



TOWN OF HUDSON

Engineering Department



12 School Street • Hudson, New Hampshire 03051 • Tel: 603-886-6008 • Fax: 603-816-1291

FROM: Elvis Dhima, P.E., Town Engineer

DATE: May 1, 2023

RE: Marsh Road Pumps Station Equipment Already Purchase

Below are the shop drawing for the equipement already purchased, pumps, motors, VFD's and OLRs



FAIRBANKS NIJHUIS™

October 17, 2022

Hayes Pump Inc.
66 Old Power Mill Rd.
West Concord, MA 01742

Attn: Craig Huff

Subject: Purchase Order Number: 132657
Sales Order Number: 53113132
Project: 0913483

To Whom It May Concern:

The submittal data for the above order is attached. This 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: fmproduct@pentair.com

cc:

Enclosures: (1) pdf submittal

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
Marsh Road Water Pump Station
Hudson, NH

Supplier: Hayes Pump Inc.
66 Old Power Mill Rd.
West Concord, MA 01742

Manufacturer:

Pump: Fairbanks Nijhuis
3601 Fairbanks Ave.
Kansas City, Kansas 66106-0906
(913) 371-5000

Project Number: 0913483

Sales Order Number: 53113132

Quantity: 2

Pump Size & Model: 10M 7000AW

Motor: Nidec
P. O. Box 3946
St. Louis, MO 63136
(314) 553-2878

1. **Comment:** Setting Plan to include the 6" height of the concrete slab. The total length from the centerline of the discharge to the centerline of the suction should be 8.0 FT with dimension from top of can to centerline of the suction 87.5"

Response: Confirmed, See Revised Submittal

1. **Comment:** I'm missed this requirement during the order entry process, per but the contract drawing M001, the distance from the bottom of the pump station slab to the centerline of the suction can inlet needs to be 5'-6". (See below screenshot of section view.) This translates to distance of 81.5" from top of can to the suction centerline, and 8.0 FT from discharge connection centerline to suction inlet centerline. Please adjust overall can lengths for both project #'s 0913483 & 0913484 as needrd to accommodate this suction inlet location, and revise the setting plans and can dimensional drawings accordingly.

Response: Confirmed, See Revised Submittal

2. **Comment:** For the Project 0913483 10M- 50 HP pumps, please change the lineshaft diameter to 1-3/16".

Response: Confirmed, See Revised Submittal

3. **Comment:** Please advise if the type CT and/or type D discharge heads are provided with pressure gauge tap, either at the top of the flange or other location

Response: Confirmed, Pressure Gauge tap is Provided on the Discharge Head

Fairbanks Nijhuis
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Fairbanks Nijhuis
Included Features

- Potable Water Application – None NSF Certified
- Variable Speed Operation
- 14" Suction Can
- Pump Shipped Assembled
- 10M, 6 Stage Flanged Bowl Assembly
- Suction Bell & Threaded Discharge Case
- Dynamically Balanced 316 Stainless Steel Impellers
- 416 Stainless Steel Collet Impeller Fasteners
- 316 Stainless Steel Impeller Wear Ring
- Stainless Steel Bowl Wear Ring
- 6" Threaded Column with 1-3/16" Open Line Shaft
- 416 Stainless Steel Line Shaft and Coupling
- 304 Stainless Steel Top Shaft Sleeve
- 16-1/2 x 6 Type "CT" Above Ground Discharge Head
- 175 Lb. Seal Box
- Mechanical Seal John Crane 5610
- 416 Stainless Steel Drive Shaft
- 416 Stainless Steel Pump Shaft
- Certified Non-Witness Performance Test
- Curve Approval Required Prior to Shipment
- Test Logs Required
- Critical Speed Calculations

Fairbanks Nijhuis
Technical Clarifications & Exceptions

1. Refer also to clarifications that may be included on the vendor submittal.

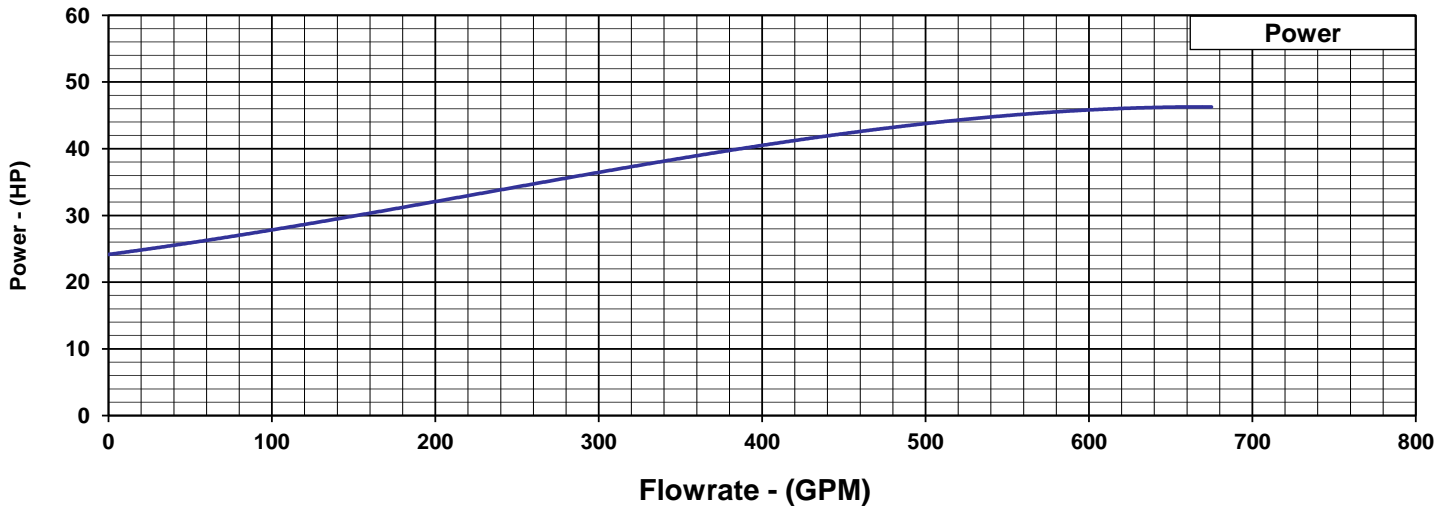
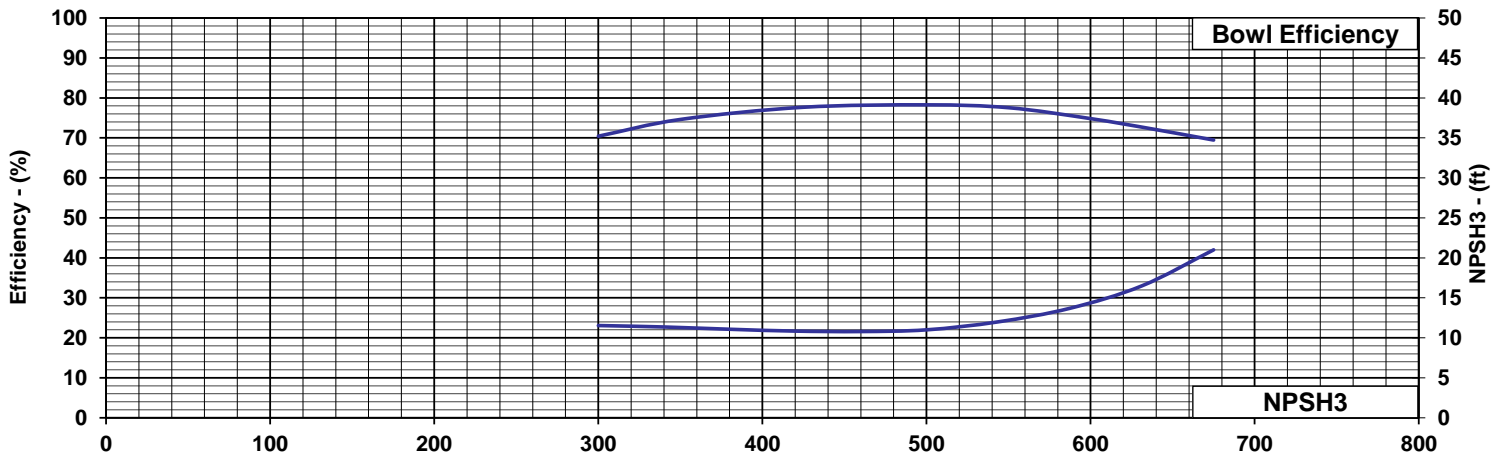
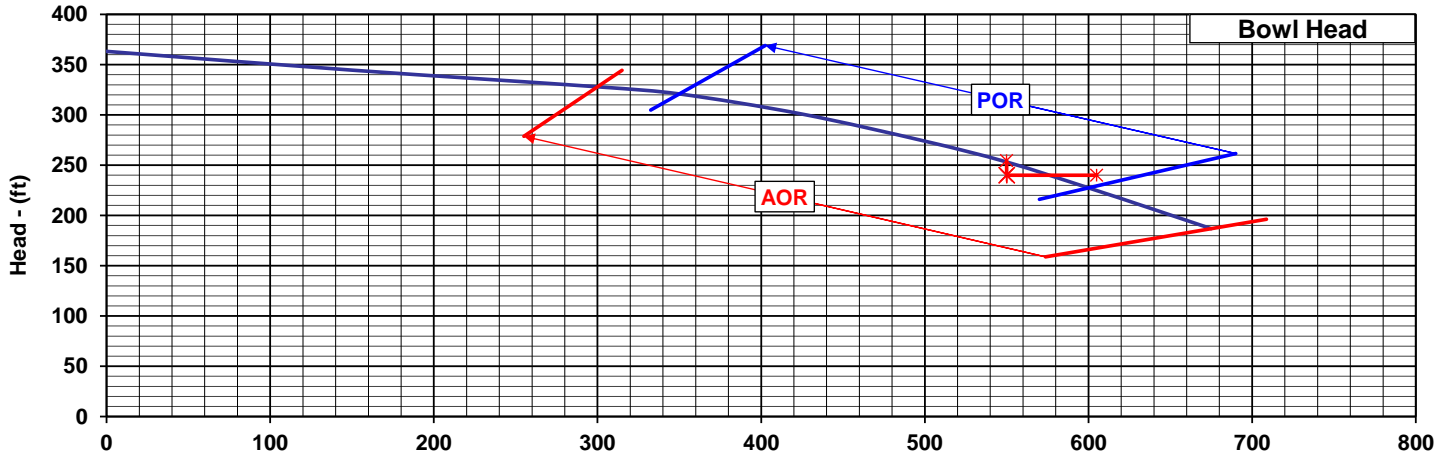
10M Submittal Curve



