	Bronze	B505 C93200
102	Impeller Key	Steel	A108 C10180
126	Water Slinger	Rubber	Neoprene
163	Bearing, Lower Bowl	Bronze/Rubber	B584 C85700/Nitrile
163B	Restrictor	Teflon	Teflon
168	Bearing, Upper Bowl	Bronze/Rubber	B584 C85700/Nitrile
456	Mechanical Seal	Commercial	Commercial
	Hydrocone	Aluminum	B26 AL 319
	Bowl Bolting	Stainless Steel	AISI 304
	Column Bolting	Stainless Steel	AISI 304
	Discharge Head Bolting	Stainless Steel	AISI 304

¹ Material specifications are ASTM unless otherwise noted and are for description of chemistry only.



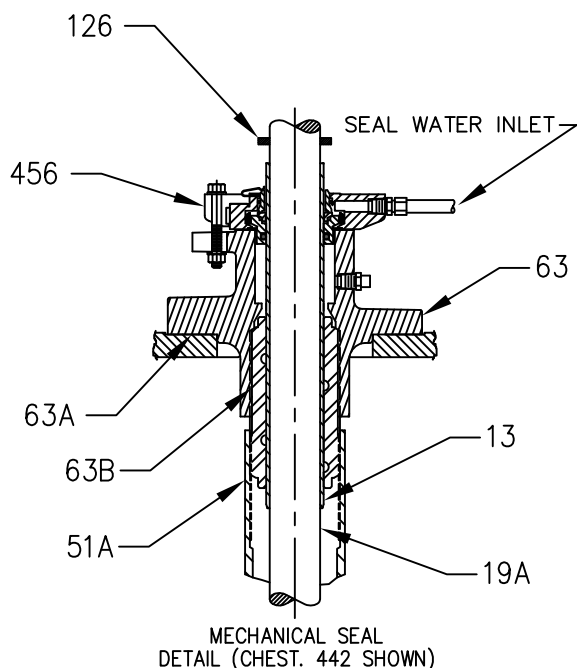
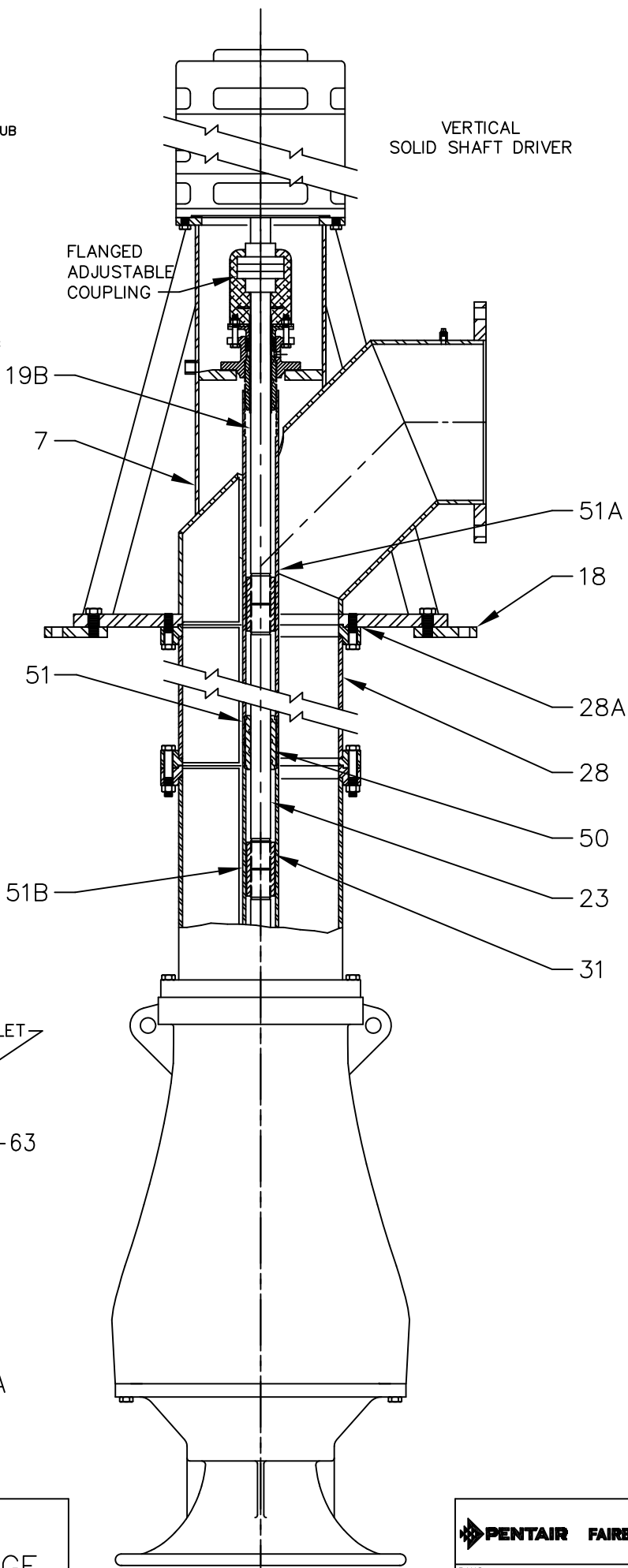
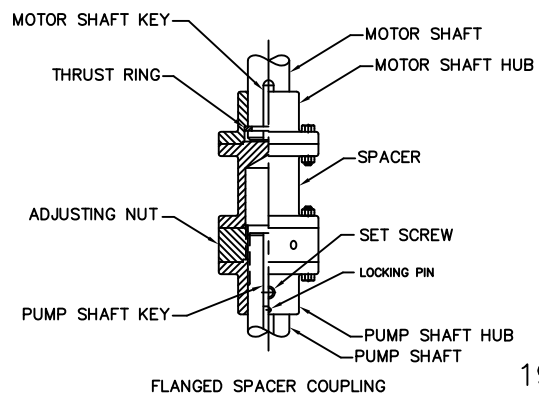
WEAR RING CONSTRUCTION



ASSEMBLY
20" VTSH (BOWL ONLY)

PENTAIR FAIRBANKS NIJHUIS

DWG NO	064946AB	REV NO	0
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ASSEMBLY 20" VTSH
 ABOVE GROUND DISCHARGE

MANUF. YEAR	2015	MAX. CASING PSI	65			
SIZE	20	INCH	MODEL	VTSH	STAGE	1
GPM	9750	TOTAL HD.	34	FT.	RPM	885
FRAME		LUBE	WATER	IMP.DIA.	18.30	
SERIAL	2433533-0,-1,-2					
MADE IN USA OF IMPORTED AND DOMESTIC MATERIALS.				PENTAIR		
S21A136M				FAIRBANKS NIJHUIS™ KANSAS CITY, KANSAS		

FULL DATA NAMEPLATE

Fairbanks Nijhuis
Technical Data ¹

Column	
Size	20
Column O.D.	20
Wall Thickness.....	3/8
Flange O.D.....	23-3/4
Pipe Weight per Ft (Lbs).....	78.6
Enclosing Tube	
Size.	3-1/2
Schedule	80
Outside Diameter.....	4
Tube Weight / Ft. (Lbs)	12.50
Connector Bearing Spacing; Normal	60
Connector Bearing Spacing; Maximum	120
Flush Water Requirements	
Flow (GPM).....	1.0
Pressure (PSI)	54
Lineshaft	
Line Shaft Diameter	2-7/16
Weight (Lbs /Foot)	15.87
Bowl Assembly	
Weight (Lbs)	4100
K _T (Thrust Factor), (Lbs/Ft)	37.8
K _A (Rotor Weight) (Lbs).....	639
Wear Ring Nominal Clearance.....	0.030
Nominal Bowl Assembly End Play	1-1/4
Nominal Bowl Wall Thickness	7/8
Bowl Shaft Diameter At Lower Bearing	3-1/2
Discharge Head	
Weight (Lbs).....	1700
Discharge Flange Size (150lb ANSI).....	20
Discharge Vent Size (NPT).....	2
Discharge Gauge Size (NPT)	1/2
Sealing Box	
Sleeve O. D.	2-5/8
Box I. D.	3-7/16
Box Depth	1.39
Impeller Data	
Inlet Area In ²	184.75
Maximum Sphere Size	5
WR ² (Lb-Ft ²).....	179.21
Weight (Lbs).....	406
Impeller Fastener	
Size	1-1/4-7
Tightening Torque (Ft-Lbs).....	300

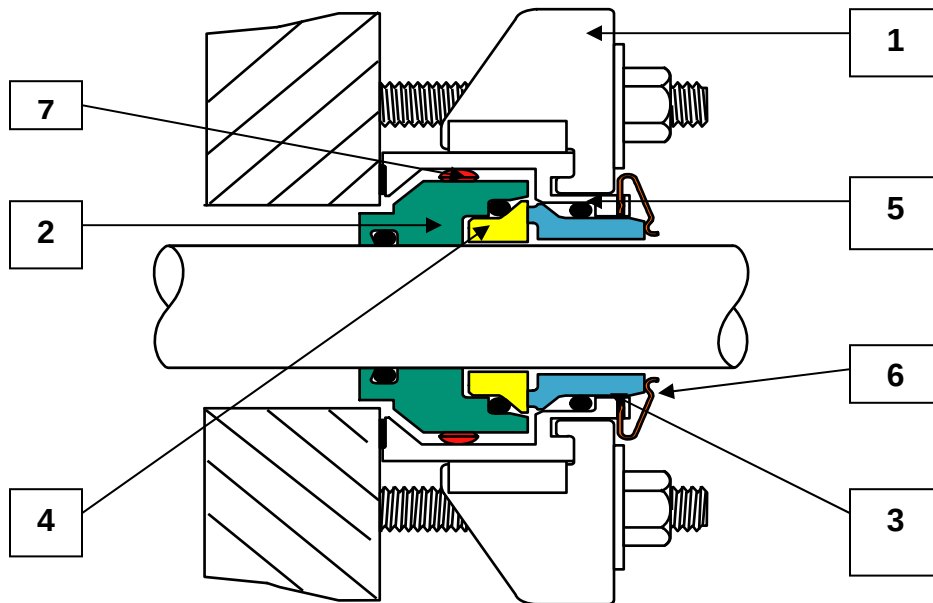
¹ Values shown are in inches unless otherwise noted.

Fairbanks Nijhuis
Minimum Submergence

Use the following chart to determine the submergence required to prevent vortexing. Submergence is measured from the suction bell.

VTSH Minimum Submergence	
GPM	Inches
3000	38
4000	42
5000	47
6000	50
7000	54
8000	57
9000	60
10000	63

442 Split Seal Data Sheet



Materials of Construction

- | | | |
|----|-------------------|---------------------------------|
| 1. | Gland: | 316 Stainless Steel |
| 2. | Rotary Holder: | 316 Stainless Steel |
| 3. | Stationary faces: | Carbon* |
| 4. | Rotary faces: | Reaction Bonded Silicon Carbide |
| 5. | O-rings: | Fluorocarbon* (Viton) * |
| 6. | Springs: | Elgiloy |
| 7. | Centering Button: | Ryton |
| 8. | Flush Port: | 3/8" NPT |

* Standard Construction

CHESTERTON®

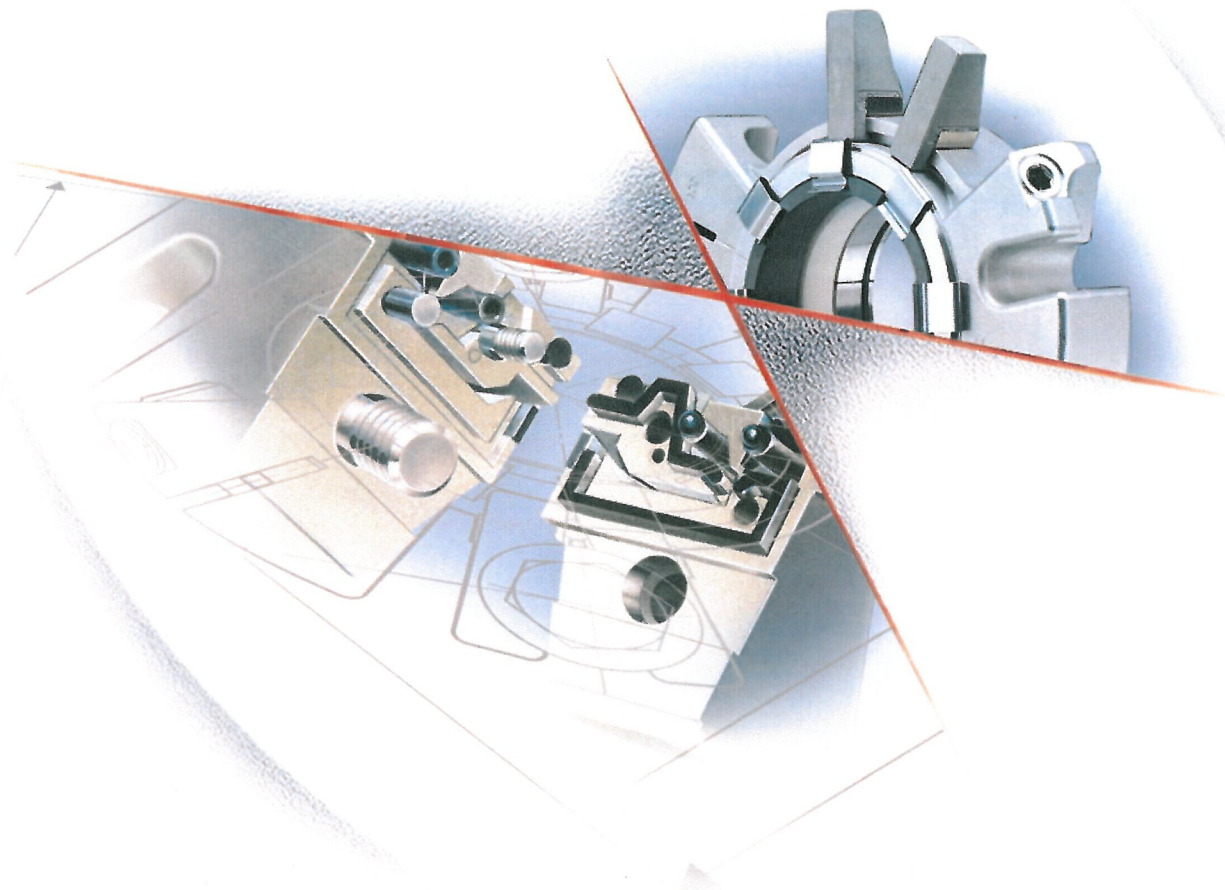
ISO 9001
CERTIFIED



442™ Split Mechanical Seal

Patented

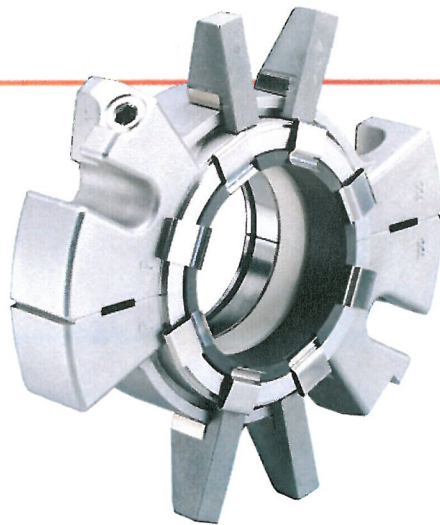
- Superior performance from new generation split seal
- Fast installation without the need for disassembly
- Widest range of services of any split seal
- Best selling split seal with largest installed base globally
- Customer tested to assure reliability and value



***The high reliability
split mechanical seal***

CHESTERTON®

442™ Split Mechanical Seal



Superior performance from new generation split seal technology

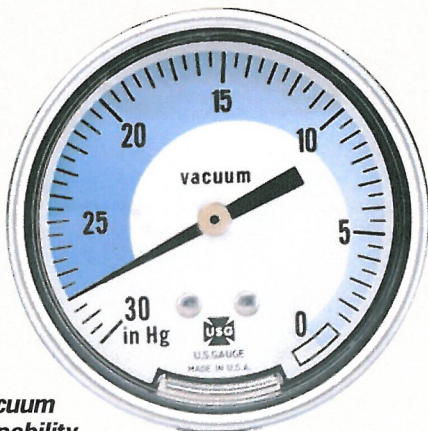
The CHESTERTON® 442 Split Mechanical Seal is the first new generation split seal, featuring superior performance and reliability. Patented 442 construction enables the seal to handle pressures three and one-half times higher than conventional split seals. In addition, the 442 is the only split seal specifically designed to be able to withstand vacuum in the stuffing box. This makes it the ideal seal for suction lift pumping applications or mixer applications where the vessel is first purged then pressurized.

The 442 Seal has other reliability-enhancing features, including automatic face centering for reliable face mating, and hydraulically balanced faces for low heat generation. With the advent of the 442 Seal, a split seal is available which can outperform many conventional seals.

**When you see CHESTERTON,
you see the future of sealing.**

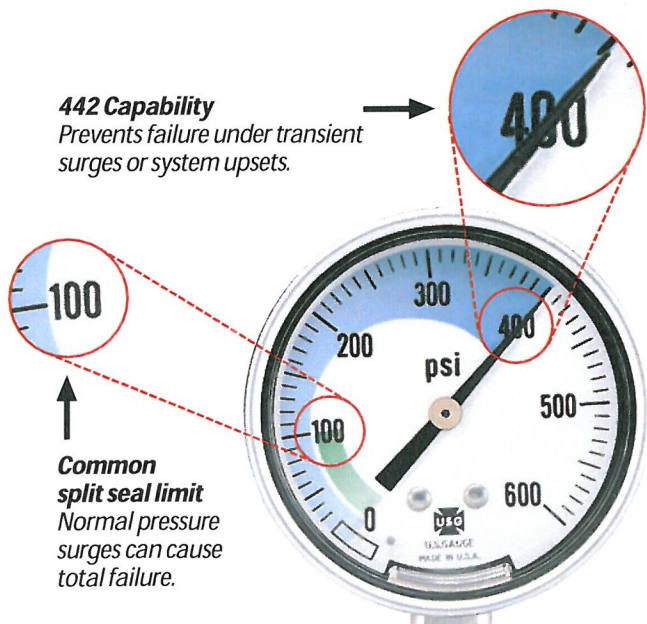
Fast installation without the need for equipment disassembly... user rebuildable in the field.

The 442 Mechanical Split Seal installs 50% quicker than other split seal designs. Patent pending assembly screws won't fall out and get lost. Shaft O-ring is butt-jointed and retained, eliminating the need for glue which can damage seal function. Patent pending centering buttons automatically center the seal before start-up. No shims or clips are needed. All springs are fixed to the gland and need no positioning or assembly. Anti-rotation lock of the stationary face is automatic and does not have to be lined up. In addition, the 442 is user rebuildable with an inexpensive parts kit. Rebuilds are fast and easy; you won't need to have a spare seal on hand while the seal goes out for a lengthy rebuild at the factory. The 442 can be rebuilt time after time without the need for clumsy glue joints or hand cutting of parts to difficult tolerances.



Vacuum Capability

The 442 is the only split seal specifically designed to be able to withstand vacuum in the stuffing box.



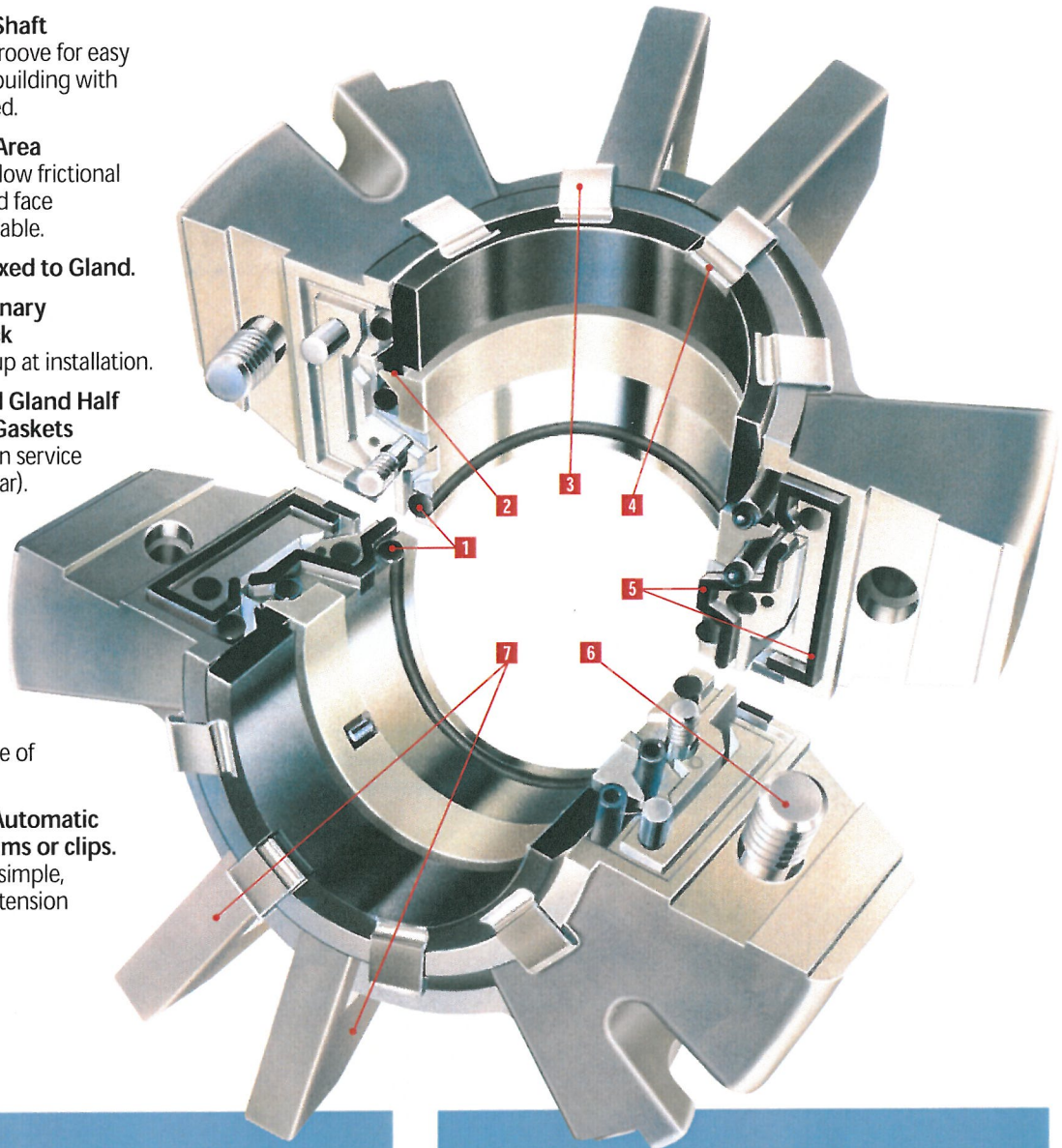
442 Capability

Prevents failure under transient surges or system upsets.

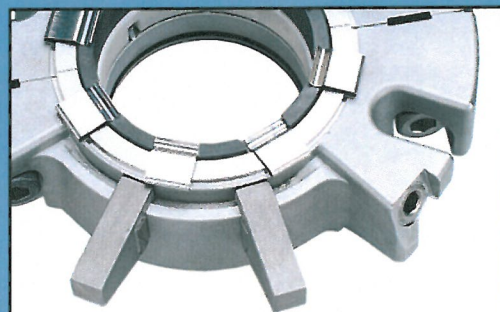
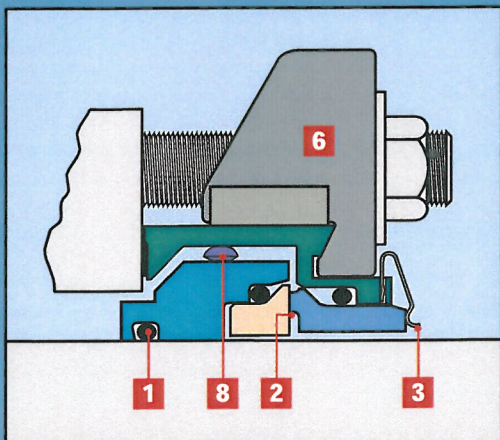
**Common
split seal limit**
*Normal pressure
surges can cause
total failure.*

Construction Details

- 1 Static O-ring on Shaft**
Held in a captive groove for easy installation and rebuilding with no adhesive needed.
- 2 Narrow Contact Area**
Balanced faces for low frictional heat. Optional hard face combinations available.
- 3 Finger Springs Fixed to Gland.**
- 4 Automatic Stationary Anti-rotation Lock**
No need to line it up at installation.
- 5 Double Captured Gland Half and Rotary Half Gaskets**
Prevent extrusion in service up to 400 psi (28 bar).
- 6 Patent Pending Gland and Holder Screws**
Won't fall out at installation.
- 7 Patented Adjustable Gland™ Tabs**
Fit the widest range of bolt circles.
- 8 Patent Pending Automatic Centering; no shims or clips.**
Makes installation simple, even with short extension packing sleeves. (See inset).

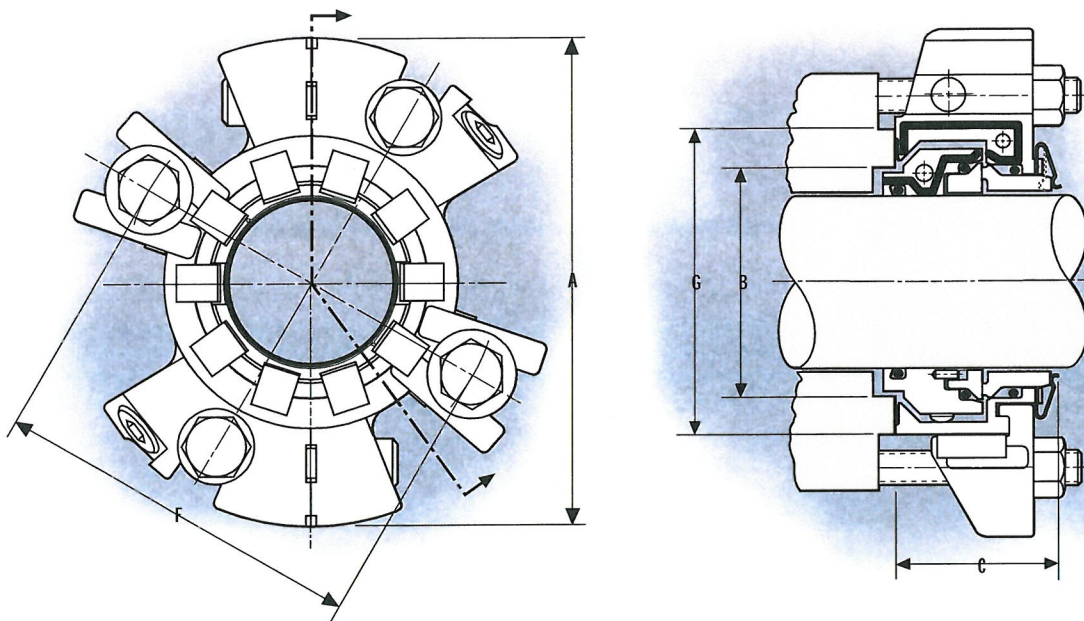


Inset



Built-in flush ports are on each side for ease of piping in high solids applications.

442 Seal Specifications



442 DIMENSIONAL DATA (INCH)

SHAFT SIZE	GLAND OD	STUFFING BOX BORE		OB LENGTH	BOLT CIRCLE BY BOLT SIZE					STUFFING BOX BORE OD	
					F MIN						G
					A	B	B	C	3/8"		1/2"
MAX	MIN	MAX									
1.250	4.91	1.86	2.10	1.78	3.17	3.29	3.42	3.54	3.67	2.35	
1.375	5.01	1.94	2.38	1.78	3.25	3.38	3.50	3.63	3.75	2.63	
1.500	5.13	2.06	2.50	1.78	3.38	3.50	3.62	3.75	3.87	2.75	
1.625	5.26	2.19	2.63	1.78	3.50	3.62	3.75	3.87	4.00	2.87	
1.750	5.38	2.31	2.75	1.78	3.63	3.75	3.87	4.00	4.12	3.00	
1.875	5.50	2.44	2.88	1.78	3.75	3.87	4.00	4.12	4.25	3.12	
2.000	5.63	2.56	3.12	1.78	3.88	4.00	4.12	4.25	4.37	3.25	
2.125	5.76	2.69	3.12	1.78	4.00	4.12	4.25	4.37	4.50	3.37	
2.250	5.88	2.81	3.25	1.78	4.13	4.25	4.37	4.50	4.62	3.50	
2.375	6.01	2.94	3.37	1.78	4.25	4.37	4.50	4.62	4.75	3.62	
2.500	6.13	3.06	3.75	1.78	4.63	4.75	4.87	5.00	5.12	4.00	
2.625	7.76	3.35	4.25	2.24	5.38	5.50	5.63	5.75	5.88	4.75	
2.750	7.76	3.35	4.25	2.24	5.38	5.50	5.63	5.75	5.88	4.75	
2.875	8.01	3.60	4.50	2.24	5.63	5.75	5.88	6.00	6.13	5.00	
3.000	8.01	3.60	4.50	2.24	5.63	5.75	5.88	6.00	6.13	5.00	
3.125	8.26	3.85	4.75	2.24	5.88	6.00	6.13	6.25	6.38	5.25	
2.250	8.26	3.85	4.75	2.24	5.88	6.00	6.13	6.25	6.38	5.25	
3.375	8.51	4.10	5.00	2.24	6.13	6.25	6.38	6.50	6.63	5.50	
3.500	8.51	4.10	5.00	2.24	6.13	6.25	6.38	6.50	6.63	5.50	
3.625	8.77	4.35	5.25	2.24	6.38	6.50	6.63	6.75	6.88	5.75	
3.750	8.77	4.35	5.25	2.24	6.38	6.50	6.63	6.75	6.88	5.75	
3.875	9.02	4.60	5.50	2.24	6.63	6.75	6.88	7.00	7.13	6.00	
4.000	9.02	4.60	5.50	2.24	6.63	6.75	6.88	7.00	7.13	6.00	
4.125	9.27	4.85	5.75	2.24	6.88	7.00	7.13	7.25	7.38	6.25	
4.250	9.27	4.85	5.75	2.24	6.88	7.00	7.13	7.25	7.38	6.25	
4.375	9.52	5.10	6.00	2.24	7.13	7.25	7.38	7.50	7.63	6.50	
4.500	9.52	5.10	6.00	2.24	7.13	7.25	7.38	7.50	7.63	6.50	
4.625	9.77	5.35	6.25	2.24	7.38	7.50	7.63	7.75	7.88	6.75	
4.750	9.77	5.35	6.25	2.24	7.38	7.50	7.63	7.75	7.88	6.75	

STANDARD MATERIALS

Rotary Faces:

- Ceramic
- Reaction Bonded Silicon Carbide

Stationary Faces:

- Carbon
- Duplex Carbide™
- Reaction Bonded Silicon Carbide

Elastomers:

- AFLAS†, Ethylene Propylene, Fluorocarbon

All Metal Parts:

- 316SS

Springs:

- Elgiloy*

OPERATING LIMITS

Speed Limits:

- To 4000 fpm (20 mps)

Temperature Limits:

- To 250°F (120°C)

Pressure Limits:

All 442 seals can withstand operating pressures from full vacuum (25 in/635 mm Hg) to the maximum pressures at the conditions listed below.

■ Small Sizes:

1.250" through 2.500"/32mm through 60 mm
Carbon/Ceramic (3600 RPM) 350 psig/24 bar g
Carbon/Reaction Bonded Silicon Carbide (3600 RPM) 400 psig/28 bar g

The above pressure limits are for a standard 442 seal. Higher speeds and pressures are possible with the use of set screws.

Consult factory for higher operating conditions.

■ Large Sizes:

2.625" through 4.750"/65 mm through 120 mm
Carbon/Ceramic (1750 RPM) 200 psig/14 bar g
Carbon/Reaction Bonded Silicon Carbide (1750 RPM) 250 psig/18 bar g

The above pressure limits are for a standard 442 seal. Higher speeds and pressures are possible with the use of set screws.

Consult factory for higher operating conditions.

■ Extra Large Sizes:

5.000" through 7.750"/125 mm through 195 mm
Carbon/Ceramic (875 RPM) 200 psig/14 bar g
Carbon/Reaction Bonded Silicon Carbide (875 RPM) 200 psig/14 bar g

The above pressure limits are for a standard 442 seal. Higher speeds and pressures are possible with the use of set screws.

Consult factory for higher operating conditions.

* Elgiloy is a Registered Trademark of Elgiloy Limited partnership.

† Asahi Glass Company Ltd. Registered Trademark.

442 OVERSIZE DIMENSIONAL DATA (METRIC)

SHAFT SIZE	GLAND OD	STUFFING BOX BORE		OB LENGTH	BOLT CIRCLE BY BOLT SIZE								STUFFING BOX BORE OD
	A	B	B	C	F MIN								G
	MAX	MIN	MAX		8 mm	10 mm	12 mm	14 mm	16 mm	18 mm	20 mm	22 mm	MIN
125,0	286,4	150,1	177,8	87,6						214,6	216,6	218,6	190,5
130,0	292,8	155,1	184,2	87,6						220,9	222,9	224,9	196,9
135,0	299,2	160,1	190,5	87,6						227,3	229,3	231,3	203,2
140,0	305,6	165,2	190,5	87,6						227,3	229,3	231,3	203,2
145,0	312,0	170,2	196,9	87,6						233,6	235,6	237,6	209,6
150,0	209,6	175,2	203,2	87,6						240,0	242,0	244,0	215,9
155,0	324,7	180,1	209,6	87,6						246,3	248,3	250,3	222,3
160,0	324,7	185,1	215,9	87,6						253,0	255,0	257,0	228,6
165,0	331,0	190,1	215,9	87,6						253,0	255,0	257,0	228,6
170,0	337,5	195,1	222,3	87,6						259,3	261,3	263,3	235,0
175,0	337,5	200,2	228,6	87,6						265,7	267,7	269,7	241,3
180,0	337,5	205,2	228,6	87,6						272,0	274,0	276,0	241,3
185,0	343,9	210,2	235,0	87,6						272,0	274,0	276,0	247,7
190,0	350,2	215,1	241,3	87,6						278,4	280,4	282,4	254,0
195,0	356,6	220,1	247,7	87,6						284,7	286,7	288,7	260,4

CHESTERTON®

442™ Split Mechanical Seal

**Why disassemble equipment?
442 Split Seals install in minutes
without costly, time-consuming
disassembly.**

The CHESTERTON 442 Split Mechanical Seal provides the sealing capability of traditional mechanical seals without the need to disassemble the pump, mixer or similar equipment. All parts are split to slip around the shaft and assemble in place, in the field.

The 442 Split Seal is a dramatic time saver with fast, easy installation, plus the ability to be rebuilt time after time to get back in service fast. This is the perfect seal and the perfect time and money saver for common applications in Power, Pulp & Paper, Water and Wastewater, and CPI industries.



***Save time, save money,
stop leakage fast and easy!***

Widest range of services of any split seal

The 442 Seal has the performance features needed to provide high reliability in common pump and mixer services. The 442 is so compact that it has the shortest distance to first obstruction of any split seal and the patented Adjustable Gland™ makes it easy to fit.

The 442 is customer tested to assure value and reliability in the complete range of common aqueous and mild chemical services. It will become a trusted component of your plantwide sealing strategy.

A.W. CHESTERTON CO.

Middlesex Industrial Park, 225 Fallon Road
Stoneham, Massachusetts 02180-9101 USA
Telephone: 781-438-7000
Fax: 781-438-8971
Web Address: www.chesterton.com

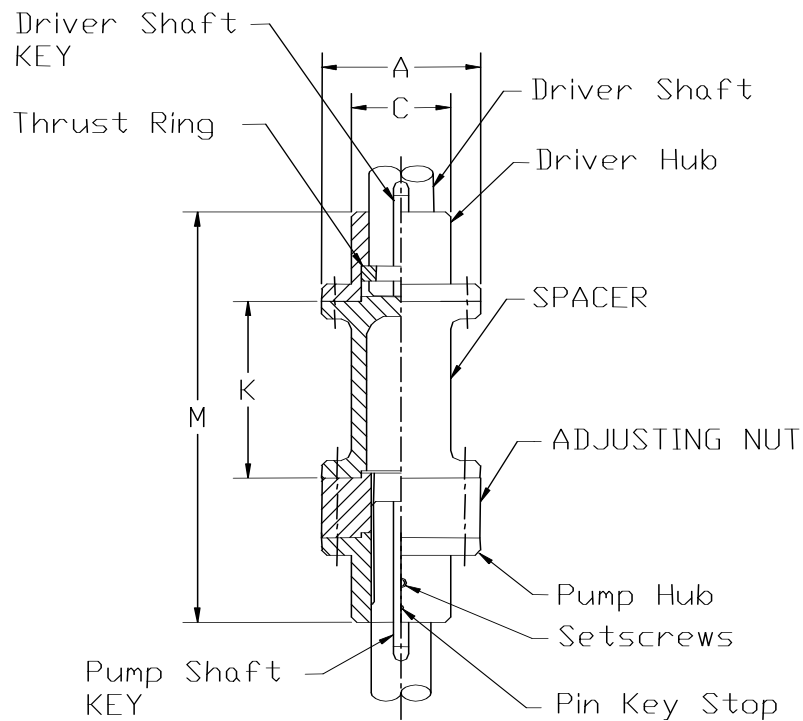
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FORM NO. 073385 REV.4

PRINTED IN USA 6/99

Fairbanks Nijhuis
Style IV Adjustable Coupling



Technical Data

Size	CPAT 2625
Horsepower Per 100 Rpm	33.8
Thrust Capacity, Lbs.	28500
Bolts (No. & Size).....	(6) 1/2
WR ² , Lbs-In ²	159.13
Maximum Bore.....	2-5/8
Weight, Lbs.	35.08

Dimensional Data

A.....	5-3/4
C.....	3-7/8
K.....	4-7/16
M	13-13/16

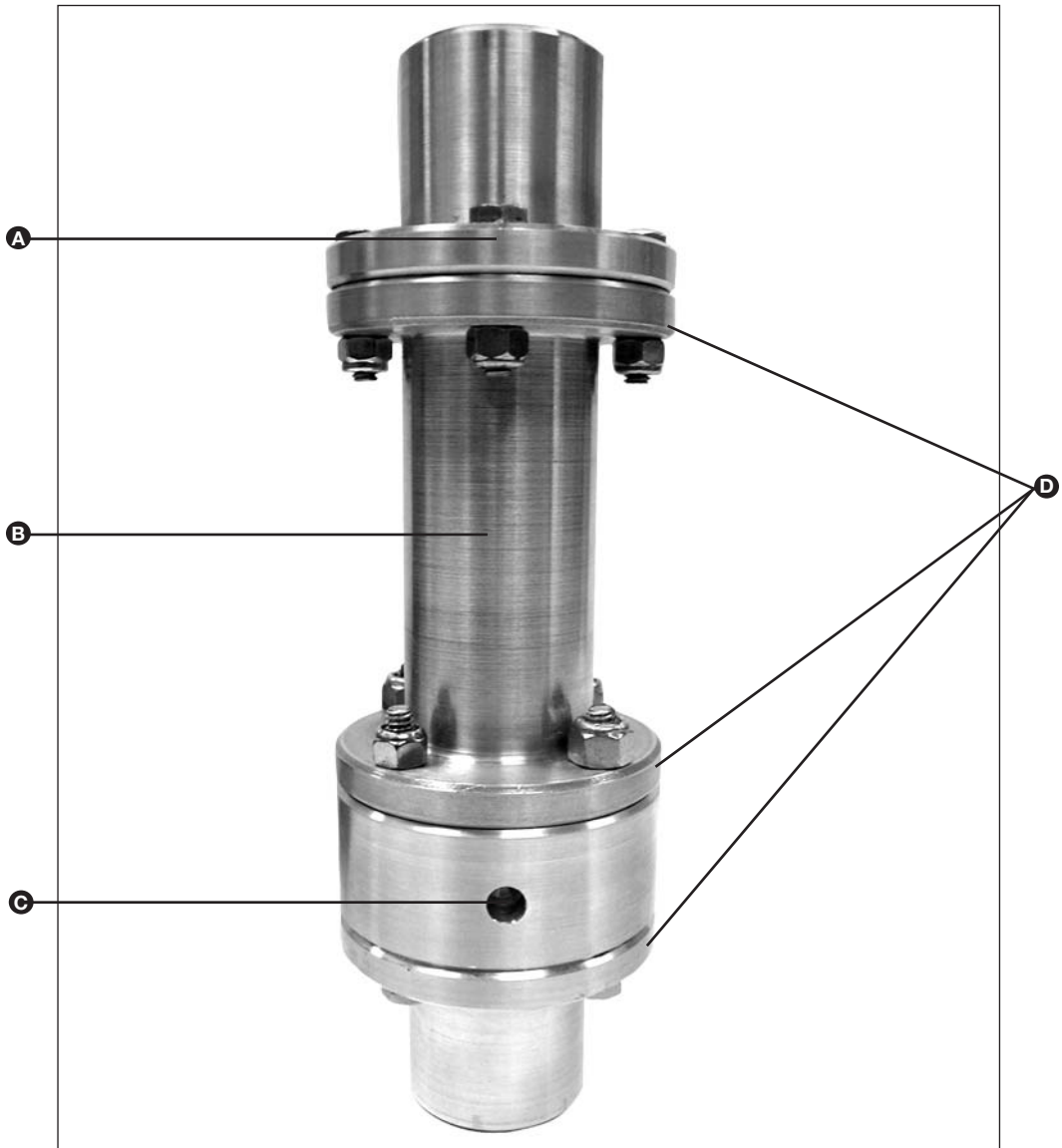


Type CPLR & CPAT

METASTREAM® C-Series Rigid Couplings

CPLR & CPAT

- A – Motor hub and split ring to NEMA standard
- B – Variable length spacer
- C – Externally adjustable shaft nut
- D – Pilot fits insure repeatable concentric installation



Product Description

Metastream® C-Series Couplings incorporate a segmented, piloted locating design. This eliminates the shaft distortion associated with conventional 'clam shell' coupling designs. The CPLR is for industrial applications and the CPAT is for higher speed applications:

- Easily adjustable for setting vertical clearance.
- Infinite life.
- Corrosion-resistant phosphate coating on AISI 1040 steel.
- Robust design.

Design Features

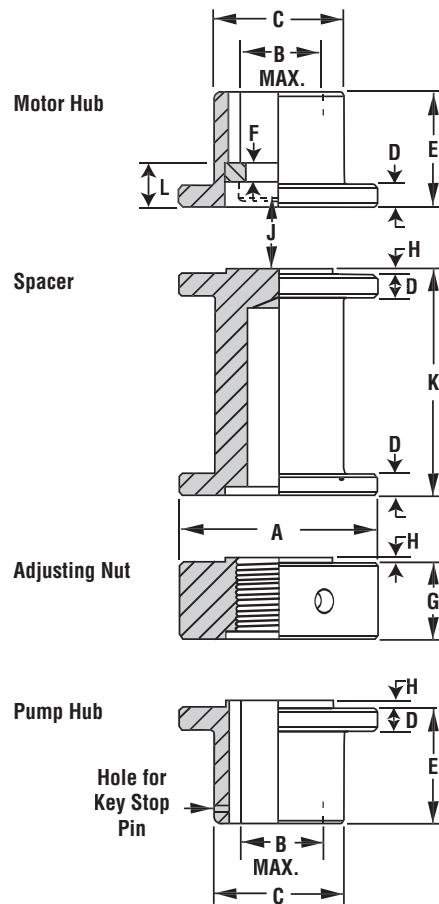
- Designed to transmit torque between vertical mounted equipment including:
 - Vertical Pumps.
 - Vertical Turbines.
 - Vertical Mixers.
- CPAT meets requirements of API 610 8th Edition.
- Optional materials & coatings available.
- Electrically insulated design available.



Type CPLR & CPAT

METASTREAM® C-Series Rigid Couplings

Dimensions and Technical Data



Coupling Size	HP/100 RPM	Trust CAP.-LB	Fit NEMA Frame	Bolts Per FLG	Bolt DIA.	A	B	C	D	E	F	G	H	J	K		L
															STD	MIN	
1125	2.7	4500	182-215	4	1/4	3.00	1.125	1.75	0.38	2.00	0.375	1.25	0.125	0.016	4.44	1.63	0.89
1625	8.0	11000	254-326	6	5/16	4.00	1.625	2.50	0.44	2.25	0.375	1.50	0.125	0.016	4.44	1.75	0.89
2125	17.9	28500	364-445	6	1/2	5.13	2.125	3.13	0.63	2.69	0.375	1.75	0.125	0.016	4.44	2.63	0.89
2625	33.8	28500	No std	6	1/2	5.88	2.625	3.88	0.63	2.94	*	3.50	0.125	0.016	4.44	2.63	0.89
2875	44.4	28500	No std	6	1/2	6.38	2.875	4.38	0.75	3.44	*	3.50	0.125	0.016	4.44	2.88	0.89
3125	57.0	38000	No std	8	1/2	6.75	3.125	4.63	0.75	4.00	*	3.50	0.125	0.016	4.44	2.88	0.89
3875	109	66000	No std	6	3/4	8.94	3.875	5.88	0.81	4.38	*	4.00	0.125	0.016	4.44	3.13	0.89
5000	310	159000	No std	8	1	11.75	5.000	7.50	1.00	6.00	*	3.00	0.250	0.125	No std	4.50	1.38
6000	404	199000	No std	10	1	13.25	6.000	9.00	1.13	9.25	0.625	2.38	0.250	0.125	No std	4.75	1.63
7250	712	278000	No std	14	1	15.00	7.250	10.75	2.25	10.75	0.750	3.69	0.313	0.125	No std	7.06	1.94
8500	1148	294000	No std	12	1-1/8	17.25	8.500	12.50	2.25	15.00	0.750	3.56	0.313	0.125	No std	7.31	1.94
10500	2164	352000	No std	12	1-1/8	20.50	10.500	15.00	2.75	18.38	0.750	4.19	0.313	0.125	No std	8.31	1.94

Notes:

1. Driver hub bores are in 0.25" increments from 0.875" to and including 3.875" then any diameter up to 10.500". Standard bores are to AGMA 9002 Class 2 clearance and keyways to AGMA 9002 commercial tolerance for both driver and driven hubs.
2. John Crane Flexibox does not furnish the key stop pin.
3. 3/8 or 1/2 inch thick split rings are standard options on sizes 2625 thru 3875 and 1/2 or 3/4 inch on size 5000.
4. Adjusting nuts can be supplied blank or threaded. Standard threads are ANSI UN Class 2B, left or right hand.
5. NEMA frame sizes apply to VP and HP series.

Table refers to Standard Range. Modified designs to meet specific customer requirements are available.



Type CPLR & CPAT

METASTREAM® C-Series Rigid Couplings

Configurations

Style 1

Non-spacer style provides easy assembly on driver and rotating driven equipment shafts. Usually used on equipment where there is a minimum of distance between shaft ends.

Style 2

Non-spacer style with an adjusting nut so that vertical clearances in the driven equipment may be attained. Usually used on equipment where there is a minimum of distance between shaft ends.

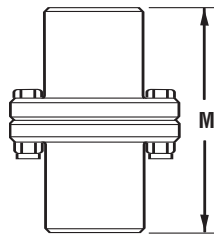
Style 3

Spacer Coupling style offers a spacer whereby the driven equipment may be worked on without the disassembly or removal of the driver.

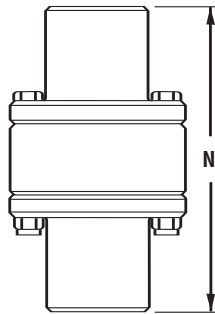
Style 4

Spacer Type Rigid Coupling offers a removable spacer for easy maintenance of driven equipment and an adjusting nut assembly, whereby the vertical clearance in the driven equipment may be attained.

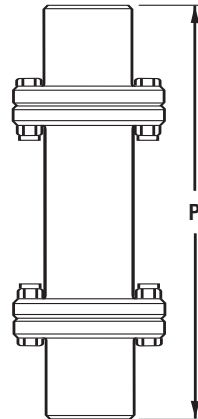
Style 1



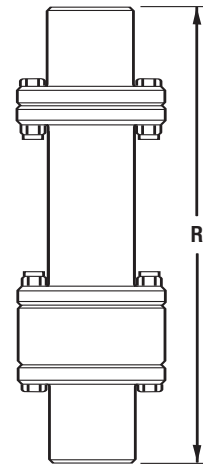
Style 2



Style 3



Style 4



Coupling Size	M	N	P		R	
			STD	MIN	STD	MIN
1125	4.00	5.25	8.31	5.50	9.56	6.75
1625	4.50	6.00	8.81	6.13	10.31	7.63
2125	5.38	7.13	9.69	7.88	11.44	9.63
2625	5.88	9.38	10.19	8.38	13.69	11.88
2875	6.88	10.38	11.19	9.63	14.69	13.13
3125	8.00	11.50	12.31	10.75	15.81	14.25
3875	8.76	12.75	13.07	11.76	17.06	15.75
5000	12.00	15.00	No std	16.50	No std	19.50
6000	18.50	20.88	No std	23.00	No std	25.38
7250	21.50	25.19	No std	28.25	No std	31.94
8500	30.00	33.56	No std	37.00	No std	37.00
10500	36.76	40.94	No std	44.76	No std	48.94



Type CPLR & CPAT

METASTREAM® C-Series Rigid Couplings

Selection Procedure

Step 1

Determine the shaft diameter of the driver and compare to the maximum sized hub bore in column B of the dimensions shown on page 2. If the driver is a standard Nema HP or VP series motor, use the column marked 'Fit Nema Frame' to determine the coupling size required.

Step 2

Determine the shaft diameter of the driven equipment and compare to the maximum sized hub bore in column B of the dimensions shown on page 2. The shaft size of the driven equipment should not exceed the maximum bore size to determine the coupling size.

Step 3

The largest size shaft of either the driver or driven equipment will determine the ultimate coupling size.

Step 4

Specify the coupling configuration and type, bore size for the driver and driven equipment hubs, type of fit, and adjusting nut thread details.

Step 5

Select type CPLR for standard coupling tolerances or type CPAT for API 610 8th edition tolerances.

Balance Recommendations

As supplied, standard CPLR and CPAT couplings meet AGMA Balance Class 8 with clearance fit bores. The standard CPAT coupling meets AGMA Balance Class 9 with transition/interference fit bores. While dynamic balancing is not normally required, if specified, John Crane Flexibox recommends component balancing. Any potential benefits of assembly balancing are negated by the installation fits and adjustable nature of the application. Contact John Crane Flexibox if your application warrants balancing consideration.