FAIRBANKS NIJHUIS™

CURVE NUMBER:	0913483C	SPEED	1780 RPM	DRIVER	50 HP	DIAMETER	AS REQ'D	SPHERE	0.68"	GUARANTEED VALUES							
REV.	0	STAGES	6	IMPELLER	STD	DATE	7/1/2022	BY	WSF	FLOW	550	HEAD	240	BOWL EFF	----	HP	----
THIS CURVE IS BASED ON THE ACTUAL TEST PERFORMANCE OF A SIMILAR PUMP. ONLY THE INDICATED POINT(S) IS GUARANTEED.										----	----	----	----				
										----	----	----	----				
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Acceptance Grade 1U per ANSI/HI 14.6.3.4.



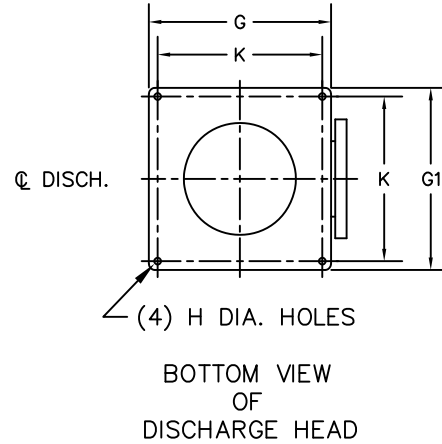
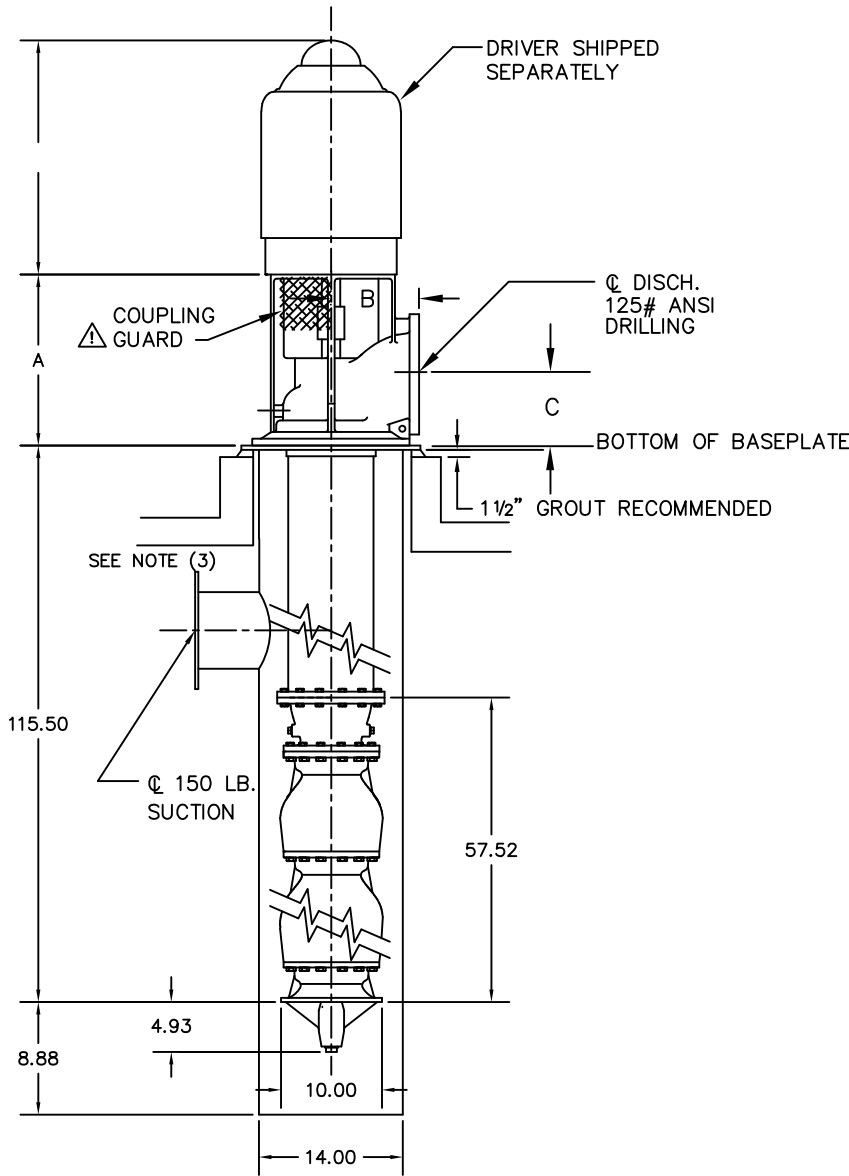
Flowrate - (GPM)

! WARNING

DO NOT OPERATE THIS MACHINE WITHOUT PROTECTIVE GUARD IN PLACE. ANY OPERATION OF THIS MACHINE WITHOUT PROTECTIVE GUARD CAN RESULT IN SEVERE BODILY INJURY.

DISCHARGE HEAD DIMENSIONS

HEAD SIZE	A	B	C	F	G	G1	H	K
16 1/2 x 6	21 1/2	11 3/8	8 1/2	7/8	20 1/2	20	7/8	16 13/16

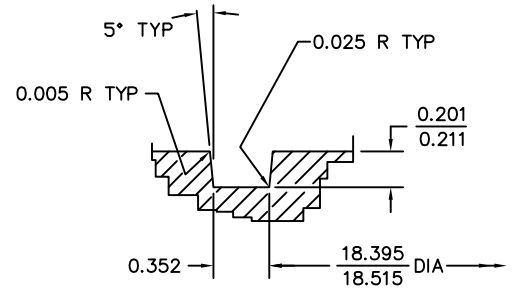
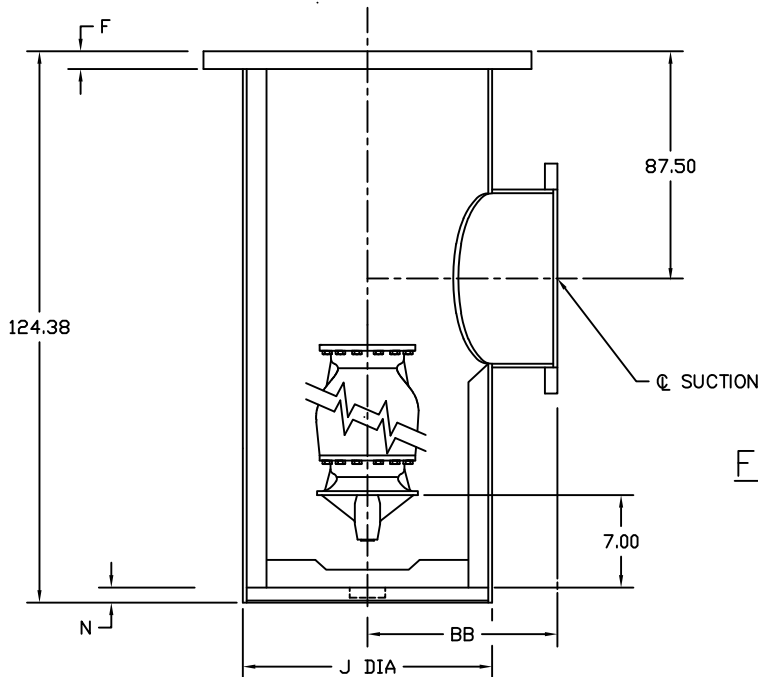
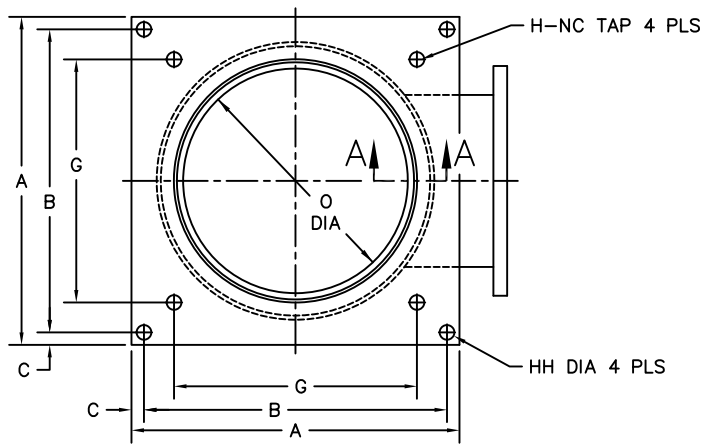


1. THIS DRAWING NOT FOR CONSTRUCTION OR INSTALLATION UNLESS CERTIFIED. DIMENSIONS SHOWN ARE TYPICAL AND MAY VARY DUE TO VARIOUS TOLERANCES.
2. SUCTION CAN MUST BE SUPPORTED ON ALL 4 SIDES AND GROUTED IN PLACE.
3. SEE SHEET 2 OF 2 FOR ADDITIONAL POT DIMENSIONS
4. CUSTOMER TO VERIFY OR ADVISE OVERALL LENGTH PRIOR TO OR AT RELEASE.