Europe

Slough, UK

Tel: 44-1753-224000

Fax: 44-1753-224224

North America

Houston

Tel: 1-713-944-6690

Fax: 1-713-946-8252

Latin America

São Paulo, Brazil

Tel: 55-11-3371-2500

Fax: 55-11-3371-2599

Middle East & Africa

Dubai, United Arab Emirates

Tel: 971-4-3438940

Fax: 971-4-3438970

Asia

Singapore

Tel: 65-6512-5200

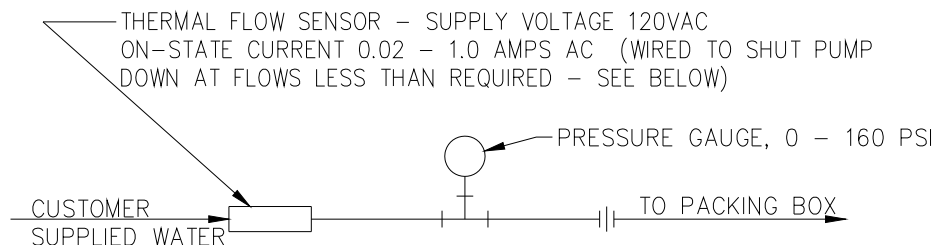
Fax: 65-6512-5233

For your nearest John Crane facility, please contact one of the locations above.

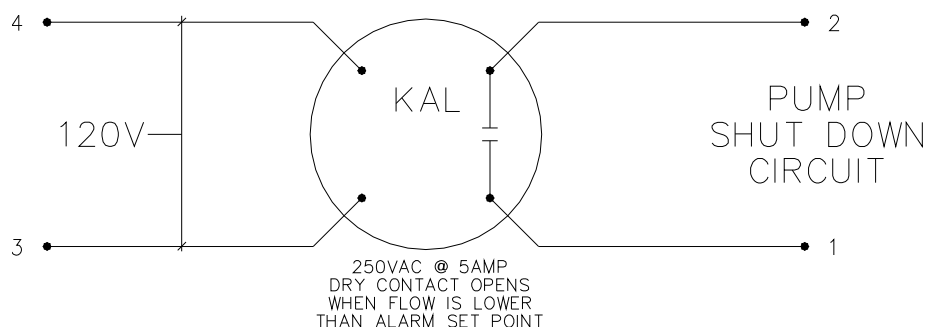
If the products featured will be used in a potentially dangerous and/or hazardous process, your John Crane representative should be consulted prior to their selection and use. In the interest of continuous development, John Crane Companies reserve the right to alter designs and specifications without prior notice.

Fairbanks Nijhuis

Seal Water Schematic & Specifications



Flow Meter Wiring Diagram¹



Specifications

- The following water quality standard is recommended as a minimum for water used to flush the bearing system of this VTSH pump.
 - pH Value: 6.0-8.0
 - Solids Content:
 - Dissolved: 500 PPM (MG/L)
 - Suspended: 30 PPM (MG/L)
 - Maximum Particle Size: 60 Microns
 - Maximum Individual Dissolved Ions:
 - Hardness: (Ca⁺, Mg⁺) 220 PPM (MG/L)
 - Calcium Carbonate (CaCO₃): 10PPM (MG/L)
 - Sulfate (SO₄): 50PPM (MG/L)
 - Temperature Range: 35°F - 100°F.
- The flush water system is to be operated as follows:
 - Rubber Bowl Bearings
 - For moderate service, the bearings must be flushed for a minimum of 5 minutes before starting the pump, continuously while in operation and at least 15 minutes after the pump is stopped.
 - Continuous fresh water flushing is required for applications where the fluid may included an excessive amount of abrasive fines, sand or grit.
- Flow Requirements

Pump Size	Nominal Flow (GPM)	Alarm Flow (GPM)	Minimum Pressure (PSI)
20"	1.0	0.5	54

¹ Wiring and hook up of flow switch not by Fairbanks Nijhuis

SAFEMATIC Safeunit Ultima

Extended Operation Area to Optimise Seal Operation in Extreme Conditions

Safeunit Ultima is specially designed to control seal water flow and pressure. This increases the reliability of seals used in pumps and process machinery while reducing seal water consumption up to 80%. It is designed for use in harsh operating environments where high temperature, high pressure and chemically aggressive elements are present. This makes it ideal for extreme applications found in pulp, paper and chemical industry processes, plus a wide variety of mining and general industrial uses.

The easy to install Safeunit Ultima not only controls and monitors seal water flow and pressure, but also drastically reduces seal water consumption. This results in increased sealing reliability, longer process equipment uptime plus reduced shutdowns and lower maintenance costs.

Safeunit Ultima Options are Available for all Seal Water Control Needs:

Type SUP for packing or single flush seals



Type SUQ for non pressurised quench seals



Type SUD for double mechanical seals

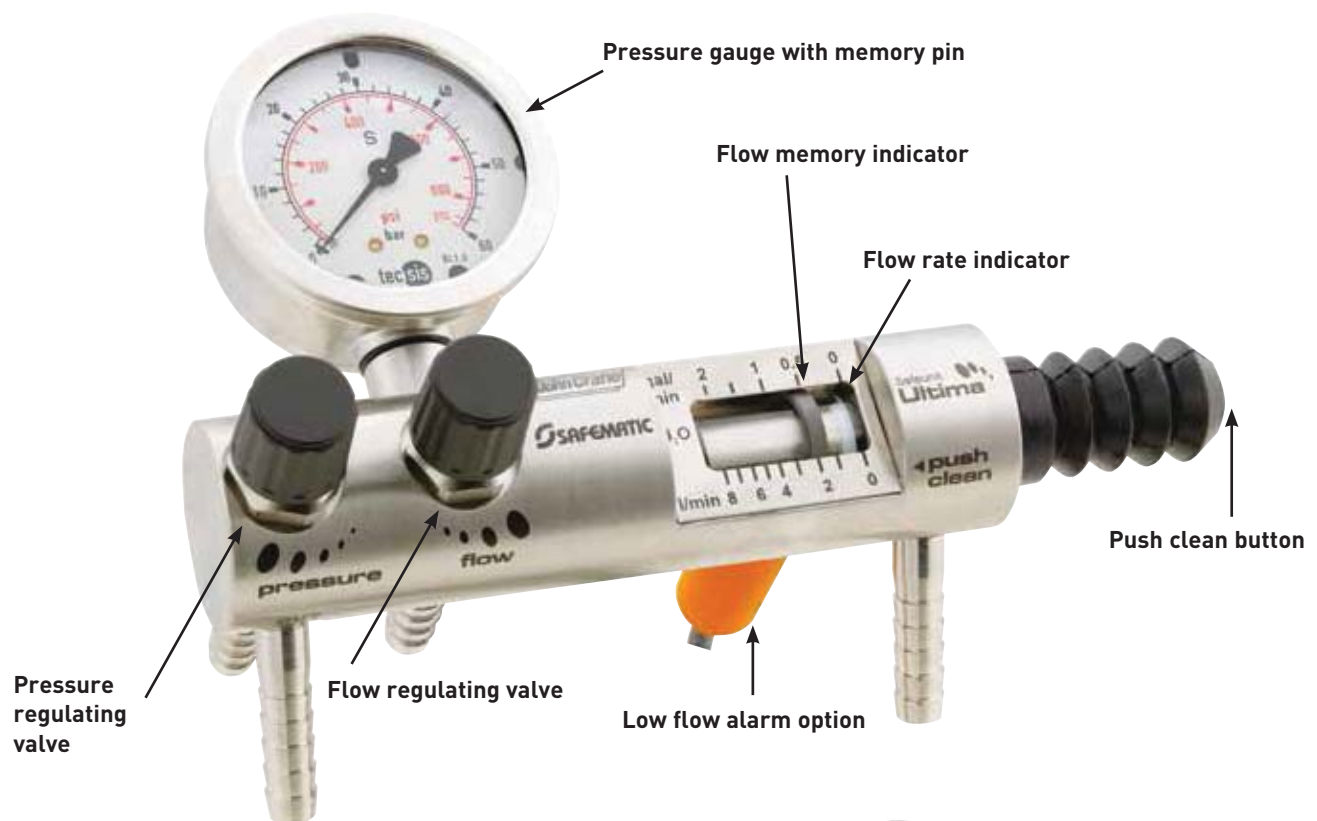


SAFEMATIC Safeunit Ultima

Robust and Compact Seal Water Unit with:

- Advanced design to reduce seal water pressure loss
- Rugged heavy duty structure
- Patented cleaning plunger that cleans the display and check valve during operation
- Improved accuracy
- Excellent resistance to chemical attacks and corrosion
- Proven regulating valve design providing reliable seal performance
- Greater operating temperatures (up to 212°F/100°C)
- Optional 870 psi(g)/60 bar(g) pressure capability

New Robust Stainless Steel Design



New Improved Operating Area:

- Max. temperature 212°F/100°C
- Max. pressure 870 psi(g)/60 bar(g)



Mechanical Sealing Systems with Safeunit Ultima

Safeunit Ultima Options

Safeunit Ultima type:

- Type SUP
- Type SUQ
- Type SUD

Flow:

- 0.75 gpm (3 l/min)
- 2 gpm (8 l/min)
- 4 gpm (15 l/min)

Pressure area:

- 360 psi(g)/25 bar(g)
- 870 psi(g)/60 bar(g)

Complete hose assembly:

- Yes

Seal Connections:

- | | | | |
|-------|-------|---------|-------|
| ▪ NPT | ▪ 1/8 | ▪ 1/4 | ▪ 3/8 |
| ▪ R | ▪ 1/2 | ▪ Other | |

Mounting:

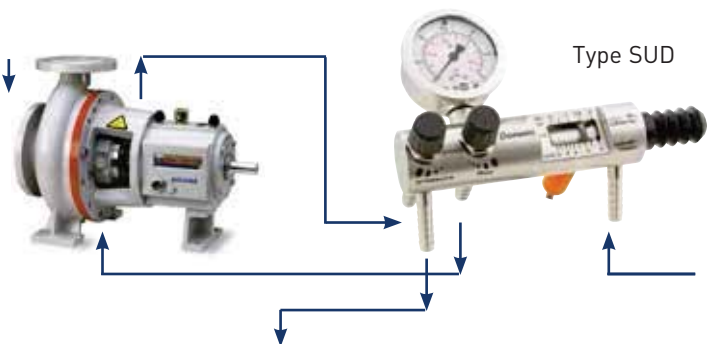
- Bracket
- Stand



Type SUP



Type SUQ



Type SUD

Alarm:

- AC-1 (20-250 VAC/DC)
- DC-1 (10-36 VDC)



SAFEMATIC™ is a registered trademark of John Crane

For your nearest John Crane facility, please contact one of the locations below.

North America
United States of America
1-800-SEALING
Tel: 1-847-967-2400
Fax: 1-847-967-3915

Europe
United Kingdom
Tel: 44-1753-224000
Fax: 44-1753-224224

Latin America
Brazil
Tel: 55-11-3371-2500
Fax: 55-11-3371-2599

Middle East & Africa
United Arab Emirates
Tel: 971-481-27800
Fax: 971-488-62830

Asia Pacific
Singapore
Tel: 65-6518-1800
Fax: 65-6518-1803

Fairbanks Nijhuis
Furnished Spare Parts

<u>Ref. No.</u>	<u>Description</u>	<u>Quantity</u>
163, 168	Bowl Bearings	1 Set
456	Mechanical Seal (repair kit)	1
9, 9A, 102	Impeller Fastener	1
16	Bowl Wear Ring	1
1, 17	Impeller with Wear Ring	1

Spare parts will be packed in wooden boxes, labeled with Pentair name and address, local representative name and address, and list of equipment in box.

Fairbanks Nijhuis
Paint Specifications

Above Ground Coating

- **Coating Manufacturer** Tnemec
- **Surface Preparation** SSPC-SP6, Commercial Blast Cleanin.
- **Finish Coat** Series N69
- **Number of Coats** One
- **Dry Film Thickness** 4.0 to 6.0 mils
- **Color** ANSI G1 Light Grey
- **Surfaces to be coated** Exterior of Discharge Head
Exposed portions of the packing box
Top, unmachined portion of sole plate

Below Ground Coating

- **Coating Manufacturer** Carboline
- **Surface Preparation** SSPC-SP10, Near White Blast Cleaning
- **Prime Coat** Bitumastic 300M
- **Number of Coats** As Required
- **Color** Black
- **Surfaces to be coated** Exterior of Bowl Assembly
Interior and Exterior of Column
Exterior of Enclosing Tube
Interior of Discharge Head including packing box exposed surfaces
- **Finish Coat** Series N140 Pota-Pox Plus
- **Number of Coats** As Required
- **Dry Film Thickness** 16 mils
- **Color** Black
- **Surfaces to be coated** Exterior of Bowl Assembly
Interior and Exterior of Column
Exterior of Enclosing Tube
Interior of Discharge Head including packing box exposed surfaces
Bottom of Sole Plate

HI-BUILD EPOXOLINE II N69 or V69

PRODUCT PROFILE

GENERIC DESCRIPTION Polyamidoamine Epoxy

COMMON USAGE

An advanced generation epoxy for protection and finishing of steel and concrete. It has excellent resistance to abrasion and is suitable for immersion as well as chemical contact exposure. Contact your local Tnemec representative for a list of chemicals. This product can also be used for lining storage tanks that contain demineralized, deionized or distilled water. **Note:** Series V69 conforms with air pollution regulations limiting Volatile Organic Compounds (VOC) to a maximum of 250 grams/litre (2.08 lbs/gal) in areas requiring less than 100 grams/litre VOC, please refer to the Series L69 data sheet.

COLORS

Refer to Tnemec Color Guide. **Note:** Epoxies chalk with extended exposure to sunlight. Lack of ventilation, incomplete mixing, miscatalyzation or the use of heaters that emit carbon dioxide and carbon monoxide during application and initial stages of curing may cause yellowing to occur.

FINISH

Satin

SPECIAL QUALIFICATIONS

A two-coat system at 4.0-6.0 dry mills (100-150 dry microns) per coat passes the performance requirements of **MIL-PRF-4556F** for fuel storage.

PERFORMANCE CRITERIA

Extensive test data available. Contact your Tnemec representative for specific test results.

COATING SYSTEM

PRIMERS

Steel: Self-priming or Series 1, 27, 37H, 66, 90E-92, 90-97, 90-1K97, 91-H₂O, 94-H₂O, 135, 161, 394, 530
Galvanized Steel and Non-Ferrous Metal: Self-priming or Series 66, 161
Concrete: Self-priming or Series 130, 218
CMU: Self-priming or 54-562, 130, 215, 216, 218

TOPCOATS

46H-413, 66, L69, N69, 73, 84, 104, 113, 114, 161, 175, 1028, 1029, 1070, 1071, 1072, 1074, 1074U, 1075, 1075U, 1077, 1078. Refer to COLORS on applicable topcoat data sheets for additional information. **Note:** The following recoat times apply for Series N69/V69: Immersion Service—Surface must be scarified after 60 days. Atmospheric Service—After 60 days, scarification or an epoxy tie-coat is required. Contact your Tnemec representative for specific recommendations.

SURFACE PREPARATION

PRIMED STEEL

Immersion Service: Scarify the Series 66, N69/V69 or 161 prime coat surface by abrasive blasting with fine abrasive before topcoating if it has been exterior exposed for 60 days or longer and N69/V69 is the specified topcoat.

STEEL

Immersion Service: SSPC-SP10/NACE 2 Near-White Blast Cleaning
Non-Immersion Service: SSPC-SP6/NACE 3 Commercial Blast Cleaning

GALVANIZED STEEL & NON-FERROUS METAL

Surface preparation recommendations will vary depending on substrate and exposure conditions. Contact your Tnemec representative or Tnemec Technical Services.

CAST/DUCTILE IRON

Contact your Tnemec representative or Tnemec Technical Services.

CONCRETE

Allow new concrete to cure 28 days. For optimum results and/or immersion service, abrasive blast referencing SSPC-SP13/NACE 6, ICRI CSP 2-4 Surface Preparation of Concrete and Tnemec's Surface Preparation and Application Guide.

CMU

Allow mortar to cure for 28 days. Level protrusions and mortar spatter.

PAINTED SURFACES

Non-Immersion Service: Ask your Tnemec representative for specific recommendations.

ALL SURFACES

Must be clean, dry and free of oil, grease, chalk and other contaminants.

TECHNICAL DATA

VOLUME SOLIDS

67.0 ± 2.0% (mixed) †

RECOMMENDED DFT

2.0 to 10.0 mils (50 to 255 microns) per coat. **Note:** MIL-PRF-4556F applications require two coats at 4.0-6.0 mils (100-150 microns) per coat. Otherwise, the number of coats and thickness requirements will vary with substrate, application method and exposure. Contact your Tnemec representative.

CURING TIME AT 5 MILS DFT

Without 44-700 Accelerator

Temperature	To Handle	To Recoat	Immersion
90°F (32°C)	4 hours	7 hours	6 days
80°F (27°C)	5 hours	8 hours	7 days
70°F (21°C)	7 hours	10 hours	7 days
60°F (16°C)	8 hours	12 hours	9 days
50°F (10°C)	12 hours	16 hours	12 days

Curing time varies with surface temperature, air movement, humidity and film thickness. **Note:** For faster curing and low-temperature applications, add No. 44-700 Epoxy Accelerator; see separate product data sheet.

VOLATILE ORGANIC COMPOUNDS

N69 - Unthinned: 2.40 lbs/gallon (285 grams/litre)
Thinned 10% (No. 4 Thinner): 2.80 lbs/gallon (334 grams/litre)
Thinned 10% (No. 60 Thinner): 2.80 lbs/gallon (335 grams/litre)
V69 - Unthinned: 1.95 lbs/gallon (234 grams/litre)
Thinned 2.5%: 2.08 lbs/gallon (250 grams/litre) †

HAPS

N69 - Unthinned: 2.40 lbs/gal solids
Thinned 10% (No. 4 Thinner): 3.25 lbs/gal solids
Thinned 10% (No. 60 Thinner): 2.40 lbs/gal solids
V69 - Unthinned: 2.05 lbs/gal solids
Thinned 2.5%: 2.30 lbs/gal solids)

THEORETICAL COVERAGE

1,074 mil sq ft/gal (26.4 m²/L at 25 microns). See APPLICATION for coverage rates. †

HI-BUILD EPOXOLINE II | N69 or V69

NUMBER OF COMPONENTS	Two: Part A (amine) and Part B (epoxy)
PACKAGING	5 gallon (18.9L) pails and 1 gallon (3.79L) cans — Order in multiples of 2.
NET WEIGHT PER GALLON	N69: 13.67 ± 0.25 lbs (6.10 ± .11 kg) (mixed) V69: 14.01 ± 0.25 lbs (6.36 ± .11 kg) (mixed) †
STORAGE TEMPERATURE	Minimum 20°F (-7°C) Maximum 110°F (43°C)
TEMPERATURE RESISTANCE	(Dry) Continuous 250°F (121°C) Intermittent 275°F (135°C)
SHelf LIFE	Part A: 24 months; Part B: 12 months at recommended storage temperature.
FLASH POINT - SETA	N69 & V69 Part A: 82°F (28°C) N69 Part B: 93°F (34°C) V69 Part B: 86°F (30°C)
HEALTH & SAFETY	Paint products contain chemical ingredients which are considered hazardous. Read container label warning and Material Safety Data Sheet for important health and safety information prior to the use of this product. Keep out of the reach of children.

APPLICATION

COVERAGE RATES

	Dry Mils (Microns)	Wet Mils (Microns)	Sq Ft/Gal (m²/Gal)
Suggested (1)	6.0 (150)	9.0 (230)	179 (16.6)
Minimum	2.0 (50)	3.0 (75)	537 (49.9)
Maximum	10.0 (250)	15.0 (375)	107 (10.0)

Dense Concrete & Masonry: From 100 to 150 sq ft (9.3 to 13.9 m²) per gallon.

CMU: From 75 to 100 sq ft (7.0 to 9.3 m²) per gallon.

(1) Note for Steel: Roller or brush application requires two or more coats to obtain recommended film thickness. Also, Series N69 can be spray applied to an optional high-build film thickness range of 8.0 to 10.0 dry mils (205 to 255 dry microns) or 11.5 to 14.5 wet mils (209 to 370 wet microns). Allow for overspray and surface irregularities. Film thickness is rounded to the nearest 0.5 mil or 5 microns. Application of coating below minimum or above maximum recommended dry film thicknesses may adversely affect coating performance. †

MIXING

1. Start with equal amounts of both Parts A & B.
 2. Using a power mixer, separately stir Parts A & B.
 3. (For accelerated version. If not using 44-700, skip to No. 4.) Add four (4) fluid ounces of 44-700 per gallon of Part A while Part A is under agitation.
 4. Add Part A to Part B under agitation, stir until thoroughly mixed.
 5. Both components must be above 50°F (10°C) prior to mixing. For application of the unaccelerated version to surfaces between 50°F to 60°F (10°C to 16°C) or the accelerated version to surfaces between 35°F to 50°F (2°C to 10°C), allow mixed material to stand 30 minutes and restir before using.
 6. For optimum application properties, the material temperature should be above 60°F (16°C).
- Note:** The use of more than the recommended amount of 44-700 will adversely affect performance.

THINNING

Use No. 4 or No. 60 Thinner. For air spray, thin up to 10% or 3/4 pint (380 mL) per gallon. For airless spray, roller or brush, thin up to 5% or 1/4 pint (190 mL) per gallon. **Note:** When using Series V69, a maximum of 2.5% of No. 4 Thinner may be used to comply with VOC regulations.

POT LIFE

Without 44-700 15 hours at 50°F (10°C) 5 hours at 77°F (25°C) 3 hours at 100°F (38°C)
With 44-700 8 hours at 35°F (2°C) 4 hours at 77°F (25°C) 1 hour at 100°F (38°C)

APPLICATION EQUIPMENT

Air Spray ‡

Gun	Fluid Tip	Air Cap	Air Hose ID	Mat'l Hose ID	Atomizing Pressure	Pot Pressure
DeVilbiss JGA	E	765 or 704	5/16" or 3/8" (7.9 or 9.5 mm)	3/8" or 1/2" (9.5 or 12.7 mm)	75-100 psi (5.2-6.9 bar)	10-20 psi (0.7-1.4 bar)

Low temperatures or longer hoses require higher pot pressure.

Airless Spray ‡

Tip Orifice	Atomizing Pressure	Mat'l Hose ID	Manifold Filter
0.015"-0.019" (380-485 microns)	3000-4800 psi (207-330 bar)	1/4" or 3/8" (6.4 or 9.5 mm)	60 mesh (250 microns)

Use appropriate tip/atomizing pressure for equipment, applicator technique and weather conditions.

‡ Spray application of first coat on CMU should be followed by backrolling. **Note:** Application over inorganic zinc-rich primers: Apply a wet mist coat and allow tiny bubbles to form. When bubbles disappear in 1 to 2 minutes, apply a full wet coat at specified mil thickness.

Roller: Use 3/8" or 1/2" (9.5 mm or 12.7 mm) synthetic woven nap roller cover. Use longer nap to obtain penetration on rough or porous surfaces.

Brush: Recommended for small areas only. Use high quality natural or synthetic bristle brushes.

SURFACE TEMPERATURE

Minimum 50°F (10°C) Maximum 135°F (57°C)

The surface should be dry and at least 5°F (3°C) above the dew point. Coating will not cure below minimum surface temperature.

CLEANUP

Flush and clean all equipment immediately after use with the recommended thinner or MEK.

† Values may vary with color.

WARRANTY & LIMITATION OF SELLER'S LIABILITY: Tnemec Company, Inc. warrants only that its coatings represented herein meet the formulation standards of Tnemec Company, Inc. THE WARRANTY DESCRIBED IN THE ABOVE PARAGRAPH SHALL BE IN LIEU OF ANY OTHER WARRANTY, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. THERE ARE NO WARRANTIES THAT EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF. The buyer's sole and exclusive remedy against Tnemec Company, Inc. shall be for replacement of the product in the event a defective condition of the product should be found to exist and the exclusive remedy shall not have failed its essential purpose as long as Tnemec is willing to provide comparable replacement product to the buyer. NO OTHER REMEDY (INCLUDING, BUT NOT LIMITED TO, INCIDENTAL OR CONSEQUENTIAL DAMAGES FOR LOST PROFITS, LOST SALES, INJURY TO PERSON OR PROPERTY, ENVIRONMENTAL INJURIES OR ANY OTHER INCIDENTAL OR CONSEQUENTIAL LOSS) SHALL BE AVAILABLE TO THE BUYER. Technical and application information herein is provided for the purpose of establishing a general profile of the coating and proper coating application procedures. Test performance results were obtained in a controlled environment and Tnemec Company makes no claim that these tests or any other tests, accurately represent all environments. As application, environmental and design factors can vary significantly, due care should be exercised in the selection and use of the coating.