○ CONTRACTOR TO ADVISE Q INLET ELEVATION.

REV. 1 - OAL WAS 85.75 - JEA 9/27/22
 REV. 2 - OAL WAS 109.50 - JEA 10/17/22

CUSTOMER HAYES PUMP INC.					P.O. 132657		
JOB NAME MARSH ROAD							
PUMP SIZE & MODEL 10M 7000AW		STAGES 6	GPM 550	TDH 240	RPM 1800	ROT CCW	SETTING PLAN MODEL 7000 PUMP TYPE "CT" SURFACE DISCHARGE HEAD
MOTOR NIDEC	HP 50	FRAME 326TP	PHASE 3	HERTZ 60	VOLTS 230-460	ENCL WPI	
CERTIFIED FOR PROJECT: 0913483			CERTIFIED BY JEA			DATE 7/1/22	
DWG. NO. 0913483SP						REV 2	



18 1/2" O-RING GROOVE
FOR 6"-10" DISCHARGE HEADS
SECTION A-A

1. THIS DRAWING NOT FOR CONSTRUCTION OR INSTALLATION UNLESS CERTIFIED. DIMENSIONS SHOWN ARE TYPICAL AND MAY VARY DUE TO VARIOUS TOLERANCES.
2. SUCTION CAN FLANGE MUST BE SUPPORTED ON ALL FOUR (4) SIDES AND GROUTED IN PLACE.
3. CUSTOMER TO VERIFY OR ADVISE OVERALL LENGTH PRIOR TO OR AT RELEASE.

4. SUCTION PRESSURE LIMITED TO 40 PSI.

SUCTION CAN DIMENSIONS												
CAN SIZE	J DIA	O-RING SIZE	A	B	C	F	G	H	N	O	BB	HH
14	14	18 1/2	25	21	2	1 1/4	16 1/2	3/4"-10	1 7/8	13 1/4	10 7/8	7/8

150# SUCTION FLG. DIM.					
NOM. SIZE	FLG. DIA.	FLG. THK.	NO. BOLTS	HOLE SIZE	B.C. DIA
10	16	1 1/4	12	1	14 1/4

REV. 1 - C.L. DOWN WAS 9.00" & OAL WAS 96.00 - JEA 9/27/22
REV. 2 - C.L. DOWN WAS 81.50" & OAL WAS 118.38" - JEA 10/17/22

CUSTOMER HAYES PUMP INC.				P.O. NO. 132657											
JOB NAME MARSH ROAD WATER PUMP STATION				TAG NAME											
PUMP SIZE AND MODEL 10M 7000AW		STAGES 6		GPM 550		TDH 240		RPM 1800		ROTATION CW		DISCH POS			
MOTOR NIDEC		HP 50		FRAME 326TP		PHASE 3		HERTZ 60		VOLTS 230-460		ENCLOSURE WPI			
CERTIFIED FOR PROJECT: 0913483				CERTIFIED BY JEA				DATE 7/1/22							

Fairbanks Nijhuis
Material Specifications

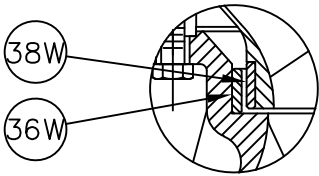
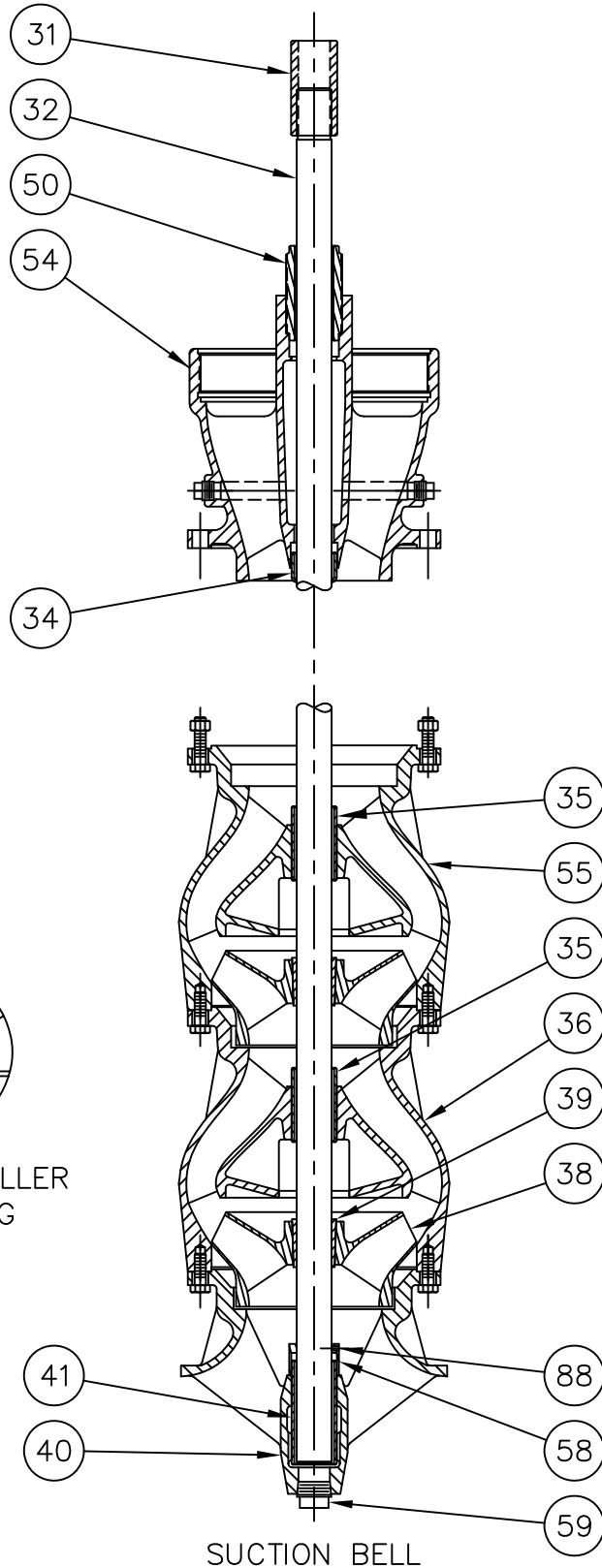
<u>Item</u>	<u>Description</u>	<u>Material</u>	<u>Specification¹</u>
1	Top Shaft Adjusting Nut	Steel	A108 Gr. 12114
6	Water Slinger	Rubber	Neoprene
7	Discharge Head	Cast Iron	A48 Class 30
11	Gasket	Tag Board	F104
13	Top Shaft Sleeve	Stainless Steel	AISI 304 SSTL.
16	Column Flange Gasket	Tag Board	F104
17	Seal Box	Cast Iron	A48 Class 30
17A	Seal Box Bushing	Bismuth Bronze	C89835
19A	Motor Shaft	Steel	AISI 1045
19B	Top Shaft	Stainless Steel	A582 S41600 MOD
21	Top Column	Steel	A53 & A36 ¹
23	Line Shaft	Stainless Steel	A582 S41600 MOD
24	Column Coupling	Steel	A53 Gr. B
25	Bearing Retainer	SST or Bronze	Mfg. Option
26	Bearing	Neoprene	Commercial
29	Shaft Sleeve	Stainless Steel	AISI 304
30	Column	Steel	A53 & A36 ¹
31	Shaft Coupling	Steel ²	A108 Grade 12L14
32	Pump Shaft	Stainless Steel	A582 S41600 MOD
34	Top Bowl Bearing	Bronze	B505 Alloy 932
35	Inter Bowl Bearing	Bronze	B505 Alloy 932
36	Inter Bowl	Cast Iron ³	A48 Class 30
36W	Bowl Wear Ring	Stainless Steel	A743 CA-40 MOD
38	Impeller	Stainless Steel	A743 GR CF-8M
38W	Impeller Wear Ring	Stainless Steel	A743 GR CF-8M
39	Drive Collet	Stainless Steel	A582 S41600
40	Suction Bell	Cast Iron	A48 Class 30
41	Suction Bearing	Bronze	B505 Alloy 932
50	Connector Bearing	Bronze	B505 Alloy 932
54	Discharge Case	Cast Iron	A48 Class 30
55	Top Inter Bowl	Cast Iron ³	A48 Class 30
58	Sand Collar	Bronze	B505 C93200
59	Suction Bowl Plug	Cast Iron	Commercial
88	Set Screw	Stainless Steel	18-8 SSTL.
456	Mechanical Seal	---	Commercial
	Bowl Bolting	Steel	Commercial
	Discharge Head Bolting	Steel	Commercial