Selection & Specification Data

Generic Type	Coal Tar Epoxy
Description	Renowned high build coal tar epoxy for protection of steel and concrete in single or two-coat applications in a broad variety of aggressive industrial applications.
Features	▪ Excellent chemical, corrosion and abrasion resistance ▪ High-build up to 24 mils (610 microns) in a single coat ▪ Compatible with controlled cathodic protection ▪ Meets or exceeds all requirements of: • Corp of Engineers C-200, C200a • AWWA C-210-92 for exterior • SSPC-Paint 16 • Steel Tank Institute Corrosion Control System STI-P₃
Color	Black (0900)
Finish	Gloss. Will discolor, chalk and lose gloss in sunlight exposure.
Primers	Self-priming, Carboguard 888 or others as recommended.
Topcoats	Not recommended
Dry Film Thickness	16.0 mils (400 microns) in one or two coats. Total dry film thickness less than 8 mils (200 microns) or in excess of 24 mils (610 microns) not recommended.
Solids Content	By Volume: 74% ± 2%
Theoretical Coverage Rate	1187 mil ft ² (29.1 m ² /l at 25 microns) Allow for loss in mixing and application
VOC Values	As supplied: 1.85 lbs/gal (222 g/l) Thinned: 20 oz/gal w/ #10:* 2.6 lbs/gal (309 g/l) 25 oz/gal w/ #10: 2.7 lbs/gal (327 g/l) These are nominal values. *Maximum thinning for 250 g/l restricted areas is 6 oz/gal.
Dry Temp. Resistance	Continuous: 350°F (177°C) Non-Continuous: 370°F (190°C)
Wet Temp. Resistance	Immersion temperature should not exceed 120°F (49°C).
Limitations	Do not use for potable water requirements

Substrates & Surface Preparation

General	Surfaces must be clean and dry. Employ adequate methods to remove dirt, dust, oil and all other contaminants that could interfere with adhesion of the coating.
Steel	<u>Immersion:</u> SSPC-SP10 <u>Non-Immersion:</u> SSPC-SP6. SSPC-SP2 or SP3 as minimum requirement imparting proper profile. <u>Surface Profile:</u> 2.0-3.0 mils (50-75 micron)
Concrete	Concrete must be cured 28 days at 75°F (24°C) and 50% relative humidity or equivalent. Prepare surfaces in accordance with ASTM D4258 Surface Cleaning of Concrete and ASTM D4259 Abrading Concrete. Voids in concrete may require surfacing.

Performance Data

Test Method	System	Results	Report #
ASTM D4060 Abrasion	Blasted Steel 2 cts. 300M	130 mg. loss after 1000 cycles. CS17 wheel, 1000 gm load.	02877
ASTM D4541 Adhesion	Blasted Steel 2 cts. 300M	1443 psi (Pneumatic)	02877
ASTM D2794 Impact	Blasted Steel 2 cts. 300M	Impact site diameter. Inches: 3/8, 3/8, 1/2 100 in/lbs Gardner Impact at 1/2 in. diam.	02877
ASTM B117 Salt Fog	Blasted Steel 2 cts. 300M	No blistering, rusting or delamination. No measurable undercutting at scribe after 2000 hrs.	02938

Test reports and additional data available upon written request.

Bitumastic® 300M

Application Equipment

Listed below are general equipment guidelines for the application of this product. Job site conditions may require modifications to these guidelines to achieve the desired results.

General Guidelines:

Spray Application (General) This is a high solids coating and may require adjustments in spray techniques. Wet film thickness is easily and quickly achieved. The following spray equipment has been found suitable and is available from manufacturers such as Binks, DeVilbiss and Graco.

Conventional Spray Pressure pot equipped with dual regulators, 3/8" I.D. minimum material hose, with 50' maximum material hose .086" I.D. fluid tip and appropriate air cap.

Airless Spray Pump Ratio: 30:1 (min.)*
GPM Output: 3.0 (min.)
Material Hose: ½" I.D. (min.)
Tip Size: .023-.035"
Output PSI: 2100-2500
Filter Size: 30 mesh
*Teflon packings are recommended and available from the pump manufacturer.

Brush & Roller (General) Recommended for touch up, striping of weld seams and hard-to-coat areas only. Avoid excessive re-brushing or re-rolling.

Brush Use a medium bristle brush.

Roller Use a short-nap synthetic roller cover with phenolic core.

Mixing & Thinning

Mixing Power mix separately, then combine and power mix for a minimum of two minutes. DO NOT MIX PARTIAL KITS.

Ratio 4:1 Ratio (A to B)

Thinning Up to 20 oz/gal (16%) w/ #10
Up to 25 oz/gal (20%) w/ #10 for the first coat application to concrete. Use of thinners other than those supplied or recommended by Carboline may adversely affect product performance and void product warranty, whether expressed or implied.

Pot Life 75°F (24°C) 2 Hours
90°F (32°C) 1 Hour
Pot life ends when coating loses body and begins to sag.

Cleanup & Safety

Cleanup Use Thinner #2 or Acetone. In case of spillage, absorb and dispose of in accordance with local applicable regulations.

Safety Read and follow all caution statements on this product data sheet and on the MSDS for this product. Employ normal workmanlike safety precautions. Hypersensitive persons should wear protective clothing, gloves and use protective cream on face, hands and all exposed areas.

Caution This product contains flammable solvents. Keep away from sparks and open flames. All electrical equipment and installations should be made and grounded in accordance with the National Electric Code. In areas where explosion hazards exist, workmen should be required to use non-ferrous tools and wear conductive and non-sparking shoes.

Application Conditions

Condition	Material	Surface	Ambient	Humidity
Normal	60-85°F (16-29°C)	60-85°F (16-29°C)	60-85°F (16-29°C)	0-80%
Minimum	50°F (10°C)	50°F (10°C)	50°F (10°C)	0%
Maximum	90°F (32°C)	125°F (52°C)	110°F (43°C)	90%

Condensation due to substrate temperatures below the dew point can cause flash rusting on prepared steel and interfere with proper adhesion to the substrate. Special application techniques may be required above or below normal application conditions.

Curing Schedule

Surface Temp. & 50% Relative Humidity	Dry to Touch	Minimum Recoat Time	Maximum Recoat Time	Cure for Immersion
50°F (10°C)	8 Hours	10 Hours	24 Hours	14 Days
75°F (24°C)	4 Hours	6 Hours	24 Hours	7 Days
90°F (32°C)	2 Hours	3 Hours	24 Hours	5 Days

These times are based on a 16.0 mil (400 micron) dry film thickness. Higher film thickness, insufficient ventilation, high humidity or cooler temperatures will require longer cure times. Excessive humidity or condensation on the surface during curing can interfere with the cure, can cause discoloration and may result in a surface haze. Any haze or blush must be removed by water washing before recoating. If the **maximum recoat time** is exceeded, the surface must be abraded by sweep blasting prior to the application of additional coats. **Holiday Detection** (if required): Wet sponge types may be used if the dry film thickness is below 20 mils (500 microns). High voltage spark testing should be used when the dry film thickness exceeds 20 mils (500 microns). Refer to NACE RP0188-90 for specific procedures.

Packaging, Handling & Storage

Shipping Weight (Approximate)	<u>1.25 Gallon Kit</u> 12 lbs (6 kg)	<u>5 Gallon Kit</u> 50 lbs (26 kg)
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Flash Point (Setaflash) 75°F (24°C) for Part A
>200°F (93°C) for Part B

Storage (General) Store Indoors.

Storage Temperature & Humidity 40° -110°F (4°-43°C)
0-100% Relative Humidity

Shelf Life Part A: Min. 12 months at 75°F (24°C)
Part B: Min. 24 months at 75°F (24°C)

***Shelf Life: (actual stated shelf life) when kept at recommended storage conditions and in original unopened containers.**



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SECTION 43 08 20.11

TESTS ON PUMPING EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes requirements for tests on pumping equipment including the following for each pump provided:

1. Shop hydrostatic testing.
2. Shop performance testing.
3. Field running and performance testing.
4. Field vibration testing.

1.2 REFERENCES

- A. Testing shall be in accordance with the latest revisions of the Test Code of the Hydraulic Institutes Standards (HIS), except where more stringent requirements have been specified herein

1.3 SUBMITTALS

- A. In addition to those submittals identified in the Special Provisions, the following items shall be submitted:

1. The Contractor shall submit a detailed testing plan to the Engineer for all field testing specified herein. The testing plan shall be approved prior to the initiation of the field tests. The testing plan shall include the Contractors schedule and procedures for conducting all field tests.

1.3-A.1.

2. Five copies of the shop hydrostatic test results.

3. Five copies of the shop performance test results in the form of performance curves certified as to actual test date and witness for each pump tested.

4. Five copies of field running test results shall be submitted. Field test results shall also be included in the Operation and Maintenance Manuals.

1.3-A.4.

PART 2 PRODUCTS

2.1 GENERAL

- A. Model Test for Performance will not be allowed.

- B. Shop testing may be witnessed by the Engineer where indicated in the technical specifications. The Contractor shall give the Engineer fourteen (14) calendar days notice prior to scheduled shop testing. ✓

2.2 TEST EQUIPMENT

- A. Manufacturer shall furnish materials and equipment including drives required to perform shop test. ✓
- B. Contractor shall furnish materials and equipment required to perform field test. ✓

PART 3 EXECUTION

3.1 SHOP HYDROSTATIC TEST

- A. Hydrostatic pressure test shall be at a pressure equal to twice the specified shut-off head or 150 psi, whichever is greater.
- B. The casings and heads shall show no:
1. Undue deflection
 2. Sign of weakness
 3. Sweating through porous metal
 4. Leakage
- ✓

3.2 SHOP PERFORMANCE TESTING

- A. The pump manufacturer shall perform the following inspections and tests on each pump before shipment from the factory.
1. Impeller, motor rating, and electrical connections shall be checked for compliance with specifications. ✓
 2. A motor and cable insulation test for moisture content or insulation defects shall be made. 3.2-A.2.
 3. The pump shall be run dry to establish correct rotation and mechanical integrity. ✓
 4. The pump shall be run wet for 30 minutes. ✓
 5. During the test under item 4), amperage and voltage shall be recorded. ✓
 6. After operational test under item 4), the insulation test under item 2) is to be performed again. 3.2-A.6.
 7. Immediately prior to shipment, each pump cable end shall be fitted with a shrink fit rubber boot or plastic dipped to protect the pump from water seepage that could occur on site before electrical installation is complete. 3.2-A.7.

- B. Electrically and functionally test the pump control components prior to shipment. 3.2-B
- C. For submersible pumps and dry-pit submersible pumps, submerge pumps for at least 2 hours after which a megger test shall be performed on the motor windings and cables. Record results. 3.2-C
- D. Each pump shall be tested at maximum rated speed over a range of operating conditions (minimum of six evenly spaced test points plus the pump shut-off point), consistent with the design or performance criteria as specified in the technical specification for the pumping equipment, to develop its performance curves for:
 - 1. Head-capacity (TDH-Flow) ✓
 - 2. Power input (BHP) ✓
 - 3. Efficiency ✓
 - 4. Net Positive Suction Head Required 3.2-D.4.
- E. A written report certifying the foregoing steps shall be supplied with each pump. ✓

3.3 FIELD RUNNING AND PERFORMANCE TESTING

- A. Each pump assembly with its drive unit and auxiliary equipment shall be field tested after installation.
- B. The pump manufacturer or manufacturer's representative shall be present during the field running and performance testing. Where pumps are equipped with variable frequency drives (VFD), the VFD manufacturer or manufacturer's representative shall also be present during all tests.
- C. The Contractor shall provide test water to conduct the field running and performance tests. Wet well(s) and piping which are part of the pumping system being tested shall be filled with test water to design elevations unless otherwise directed. The Contractor shall provide continuous flow of test water as required to conduct the performance running tests specified herein. 3.3
- D. Tests shall not be started on any pump assembly until the pump manufacturer or pump manufacturer's representative is present and has completed the inspection for proper assembly, erection and alignment. Manufacturer or manufacturer's representative shall provide Certification of Installation, in accordance with the Special Provisions.
- E. Test shall be conducted by the Contractor and the pump manufacturer or manufacturer's representative and witnessed by the Engineer, and shall demonstrate the following under operating conditions:
 - 1. Pump has been properly installed and has no mechanical defects.
 - 2. Pump is in proper alignment and has been properly connected.

3. Pump is free from undue vibration over the full range of operating conditions.

4. Pump is free from overloading and overheating.

F. Power for testing shall be provided by the Contractor.

G. The following field running performance tests shall be conducted by the Contractor. Each pump assembly with its drive unit and auxiliary equipment shall be tested.

1. Demonstrate that pump check valves open properly at pump start up. Where check valve limit switches are provided, demonstrate that these operate properly.

2. Demonstrate proper functioning pump discharge and/or suction pressure gages. Verify that pressure gage instrument range is as specified.

3. Where air/vacuum release valves are provided as part of the pumping system, demonstrate proper operation during pump start and stop.

4. Where pump control valves, pressure switches or other pump control equipment or accessories are provided and required for pump operation, the Contractor shall demonstrate that such equipment and accessories are functioning as intended.

5. Operate each pump at rated speed for 30 minutes without other pumps running and record the following data at every 5 minute interval:

a. Pump suction and discharge pressures

b. Volts and amps on each phase

c. Flow rate (where flow meters are part of the pumping system, installed and calibrated)

d. Hertz output from drive for pumps with VFD equipment

6. For pumps equipped with VFDs, operate each pump at minimum speed (at which speed the pump discharge is greater than zero) 15 minutes without other pumps running and record the above data at every 5 minute interval.

7. Compare the above data with the certified pump performance curves.

8. Verify two additional operating points on the certified pump performance curve for each pump by recording discharge flow rates and suction/discharge pressures for:

a. Throttled conditions (partially close the pump discharge valve, or other downstream isolation valve).

b. Shut-off conditions (record pump shut-off pressure by closing the

3.3

pump discharge valve – discharge flow rate is zero.

Confirm with the pump manufacturer before conducting the pump shut-off test.

9. For variable speed controlled pumps, repeat the above “rated speed” test only, for each pump at a speed of 75% (or as otherwise directed by the Engineer) of the rated pump speed.
10. Where two or more pumps are tested, the Contractor shall run all pumps simultaneously. The design dedicated stand-by pump shall not be running. Test duration shall be 5 minutes. Record total discharge flow rate. The Contractor shall provide the test water quantity necessary to conduct this test.
11. Where flow meters are not part of the pumping system, quantification of discharge flow rate shall be based on wet well draw-down (suction side of pump), or wet well (tank) fill-up (discharge side of pump). Supply of test water in the “draw-down” mode shall be halted during the draw-down test.
12. Where flow meters are used for discharge flow rate recording, a minimum of one “draw-down” or “fill-up” test shall be conducted when feasible to compare flow meter readings. Draw-down volume (or equivalent wet well level change) and draw-down time shall be recorded. Average flow rate shall be computed as the draw-down volume divided with the draw-down time. During the draw-down period, the flow meter reading shall be recorded at five different times and averaged.

3.3

3.4 FIELD VIBRATION TESTING

A. General

1. Perform a vibration analysis on all pumps after they are installed and ready to run. All vibration readings used for acceptance shall be taken with the pumps operating at the primary design point. The vibration analysis shall be performed by qualified technicians. The technicians credentials shall be approved by the Engineer prior to start of testing. An authorized representative of the County shall witness the testing.
2. Overall lateral vibrations (i.e. vibrations acting side-to-side, up and down, or axially) shall be analyzed in the field. At a minimum, points to be analyzed shall include pump base plate, pump casing, and pump motor.
3. A background preliminary vibration check shall be taken on each pump to be tested with the pump off. Any background vibration from sources outside the machine being tested shall be accounted for in the running pump vibration levels.

3.4

B. Vibration Testing

1. Vibration shall be measured with an FFT analyzer or data collector. Spectrum plots shall be provided in printed form. The test equipment shall be capable of providing a complete broadband or “Overall (OA)” value in

addition to individual frequency components. The type, model, serial number, and latest certified calibration date of all test equipment used in the measurement of vibration levels for machine acceptance shall be documented. Measurements shall be taken with a Hanning Window setting and four linear, non-overlapping averages.

2. The sensor used shall be an accelerometer with a magnetic mount. Handheld pickups are not acceptable unless machine casing design interferences preclude the use of a magnetic base. The magnetically mounted sensors shall be mounted such that the magnetic base can be attached firmly without rocking.
3. Vibration amplitude readings in inches/second peak vs. frequency in cycles per minute (CPM) shall be used. Both a vibration spectrum and overall value shall be recorded for each measurement point shown on the testing diagram at the end of this section.
4. When coupled or belt-driven equipment is running and operating under load, record vibration data. If the equipment fails to meet the vibration tolerances, record the vibration readings on the driver unit disconnected from the driven equipment. Use this data to compare with the vibration of the complete unit to determine the source of the problem.

3.4

C. Documentation

1. Four copies of the vibration report on tested machinery shall be submitted to the Engineer:
 - a. Outlining the procedures used;
 - b. Stating the vibration standards used for the equipment;
 - c. Stating the analysis results for each piece of equipment;
 - d. Discussing the source of any unacceptable vibration found (rotor unbalance, shaft misalignment, bearing problems, vane pass vibration, etc.) and recommended actions to correct.
2. A complete set of vibration spectra shall be submitted for each piece of equipment tested.

D. Vibration Tolerances

1. Vibration tolerances to be applied to each measurement point on the pumps in the field shall be as follows:
 - a. The "Overall (OA)" or total broadband unfiltered reading shall be no more than 0.25 inches/ second peak vibration velocity.

- b. Vibration tolerances to be applied to the individual frequency peaks in the vibration spectrum shall be as follows:

<u>Frequency Range</u>	<u>Tolerance</u>
Subsynchronous (below motor RPM)	No vibration peaks in excess of 0.03 inches/second peak vibration velocity
At motor or pump RPM	Not to exceed 0.10 inches/second peak vibration velocity
At impeller blade pass frequency (number of impeller blades times pump RPM)	Not to exceed 0.15 inches/second peak vibration velocity
Above impeller blade pass frequency out to 120,000 cycles per minute (CPM)	No vibration peaks in excess of 0.08 inches/second peak vibration velocity

3.4

2. On variable frequency drive (VFD) applications, vibration shall be evaluated against the tolerances as follows:

- a. Store and evaluate the vibration data against the above tolerances at all measurement points designated on the attached testing diagram under full speed conditions. These readings shall be included in the vibration report.
- b. Select the measurement point with the highest amplitude vibration frequency of interest and/or overall vibration level and place the accelerometer at that location.
- c. The equipment speed shall then be manually reduced at the VFD in 1 Hertz increments from full speed to designed minimum speed (or flow) while observing or storing (vibration analyst option) the vibration data.
- d. Note and record any significant increases in vibration which may indicate a critical speed or resonance problem. Also note and record the pump shaft speed or VFD Hertz output setting at which the problem (if any) occurs.

3.5 ACCEPTANCE

- A. Acceptance of hydraulic performance shall depend upon satisfactory shop performance test as demonstrated by certified performance curves.
- B. Final acceptance of each pumping unit shall depend upon satisfactory operation as demonstrated by the field running test and operation under field conditions.
- C. Prior to final acceptance the Contractor shall correct all deficiencies.

3.5

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3.6 FINAL ALIGNMENT

- A. After 24 hours of operation the alignment of the unit shall be checked and adjusted, if required.
- B. Check the unit for being "pinned", where required.

} 3.6

* * * * *

SECTION 43 21 13.31

VERTICAL TURBINE SOLIDS HANDLING PUMPS

PART 1- GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This specification includes the supply of three (3) single stage, Vertical Turbine Solids Handling (VTSH) Pumps, each having a discharge flow capacity as shown in Section 2.2. Each unit shall be supplied complete with non-clog suction bowl assembly capable of passing 5 inch solids, column with splitter vane, enclosed line shaft, surface discharge head, sole plate, and motors. Pumps less than 30 feet in length shall be shipped completely assembled, less motor.
- B. The pumps and the bearing protection system shall be provided by a single supplier to maintain sole-source responsibility. The pump supplier shall coordinate with the supplier of the VFD's as specified in electrical Division 26. The VFD manufacturer shall review the pump motor submittals and shall provide written verification that the selected VFD is suitable for operating the pump and motors provided under the Contract particularly with respect to starting torque and a continuous output torque.
- C. Motors shall conform to requirements of Division 26 Section "Common Motor Requirements."

1.3 EQUIPMENT IDENTIFICATION

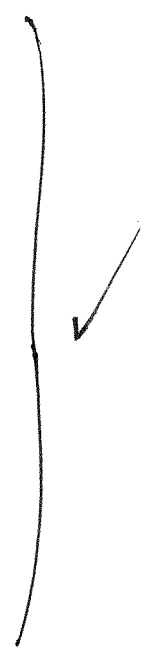
- A. Equipment covered under this specification is identified as follows:

Primary Effluent Pump No. 1
Primary Effluent Pump No. 2
Primary Effluent Pump No. 3

1.4 RELATED WORK

- A. Related sections include the following:
 - 1. Division 9
 - a. Section "Painting"
 - 2. Division 26
 - a. Section "Common Motor Requirements"
 - 3. Division 40
 - a. Section "Pressure Gauges"
 - 4. Division 40
 - a. Section "Tests on Pumping Equipment"

1.5 REFERENCES

- A. The properties of all materials, design, fabrication and performance of the equipment to be furnished under this section shall be in accordance with the latest issue of applicable standard specifications. The governing authorities of these standards are listed below.
1. AICS, American Institute of Steel Construction
 2. AISI American Iron and Steel Institute
 3. ANSI, American National Standards Institute
 4. ASCE, American Society of Civil Engineers
 5. ASME, American Society of Mechanical Engineers
 6. ASTM, American Society of Testing and Materials
 7. AWS, American Welding Society
 8. IBC, International Building Code
 9. IEC, International Electric Code
 10. IEEE, Institute of Electrical and Electronics Engineers
 11. NEC, National Electrical Code
 12. NEMA, National Electrical Manufacturers Association
 13. Underwriters Laboratory (UL and cUL)
- 

1.6 SUBMITTALS

- A. Submittals shall conform to the General and Supplementary Conditions.
- B. Compliance Statement: With each submittal, include a Compliance Statement listing each Specification Section, and Part 1, 2, and 3 Sub-Sections, stating, paragraph-by-paragraph, compliance with the Specification, each minor nonconformity that is within the intent of the Specification, and proposed nonconformities. Provide short description of minor nonconformities, and detailed explanation of other nonconformities.
- C. In addition to those submittals identified in the General Conditions, the following items shall also be submitted:
1. Performance data curves showing head, capacity, horsepower demand, pump efficiency, and net positive suction head required over the entire operating range of the pump at both design minimum and rated speed. Indicate separately the head, capacity, horsepower demand and overall efficiency at the guarantee point.
 2. Catalog data on pumps, motors, drives and all appurtenances. Shop drawings providing layout of mechanical equipment and anchor bolt locations. Provide dimensions of any required pipe or column penetrations.
 3. Certified pump curves showing head, capacity, horsepower demand, pump efficiency, and net positive suction head required over the entire operating range of the pump at both minimum and rated speed. Indicate separately the head, capacity, horsepower demand and overall efficiency at the guarantee point.
- 

4. Installation or placing drawings for equipment, drives and bases.
 5. Suggested spare parts list with current price information.
 6. List of special tools required for checking, testing, parts replacement, and maintenance. (Special tools are those which have been specially designed or adapted for use on parts of the equipment, and which are not customarily and routinely carried by maintenance mechanics.)
 7. List of materials and supplies furnished with the equipment.
 8. Requirements for handling, maintenance, storage and protection prior to installation.
 9. Requirements for routine maintenance required prior to plant startup.
 10. Motor submittals shall conform to Division 26 Section "Common Motor Requirements".
 12. Manufacturer's installation recommendations.
 13. Warranty information
- E. Submit Operation and Maintenance Manuals in accordance with the General Conditions.
- F. Submit Manufacturer's certification that all materials furnished are in compliance with the applicable requirements of this Specification.
- G. Submit Manufacturer's Certificate of proper installation.

1.7 QUALITY ASSURANCE

- A. All pumping equipment furnished under this Section shall be of a design and manufacture that has been used in similar applications, and it shall be demonstrated to the satisfaction of the Owner that the quality is equal to equipment made by that manufacturer specifically named herein.
- B. Manufacturers shall have installations of like or similar application with a minimum of 15 years service for this pump size.
- C. Unit responsibility. Pump(s), complete with motor, necessary guards, and all other specified accessories and appurtenances shall be furnished by the pump manufacturer to insure compatibility and integrity of the individual components, and provide the specified warranty for all components.
- D. The VTSH type pump(s) specified in this section shall be furnished by and be the product of one manufacturer.
- E. Pumps are to be engineered and manufactured under a written Quality Assurance program. The Quality Assurance program is to be in effect for at least ten years, to

include a written record of periodic internal and external audits to confirm compliance with such program.

- F. Pump(s) are to be engineered and manufactured under the certification of ISO-9001:2000.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver VTSH Pumps and appurtenances in shipping splits that can be moved past obstructions in the delivery path.
- B. Coordinate delivery of VTSH Pumps and appurtenances to allow movement into designated space.
- C. Contractor shall store appurtenances in clean dry indoor rooms with a temporary dehumidifier and electric heating to maintain the storeroom between 5 and 40 deg. C with humidity less than 90%. Comply with manufacturer's additional written instructions for handling, maintenance, storing and periodic inspection and testing prior to installation. Motor windings shall be megger-tested monthly during storage. Units that have absorbed excessive moisture due to poor humidity and temperature control shall be returned to the manufacturer for drying-out and reestablishing acceptable megger test values at no additional cost to the Owner. Energize panel heaters during storage periods exceeding two weeks.
- D. Handle VTSH Pumps and appurtenances components according to manufacturer's written instructions. Use factory-installed lifting provisions.

1.9 WARRANTY

- A. Provide parts and labor warranty in accordance with the General Conditions.
- B. In addition, the pump manufacturer shall warrant the pumps with a five (5) year prorated limited warranty from the date of shipment. Associated with this warranty, and to validate this warranty, the pump manufacturer shall have a factory authorized repair facility within 200 miles of the pump installation. The pump repair facility shall have the ability to troubleshoot, repair and test the pumps using state of the art equipment. The authorized repair facility shall have a 24/7 emergency service available.
- C. The warranty shall provide full protection for the pump against VFD-induced bearing damage for the life of the motor.