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

² Pump Shaft Coupling is Stainless Steel, ASTM A582 S41600

³ Bowls are coated Cast Iron

THREADED COLUMN



BOWL & IMPELLER
WEAR RING

SUCTION BELL

FLANGED BOWL ASSEMBLY
10M
OPEN LINESHAFT



DWG NO 0913483AB REV NO 0

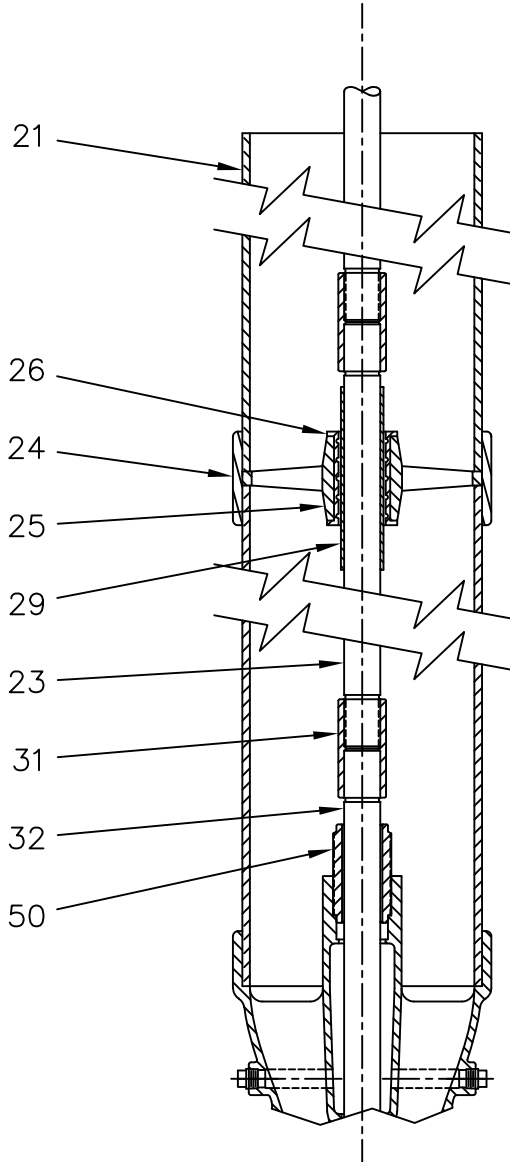


WARNING

ALWAYS BE SURE LIFTING EQUIPMENT IS OF ADEQUATE SIZE TO PREVENT POSSIBLE SERIOUS PERSONAL INJURY OR DAMAGE TO THE EQUIPMENT.

SEE MECHANICAL SEAL

DETAIL



THREADED COLUMN

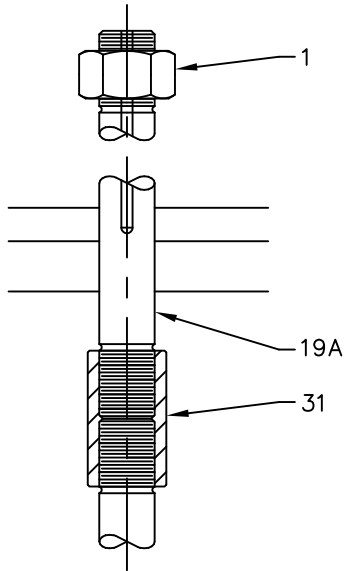
NOTES:

- (1) COLUMN SECTIONS ARE TO BE LIFTED BY EYEBOLTS OR "COLUMN CLAMPS" (SUPPLIED BY OTHERS).
- (2) COLUMN, AND SHAFT ASSEMBLIES SHOULD BE SECURED TOGETHER BY ROPE SLINGS OR OTHER SUITABLE MEANS.
- (3) BEARING CENTERS (MAX)
TOP: 6.5'
INTER: 5'
COLUMN & SHAFT LENGTHS (MAX): 10'
SHAFT PROJECTION: 17.5"
- (4) REFER TO TECHNICAL DATA PAGE FOR OTHER DIMENSIONS AND WEIGHTS.

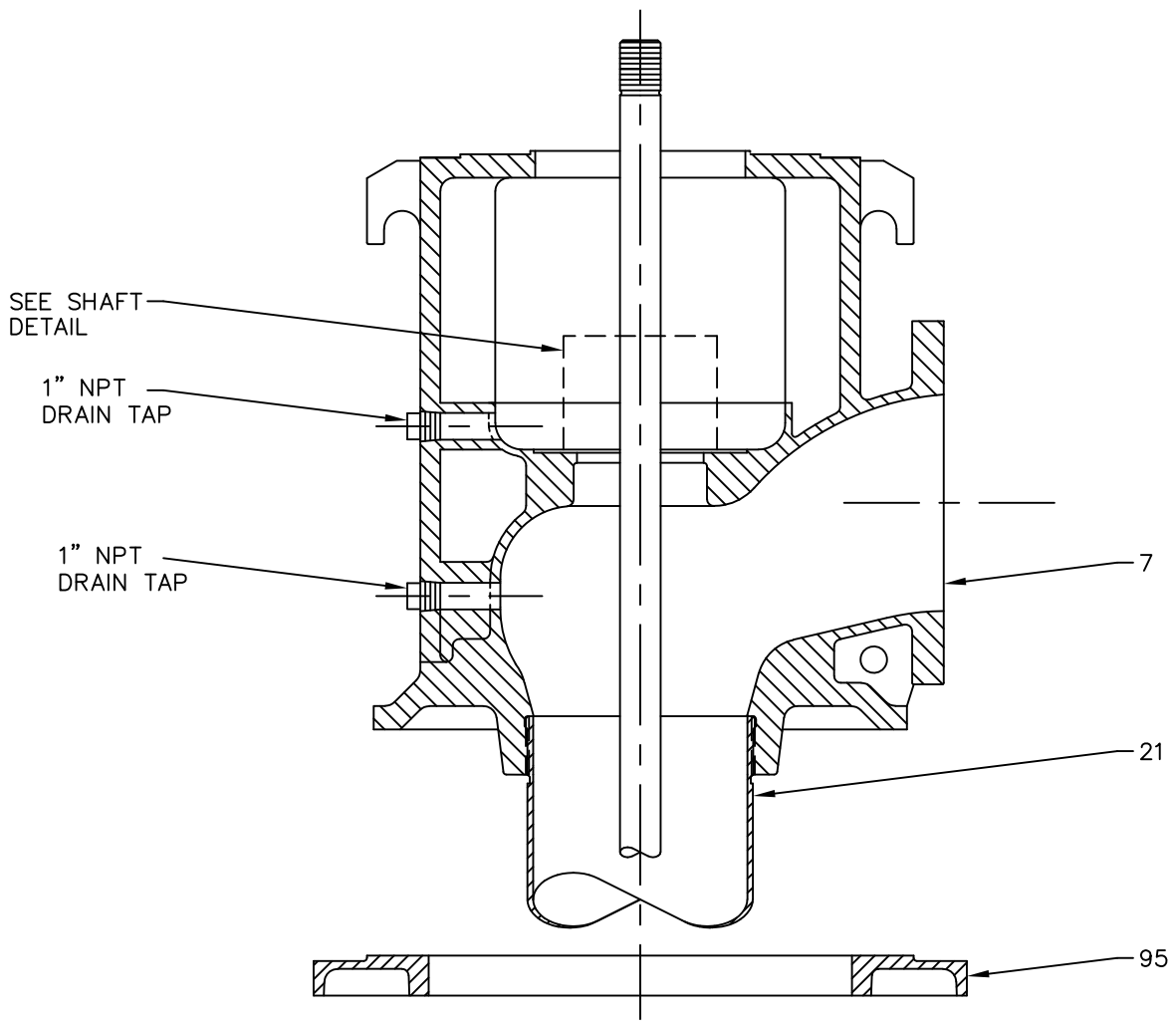
OPEN LINESHAFT
COLUMN SECTIONS



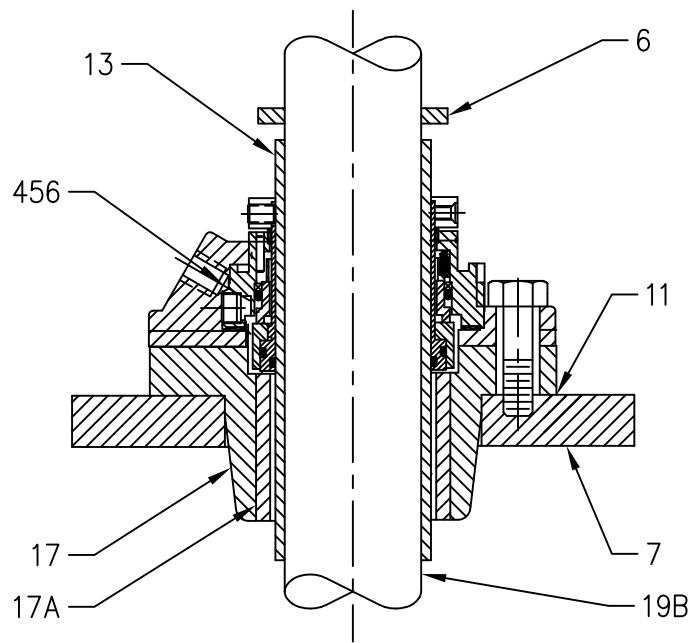
DWG NO 0913483AC REV NO 0



VERTICAL HOLLOW
SHAFT DRIVER



ASSEMBLY
TYPE "CT" DISCHARGE HEAD



OUTSIDE CARTRIDGE
 MECHANICAL SEAL ASSEMBLY
 CRANE 5610

MECHANICAL SEAL
 WITH SHAFT SLEEVE



DWG NO	0913483AS	REV NO	0
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Fairbanks Nijhuis
Technical Data⁴

Bowl Assembly

Bowl Size	10M
Pump Shaft Diameter.....	1-7/16
Bowl Weight, First Stage Lb.	180
Bowl Weight, Each Additional Stage, Lb	49
Allowable Shaft Stretch.....	0.63
Maximum Working Pressure, Standard Material, PSI	475
Maximum Hydro Pressure, Standard Material, PSI.....	712.50
Impeller	
Impeller Eye Area, Sq. In.....	11.19
Thrust Factor, K _T , Lb./Ft.....	3.8
Rotor Weight Per Stage, K _A , Lb.....	15.75
Maximum Sphere Size	0.68
WK ² (Per Stage) Lb.-Ft. ²52
Running Position (Above Seat)	0.200
Maximum Clearances	
Bowl Bearings.....	.0014
Wear Ring.....	0.018

Column

Nominal Size.....	6
Outside Diameter.....	6.625
Wall Thickness	0.280
Weight Per Foot (Lbs./Ft.)	18.97
Coupling O. d	7.31
Coupling Weight (Lbs.)	12.70

Line Shaft

Size	1-3/16
Weight Per Foot (Lbs./Ft.)	4.18
Shaft Coupling Weight (Lbs.).....	1.6
Shaft Sleeve Thickness	0.093

Sealing Box

Inside Diameter of Box.....	2-3/16
Depth of Box	1-5/8
Outside Diameter of Sleeve.....	1-7/16
Max Bearing Clearances	
Lineshaft	0.025
Sealing Box.....	0.020

Discharge Head

Size	16-1/2 X 6
Type	CT
Maximum Discharge Pressure, PSI	
125 Lb. Flange.....	175
Weight, Including Packing Box, Lbs.	432

⁴ Values shown are in inches unless otherwise noted.

Lateral Natural Frequency Analysis

Project Name: Marsh Road Water Pump Station
Sales Order Number: 53113132
Project Number: 0913483
Pump Model: 10M
Revision: 0

Prepared By: Billy Faltas
Engineer

Date Prepared: 7/29/2022

Lateral Natural Frequency Analysis

Ref: 0913483LC PG1

Revision: 0

Analysis Conclusion

All structural natural frequencies are outside of the required separation margin. There should be no excessive vibration due to structural resonance when the pump is operated within the specified operating region.

Summary of Results For Pump and Motor Assembly

The X direction natural frequency is outside of the required separation margin.

The Y direction natural frequency is outside of the required separation margin.

ω_{1x}	= 3166	RPM
ω_{1y}	= 3241	RPM
Min Speed	= 1080	RPM
Max Speed	= 1780	RPM
ω_{1x} Percentage of Min Speed	= 293%	
ω_{1x} Percentage of Max Speed	= 178%	
ω_{1y} Percentage of Min Speed	= 300%	
ω_{1y} Percentage of Max Speed	= 182%	

Required Margin = 20%

Summary of Results For Column Assembly

The natural frequency is outside of the required separation margin.

ω_1	= 862	RPM
Minimum Speed	= 1080	RPM
Maximum Speed	= 1780	RPM
ω_1 Percentage of Min Speed	= 80%	
ω_1 Percentage of Max Speed	= 48%	

Required Margin = 20%

Lateral Natural Frequency Analysis

Ref: 0913483LC PG2

Revision: 0

Summary of Analysis Method For Pump and Motor Assembly

Analysis is performed in accordance with ANSI/HI 9.6.8-2014. The above floor portion of the pump was analyzed as a cantilever beam to find its first, or lowest, natural frequency. The foundation was assumed to be rigid. The discharge pipe was assumed to add no support to the pump. The beam was given a non-constant stiffness along its length to model the changing geometry. To reflect the non-symmetry of the problem, two axes were analyzed with each axis having a different stiffness. The Y-axis is parallel to the discharge pipe centerline. The X-axis is perpendicular to the Y-axis. A numerical method was used to find the deflection, D , at the free end of the beam.

The first natural frequency is given by the equation, $\omega_1 = \frac{187.7}{\sqrt{D}}$, where ω is the natural frequency in RPM.

In order to model the motor's effect on the system, the motor's equivalent moment of inertia was calculated using the data supplied by the motor manufacturer and the equation for deflection of a cantilever beam with a constant moment of inertia.

$$I = \frac{FL^3}{3Ey} \quad in^4$$

Where I is the equivalent moment of inertia of the motor, F (lb) is the weight of the motor, L (in) is the height of the motor's center of gravity relative to its base, E (psi) is the modulus of elasticity of the pump material, and y (in) is the deflection of the motor at its center of gravity.

Summary of Results For Pump and Motor Assembly

The X direction natural frequency is outside of the required separation margin.

The Y direction natural frequency is outside of the required separation margin.

ω_{1x}	= 3166	RPM
ω_{1y}	= 3241	RPM
Min Speed	= 1080	RPM
Max Speed	= 1780	RPM
ω_{1x} Percentage of Min Speed	= 293%	
ω_{1x} Percentage of Max Speed	= 178%	
ω_{1y} Percentage of Min Speed	= 300%	
ω_{1y} Percentage of Max Speed	= 182%	

Required Margin = 20%

Lateral Natural Frequency Analysis

Ref: 0913483LC PG3

Revision: 0

Inputs For Pump and Motor Assembly

Pump

Type of Discharge Head = CT
Discharge Head Size = 16-1/2 x 6
Variable Speed Application = Yes
Discharge Head Height = 21.5 in
Discharge Head Weight = 432 lbs
Elastic Modulus = 15000000 psi

Motor

Motor Weight = 675 lbs
Motor Center of Gravity = 13 in
Motor Deflection at Center of Gravity = 0.00301 in
Motor Reed Critical Frequency = 57 Hz

Operating Conditions

Minimum Operating Speed = 1080 RPM
Maximum Operating Speed = 1780 RPM
Required Separation Margin = 20%

Calculations For Pump and Motor Assembly

Motor Moment of Inertia

$I = 10.95 \text{ in}^4$

$$I = \frac{FL^3}{3Ey} \text{ in}^4$$

Height

Discharge Head Height plus Motor CG = 34.5 in

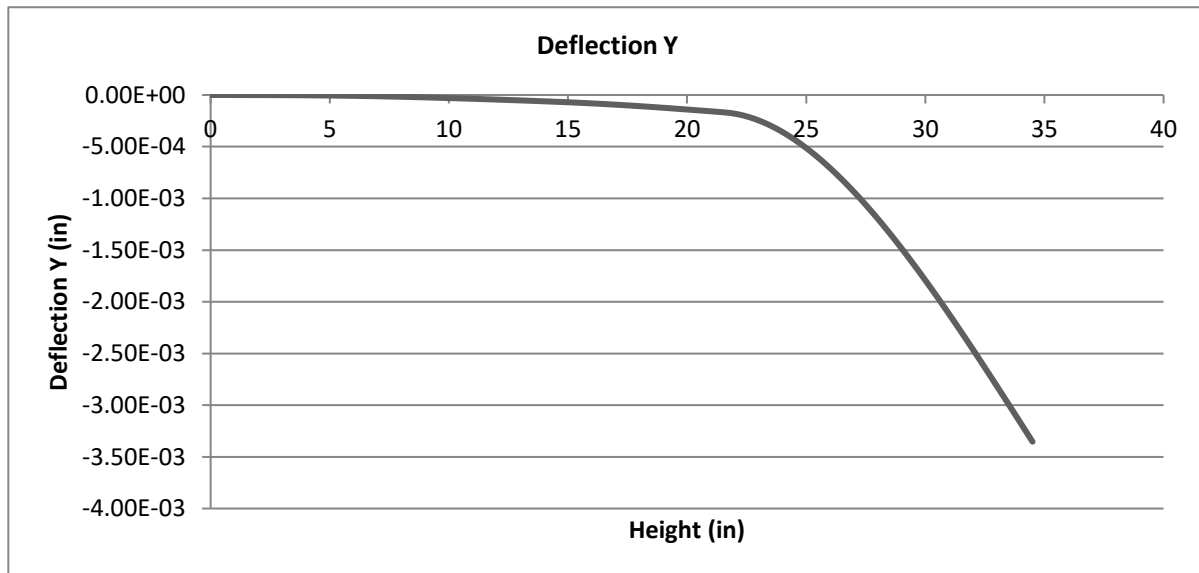
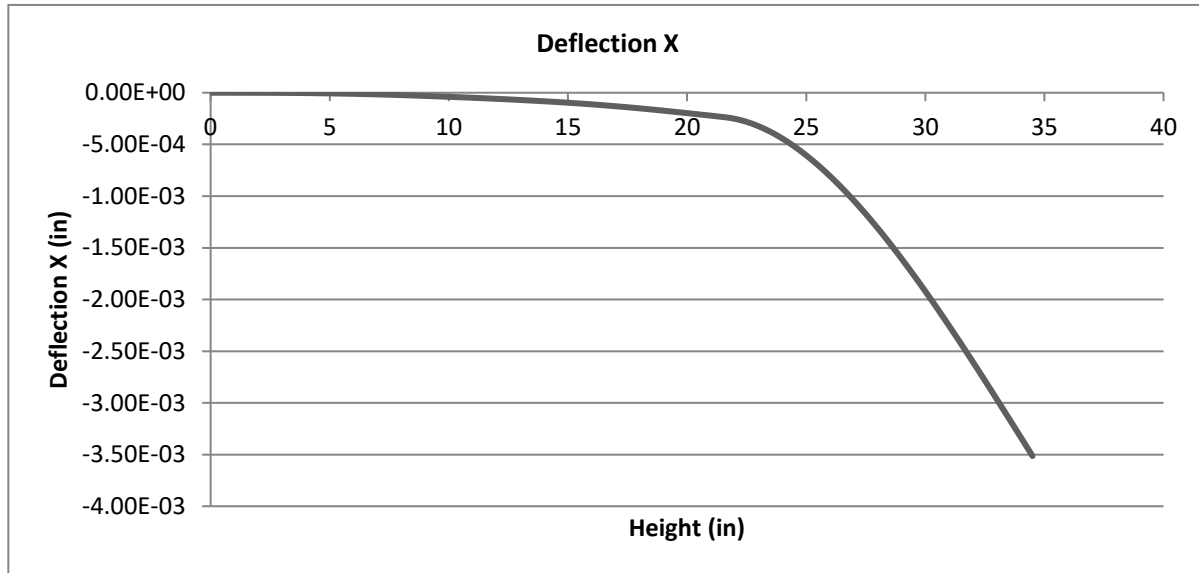
Lateral Natural Frequency Analysis

Ref: 0913483LC PG4

Revision: 0

Calculations Continued

A plot of the deflection of the pump and motor assembly obtained from the numerical results is shown below.