PART 2- PRODUCTS

2.1 MANUFACTURER AND SYSTEM SUPPLIERS

- A. The project design is based on Flowserve and Fairbanks-Nijhuis as listed in this Section.

- B. If any other manufacturer other than those listed in this Section, or substitution, are proposed by the Contractor for the Work covered in this Section, it shall be the responsibility of the Contractor to perform any required redesign and coordination associated with, but not limited to, mechanical equipment layout, electrical wiring, conduit and controls, and structural/architectural work, at no additional cost to the Contract.
- C. No substitution of the listed manufacturer(s) will be allowed without prior approval by the Engineer, in accordance with the requirements outlined on the Bid Form.
- D. Acceptable manufacturers:
1. Flowserve
 2. Fairbanks Nijhuis
 3. Or Approved Equal

2.2 VERTICAL TURBINE SOLIDS HANDLING PUMPS (VTSH)

A. Performance/Design Criteria

1. The pumps shall be designed for continuous operation and will be operated continuously under normal service using variable frequency drive (VFD) equipment.
2. Discharge size shall be 20-inch diameter.
3. Design Criteria

	Flow (Gpm)	TDH (ft.)	Pump Speed (RPM)	NPSHR @ Rated Condition (ft.)	Min. Bowl Eff	Max. Shutoff Head (ft.)	Maximum HP (over entire curve)
* Maximum Condition	9750	34	880	26	82	79	125
**Normal Condition	7000	26	705	14	83	49	125
***Minimum Condition	4000	23	585	7	77	34	125
*Max flow combination of two -20" pumps total flow = 18,500 gpm ** Normal Operating Condition, 1 pump running should be at or near BEP. *** *Minimum expected flow for individual pump. TDH = Total Dynamic Head.							

4. Actual Pump performance shall not vary by more than 3 percent for total produced head or 1 percent for pump operational efficiency from the values shown above.

B. Description/Materials and Construction

1. Bowl Assembly
 - a. Pump bowl shall be of close-grained cast iron construction conforming to ASTM A48 CL30, free of blow and sand holes.

Discharge bowl shall contain three symmetrically arranged diffusion vanes.

- b. Impeller shall be of the enclosed solids handling type, statically and dynamically balanced, containing a maximum of two vanes and shall be one-piece cast iron conforming to ASTM A48 CL30. All casting connections shall be rabbet fitted. The impeller and bowl diffusion vanes shall be of a hydrofoil design with well-rounded leading edges to prevent the accumulation of fibrous and stringy material. The non-clog impeller shall be secured to the tapered shaft using a key and bolt.
- c. Upper and lower bronze-backed rubber bearings shall maintain alignment of the shaft through the bowl. The bowl shaft shall be 416 stainless steel with chrome plating at the bearing area.
- d. Bowl bearings must be protected by a restrictor-bushing system. This protection system shall incorporate a Teflon bushing that limits backflow of sand, grit or other potential destructive material during pump shutdown. This restrictor bushing shall also throttle or limit the amount of flush water used during pump operation, as well as provide proper pressurization of the enclosing tube and bearing lubrication system. The restrictor bushing shall be locked in place with a retaining ring, but be free to "float" along the shaft.
- e. The impeller and bowl passageways and the clearance between the periphery of the maximum diameter impeller and bowl diffuser vanes shall be capable of passing a 5" diameter sphere.
- f. The suction bell shall be free of bearing hubs and supporting ribs or vanes to allow unobstructed flow to the impeller. Impeller shall be fitted with an axial type wear ring of ASTM A743 CA40 material with a hardness range of 300-350 Brinell.
- g. To prevent vortexing and undesirable eddys, a cast aluminum hydrocone shall be provided. The contractor shall permanently mount the hydrocone to the sump floor. It is to be located below the suction bell on the pump centerline for each pump.

2. Column Assembly

- a. Column pipe shall be of flanged type and not less 20" in diameter on the 20" VTSH. The 20" VTSH shall have a minimum wall thickness of 3/8" inches. Column pipe shall be furnished in maximum lengths of ten (10) feet and shall be connected by flanged joints registered to ensure proper alignment after assembly. Column pipe shall contain a splitter vane to prevent trash and stringy material from accumulating on the shaft enclosing tube. The splitter vane shall be securely welded in place and shall run the entire length of the column. It shall be aligned with the bowl diffusion

vane and the discharge elbow splitter vane. Use of "Spider Type" bearing retainers is not acceptable. ✓

- b. Line shafting shall be minimum of 2-7/16" inches in diameter and shall be 416 stainless steel on the 20" VTSH. The line shafting shall be furnished in interchangeable sections with a maximum length of ten (10) feet and shall be coupled with threaded couplings. An enclosing tube shall be provided to house the lineshaft. The 20" VTSH shall be provided with 4" schedule 80 pipe furnished in interchangeable sections also not to exceed five (5) feet in length. The ends of the enclosing tube shall be machined to receive connector bearings. These lineshaft bearings shall be of bronze material and designed for fresh water flush. ✓

- c. The column length (pump setting) dimension from the bottom of the base plate to the bottom of the inlet bell shall be 16.92 feet. ✓

3. Discharge Head

- a. Pumps shall be provided with a fabricated quadraped steel discharge head and sole plate for mounting the driver. Discharge head shall be of the above-ground (surface), three-section, mitered style and designed to prevent the collection of stringy material by the use of a splitter vane. ✓

- b. Discharge heads shall be provided with a 20" 150 pound ANSI flanged connections, a packing box, which shall connect to the line enclosing tube with a threaded line shaft bearing. The packing box shall contain a Chesterton 442 water flushed split mechanical seal. A two-piece top shaft shall be provided with a 304 stainless steel sleeve at the packing box. Each pump shall contain a suitable drain tap for packing box leakage. 2.2-B.3.b.

- c. The discharge head shall include a tapped connection for installation of an air and vacuum release valve, sized and supplied by the pump manufacturer. 2.2-B.3.c.

- d. The discharge head shall include a tapped connection for a discharge pressure gauge sized and supplied by the pump manufacturer in accordance with Division 40 Section "Pressure Gauges". 2.2-B.3.d.

4. Bearing Protection System

- a. A seal water flush assembly for flushing, lubricating and cooling the bearings shall be connected to each stuffing box. Pump manufacturer shall provide a seal water monitoring and control system for each pump sized by the manufacturer for the specific pump and service conditions. The system shall be a component system with flow volume and pressure monitoring and regulating capabilities. It shall also include an integral flow switch to signal low seal water flow. System shall be John Crane Safeunit Ultima, or equal. 2.2-B.4.a.

- b. The bearings must be flushed for a minimum of five (5) minutes prior to pump start, continuously while in operation and at least 15 minutes after stopping for proper lubrication. This is to prevent grit and foreign material from fouling the bearings.

5. Pump Driver

- a. The pumps shall be driven by vertical solid shaft, high efficiency, inverter-duty motors Compatible with VFD starters and rated for installation in a Class 1 Division 1 hazardous classified space. Motor shall have Class F insulation. Motors shall conform to requirements of Division 26 Section "Common Motor Requirements".
- b. Motors shall be provided by the pump manufacturer and shall be designed for use with the vertical turbine pumps. Motors shall be provided with operating characteristics as specified herein and shall be suitable for operation with PWM type variable frequency drives.
- c. Horsepower and speeds shall be as specified herein Performance/Design Criteria for each VTSH Pump and shall be suitable for operation on 3/60/460 volt service.
- d. Motor shall be non-overloading anywhere on the hydraulic curve.
- e. Auxilliary fans shall be provided if required to properly cool the motor when operating at minimum speed with ambient room temperatures up to 35C.
- f. Equip motor with a non-conductive thrust bearing carrier with a resistance of more than 1 gigaohm at 1,000 volts and a shaft grounding ring mounted above the motor shaft guide bearing. The grounding ring shall be electrically connected to the motor ground in accordance with Section 26 "Common Motor Requirements".

2.3 SOURCE QUALITY CONTROL

A. Factory Quality Certification

- 1. Submit copy of factory quality assurance certificate.

B. Factory Assembly

- 1. The Vertical Turbine Solids Handling Pumps shall be manufactured in accordance with the factory quality certified documents.

C. Perform shop testing in accordance with the requirements of the Section entitled "Tests on Pumping Equipment". Submit shop tests reports to confirm testing was successfully completed.

2.4 SHOP FINISHES

A. Coatings

1. Outside of the bowl, inside and outside of the column, outside of the tube and interior of head shall be coated with Carboline 300M coal tar epoxy, at a minimum dry-film thickness of 16 mils. Exterior surfaces above floor level (everything including and above the base plate) shall receive the standard machinery enamel finish suitable for corrosive environments, ANSIGI light gray paint.
2. With the exception of those parts and components customarily furnished unpainted, prepare and coat all metal surfaces with rust inhibitive shop paint. Shop paint shall be fully compatible with the field paint specified.
3. Protect machined surfaces against damage and corrosion by other means.
4. Surface preparation and application of the shop paint coating shall be as specified in the Section entitled "Painting".

2.5 SPARE PARTS

A. Furnish the following spare parts for each size of the pump specified:

1. One (1) Impeller with wear ring and fastener.
2. One (1) Bowl wear ring.
3. One (1) Bowl bearing with lip seal.
4. One (1) Stuffing box throat bushing.
5. One (1) Mechanical seal repair kit.

B. Package spare parts in wooden boxes, labeled with the manufacturer's names, address and telephone number; local representative's name, address and telephone number; name of equipment the parts are for and list parts contained therein.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Prior to installation examine areas and conditions for compliance with manufacturer's installation recommendations and requirements.
- B. Prior to installation examine roughing-in of pump settings systems to verify the following:
 1. Pump Settings are within the limitations established by the manufacturer.
 2. Each utility pipe and conduit is in the correct location.
 3. Examine walls, floors, roofs, and concrete bases for suitable conditions for installation, for example, all overhead work of other trades is complete.

4. Verify that ground connections are in place and that installation of grounding described in Section "Grounding" is complete.
5. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 MANUFACTURER'S FIELD SERVICES

- A. Provide manufacturer's services at the jobsite designated by the Owner for the minimum hours listed below, travel time excluded:
 1. 8 hours for installation assistance, inspection, and certification of installation.
 2. 8 hours for performance testing.
 3. 4 hours for operational training.
- B. Each jobsite visit shall be scheduled separately with minimum seven (7) calendar days notice prior to each visit. The service visit for operational training shall be scheduled in coordination with the Owner's operations staff and shall be at such times as requested by the Owner.
- C. Field testing of each of the vertical turbine pumps shall be performed in accordance with the Contract Documents as follows:
 1. Pre-test Checkout
 - a. Pump Alignment
 - (1) Before pedestal is grouted check that pump column assembly is absolutely vertical.
 - (2) Check for piping stresses after final alignment and bolting. Loosen flange bolts and measure pipe deflection or movement due to forcing of pipe into position. If pipe movement occurs, realign piping. Grout pumps.
 - b. Rotate pump by hand to determine free rotation with motor leads disconnected.
 - c. Demonstrate that each unit:
 - (1) Has been properly installed.
 - (2) Is in proper alignment.
 - (3) Has been properly connected.
 - (4) Has no visual defects.
 - (5) Has no mechanical defects.
 - d. Furnish Manufacturer's Certificate of Installation.

Part 3

2. Performance Tests

- a. Perform pump running tests in accordance with the Section, entitled "Tests on Pump Equipment".
 - b. Measure noise levels five feet from motor with approved test instruments to verify that noise level is below 90 dba.
- D. Prepare and submit a written report covering installation and performance testing performed and corrective action taken.
- E. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- F. Above services shall be provided by the manufacturer's qualified factory-trained service staff.

Part 3

* * * * *

CERTIFIED MOTOR PERFORMANCE DATAMOTOR MANUFACTURER: U.S. ELECTRICAL MOTORS DATE: 7-Apr-15FM PURCHASE ORDER #: 2707293 FM TAG#: 064946A02PERFORMANCE DATA BASED ON STANDARD RULES OF: X IEEE X ASA X NEMA

HP	SYNCHRONOUS SPEED (RPM)	FULL LOAD * SPEED (RPM)	FRAME NUMBER	TYPE	ENCLOSURE
125	900	885	447VP	TVI4	TEFC

*Full Load Speed Tolerance Per NEMA MG1-12.46 is +/- 20% of slip (Slip=Synchronous RPM-Full Load RPM)

PHASE	HERTZ	VOLTS	AMPERES		INSULATION CLASS	MAX. TEMP. RISE	SERVICE FACTOR	NEMA KVA/HP CODE	NEMA DESIGN
			FULL LOAD	LOCKED ROTOR		<u>X</u> RESIS. THERM.			
3	60	460	164.9	908.0	F	80 DEG C AT 1.0 SF	1.15	G	B

GUARANTEED EFFICIENCY			POWER FACTOR			TORQUE AT FULL VOLTAGE		
						FULL LOAD TORQUE AT FULL LOAD SPEED (LB.FT)	LOCKED STARTING	PULLOUT BREAKDOWN
FULL LOAD	3/4 LOAD	1/2 LOAD	FULL LOAD	3/4 LOAD	1/2 LOAD	PERCENT OF FULL LOAD		
93.6	94.0	93.7	79.5	76.0	67.5	740.1	120	200

VSS ☒ VHS ☐ NRR ☐ SRC ☐ HORIZ ☐**BEARINGS:**

Drive End Lubrication:

☒ Oil ☐ Grease

Opposite End Lubrication:

☐ Oil ☒ Grease**PAINT:** (Attach Technical Data Sheets)☒ Factory Standard☐ Other _____MOTOR NO.: 20142830MOTOR WEIGHT: 2200 LBS.ROTATION: ☐ BI-DIRECTIONAL ☐ CW ☒ CCWCertified by:  Date: 7-Apr-15 Revision # 2

Accessory Data

Motor Manufacturer: U.S. ELECTRICAL MOTORS Date: 7-Apr-15FM Purchase Order #: 2707293 FM Tag #: 064946A02

	Required	Not Required	Description
Space Heaters:	☒	☐	Watts: <u>192</u> Voltage: <u>115</u>
Thermostats:	☒	☐	Type: ☐ N.O. ☒ N.C.
Thermistors:	☐	☒	Make & Model: _____ Trip Range: _____ ☐ relay not Supplied ☐ relay supplied: Type: ☐ factory set ☐ field adjustable ☐ wiring diagram/cut sheet attached. Ref.: _____
Quantity Per Motor: _____			
Winding RTD's:	☐	☒	Make & Model: _____ Construction/OHM Rating: _____ ☐ relay not Supplied ☐ relay supplied: Type: ☐ factory set ☐ field adjustable ☐ wiring diagram/cut sheet attached. Ref.: _____
Quantity Per Motor: _____			
Bearing RTD's:	☐	☒	Make & Model: _____ Construction/OHM Rating: _____ ☐ relay not Supplied ☐ relay supplied: Type: ☐ factory set ☐ field adjustable ☐ wiring diagram/cut sheet attached. Ref.: _____
Quantity			
Vibration Sensor:	☐	☒	Make & Model: _____ ☐ relay not Supplied ☐ relay supplied: Type: ☐ factory set ☐ field adjustable ☐ wiring diagram/cut sheet attached. Ref.: _____
Quantity:			
Tests:	☒	☐	☐ Complete Initial Test, unwitnessed ☐ Sound Test, unwitnessed ☐ Vibration Test, unwitnessed ☐ Polarization Index, unwitnessed ☐ Complete Initial Test, witnessed ☐ Sound Test, witnessed ☒ Short Commercial Test (Routine), unwitnessed ☐ IEEE841+ Enhanced No Load Test, unwitnessed

Other Features: TEFC, VERTICAL SOLID SHAFT, HIGH THRUST, PREMIUM EFFICIENT, INVERTER DUTY PER PART 31
1.15 SERVICE FACTOR (1.0 ON VFD POWER), CLASS F INSULATION, 40 DEGREE C AMBIENT, INSULIFE 2000 TREATMENT
NEMA DESIGN B, 3300 FT ALTITUDE, INPRO MGS GROUND SEAL, CCW ROTATION F.O.D.E., INSULATED BEARINGS
BRASS DRAIN, GROUND LUG IN CONDUIT BOX, 115V SPACE HEATERS, Q3 NORMALLY CLOSED THERMOSTATS
SPECIAL BALANCE, DIRECT-ON-LINE START, RANDOM WOUND, KVA CODE G, CAST IRON MAIN CONDUIT BOX
100,000 HR L-10 BEARING LIFE, DRAINS & BREATHERS, BD = 16 1/2, AH = 4 1/2, U = 2 1/8

Exceptions & Clarifications: **REVISION #1, 12/16/2014:** CHANGED 'BD' DIMENSION TO 20". WARRANTY TERMS CHANGED
 TO 36/42 MONTHS. **REVISION #2, 4/7/2015:** CHANGED FROM EXPLOSION PROOF TO TEFC. REVISED MOTOR DATA AND
 DRAWINGS. PROVIDED 'CHECK THE SPEC'. PROVIDED RESPONSE TO SUBMITTAL REVIEW COMMENTS.

Certified by:  Date: 7-Apr-15 Revision #: 2

EFFECTIVE:
27-NOV-12

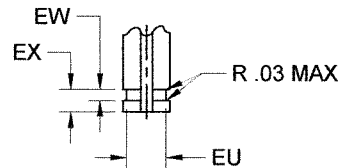
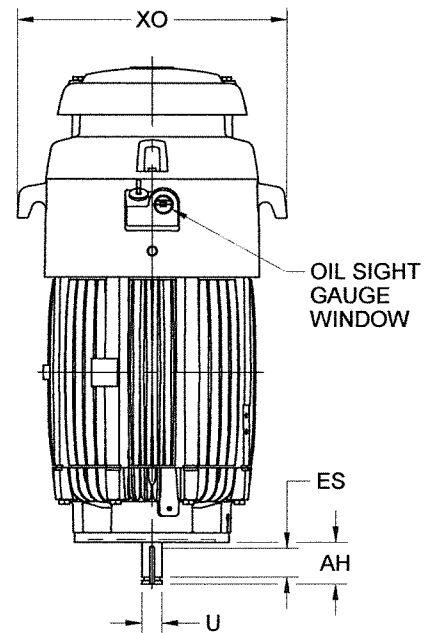
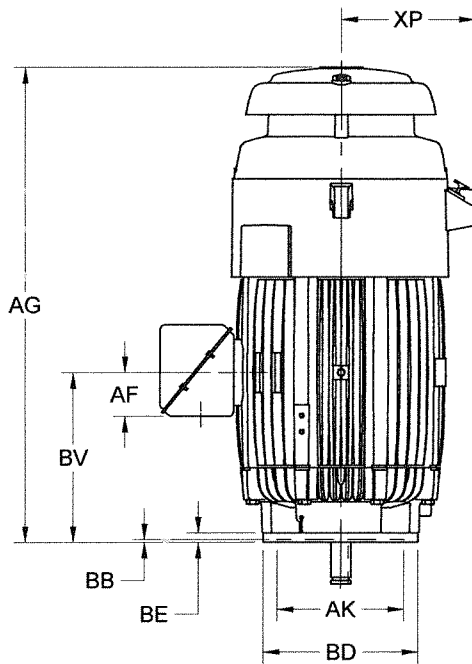
SUPERSEDES:
06-FEB-12

VERTICAL MOTORS

WITH NEMA "P" BASE
FRAME: 440VP, VPA
BASIC TYPE: LV4, TV4

PRINT:
09-2079

SHEET:
1 OF 1



ALL DIMENSIONS ARE IN INCHES AND MILLIMETERS

UNITS	P ²	U	AH	AJ	AK
IN	23.25	2.125	4.50	14.750	13.500
MM	591	53.98	114.30	374.65	342.90

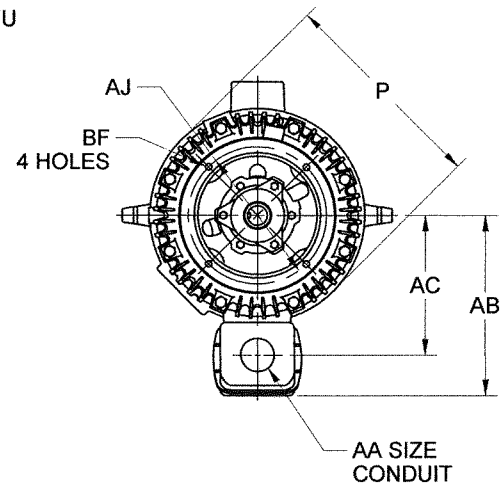
UNITS	BB MIN	BE	BF	ES MIN	EU
IN	.25	1.00	.69	3.03	1.750
MM	6	25	18	77	44.45

UNITS	EW	EX	XO	XP	SQ KEY
IN	.375	.750	28.94	14.38	.500
MM	9.53	19.05	735	365	12.70

TYPE	UNITS	AA	AB	AC	AF
TV4	IN	3.00	19.38	14.88	4.72
	MM		492	378	120
LV4	IN	3 NPT	19.66	14.63	4.56
	MM		499	371	116

FRAME	UNITS	AG	BV
444, 445	IN	47.56	16.50
	MM	1208	419
447	IN	51.06	18.25
	MM	1297	464

FRAME	UNITS	BD MAX
440VP	IN	16.50
	MM	419
440VPA	IN	20.00
	MM	508



TOLERANCES	
FACE RUNOUT	.007 T.I.R.
PERMISSIBLE ECCENTRICITY OF MOUNTING RABBET	.007 T.I.R.
PERMISSIBLE SHAFT RUNOUT	.002 T.I.R.

- DIMENSIONS MAY VARY $\pm .25"$ DUE TO CASTING AND/OR FABRICATION VARIATIONS.
- LARGEST MOTOR WIDTH.
- TOLERANCES ARE IN INCHES.
- CONDUIT BOX MAY BE ROTATED IN STEPS OF 90 DEGREES. STANDARD AS SHOWN WITH CONDUIT OPENING DOWN.

09-2079/1

Nidec Motor Corporation
St. Louis, Missouri

INFORMATION DISCLOSED ON THIS DOCUMENT IS CONSIDERED PROPRIETARY AND SHALL NOT BE REPRODUCED OR DISCLOSED WITHOUT WRITTEN CONSENT OF NIDEC MOTOR CORPORATION



ISSUED BY
K. FRIEDMAN
APPROVED BY
J. O'BRIEN

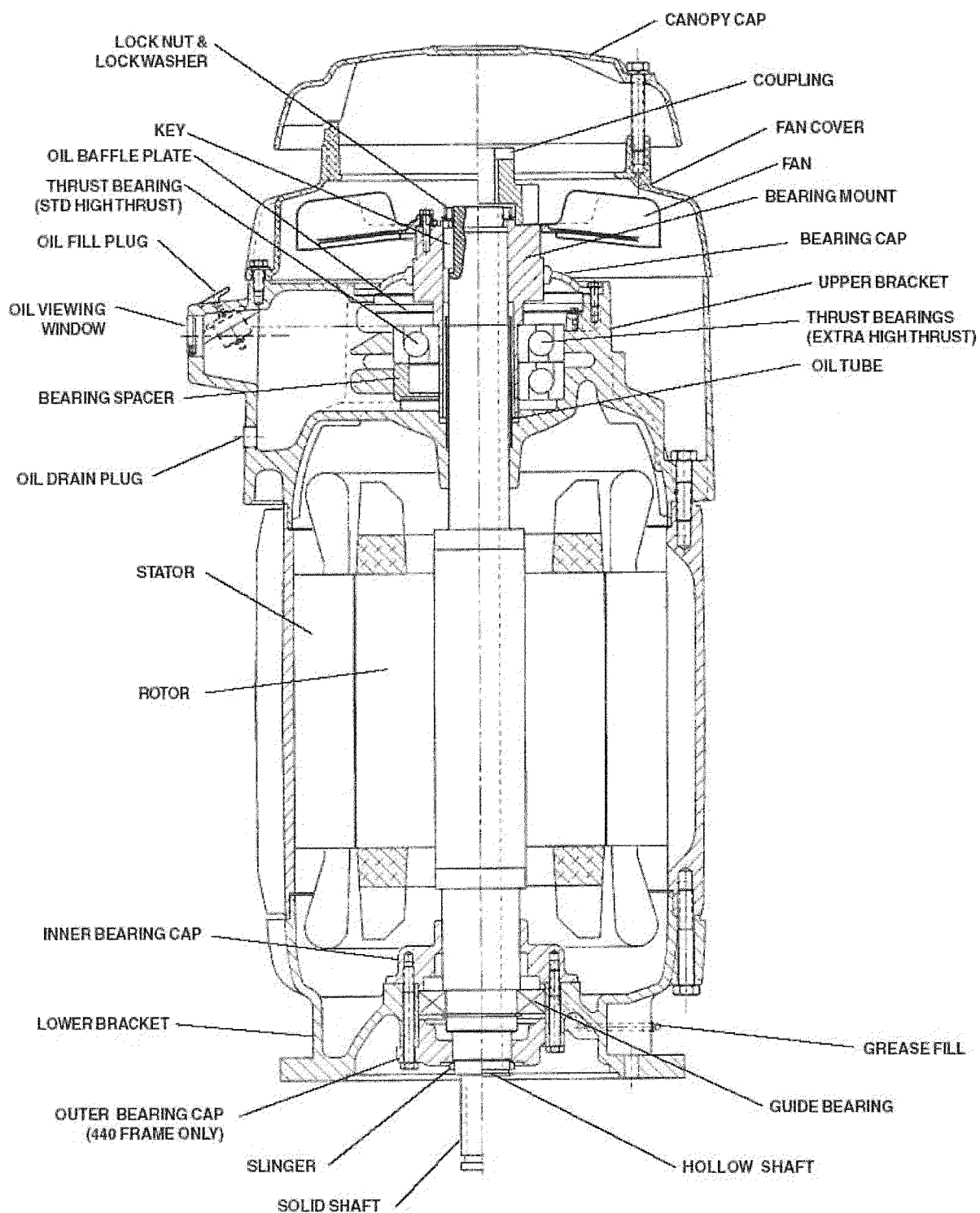
IHP_DP_NMCA (MAR-2011) SOLIDEDGE



INSTALLATION AND MAINTENANCE

Spare Parts

400 Thru 440 Frame
Types TU, LU, TV-4 and LV-4
High Thrust



TYPICAL REED CRITICAL FREQUENCY DATA

+/- 20% accuracy on below Reed Critical Frequency (RCF) value unless otherwise noted.
Note: Motor RCF Test Data can be provided at time of motor shipment through special test.
Please contact your Nidec Motor Corporation representative for more information.