Deflection at 34.5in X

$$D_x = 0.003514 \text{ in}$$

Deflection at 34.5in Y

$$D_y = 0.00335 \text{ in}$$

Lateral Natural Frequency Analysis

Ref: 0913483LC PG5

Revision: 0

Calculations Continued

Natural Frequency

$$\omega_{1x} = 3166 \quad \text{RPM}$$

$$\omega_{1x} \text{ Percentage of Min Speed} = 293\%$$

$$\omega_{1x} \text{ Percentage of Max Speed} = 178\%$$

$$\omega_1 = \frac{187.7}{\sqrt{D}}$$

$$\omega_{1y} = 3241 \quad \text{RPM}$$

$$\omega_{1y} \text{ Percentage of Min Speed} = 300\%$$

$$\omega_{1y} \text{ Percentage of Max Speed} = 182\%$$

Required Margin = 20%

Lateral Natural Frequency Analysis

Ref: 0913483LC PG6

Revision: 0

Summary of Analysis Method For Column Assembly

Analysis is performed in accordance with ANSI/HI 9.6.8-2014. The below floor portion of the pump was analyzed as a cantilever beam to find its first, or lowest, natural frequency. The foundation was assumed to be rigid. The beam was given a non-constant stiffness along its length to model the changing geometry. A numerical method was used to find the deflection, D , at the free end of the beam.

The first natural frequency is given by the equation, $\omega_1 = \frac{187.7}{\sqrt{D}}$, where ω is the natural frequency.

Summary of Results For Column Assembly

The natural frequency is outside of the required separation margin.

$\omega_1 = 862$ RPM

Minimum Speed = 1080 RPM

Maximum Speed = 1780 RPM

ω_1 Percentage of Min Speed = 80%

ω_1 Percentage of Max Speed = 48%

Required Margin = 20%

Lateral Natural Frequency Analysis

Ref: 0913483LC PG7

Revision: 0

Inputs For Column Assembly

Pump

Pump Model = 10M
 Number of Stages = 6
 Pump Length = 85.75 in
 Bowl Assembly Length = 57.52 in
 Bowl Assembly Weight = 425 lbs
 Bowl Assembly Elastic Modulus = 14500000 psi
 Column Size = 6 in
 Column Elastic Modulus = 30000000 psi

Operating Conditions

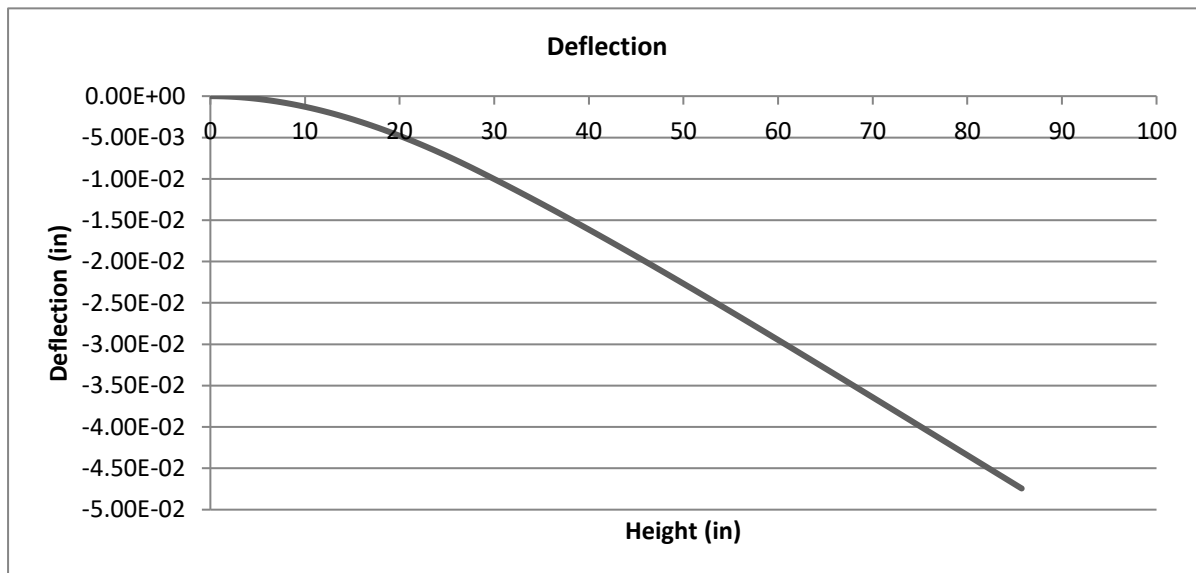
Minimum Speed = 1080 RPM
 Maximum Speed = 1780 RPM
 Required Margin = 20%

Calculations For Column Assembly

Column Length = 28.23 in
 Column Weight Per Foot = 18.97 lbs/ft
 Column Moment of Inertia = 28.14 in⁴

$$Inertia = \frac{\pi}{64} (OD^4 - ID^4)$$

A plot of the deflection of the pump obtained from the numerical results is shown below.



Deflection at 85.75in

D = 0.0474 in

Lateral Natural Frequency Analysis

Ref: 0913483LC PG8

Revision: 0

Calculations Continued

Natural Frequency

$$\omega_1 = 862$$

RPM

$$\omega_1 = \frac{187.7}{\sqrt{D}}$$

ω_1 Percentage of Min Speed = 80%

ω_1 Percentage of Max Speed = 48%

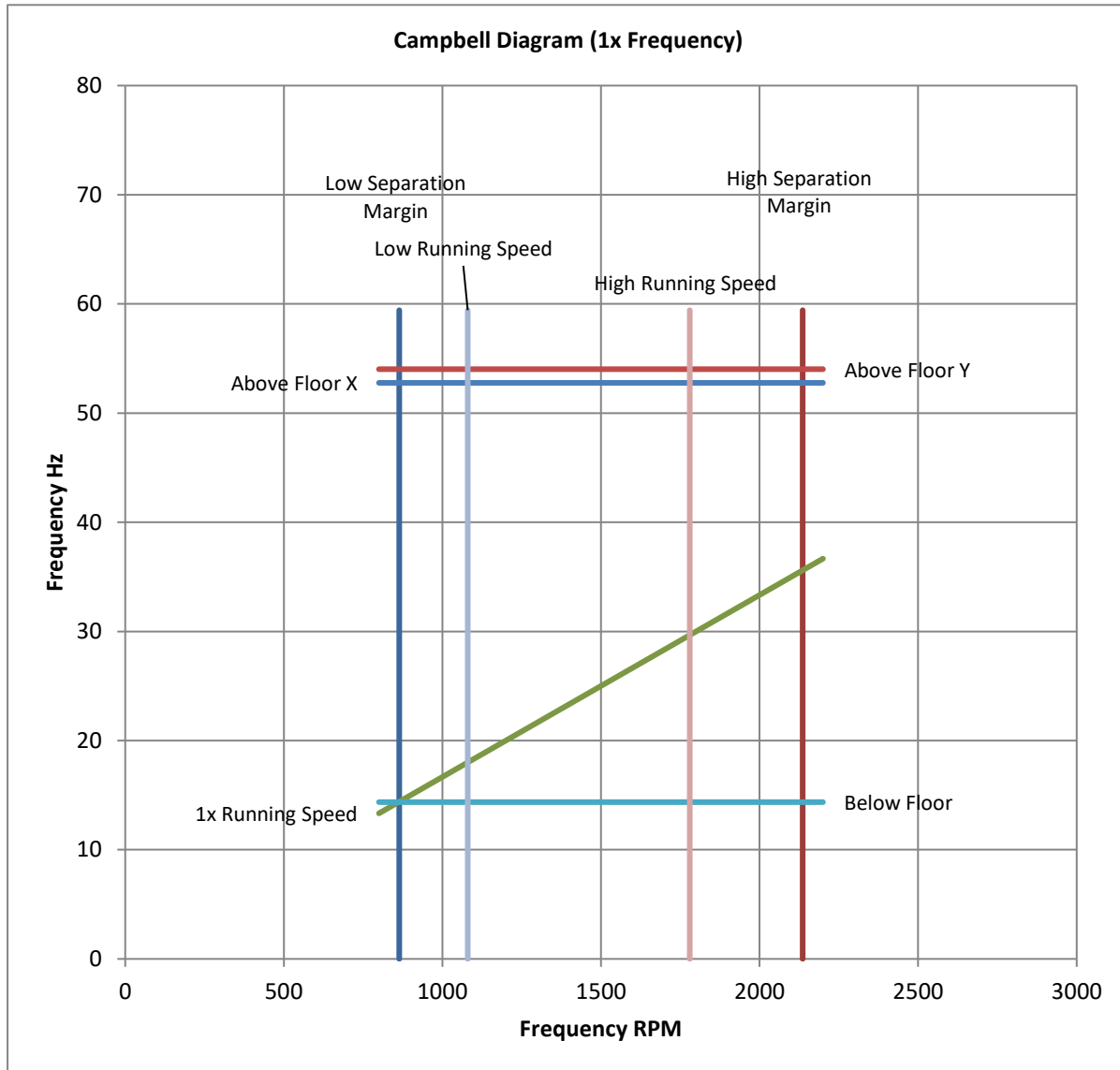
Required Margin = 20%

Lateral Natural Frequency Analysis

Ref: 0913483LC PG9

Revision: 0

A Campbell diagram provides a visual method to verify no resonance conditions will occur when operating a pump over its operating speed range. The diagram is constructed by plotting frequency in Hz versus frequency in RPM. Common excitation frequencies are shown as diagonal lines. The natural frequencies of the pump are shown as horizontal lines. A resonance condition is likely to occur when a horizontal line crosses a diagonal line within the operating speed range.



Rotor Torsional Natural Frequency Analysis

Project Name: Marsh Road Water Pump Station
Sales Order Number: 53113132
Project Number: 0913483
Pump Model: 10M
Revision: 0

Prepared By: Billy Faltas
Engineer

Date Prepared: 7/29/2022

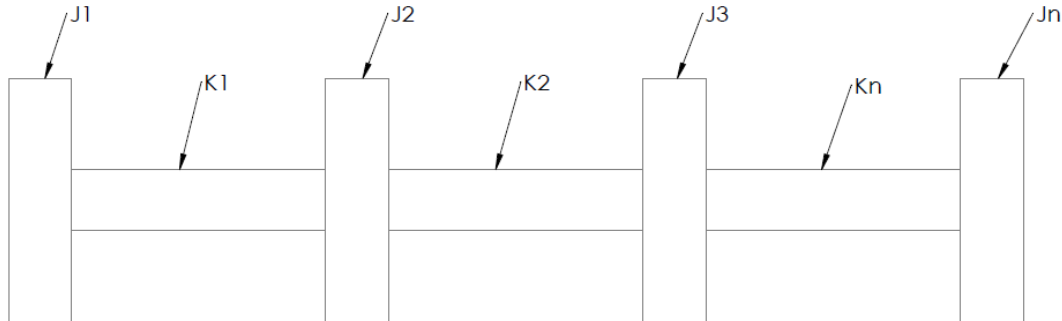
Rotor Torsional Natural Frequency Analysis

Ref: 0913483TC PG1

Revision: 0

Summary of Analysis Method

Analysis is performed in accordance with ANSI/HI 9.6.8-2014. The torsional natural frequencies were calculated using Holzer's method. A diagram of the system is shown below.



Where J_1 and J_2 are the masses of the motor and coupling, respectively. K_1 is the motor shaft stiffness and K_2 is the line shaft stiffness above the top most impeller. J_3 is mass of the top most impeller. K_n is the stiffness of the pump shaft between each impeller stage and J_n is the mass of each impeller below the top impeller.

Summary of Results

A torsional natural frequency in the separation margin was found. A steady state torsional stress analysis will be performed to verify safe operation of the pump rotor.

The torsional natural frequency associated with the highest amount of torque is shown below.

$\omega = 1690$ RPM Required Margin = 20%

Min Speed = 1080 RPM Min Vane Pass = 60480 RPM

Max Speed = 1780 RPM Max Vane Pass = 99680 RPM

ω Percentage of Min Speed = 157%

ω Percentage of Min Vane Pass = 3%

ω Percentage of Max Speed = 95%

ω Percentage of Max Vane Pass = 2%

Although there is a torsional natural frequency in the operating range, the torsional stress analysis showed that there will be no adverse affect on the life of the pump.

Shaft Stress = 4065 psi

Allowable Stress = 8125 psi

Factor of Safety = 2.00

Rotor Torsional Natural Frequency Analysis

Ref: 0913483TC PG2

Revision: 0

Inputs

Rotor Inertias

$WR^2_1 = 8.69$	lb-ft ²
$WR^2_2 = 0.00$	lb-ft ²
$WR^2_3 = 0.52$	lb-ft ²
$WR^2_n = 0.52$	lb-ft ²

Shafting

$K_1 = 8.42E+04$	in-lb/rad
$K_2 = 4.40E+04$	in-lb/rad
$K_n = 5.84E+05$	in-lb/rad

Pump

Model = 10M
Number of Stages = 6
Number of Impeller Vanes = 7
Number of Bowl Vanes = 8

Operating Conditions

Minimum Speed = 1080	RPM
Maximum Speed = 1780	RPM
Separation Margin = 20%	

Calculations

Rotor Masses

$J_1 = 3.24$	in-lb-sec ⁴
$J_2 = 0.00$	in-lb-sec ⁴
$J_3 = 0.19$	in-lb-sec ⁴
$J_n = 0.19$	in-lb-sec ²

$$J = \frac{144 \frac{\text{in}^2}{\text{ft}^2}}{386.4 \frac{\text{in}}{\text{sec}^2}}$$

Vane Pass

Min Vane Pass = 60480	RPM
Max Vane Pass = 99680	RPM

Torsional Natural Frequencies

The lowest torsional natural frequencies calculated are reported below.

$\omega_1 = 1690$	RPM
$\omega_2 = 8829$	RPM
$\omega_3 = 16685$	RPM
$\omega_4 = 23498$	RPM
$\omega_5 = 28740$	RPM
$\omega_6 = 32039$	RPM
$\omega_7 = 89899$	RPM

Rotor Torsional Natural Frequency Analysis

Ref: 0913483TC PG3

Revision: 0

Calculations Continued

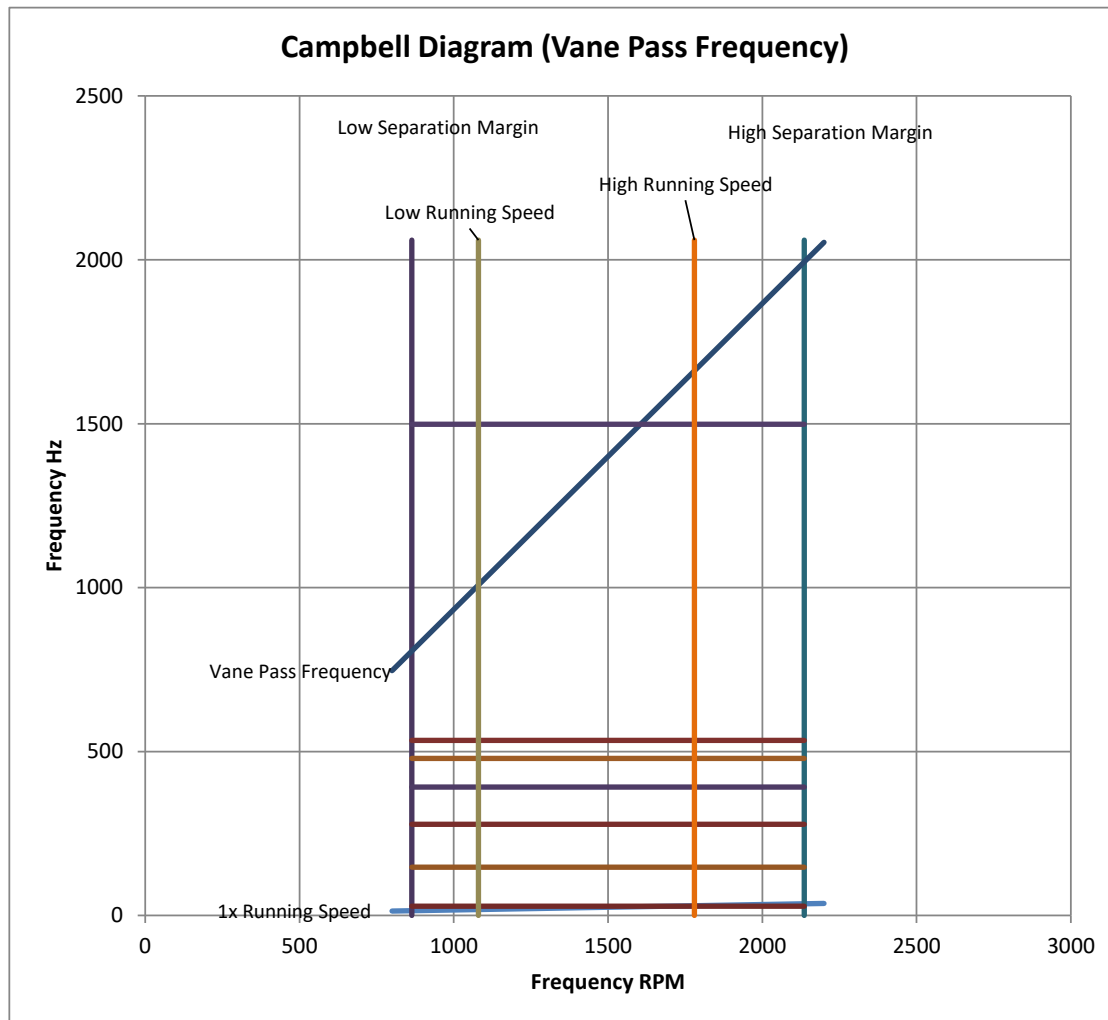
ω_1 % of Min Speed =	157%
ω_1 % of Max Speed =	95%
ω_1 % of Min Vane Pass =	3%
ω_1 % of Max Vane Pass =	2%
ω_2 % of Min Speed =	818%
ω_2 % of Max Speed =	496%
ω_2 % of Min Vane Pass =	15%
ω_2 % of Max Vane Pass =	9%
ω_3 % of Min Speed =	1545%
ω_3 % of Max Speed =	937%
ω_3 % of Min Vane Pass =	28%
ω_3 % of Max Vane Pass =	17%
ω_4 % of Min Speed =	2176%
ω_4 % of Max Speed =	1320%
ω_4 % of Min Vane Pass =	39%
ω_4 % of Max Vane Pass =	24%
ω_5 % of Min Speed =	2661%
ω_5 % of Max Speed =	1615%
ω_5 % of Min Vane Pass =	48%
ω_5 % of Max Vane Pass =	29%
ω_6 % of Min Speed =	2967%
ω_6 % of Max Speed =	1800%
ω_6 % of Min Vane Pass =	53%
ω_6 % of Max Vane Pass =	32%
ω_7 % of Min Speed =	8324%
ω_7 % of Max Speed =	5050%
ω_7 % of Min Vane Pass =	149%
ω_7 % of Max Vane Pass =	90%

Rotor Torsional Natural Frequency Analysis

Ref: 0913483TC PG4

Revision: 0

A Campbell diagram provides a visual method to verify no resonance conditions will occur when operating a pump over its operating speed range. The diagram is constructed by plotting frequency in Hz versus frequency in RPM. Common excitation frequencies are shown as diagonal lines. The torsional natural frequencies of the pump are shown as horizontal lines. A resonance condition is likely to occur when a horizontal line crosses a diagonal line within the operating speed range. For clarity two different Hz frequency scales are shown below.