MODEL NO: NA
CATALOG NO: NA

Frame: 447VP Type: TVI4

REED CRITICAL FREQUENCY:	50	HZ
CENTER OF GRAVITY:	21	IN
DEFLECTION @ CENTER OF GRAVITY:	0.0039	IN
UNIT WEIGHT:	2300	LBS.
BASE DIAMETER:	16.5	IN.
MAXIMUM MOTOR DIAMETER:	23.25	IN.
DATE:	4/6/2015	



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NAMEPLATE DATA

CATALOG NUMBER:		NAMEPLATE PART #: 422707-005	
MODEL	FR 447VP	TYPE TVI4	ENCL TEFC
SHAFT END BRG 90BC02J3 - QTY 1		OPP END BRG 100BT03M - QTY 1	
PH 3	MAX AMB 40 C	ID# (ref: Order#: 20142830, Type: SO, Line#: 100)	
INSUL CLASS F	Asm. Pos.	DUTY CONT	
HP 125	RPM 885	HP	RPM
VOLTS 460		VOLTS	
FL AMPS 157.0		FL AMPS	
SF AMPS 179.0		SF AMPS	
SF 1.15	DESIGN B	CODE G	
NEMA NOM EFFICIENCY 94.5	NOM PF 79.5	KiloWatt 93.3	
GUARANTEED EFFICIENCY 93.6	MAX KVAR	HZ 60	

HAZARDOUS LOCATION DATA (IF APPLICABLE):

DIVISION	CLASS I	GROUP I
TEMP CODE	CLASS II	GROUP II

VFD DATA (IF APPLICABLE):

VOLTS 460	
AMPS 164.9	
TORQUE 1 740.1LB-FT	TORQUE 2
VFD LOAD TYPE 1 VT/PWM	VFD LOAD TYPE 2
VFD HERTZ RANGE 1 6-60	VFD HERTZ RANGE 2
VFD SPEED RANGE 1 90-900	VFD SPEED RANGE 2
SERVICE FACTOR 1.00	FL SLIP
NO. POLES	MAGNETIZING AMPS
VECTOR MAX RPM	Encoder PPR
Radians / Seconds	Encoder Volts

TEAO DATA (IF APPLICABLE):

HP (AIR OVER)	HP (AIR OVER M/S)	RPM (AIR OVER)	RPM (AIR OVER M/S)
FPM AIR VELOCITY	FPM AIR VELOCITY M/S	FPM AIR VELOCITY SEC	

ADDITIONAL NAMEPLATE DATA:

Decal / Plate	WD=499495	Customer PN	FMB064946A02
Notes		Non Rev Ratchet	
Max Temp Rise	80C RISE/RES@1.00SF	OPP/Upper Oil Cap	4.62 QT/4.4 L
Thermal (WDG)	OVER TEMP PROT 2	SHAFT/Lower Oil Cap	GREASE
Altitude			
Regulatory Notes		Regulatory Compliance	
COS		Marine Duty	
Balance	0.06 IN/SEC	Arctic Duty	
3/4 Load Eff.	94.9	Inrush Limit	
Motor Weight (LBS)	2200	Direction of Rotation	
Sound Level		Special Note 1	
Vertical Thrust (LBS)	11700	Special Note 2	
Thrust Percentage	100% HT	Special Note 3	
Bearing Life	100K	Special Note 4	
Starting Method		Special Note 5	
Number of Starts		Special Note 6	
200/208V 60Hz Max Amps		SH Max. Temp.	
190V 50 hz Max Amps		SH Voltage	SH VOLTS=115V
380V 50 Hz Max Amps		SH Watts	SH WATTS=192W
NEMA Inertia		Load Inertia	
Sumpheater Voltage		Sumpheater Wattage	
Special Accessory Note 1		Special Accessory Note 16	
Special Accessory Note 2		Special Accessory Note 17	
Special Accessory Note 3		Special Accessory Note 18	
Special Accessory Note 4		Special Accessory Note 19	
Special Accessory Note 5		Special Accessory Note 20	
Special Accessory Note 6		Special Accessory Note 21	
Special Accessory Note 7		Special Accessory Note 22	
Special Accessory Note 8		Special Accessory Note 23	
Special Accessory Note 9		Special Accessory Note 24	
Special Accessory Note 10		Special Accessory Note 25	
Special Accessory Note 11		Special Accessory Note 26	
Special Accessory Note 12		Special Accessory Note 27	
Special Accessory Note 13		Special Accessory Note 28	
Special Accessory Note 14		Special Accessory Note 29	
Special Accessory Note 15		Special Accessory Note 30	

NIDEC MOTOR CORPORATION
ST. LOUIS, MO



TYPICAL NAMEPLATE DATA
 ACTUAL MOTOR NAMEPLATE LAYOUT MAY VARY
 SOME FIELDS MAY BE OMITTED

Nidec trademarks followed by the ® symbol are registered with the U.S. Patent and Trademark Office.



IX. LUBRICATION

Motor must be at rest and electrical controls should be locked open to prevent energizing while being serviced. If motor is being taken out of storage refer to **Section III "STORAGE", item 4** for instructions.

1. Oil Lubricated Bearings.

Motors are tested with oil at our manufacturing facility then drained prior to shipment. A small amount of residual oil and rust inhibitor will remain in the oil sump. This residual oil and rust inhibitor is compatible with Turbine Type Mineral Oils and Synthetic, PAO (Poly Alpha Olefin) based oils listed in this manual. It is not necessary to drain this residual oil when adding new oil for operation.

Change oil once per year with normal service conditions. Frequent starting and stopping, damp or dusty environment, extreme temperature, or any other severe service conditions will warrant more frequent oil changes. If there is any question, consult Emerson Motor Co. Product Service Department for recommended oil change intervals regarding your particular situation.

Determine required oil ISO Viscosity Grade (VG) and base oil type from Table 3, then see Table 4 for approved oils. Add oil into oil fill hole at each bearing housing until the oil level reaches between minimum and maximum marks located on the sight gauge window. It is important to wipe excess oil from the threads of the drain hole and to coat the plug threads with Gasoila[®] P/N SS08, manufactured by Federal Process Corporation or equivalent thread sealant before replacing the drain plug. Plug should be tightened to a minimum of 20 lb.-ft. using a torque wrench. See the motor nameplate or Table 5 for the approximate quantity of oil required.

2. Grease Lubricated Bearings.

A. Relubrication of Units in Service

Grease lubricated bearings are pre-lubricated at the factory and normally do not require initial lubrication. Relubricating interval depends upon speed, type of bearing and service. Refer to Table 1 or suggested regreasing intervals and quantities. Note that operating environment and application may dictate more frequent lubrication. To relubricate bearings, remove the drain plug. Inspect grease drain and remove any blockage (caked grease or foreign particles) with a mechanical probe, taking care not to damage bearing.

⚠ WARNING

Under NO circumstances should a mechanical probe be used while the motor is in operation.

Add new grease at the grease inlet. New grease must be compatible with the grease already in the motor (refer to table 2 for compatible greases).

⚠ CAUTION

Greases of different bases (lithium, polyurea, clay, etc.) may not be compatible when mixed. Mixing such greases can result in reduced lubricant life and premature bearing failure. Prevent such intermixing by disassembling motor, removing all old grease and repacking with new grease per item B of this section. Refer to Table 2 for recommended greases.

Run the motor for 15 to 30 minutes with the drain plug removed to allow purging of any excess grease. Shut off unit and replace the drain plug. Return motor to service.

⚠ CAUTION

Overgreasing can cause excessive bearing temperatures, premature lubricant breakdown and bearing failure. Care should be exercised against overgreasing.





B. Change of Lubricant

Motor must be disassembled as necessary to gain full access to bearing housing(s).

Remove all old grease from bearings and housings (including all grease fill and drain holes). Inspect and replace damaged bearings. Fill bearing housings both inboard and outboard of bearing approximately 30 percent full of new grease. Grease fill ports must be completely charged with new grease. Inject new grease into bearing between rolling elements to fill bearing. Remove excess grease extending beyond the edges of the bearing races and retainers.

Table 1
Recommended Grease Replenishment Quantities & Lubrication Intervals

Bearing Number		Grease Replenishment Quantity (Fl.Oz.)	Lubrication Interval		
62xx, 72xx	63xx, 73xx		1801 thru 3600 RPM	1201 thru 1800 RPM	1200 RPM and slower
03 thru 07	03 thru 06	0.2	1 Year	2 Years	2 Years
08 thru 12	07 thru 09	0.4	6 Months	1 Year	1 Year
13 thru 15	10 thru 11	0.6	6 Months	1 Year	1 Year
16 thru 20	12 thru 15	1.0	3 Months	6 Months	6 Months
21 thru 28	16 thru 20	1.8	3 Months	6 Months	6 Months

Refer to motor nameplate for bearings provided on a specific motor. For bearings not listed in Table 1, the amount of grease required may be calculated by the formula:

$$G = 0.11 \times D \times B$$

Where: G = Quantity of grease in fluid ounces.
D = Outside diameter of bearing in inches.
B = Width of bearing in inches.

Table 2
Recommended Greases

Motor Frame Size	Motor Enclosure	Grease Manufacturer	Grease (NLGI Grade 2)
All Thru 447	All	Exxon Mobil	Polyrex-EM
449 and Up	Open Dripproof		
449 and Up	TEFC and Explosionproof	Exxon Mobil	Mobilith SHC-100

The above greases are interchangeable with the grease provided in units supplied from the factory (unless stated otherwise on motor lubrication nameplate).





INSTALLATION AND MAINTENANCE

Lubrication

Table 3
Nidec Motor Corporation Recommended Oil Viscosities

Angular Contact Thrust Bearing (7XXX Series) (ABMA BT-Series)					
Motor Enclosure	Frame Size	Speed (RPM)	Ambient Temperature	ISO VG	Base Oil Type
Open Dripproof or Weather Protected	324 and Larger	All	-15C thru 40C (5-104F)	32	Mineral or Synthetic
			41C thru 50C (105-122F)	68	Synthetic Only
Totally Enclosed or Explosion proof	404 thru 447		-15C thru 40C (5-104F)	32	Mineral or Synthetic
			41C thru 50C (105-122F)	68	Synthetic Only
	449 thru 5811	1801 - 3600	-15C thru 40C (104F)	32	Synthetic Only
		1800 & Below		68	Synthetic Only
		All	41C thru 50C (105-122F)	Refer to Office	
Spherical Roller Thrust Bearing (29XXX Series) (ABMA TS-Series)					
Motor Enclosure	Frame Size	Speed (RPM)	Ambient Temperature	ISO VG	Base Oil Type
Open Dripproof or Weather Protected	444 and Larger	1800 and Below	-15C thru 25C (5-77F)	68	Mineral or Synthetic
			6C thru 40C (42-104F)	150	
			41C thru 50C (105-122F)		
Totally Enclosed or Explosion proof	449 and Larger		-15C thru 25C (5-77F)	68	Mineral or Synthetic
			6C thru 40C (42-104F)	150	Synthetic Only
			41C thru 50C (105-122F)	Refer to Office	

Notes:

1. If lower guide bearing is oil lubricated, it should use the same oil as the thrust bearing.
2. If lower guide bearing is grease-lubricated, refer to TABLE 2 for recommended greases.
3. Refer to Nidec Motor Corporation for ambient temperatures other than those listed.

Table 4
Nidec Motor Corporation Approved Oil Specifications For Use With Anti-Friction Bearings

Oil Manufacturer	ISO VG 32		ISO VG 68		ISO VG 150	
	Viscosity: 130-165 SSU @ 100F		Viscosity: 284-347 SSU @ 100F		Viscosity: 620-765 SSU @ 100F	
	Mineral Base Oil	Synthetic Base Oil	Mineral Base Oil	Synthetic Base Oil	Mineral Base Oil	Synthetic Base Oil
Chevron USA, Inc	GST Turbine Oil 32	Tegra 32	GST Turbine Oil 68	Tegra 68	R & O Machine Oil 150	Tegra 150
Conoco Oil Co.	Hydroclear Turbine Oil 32	Syncon 32	Hydroclear Turbine Oil 68	Syncon 68	Hydroclear AW Hyd. Fluid 150	N/A
ExxonMobil	Teresstic 32	Synnestic 32	Teresstic 68	Synnestic 68	Teresstic 150	Synnestic 150
ExxonMobil	DTE Oil Light	SHC 624	DTE Oil Heavy Medium	SHC 626	DTE Oil Extra Heavy	SHC 629
Pennzoil Co., Inc	Pennzbell TO 32	Pennzbell SHD 32	Pennzbell TO 68	Pennzbell SHD 68	Pennzbell TO 150	Pennzbell SHD 150
Phillips Petroleum Co.	Magnus 32	Syndustrial "E" 32	Magnus 68	Syndustrial "E" 68	Magnus 150	N/A
Shell Oil Co.	Tellus 32	Tellus HD Oil AW SHF 32	Tellus 68	Tellus HD Oil AW SHF 68	Tellus 150	N/A
Texaco Lubricants Co.	Regal 32	Cetus PAO 32	Regal 68	Cetus PAO 68	Regal 150	N/A





Table 5
Approximate Oil Sump Capacities

Frame Size	Motor Type Designation (See Motor Nameplate)	Oil Capacity (Quarts)	
		Upper Bearing	Lower Bearing
180 - 280	AU, AV-4	Grease	Grease
180 - 280	AV		
320 - 440	RV		
320 - 360	RV-4, RU	3	
400	RV-4, RU	5	
440	RV-4 (2 pole)	17	
	RV-4, RU (4 pole & slower)	6	
180 - 440	TV-9, TV, LV-9, LV	Grease	
180 - 360	TV-4, TU, LV-4, LU		
400	TV-4, TU, LV-4, LU	6	
440	TV-4, TU, LV-4, LU	5	
449	JU, JV-4	22	
	HU, HV-4	12	
	JV-3, JV, HV	Grease	
5000	HV, EV, JV, RV	Grease	
	RU, RV-4	30	
	HU, HV-4 (4 pole & slower)	12	
	HV-4 (2 pole only)	20	
	EU, JU, EV-4, JV-4	22	5
5800	RU, RV-4	48	4
	HU, HV-4	24	3
	EU, JU, EV-4, JV-4	37	4
6800	HU, HV-4	70	3
	HV (Bow Thruster)	Grease	Grease
	HV (Other Than Bow Thruster)	70	3
8000	RU, RV-4	70	6
	RV	Grease	Grease
9600	RU, RV-4	95	13
	RV	Grease	Grease



S I L I C O N E R U B B E R H E A T E R S

Rugged, Thin, Lightweight and Flexible...Limited Only By Your Imagination

Rugged, yet thin, lightweight, and flexible ... the use of Watlow silicone rubber heaters is limited only by your imagination. With these heaters, you can put the heat where it's needed and, in the process, improve heat transfer, speed warm-ups and decrease wattage requirements.

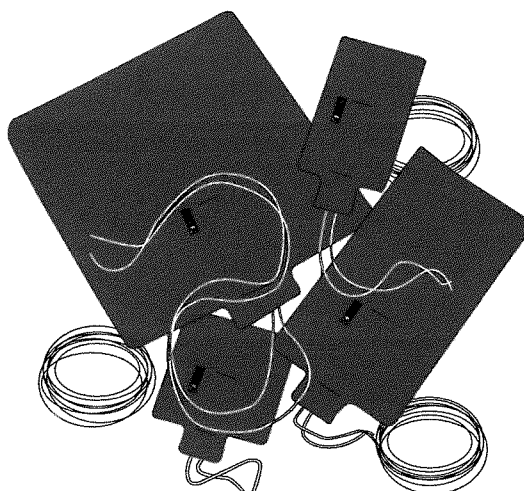
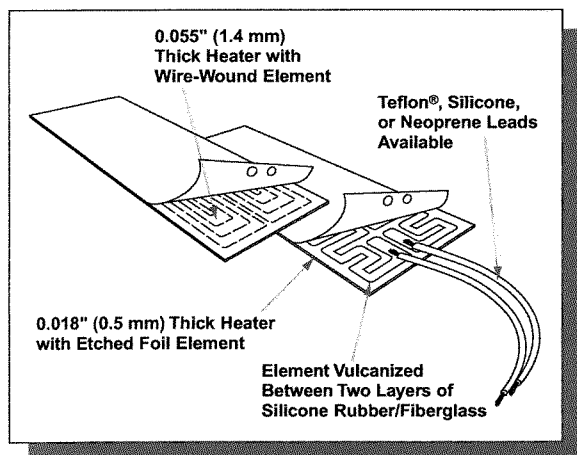
Fiberglass-reinforced silicone rubber gives your heater dimensional stability without sacrificing flexibility. Because very little material separates the element from the part, heat transfer is rapid and efficient.

Performance Capabilities

- Operating temperatures to 500°F (260°C)
- Watt densities to 80 W/in² (12.5 W/cm²) dependent upon application
- 0.055 inch (1.4 mm) thick with a wire-wound element; only 0.018 inch (0.5 mm) with an etched foil element

Applications

- Freeze protection and condensation prevention for many types of instrumentation and equipment
- Medical equipment such as blood analyzers, test tube heaters, etc.
- Computer peripherals such as laser printers
- Curing of plastic laminates
- Photo processing equipment



Features and Benefits

Designed in the exact shape and size you need

- Conforms to your equipment

More than 80 designs available immediately from stock

- Reduces down time

UR®, cUR®, and VDE recognitions

- Available on many designs

Moisture and chemical-resistant silicone rubber material

- Provides longer heater life

Vulcanizing adhesives or fasteners available

- Heaters bond easily to your part



2101 Pennsylvania Dr.
Columbia, Missouri 65202 USA
Phone: 573-474-9402
Fax: 573-474-5859
Internet: www.watlow.com
e-mail: www.watlow.com

S I L I C O N E R U B B E R H E A T E R S

Standard Silicone Rubber Specifications

Maximum width x maximum length:

- Wire-wound: 36 x 120 inches (915 mm x 3050 mm)
- Etched foil: 20 x 30 inches (510 mm x 760 mm)

Thickness (standard):

- Wire-wound: 0.055 inch (1.4 mm)
- Etched foil: 0.018 inch (0.5 mm)

Weight (standard):

- Wire-wound: 8 oz./ft² (0.24 g/cm²)
- Etched foil: 3 oz./ft² (0.09 g/cm²)

Maximum operating temperature:

- 500°F (260°C)

Maximum temperature for UL® Recognition:

- 428°F (220°C)

Minimum ambient temperature:

- -80°F (-62°C)

Maximum voltage:

- 600V~(ac)

Maximum wattage:

- Consult watt density graph on page 170 of the Watlow Heater's catalog.

Lead size:

- Sized to load

Lead length:

- 12 + 1½ - ½ inches (305 mm + 40 mm - 15 mm)

Wattage tolerance:

- Wire: ± 5 percent
- Foil: + 5 percent -10 percent

Dimensional tolerances:

- 0 to 6 inches (0 to 150 mm): ± ⅛ inch (1.6 mm)
- 6 to 18 inches (150 to 455 mm): ± ¼ inch (3.2 mm)
- 18 to 36 inches (455 mm to 915 mm): ± ⅜ (4.8 mm)
- Over 36 inches (915 mm): ± 1 percent

How to Order

To order stock silicone rubber heaters, specify the Watlow code number (from the Watlow Heater's catalog) and the quantity. To order a heater with options, specify the code number, quantity and options desired (see page 165 in the Watlow Heater's catalog). Consult Watlow before combining options.

Made-to-Order: Consult factory

For made-to-order units, Watlow will need the following application information from you:

- Size (dimensions)
- Voltage
- Wattage/watt density
- Operating temperature
- Options (leads, thermostats, attachment techniques, etc.)
- Will heater be subject to flexing?
- Element type, if you have a preference
- Agency approvals
- Quantity

Availability

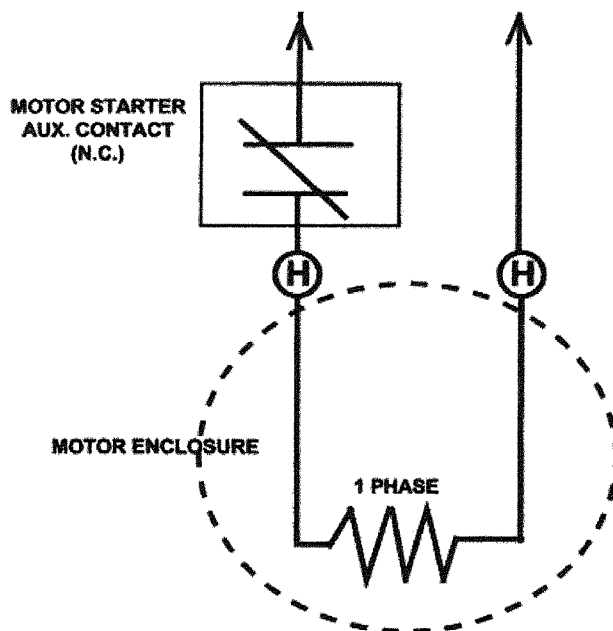
- Stock: Same day shipment of orders received by 11:00 a.m. CST.
- Stock with Options: Shipment in five working days or less. Not all options are available with stock heaters.



970798

SPACE HEATER CONNECTION DIAGRAM

SPACE HEATER LEADS MAY BE LOCATED IN EITHER THE MAIN OUTLET BOX
OR IF SO EQUIPPED, AN AUXILIARY BOX



THIS EQUIPMENT IS SUPPLIED WITH ANTI-
CONDENSATION HEATERS. HEATERS
SHOULD BE ENERGIZED WHEN EQUIPMENT
IS NOT OPERATING TO PROTECT UNIT BY
PREVENTING INTERNAL CONDENSATION.
CONNECT THE "H" OR HEATER
LEADS TO

115V VOLTS

192W WATTS RATING

SPACE HEATER NAMEPLATE (ON MOTOR)

Revision: 7/30/2008
Mike Cullen

Thermal motor protector
Temperature limiter
Thermal cut-out

10
11
12
22

Applications

- Motors
- Transformers
- Coils
- Electronics, sensors

Benefits

- Temperature and current sensitive or only temperature sensitive
- Small dimensions
- High power rating

CANTHERM

Technical data

ratings		control type	T10A / E T11A / E	T12A / E	T22A	T10B / G	T22B ¹⁾
version			normally closed			normally open	
rated current at 250 V 50/60 Hz (cos ϕ 0.95 / 0.6)			2.5 A / 1.6 A	6.3 A / 2.5 A	20.0 A / 3.0 A	2.0 A / 1.6 A	3.5 A / 2.0 A
switching cycles under rated current			10,000				
max. current under failure condition at 250 V 50/60 Hz (cos ϕ 0.95)			10.0 A	12.0 A	30.0 A	10.0 A	20.0 A
switching cycles under max. current			300		600	300	1,000
temperature rating T _a (steps in 5 K)			(50) 70 °C... 180 °C ²⁾		80 °C ... 160 °C ³⁾		
tolerances			Standard: ± 5 K				
feature of automatic action			1.C.M, 2.C		2.B, 1.C, 3.C	1.B, 2.C	
contact resistance (incl. wire of 100 mm)			< 50 mΩ				
hysteresis			30 K ± 15 K ⁴⁾ ⁵⁾				
dielectric strength (standard insulation)			2 kV				
shock / vibration testing (similar to EN 50155)			400 m/s ² sine half wave / 100 m/s ² 5 Hz ... 2.000 Hz sine				
resistances to impregnation			tight against ordinary resins and lacquers				
degrees of protection provided by enclosures (EN 60529)			IP00				
suitable for use in protection category			I, II				
approvals	VDE / ENEC		EN 60730-1 / -2-3 ⁶⁾ /-2-9				
	UL		UL 2111 / UL 873 ¹⁾				-
	CSA / cUL	 	C22.2 No. 77 / C22.2 No. 24 ¹⁾			-	-
	CQC		GB14536.1-1998 / GB14536.10-1996 ¹⁾				

¹⁾ details on request ²⁾ T10 max. T_a 160 °C ³⁾ approval to EN60730-2-2 up to 180 °C

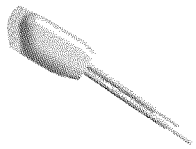
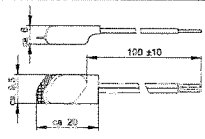
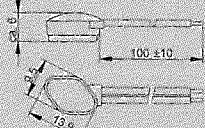
⁴⁾ T10 available with ± 3 K tolerances and smaller hysteresis ⁵⁾ at the T_a (upper and lower) limits the hysteresis could deviate ⁶⁾ different power rating

Standard wire (length 100 $\pm$ 10 mm, stripped 6 $\pm$ 1 mm)

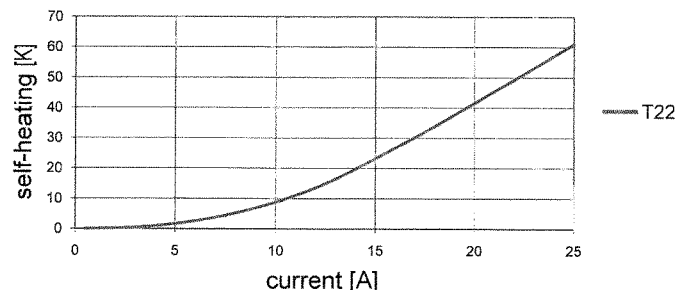
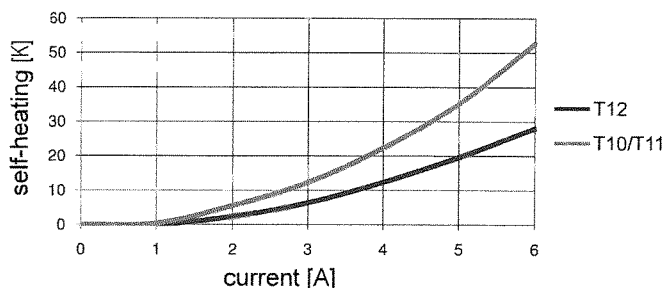
Cantherm lead	Cantherm-code	MIC code	temperature max.	operating voltage max.	diameter insulation	cross section diameter ²⁾	UL style
black	ACDA	L300	150 °C	300 V	1.57 mm	AWG24 / 0.24 mm ²	3398
yellow	AEDC	L310			1.80 mm	AWG20 / 0.48 mm ²	
black	AFDA	L320 ¹⁾			2.15 mm	AWG18 / 0.96 mm ²	
white	LCDB	L330	200 °C	600 V	0.90 mm	AWG24 / 0.24 mm ²	3557
white	LEDB	L340			1.26 mm	AWG20 / 0.61 mm ²	
white	LFDB	L350 ¹⁾			1.50 mm	AWG18 / 0.96 mm ²	
yellow		L400	150 °C	300 V	1.40 mm	AWG24 / 0.51 mm	3398
black	ASDA	L410			1.65 mm	AWG20 / 0.81 mm	
white	DFDB	L430	200 °C	300 V	1.21 mm	AWG24 / 0.51 mm	1332
white	DEDB	L440			1.51 mm	AWG20 / 0.81 mm	

¹⁾ T22 only ²⁾ for T12/T11 AWG20 and for T10 AWG24 is recommended

Standard insulation

control type	nc	no	Cantherm-code	MIC code	illustration	drawing dimensions (mm)	technical specification	approvals
T10	A	B	U102 B	U250		 different dimensions for T22	shrink cap potted	VDE, UL, cUL
T11, T12	A		U106 F					
T22	A	B	U103 C U107 G	U256				
T10	A	B	U153 V	U174			cap of PPS potted	VDE, UL, cUL
T11, T12	A		U174 O					

■ Heating by current



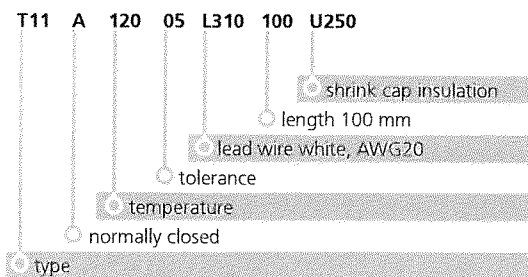
The characteristic curves are measured with a thermal control without any insulation in an oil bath.

Attention:

The heating depends on the thermal conduction of the control to the equipment or part which should be protected.

■ Ordering and marking example

Ordering example



Deviations from standard controls on request.

Marking

- T11A** type (T11 nc)
- 12005** response temperature (120°C), tolerance (± 5 K)
- 049D** date of manufacture (April 2009), country (D=Germany)

Cantherm Ordering Example [T1112025AEDCB0E]

T12A16005L320150U256

T11	120	2	5	AE	D	C	B	0	E
type	temperature	normally closed	tolerance $\pm 5^\circ\text{C}$	lead wire UL3398 20 AWG	lead length D=4"	yellow	insulation U102	housing - none	strip length .25"

Marking

T11A type (T11 nc)

12005 response temperature (120°C), tolerance (± 5 K)

049C date of manufacture (April 2009), country (C = Canada)



CANTHERMTM

Div. of Microtherm International Cooperation

Canadian Thermostats & Control Devices, Ltd.
8415 Mountain Sights Ave.
Montreal, Canada H4P 2B8

Tel: (514) 739-3274 Fax: (514) 739-2902

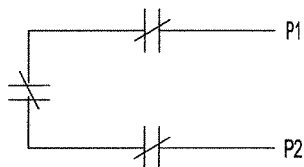
1 (800) 561-7207

WEBSITE: www.cantherm.com
E-Mail: sales@cantherm.com

THERMOSTATS

1. MOTOR IS EQUIPPED WITH QTY-3 (1 PER PHASE) NORMALLY CLOSED THERMOSTATS. THERMOSTATS ARE SET TO OPEN AT HIGH TEMPERATURE.
2. CONTACT RATINGS FOR THERMOSTATS: 120-600 VAC, 720 VA

N. C. THERMOSTATS



NOTE: THERMOSTATS LEADS MAY BE LOCATED IN EITHER THE MAIN OUTLET BOX OR IF SO EQUIPPED, AN AUXILIARY BOX.

ACCESSORY LISTING

QTY-3 N.C. THERMOSTATS

REVISION DESCRIPTION FOR: MISC		SCALE	NONE	UNITS	IN	TITLE		CUSTOMER CONNECTION DIAGRAM		NIDEC MOTOR CORPORATION	
STL0211 - UPDATED FORMAT .		TOLERANCES ON DIMENSIONS (UNLESS OTHERWISE SPECIFIED)									
		INCHES		mm		ISSUED BY		APPROVED BY		REVISION DATE	
MATERIAL:						R. KING		C. CADE		24-FEB-11	
						CODE		DWG NO.		REV	SHEET NUMBER
								0834066		G	1 OF 1
MUST BE COMPLIANT TO RoHS DIRECTIVE EU 2002/95/IEC AND REGULATION EC 1907/2006 (REACH) AS AMENDED.				ANGLES X°= ±1°						DWG SIZE	A

NIDEC CONFIDENTIAL
NIDEC MOTOR CORPORATION 24-Feb-11
NMCA (JAN-2011)

SOLIDEDGE



World leaders in the conservation of man-made resources and the environment

PRODUCT SPECIFICATION SHEET BELZONA® 1111

1. PRODUCT NAME

Belzona® 1111 (Super Metal)

Engineering grade repair system for repairing and rebuilding machinery and equipment.

Also used as a high strength structural adhesive for bonding or for creation of irregular load bearing shims with good electrical insulation characteristics.

For use in Original Equipment Manufacture or repair situations.

2. MANUFACTURER

Belzona Inc.,
2000 N.W. 88th Court
Miami, Florida 33172

Belzona Polymeric Ltd.

Claro Road, Harrogate,
HG1 4AY, England.

3. PRODUCT DESCRIPTION

A two component paste grade system based on a silicon steel alloy blended with high molecular weight reactive polymers and oligomers. When cured, the material is durable yet fully machinable.

Applications

Shafts
Hydraulic rams
Bearing housings
Keyways
Engine blocks
Casings
Pipes
Tanks
Face plates

4. TECHNICAL DATA

Base Component

Appearance	Paste
Color	Dark gray
Gel strength at 77°F (25°C)	>150 g/cm HF
Density	2.70 - 2.90 g/cm ³

Solidifier Component

Appearance	Paste
Color	Light gray
Gel strength at 77°F (25°C)	>70 g/cm QV
Density	1.63 - 1.69 g/cm ³

Mixed Properties at 68°F (20°C)

Mixing Ratio by Weight (Base : Solidifier)	5 : 1
Mixing Ratio by Volume (Base : Solidifier)	3 : 1
Mixed Form	Paste
Peak Exotherm Temperature	239 - 284°F (115 - 140°C)
Time to Peak Exotherm	25 - 42 mins.
Slump Resistance	nil at 0.5 inch (1.27 cm)
Mixed Density	2.5 g/cm ³

• Shelf Life:

Separate base and solidifier components shall have a shelf life of at least 5 years when stored between 32°F (0°C) and 86°F (30°C).

• Working Life:

Will vary according to temperature. At 77°F (25°C) the usable life of mixed material is 15 minutes.

• Volume Capacity:

The volume capacity of a 1 kg. unit of mixed **Belzona® 1111** is 24.3 in.³ (398 cm³).

• Cure Time:

Will be reduced for thicker sections and extended for thinner applications. At a thickness of approximately 1/4 in. (6 mm), allow to solidify for the times shown in the chart below before subjecting it to the conditions indicated.

5. PHYSICAL/MECHANICAL PROPERTIES

Determined after 7 days cure at 77°F (25°C). Post curing the material with heat results in a more highly cross-linked polymer.

For enhanced performance this material may be post-cured by heating to 212°F (100°C) for a period of up to 24 hours.

• Abrasion Resistance:

Taber

The Taber abrasion resistance with 1 kg load is typically:
H10 Wheels (Wet) 889 mm³
CS17 Wheels (Dry) 56 mm³ loss per 1000 cycles

• Adhesion:

Cleavage

When tested to ASTM D1062 typical values will be:

Mild steel	1400 lbs./in. (25 kgs/mm)
------------	---------------------------

Tensile Shear

When tested in accordance with ASTM D1002, using degreased strips, grit blasted to a 3-4 mil profile, typical values will be:

Aluminum	1,800 psi (126 kgs/cm ²)
Brass	1,670 psi (117 kgs/cm ²)
Copper	1,900 psi (133 kgs/cm ²)
Formica	>500 psi (35 kgs/cm ²)*
Mild steel	2,700 psi (190 kgs/cm ²)
Polyester/glass fiber	>700 psi (49 kgs/cm ²)*
Stainless steel	2,800 psi (197 kgs/cm ²)

* breakdown of substrate

• Chemical Resistance:

Once fully cured, the material will demonstrate excellent resistance to the following chemicals;

carbonic acid
10% hydrochloric acid
10% nitric acid
5% phosphoric acid
10% sulfuric acid
20% ammonia solution
lime water
20% potassium hydroxide
20% sodium hydroxide

Continued . . .

CURE TIMES

TEMPERATURE	41°F (5°C)	50°F (10°C)	59°F (15°C)	68°F (20°C)	77°F (25°C)	86°F (30°C)
Movement or use involving no loading or immersion	4 hrs	3 hrs	2¼ hrs	1¾ hrs	1 hr	¾ hr
Machining and/or light loading	6 hrs	4 hrs	3 hrs	2 hrs	1½ hrs	1 hr
Full electrical, mechanical or thermal loading	4 days	2 days	1½ day	1 day	20 hrs	16 hrs
Immersion in chemicals	5 days	4 days	3 days	2 days	1½ days	1 day

propanol
butanol
ethylene glycol
diethanolamine
methylamine (25% in water)
hydrocarbons
mineral oils
inorganic salts

* For a more detailed description of chemical resistance properties, refer to Product Data M501.

• Compressive Strength:

When tested in accordance with ASTM D695, typical values obtained will be:
13,000 psi (914 kgs/cm²) ambient cure
15,000 psi (1055 kgs/cm²) post cure

• Compressive Modulus:

When tested in accordance with ASTM D695, typical values obtained will be:
ambient cure 2.7 x 10⁵ psi
(1.9 x 10⁴ kgs/cm²)
post cure 3.7 x 10⁵ psi
(2.6 x 10⁴ kgs/cm²)

• Corrosion Resistance:

Will show no visible signs of corrosion after 5,000 hours exposure in the ASTM B117 salt spray cabinet.

• Electrical Properties:

Dielectric Strength

Tested to ASTM D149 is typically 84 volts/mil (3360 volts/mm)

Dielectric Constant

Tested to ASTM D150 is typically 10 at 1000Hz
6 at 1 MHz

Dissipation Factor

Tested to ASTM D150 is typically < 0.0005 at 1 MHz
0.0120 at 1000 HZ

Volume Resistivity

Tested to ASTM D257 is typically 5.3 x 10¹² ohm cm.

Surface Resistivity

Tested to ASTM D257 is typically 4.7 x 10¹³ ohm.

• Flexural Strength:

When tested to ASTM D790, typical values obtained will be:
9,000 psi (633 kgs/cm²) ambient cure
13,000 psi (914 kgs/cm²) post cure

• Flexural Modulus:

When tested in accordance with ASTM D790, typical values obtained will be:
ambient cure 10.6 x 10³ psi
(7.45 x 10⁴ kgs/cm²)
post cure 9.1 x 10³ psi
(6.4 x 10⁴ kgs/cm²)

• Hardness:

The hardness of the material when tested to ASTM D2240 is typically 89 Shore D.

• Heat Distortion Temperature:

Tested to ASTM D648 (264 psi fiber stress), typical values obtained will be:
136°F (58°C) ambient cure
216°F (102°C) post cure

• Heat Resistance:

For many typical applications, the product is thermally stable up to 392°F (200°C) dry and 200°F (93°C) wet, and down to -40°F (-40°C)

• Impact Strength:

The impact strength when tested to ASTM D256 is typically:
1.3 ft.lb./in., 70 J/m (un-notched) or
0.65 ft.lb./in., 35 J/m (reverse notched)

• Shrinkage:

Shrinkage is typically <0.025% when tested in accordance with DOD-C-24176A method 4.6.12.

• Thermal Expansion:

Tested to ASTM E228 the coefficient of thermal expansion is typically 31.7 ppm/°C.

6. SURFACE PREPARATION AND APPLICATION PROCEDURES

For proper technique, refer to the Belzona® Instructions For Use leaflet which is enclosed with each packaged product.

7. AVAILABILITY AND COST

Belzona® 1111 is available from a network of Belzona® Distributors throughout the world for prompt delivery to the application site. For information, consult the Belzona® Distributor in your area.

8. WARRANTY

Belzona® guarantees this product will meet the performance claims stated herein when material is stored and used as instructed in the Belzona® Instructions For Use leaflet. Belzona® further guarantees that all its products are carefully manufactured to ensure the highest quality possible and tested strictly in accordance with universally recognised standards (ASTM, ANSI, BS, DIN, etc.). Since Belzona® has no control over the use of the product described herein, no warranty for any application can be given.

9. TECHNICAL SERVICES

Complete technical assistance is available and includes fully trained Technical Consultants, technical service personnel and fully staffed research, development and quality control laboratories.

10. HEALTH AND SAFETY

Prior to using this material, please consult the relevant Material Safety Data Sheets.

11. APPROVALS/ ACCEPTANCES

The material has received recognition from organisations worldwide including:

AMERICAN BUREAU OF SHIPPING
BUREAU VERITAS
U.S. DEPARTMENT OF NAVY
GAZ DE FRANCE
RJB MINING
AIR B.P.
NATO
NUCLEAR INDUSTRY (DBA TESTED)
U.S.D.A.
GENERAL MOTORS
TOYOTA
NIPPON KAIJI KYOKI
RUSSIAN REGISTER OF SHIPPING

The technical data contained herein is based on the results of long term tests carried out in our laboratories and to the best of our knowledge is true and accurate on the date of publication. It is however subject to change without prior notice and the user should contact Belzona to verify the technical data is correct before specifying or ordering. No guarantee of accuracy is given or implied. We assume no responsibility for rates of coverage, performance or injury resulting from use. Liability, if any, is limited to the replacement of products. No other warranty or guarantee of any kind is made by Belzona, express or implied, whether statutory, by operation of law or otherwise, including merchantability or fitness for a particular purpose.

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ISO 9001:2000
Q 09335

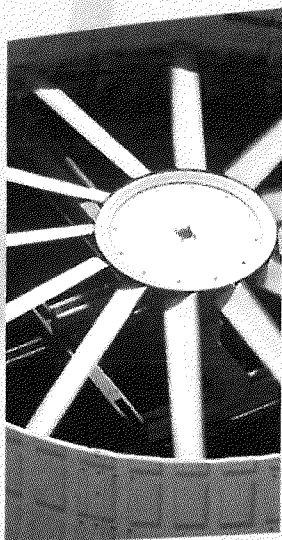
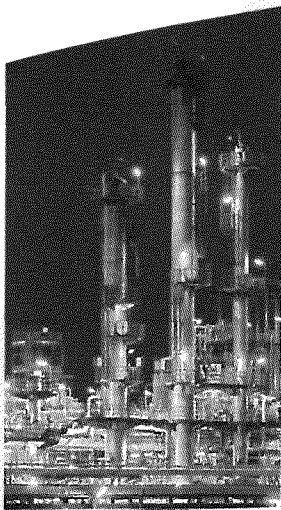
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E-Mail: belzona@belzona.com



www.belzona.com

Belzona® 1111 - Product Specification Sheet - (2)

Printed in England Publication No. 4-1-05



COMPLETE SHAFT GROUNDING SOLUTIONS

Current Diverter Ring™
and Motor Grounding Seal™



INPRO/SEAL®

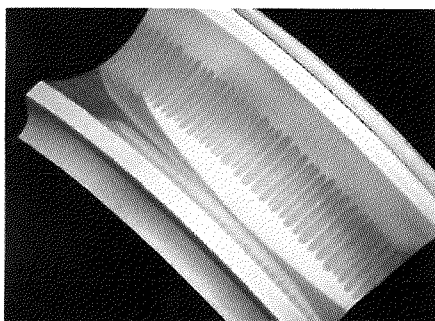
A **DOVER** COMPANY

SAFEGUARD YOUR INVESTMENT FROM BEARING DAMAGE

The VFD Challenge

Variable frequency drives (VFDs) are becoming the system of choice across a variety of industries because of their ability to reduce energy consumption – generating significant cost savings. However, these systems may also contribute to unplanned downtime.

VFDs induce high frequency voltages on the shaft that seek a path to ground through the motor's bearings or the bearings of the coupled equipment. When these voltages exceed the insulation breakdown of the lubricant, they discharge through the bearings to ground.



Stray shaft currents discharging through the bearings on rotating equipment can cause fluting on the bearing race, resulting in premature bearing failure.

The Cost of Electrical Damage

This discharge, called electrical discharge machining (EDM), causes fusion craters, pitting, frosting, and fluting. These effects make EDM a leading cause of premature bearing failure in VFD-driven motors.

Even if the motor itself has insulated bearings, shaft currents can travel to the coupled equipment, such as pumps, pillow blocks and gearboxes, and damage those bearings. The results are costly and include reduced equipment reliability, increased maintenance costs, unscheduled downtime and lost revenue.

SHAFT GROUNDING OPTIONS						
	CDR®	CERAMIC BEARING	COPPER METAL BRUSH	CARBON BRUSH	CONDUCTIVE GREASE	FILTERS ON VFD
EASY MOUNTING	✓				✓	✓
MAINTENANCE FREE	✓	✓				
HIGH ROI	✓					
LOW INITIAL COST	✓			✓	✓	
LONG LIFE	✓					
NO RPM LIMIT	✓	✓				✓

Reducing Electrical Damage

Diverting shaft currents and controlling EDM needs to be a priority for your business. Various methods have been used over the years to mitigate shaft currents, but they have all had limitations...**until now.**



The Inpro/Seal® Current Diverter Ring™ and Motor Grounding Seal™ protect bearings from harmful stray shaft currents.

**SAME-DAY
SHIPPING AVAILABLE**

The Inpro/Seal® Solution

The Inpro/Seal Current Diverter Ring™ (CDR®) uses proprietary conductive filaments to protect bearings from stray shaft currents by providing a low impedance path to ground – drawing the currents safely away from the bearings.

For severe duty applications, the Inpro/Seal Motor Grounding Seal™ (MGS®) combines proven shaft-grounding technology with the patented VBXX® Bearing Isolator to provide complete bearing protection against stray shaft currents and contamination ingress.

Benefits:

- Split designs available for easy installation
- Can be installed by OEMs or retrofitted on site
- Maintenance free at all RPMs
- Modular design allows for use with any size motor
- Multi-stage product can handle high shaft currents found in larger rotating equipment
- Can accommodate shaft sizes of 0.625 – 48.0 in. (1.59 – 121.92 cm)
- Manufactured in bronze, stainless steel and aluminum

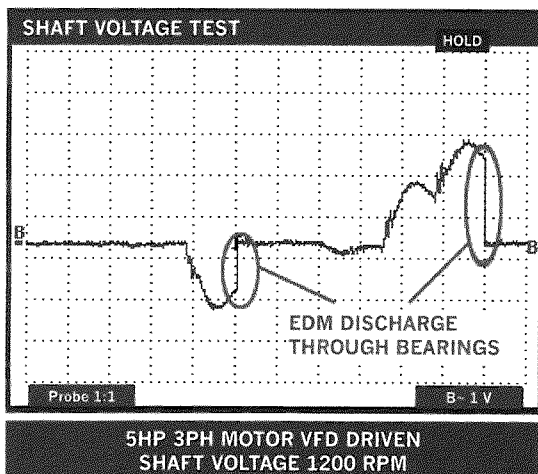
PRESS-IN

CLIP-ON

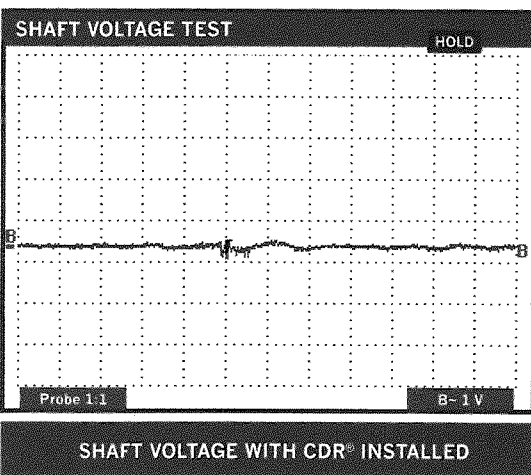
BOLT-THROUGH

EPOXY

NEMA FRONT PLATE



Stray shaft currents
discharging through
the motor's bearings.



No discharges with
the Inpro/Seal®
CDR® installed.

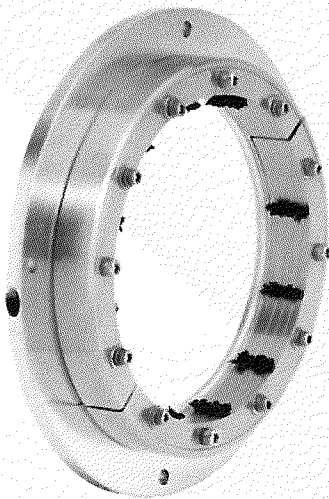
GUARANTEED PERFORMANCE

The Inpro/Seal® CDR® and MGS® are backed by a performance guarantee. See our website for complete details.

Unmatched Customer Service

Inpro/Seal's responsive global sales network is committed to making sure you have the right technology for your application, right when you need it. We know that time means money for you. That's why we offer same-day shipping on most products, even new designs. No matter what your application, we can deliver a custom engineered solution designed to meet your specific needs.

Technology you can rely on, supported by customer service you'll appreciate.



Inpro/Seal® Multi-Stage CDR® for high voltage systems.

The Inpro/Seal® CDR® is a custom engineered solution and some designs may be protected by US patents and pending patent applications as installed including US Pat. #D615,996 and #7,521,827.

Experience You Can Trust

Reducing EDM damage requires a custom engineered solution that takes into account all these factors:

- Motor size
- Bearing type
- Bearing insulation
- Existing circulating currents
- Existing system grounding configuration
- Operating equipment
- Coupled equipment

You don't need to be an expert; our knowledgeable team will help. You can count on Inpro/Seal®, the leader in bearing and system protection, to maximize the uptime of your rotating equipment. We've been the trusted source for bearing isolator technology for more than 30 years, and now we're expanding our product offerings to deliver protection from electrical damage. Inpro/Seal's line of complete shaft grounding solutions is ideal for HVAC, industrial, and wind energy applications.

The Inpro/Seal Advantage

Inpro/Seal is committed to delivering innovative technology and superior customer support...standard with every solution. When you work with Inpro/Seal, you can expect:

- Same-day shipments available on most products, including new designs
- Custom engineered solutions for your application and operating environment
- Knowledgeable sales network providing localized support
- Performance guarantee— see website for complete details

Engineering Specifications

To ensure that your equipment is protected by Inpro/Seal's shaft grounding technology, simply include the following with your specifications:

"All motors driven by variable frequency drives (VFD) shall include bearing protection in the form of a device to divert shaft currents to ground. The device shall be maintenance free and constructed of highly conductive bronze. Recommended device: Inpro/Seal Current Diverter Ring™ (CDR®)."

"All VFD driven motors operating in harsh environments shall employ complete bearing protection through the use of a non-contact or non-contacting while-rotating type seal to obtain an IP55 degree of protection as well as an integrated device to divert shaft currents to ground. Recommended device: Inpro/Seal Motor Grounding Seal™ (MGS®)."

READY TO GET STARTED?

Visit www.inpro-seal.com to contact your local Inpro/Seal representative or request a quote.



Standard
Paint
Specification

For

EM Gray

NIDEC MOTOR CORPORATION
Industrial Motors & Systems Division
Mena, Arkansas

CONTENTS

- 1.0 Scope
- 2.0 Unpainted Surfaces
- 3.0 Surface Preparation
- 4.0 Cast Aluminum and Fiberglass Parts
- 5.0 Motor Assembly
- 6.0 General
- 7.0 Finish Top Coating
- 8.0 Final Finish Inspection
- 9.0 Material Identification

1.0 Scope

Industrial Motors & Systems Division of Nidec Motor Corporation in Mena, Arkansas (formerly U.S. Electrical Motors) has selected the Hi-Solids enamel paint from "Valspar Corp." for its superior rust inhibitive qualities and durability. The paint also has excellent resistance to various chemicals. This specification covers surface preparation and application of protective coating on motors built in the Mena, Arkansas facility.

2.0 Unpainted Surfaces

The following surfaces will not require protective coating:

Anodized Aluminum	Grounding Pads
Brass	Machined Surfaces
Bronze	Motor Leads
Chromium Plated Metals	Porcelain Enamel Finishes
Copper	Rubber
Galvanized Steel	Stainless Steel
Glass	Vacuum Pressure Impregnated Parts

3.0 Surface Preparation (Cast Iron & Steel)

- A. The foundries are required to snag, remove all sand and slag from castings. This is to be immediately followed by primer paint to insure 100% coverage. Primer is to be "Valspar Corp." gray oxide primer (NMC Part No. 999712) or equivalent. Film Thickness: 1 to 3 mils.
- B. Prime all castings, in plant, if they have not been primed by the foundry.
- C. All parts are to be cleaned prior to priming or finish painting as follows:
 - 1. If parts are dirty – wash and rinse in parts washer.
 - 2. If parts are oily or greasy – clean in a phosphate dip degrease system and rinse in parts washer.
 - 3. If parts are rusty – grit blast to commercial grade.
 - 4. Welded fabricated assemblies – power wire brush all welds and degrease in the phosphate dip degreaser system and rinse in parts washer.
 - 5. Thoroughly dry all parts prior to priming or finish painting. Primer must be applied immediately after cleaning and drying process.

4.0 Cast Aluminum and Fiberglass Parts

Priming is not required on cast aluminum or fiberglass parts. Oxidation must be removed from aluminum parts with a solvent prior to finish painting. Fiberglass parts (canopy caps) are received with a white pigment in the fiberglass.

5.0 Motor Assembly

After assembling the motor, there may be surfaces that require priming or touch-up prior to final painting. These surfaces are bracket-to-frame register fits, outlet box pads, etc. Spray cans of primer are provided to allow motor assemblers to prime paint unfinished surfaces with two coats of primer. Sufficient drying time must be allowed between primer coats. If surfaces are oily, wash with clean paint thinner using a clean rag to prevent contamination of other surfaces.

6.0 General

- A. Finished coating shall not be applied to wet or damp surfaces.
- B. All coatings shall be applied in a conscientious manner and in accordance with the written application instructions of the coating manufacturer.
- C. Re-application time between coats shall be in accordance with the coating manufacturer's recommendation corresponding to the conditions of temperature and humidity.
- D. Hardware trim and other items not requiring coating may be removed as required for proper application of coatings. Such items shall be replaced after completion of work.
- E. The dry film thickness of each coat, and of the entire system, shall follow the coating manufacturer's recommendation and this specification. The number of coats specified shall be a minimum number of coats to achieve the specified film thickness.
- F. Coverage rates, as calculated by the coating manufacturer, shall be considered as the maximum allowable.
- G. All spraying equipment shall be maintained in good working order, with daily inspection, and shall be in conformity with the coating manufacturer's most recent application specification.

7.0 Finish Top Coating

All motor products must be clean and free of any dirt, oil or grease on the primed surface prior to finish painting. Except where otherwise specified, thinners shall not be used. Motors will be painted with one coat unless otherwise noted. Film thickness: 2 to 4 mils.

8.0 Final Finish Inspection

Visual inspection of completed work shall be performed on the finished motor by the Quality Assurance Department. The final surface finish is to be in accordance with industry standards for comparable equipment. Any surfaces found in violation of this specification will be rejected and will require rework. Acceptance or rejection of final finish paint is the sole responsibility of the Quality Assurance Department.

9.0 Material Identification

A. Standard Primer

NMC P/N 999712
GRAY OXIDE PRIMER
VALSPAR CORP.
#5410-E-10009
ALKYD-HI SOLIDS, FAST DRY

Alternate Primer Vendor:
SHERWIN-WILLIAMS
GRAY ALKYD B50AZ6
KEM KROMIK
UNIVERSAL METAL PRIMER

B. Standard Finish Paint

NMC P/N 138538
EM GRAY 3.5 VOC H/S ENAMEL
VALSPAR CORP.
AAA1024 DURASPAR 430
ALKYD-HI SOLIDS, FAST DRY
COLOR: BLUE-GRAY, PANTONE PMS 433C

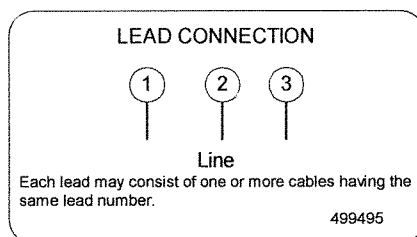
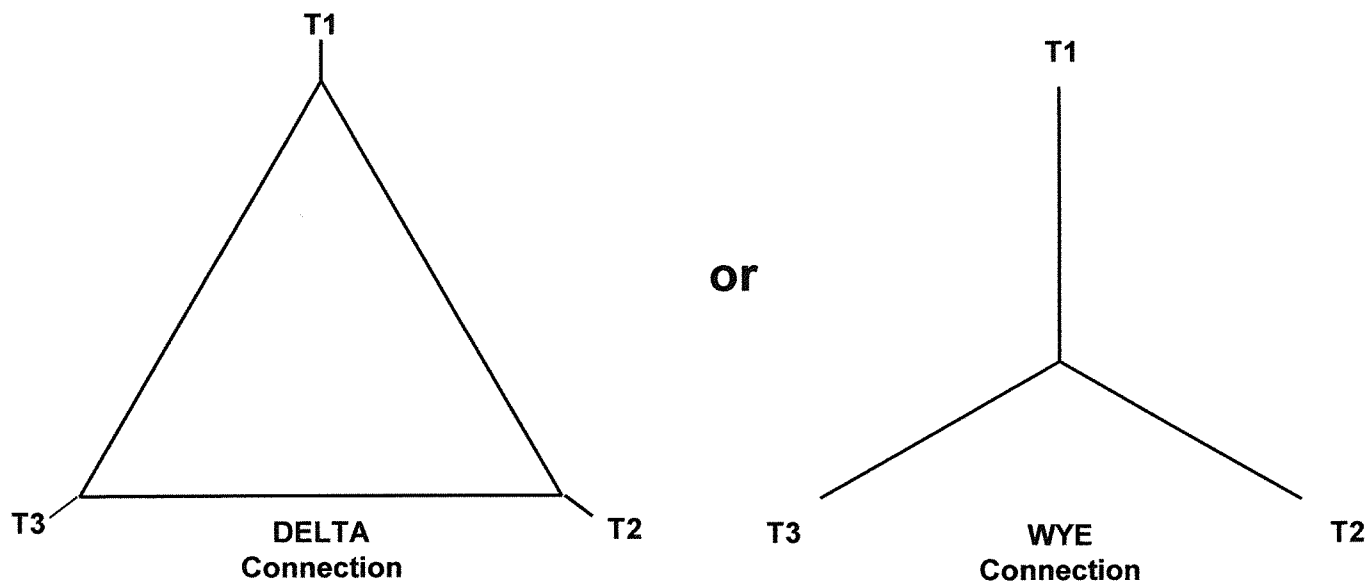
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Rev. 01/17/12 - DH

NIDEC MOTOR CORPORATION
8050 W. Florissant Avenue | St Louis, MO 63136
www.nidec-motor.com | www.usmotors.com



499495

Motor Wiring Diagram



To reverse direction of rotation interchange connections L1 and L2.

Each lead may be comprised of one or more cables.
Each cable will be marked with the appropriate lead number.

SECTION 26 00 20

COMMON MOTOR REQUIREMENTS

✓ PART 1 - GENERAL

✓ 1.1 SUMMARY

- A. Provide electric motors in conformance with this Section for electric motor-driven equipment specified in other Sections of the Specification.
- B. This Section describes requirements for horizontal and vertical 3-phase squirrel cage induction motors up to nominal 500 HP in NEMA standard frame sizes.

✓ 1.2 RELATED DOCUMENTS

- A. Drawings and General Conditions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Submersible pump motor, hermetic compressor motor, valve actuator motor, gate actuator motor, and single phase motor requirements shall be specified in other Sections of the Specification.

✓ 1.3 DEFINITIONS

- A. The following definitions apply to this Section:
 - 1. ABMA: American Bearing Manufacturers Association
 - 2. AFBMA: Anti-Friction Bearing Manufacturers Association (former name of ABMA)
 - 3. BHP: brake horsepower
 - 4. HP: horsepower
 - 5. ODP: Open drip-proof
 - 6. ODP FG: Open drip-proof, fully guarded
 - 7. PWM: pulse-width modulated
 - 8. TEFC: Totally enclosed fan-cooled
 - 9. TENV: Totally enclosed non-ventilated
 - 10. Vpeak: single amplitude zero-to-peak line-to-line voltage
 - 11. Vrated: nameplate line-to-line voltage
 - 12. VFC: variable frequency controller
 - 13. VFD: combination of variable frequency controller and motor

✓ 1.4 CODES AND STANDARDS

- A. Equipment and installation shall be in accordance with the latest revisions of the following codes and standards:
 - 1. NEMA Standard MG1-2003 (Rev. 1 – 2004) Motors and Generators
 - 2. ANSI / IEEE Standard 112 Standard Test Procedure for Polyphase Induction Motors and Generators

3. IEEE 841 Standard for Petroleum and Chemical Industry - Severe Duty Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors - Up to and Including 370 kW (500 hp)
4. NEC: National Electrical Code (NFPA 70)
5. Underwriters Laboratories, Inc. (UL)

✓ 1.5 QUALITY ASSURANCE

- A. Motors shall be designed, manufactured, and tested in accordance with the Codes and Standards referenced in this Section.
- B. Motor manufacturers shall have quality certification to ISO 9001:2000, or an equivalent quality management system acceptable to the Engineer.

✓ 1.6 SUBMITTALS

- A. Motor submittal data shall be included with the mechanical equipment shop drawing and product data submittals.
- B. For variable frequency drive applications, submit a Certification Letter as described in INVERTER DUTY MOTORS. For variable frequency drive applications in Hazardous (Classified) Locations, the certification letter shall include a statement of motor conformance to NEC Article 500 temperature rise limits for the anticipated hazardous gasses or dusts, following the recommendations in NEMA MG1-2003 31.1.4. Submittals for variable frequency drive applications without the certification letter will be considered incomplete.
- C. The motor portion of shop drawing and manufacturer's product data submittals, for mechanical equipment specified in other Sections, shall include the following:
 1. Motor assembly drawings with the following information:
 - a. Enclosure type with degree of protection (IP rating)
 - b. Materials of construction of housing, stator, rotor, fan, fan guard
 - c. Bearing types, bearing construction, shields and seals
 - d. Lubrication system
 - e. Location of lubrication fittings
 - f. Location and type of breathers and drains for totally enclosed motors
 - g. Internal and external coatings
 - h. Direction of rotation
 - i. Electrical wiring diagrams for connection of windings and accessories
 2. Motor specification data sheets with the following motor nameplate information:
 - j. Manufacturer's type and frame designation
 - k. Horsepower output
 - l. Time rating
 - m. Maximum ambient temperature for which the motor is designed
 - n. Insulation system designation
 - o. Full load RPM

- p. Voltage(s)
 - q. Frequency
 - r. Number of phases
 - s. Full load amperes
 - t. NEMA Code Letter for locked-rotor amperes (or locked rotor amperes)
 - u. NEMA nominal efficiency
 - v. Motor service factor for sine wave applications
 - w. Designation “Thermally Protected” or “OVER TEMP PROT – [type number per NEMA MG1]” (as applicable)
 - x. ABMA bearing ID number(s)
 - y. NRTL and listing for Hazardous (Classified) Areas (explosion-proof motors only)
3. Inverter Duty motor data sheets shall include the following additional information:
- z. Motor service factor for PWM variable frequency drive applications
 - aa. Motor winding insulation impulse voltage rating
 - bb. Bearing insulation
 - cc. Shaft grounding details
4. Submittals shall include information about all specified motor options, with sufficient detail to demonstrate that the motor is suitable for the drive application, including but not limited to the following:
- dd. Winding over-temperature protection devices
 - ee. Anti-condensation heaters
 - ff. Condensation drains (totally enclosed motors only)
 - gg. Shaft and bearing seals
 - hh. Anti-backspin ratchets
 - ii. Thrust bearings
 - jj. Oil lubrication accessories
 - kk. Hollow or solid shaft details
 - ll. Coupling and drive pulley details
 - mm. Mounting base details
5. Factory Test Reports
6. Manufacturer’s Installation Instructions: including manufacturer’s shipping, receiving, handling, rigging, storage and setting instructions, recommendations, cautions, and warnings.
7. Field Test Reports

✓ PART 2 - PRODUCTS

2.1 DRIVE APPLICATION

- A. Motors shall be selected by the driven equipment manufacturer for the drive application, and for operation within the motor nameplate horsepower rating without applying the service factor.
- B. Motors shall have output torque characteristics, direction of rotation, rotational speed, dimensions, bearings, and accessories suitable for the drive application. Motor output shaft dimensions and keyway shall be suitable for connection to the driven equipment coupling.
- C. Motors shall be capable of successfully accelerating inertial loads tabulated in NEMA MG1-1998 Section 12.54 without injurious heating. In cases where the actual load inertia exceeds, these values, the driven equipment manufacturer shall select a larger motor capable of successfully accelerating the inertial load without injurious heating.
- D. Motor continuous output horsepower shall be limited to the 1.0 service factor rating.

✓ 2.2 VOLTAGE RATINGS

- ✓ A. Motors ½ HP and larger shall be 460 V three phase 60 Hz, unless otherwise indicated.
- N/A B. Motors 1/3 HP and smaller shall be 120 V single phase 60 Hz, and shall be suitable for the drive applications described in other Sections.

✓ 2.3 EFFICIENCY

- A. Motors other than explosion-proof motors shall have nominal efficiencies in accordance with NEMA MG1-2003 Table 12-12 Full-Load Efficiencies for NEMA Premium™ Efficiency Electric Motors Rated 600 Volts or Less (Random Wound).
- B. Motor efficiencies shall be determined in conformance with IEEE 112 Method B.

✓ 2.4 STATOR WINDINGS AND INSULATION

- ✓ A. Motors shall have moisture-resistant Class F insulated copper stator windings. Motors shall be designed for both full-voltage and reduced-voltage starting. Additional requirements apply to VFD applications, refer to INVERTER DUTY MOTORS.
- ✓ B. Motors shall have 1.15 minimum service factor (on sine wave power), and Class B temperature rise when operated at rated HP at 1.0 service factor.
- N/A C. Motors located outdoors and in unheated indoor areas shall have encapsulated or sealed windings capable of passing the conformance tests in NEMA MG1-2003 12.62. Alternatively, 120 VAC anti-condensation heaters shall be provided.
- N/A D. Non-inverter-duty motors shall have minimum peak impulse voltage rating $V_{peak} = 1000$ V, with rise time as short as 2 microseconds, in accordance with NEMA MG1-2003 30.2.2.8.
- ✓ E. Motors 500 HP and smaller shall have stall times of 12 seconds minimum when initially at normal operating temperature, in conformance with NEMA MG1-2003 12.49.

✓ 2.5 INVERTER DUTY MOTORS

- ✓ A. Motors operating on variable frequency controllers shall be “inverter duty” type, with minimum peak impulse voltage rating $V_{peak} = 3.1$ times V_{rated} with rise time as short as 0.1 microseconds, and in accordance with NEMA MG1-2003 31.4.4.3 recommendations, to provide long insulation life when operating on PWM variable frequency controller output voltage waveforms.
- ✓ B. Inverter duty motor bearings shall be insulated on one or both ends to prevent bearing

element damage from stray electrical currents, as described in NEMA MG1-2003 31.4.4.3. Provide motor shaft grounding brush(es) to drain stray rotor currents to the motor electrical equipment grounding conductor connection point.

- ✓ C. Inverter duty motors shall be fitted with winding over-temperature accessories as described in WINDING OVERTEMPERATURE PROTECTION.
- ✓ D. For each variable frequency drive application indicated, provide a Certification Letter from the motor manufacturer stating that the motor, and in particular the peak impulse voltage insulation rating, bearing insulation, and shaft grounding method, is suitable for operation on the variable frequency controller proposed for the project, naming the specific VFC manufacturer and catalog number, and including a statement that the variable frequency drive motor branch circuit length and conductor size has been taken into consideration. Include available "skip-frequency" information and VFC setting recommendations with the Certification Letter.

✓ 2.6 DEGREE OF PROTECTION

- ✓ A. Motors housings shall have enclosures with degree of protection ratings as specified in the mechanical equipment Sections of the Specification.
- ✓ B. In the absence of motor enclosure degree of protection ratings specified in other Sections of the Specification, the following degrees of protection shall apply:
 - N/A 1. Outdoor Areas: severe-duty TEFC or TENV to IEEE 841.
 - N/A 2. Corrosive and Chemical Areas: severe-duty TEFC or TENV to IEEE 841.
 - N/A 3. Clean, Dry, Indoor Areas (not including Process Areas): ODP FG (IP32).
 - ✓ 4. Indoor Process Areas (including rooms containing pumps and process equipment): TENV or TEFC (IP55)
 - N/A 5. Hazardous (Classified) Locations: explosion-proof and dust ignition-proof TEFC or TENV severe duty to IEEE 841, NRTL-listed and labeled for the hazardous location classification, and conforming to NEC Article 500 requirements.
- N/A C. Motors located in Hazardous (Classified) Locations and operating on VFC's shall be certified by the equipment supplier and the motor manufacturer to meet NEC requirements for maximum temperature limits for the Hazardous (Classified) Location indicated when operating on the VFC at the specified maximum ambient temperature. Submit Certification Letter as described in SUBMITTALS.

✓ 2.7 MOTOR FRAMES

- A. Motor frames shall be NEMA standard sizes. Open motors over 5 HP, enclosed motors (not severe duty) over 2 HP, severe-duty and explosion-proof motors shall have cast iron frames.

✓ 2.8 AMBIENT CONDITIONS

- ✓ A. Motors shall have NEMA standard horsepower ratings for continuous duty under the following environmental conditions:
 - ✓ 1. Ambient Temperature: -25 to +40 deg. C.
 - ✓ 2. Altitude: Not exceeding 3300 feet (1000 m).
- ✓ B. Motors shall be suitable for any unusual service conditions indicated on the Drawings, or in other Sections of the Specification.

✓ 2.9 COOLING

- ✓ A. Motors shall be air-cooled, with internal or external fans. Variable speed motors shall be suitable for operation over a 4:1 speed range without separate method of cooling.
- N/A B. Motors with speed ranges greater than 4:1 shall be fitted with separate electric motor-driven forced-air cooling to prevent overheating when running continuously at the lowest specified operating speed.

✓ 2.10 INRUSH CURRENT

- A. Motors over 20 HP shall have inrush current equivalent to NEMA Code G, or lower.

✓ 2.11 MAXIMUM SPEED

- A. Unless otherwise indicated, motor synchronous speeds shall not exceed 1800 RPM.

✓ 2.12 NAMEPLATES

- A. Provide stainless steel motor nameplates with engraved or stamped markings in accordance with NEMA standards, and including the information specified in SUBMITTALS.

✓ 2.13 ROTORS

- A. Rotors shall be aluminum or copper, designed for 125% rotational speed in either direction without distortion or damage, and shall be statically and dynamically balanced as described in VIBRATION LIMITS.

✓ 2.14 BEARINGS

- ✓ A. Motors shall have re-greasable anti-friction bearings as recommended by motor manufacturer for the application. Oil lubricated ring, sleeve, and plate bearings shall be permitted only for special applications as specified in the mechanical equipment Section of the Specification, and for vertical hollow-shaft motors as described below.
- ✓ B. Motors shall have radial bearings and thrust bearings designed to carry all of the loads imposed on the motor in service.
- ✓ C. Grease fittings and either drain plugs or grease pressure relief fittings shall be provided for each bearing.
- ✓ D. Anti-friction bearings shall have minimum calculated ABMA L-10 life of 100,000 hours for flexible direct-coupled applications, and minimum calculated ABMA L-10 life of 26,280 hours in belt drive applications. Provide motors with longer calculated bearing life where indicated in other Sections of the Specification.
- N/A E. Vertical hollow-shaft motors shall be equipped with oil lubricated spherical roller thrust bearings with oil reservoirs and visual indication of oil level, and lower grease lubricated radial guide bearings. Sufficient oil shall be provided to fill the oil reservoir(s) plus any additional oil required for one refilling. The oil shall be in a properly identified container. Running fit adjustment shall be provided by means of a lockable nut at the top of the shaft. Provide anti-backspin ratchets to prevent reverse rotation.

✓ 2.15 VIBRATION LIMITS

- ✓ A. For standard motors, unfiltered motor vibration velocities shall not exceed the limits in NEMA MG1 Table 7-1 when measured in accordance with Part 7 of NEMA MG1.
- N/A B. For severe duty motors, unfiltered motor vibration velocities shall not exceed the limits in IEEE Standard 841-2001 6.9.
- N/A C. Special motor vibration limits, when required for the application, shall conform to the requirements of the manufacturer of the driven equipment.

✓ 2.16 TERMINAL BOXES

- A. Open motor terminal boxes shall be gasketed ferrous metal or cast iron, with diagonally split bolted cover.
- B. Enclosed motor terminal boxes and covers shall be cast iron, with diagonally-split bolted cover, gaskets or O-rings to IP55, and NPT-threaded conduit entry.
- C. Terminal boxes shall be suitable for top, bottom, drive end or non-drive end conduit entry by removing terminal box mounting bolts and rotating terminal box in 90 degree increments. Coordinate conduit entry quantities and sizes with motor branch circuit conduit sizes.
- D. Provide grounding lug inside terminal box for NEC-sized equipment grounding conductor.
- E. Terminal boxes shall be suitable for the conduit and wire sizes shown on the Drawings.

✓ 2.17 PROTECTION AGAINST CONDENSATION

- A. Totally enclosed motors shall be fitted with breathers and condensation drains.
- B. Provide anti-condensation heaters for motors located outdoors. The requirement for anti-condensation heaters may be waived by the Engineer if the motor is manufactured with a sealed insulation system unless the equipment manufacturer recommends anti-condensation heaters for the drive application.

✓ 2.18 WINDING OVER-TEMPERATURE PROTECTION

- A. Motor winding over-temperature shall be provided for motors in variable frequency drive applications, and where specified in the mechanical equipment Sections of the Specification.
- B. Motor winding over-temperature devices shall be as follows:
 - 1. Motors 300 HP and smaller: a minimum of three normally closed winding over-temperature switches, one in each phase. Switches shall open at the permissible temperature rise for the insulation class in accordance with NEMA MG1-2003 31.4.1.2.

✓ 2.19 REQUIRED ACCESSORIES

- N/A A. Belt-drive motor applications: adjustable motor mounting bases.
- ✓ B. Motors shall include lifting lugs.

✓ 2.20 FACTORY TEST REPORTS

- A. Motors through 200 HP: routine test, reported on IEEE 112 Annex B routine test form.

✓ PART 3 - EXECUTION

✓ 3.1 INSTALLATION

- b. The bearings must be flushed for a minimum of five (5) minutes prior to pump start, continuously while in operation and at least 15 minutes after stopping for proper lubrication. This is to prevent grit and foreign material from fouling the bearings.

✓ 5. Pump Driver

- a. The pumps shall be driven by vertical solid shaft, high efficiency, inverter-duty motors Compatible with VFD starters and rated for installation in a Class 1 Division 1 hazardous classified space. *NOT REQUIRED*
Motor shall have Class F insulation. Motors shall conform to requirements of Division 26 Section "Common Motor Requirements".
- ✓ b. Motors shall be provided by the pump manufacturer and shall be designed for use with the vertical turbine pumps. Motors shall be provided with operating characteristics as specified herein and shall be suitable for operation with PWM type variable frequency drives.
- ✓ c. Horsepower and speeds shall be as specified herein
Performance/Design Criteria for each VTSH Pump and shall be suitable for operation on 3/60/460 volt service.
- ✓ d. Motor shall be non-overloading anywhere on the hydraulic curve.
- N/A e. Auxilliary fans shall be provided if required to properly cool the motor when operating at minimum speed with ambient room temperatures up to 35C.
- ✓ f. Equip motor with a non-conductive thrust bearing carrier with a resistance of more than 1 gigaohm at 1,000 volts and a shaft grounding ring mounted above the motor shaft guide bearing. The grounding ring shall be electrically connected to the motor ground in accordance with Section 26 "Common Motor Requirements".

2.3 SOURCE QUALITY CONTROL

A. Factory Quality Certification

- 1. Submit copy of factory quality assurance certificate.

B. Factory Assembly

- 1. The Vertical Turbine Solids Handling Pumps shall be manufactured in accordance with the factory quality certified documents.

C. Perform shop testing in accordance with the requirements of the Section entitled "Tests on Pumping Equipment". Submit shop tests reports to confirm testing was successfully completed.