Rotor Torsional Natural Frequency Analysis

Ref: 0913483TC PG5

Revision: 0

In order to verify that the torsional natural frequency will have no adverse effects on the life of the pump a torsional stress analysis of the shafting was performed.

Inputs

Natural Frequency = 1690	RPM
Running Speed = 1690	RPM
Motor HP = 50	HP
Motor Speed = 1800	RPM
Shaft Minimum Diameter = 1.25	in
Shaft Ultimate Tensile Strength = 100000	psi
Fatigue Stress Failure Criteria ASME Section III	
Torque Amplification Factor = 1	%

Calculations

Torque = 1558.841	in-lb	$Torque(in - lb) = \frac{63000HP}{RPM} \cdot (1 + TAF)$
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Polar Moment of Inertia = 0.24	in ⁴	$Polar\ Moment\ of\ Inertia = \frac{\pi Shaft\ Diameter^4}{32}$
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Shaft Stress = 4065	psi	$Stress = \frac{Torque \cdot Shaft\ Radius}{Polar\ Moment\ of\ Inertia}$
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Allowable Stress = 8125	psi
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Factor of Safety = 2.00	$Factor\ of\ Safety = \frac{Allowable\ Stress}{Shaft\ Stress}$
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Conclusion

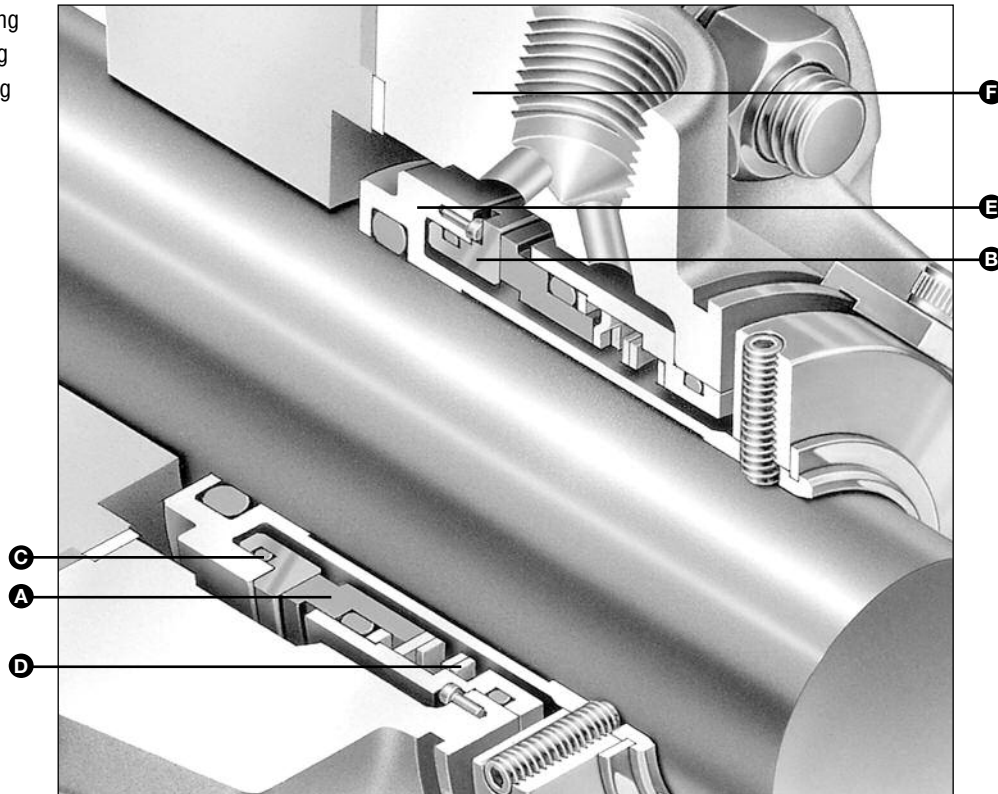
Although there is a torsional natural frequency in the operating range, the torsional stress analysis showed that there will be no adverse affect on the life of the pump.

TYPE 5610/5610Q

SINGLE O-RING SEALS

Technical Specification

- A – Face/Primary Ring
- B – Seat/Mating Ring
- C – Secondary O-ring
- D – Nonclogging Wave Spring
- E – Sleeve
- F – Gland



Product Description

The 5600 Series is a modular cartridge seal family that includes interchangeable elastomer bellows, metal bellows, and elastomer O-ring pusher seal designs.

- Type 5610 and 5610Q single seal arrangements incorporate an elastomer O-ring as the secondary sealing member
- A common seal head/mating ring set, utilized throughout all versions, is reversible to allow rotating seat/mating ring or rotating seal head operation, and is interchangeable with metal bellows seal heads
- Seal has an optional quench gland (5610Q) with carbon ring throttle bushing

Performance Capabilities

- Temperature: -20°F to 400°F/-30°C to 205°C
- Pressure: up to 3.000"/75mm: 300 psi(g)/21 bar(g) max.
75mm/3.000" and over: 200 psi(g)/13 bar(g) max.
- Speed: up to 5000 fpm/25 m/s
- End play/axial float allowance: 0.005"/0.13mm
- Runout/out of squareness: 0.002"/0.05mm

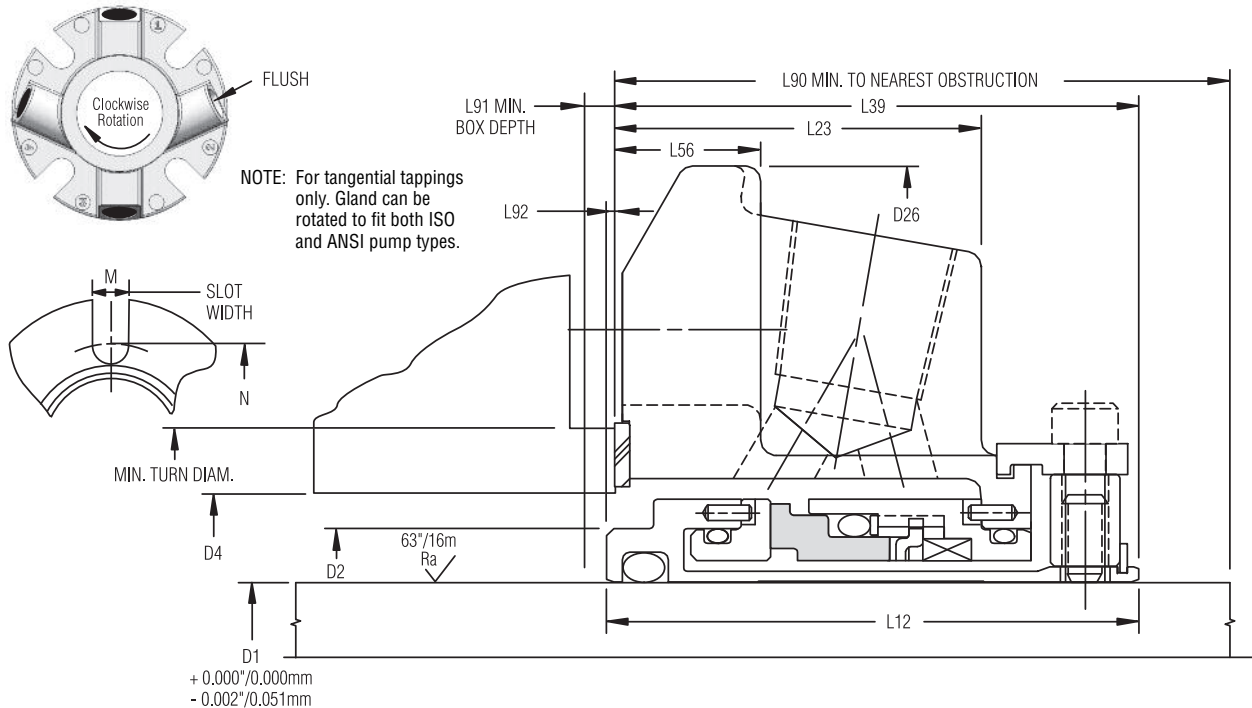
Design Features

- Reversible seal head
- Fits ANSI B73.1M, ISO 3069 and DIN 24960 seal chambers
- Optimized primary ring design for greater reliability
- Nonclogging wave spring outside the product

TYPE 5610/5610Q

SINGLE O-RING SEALS

Type 5610 Typical Arrangement



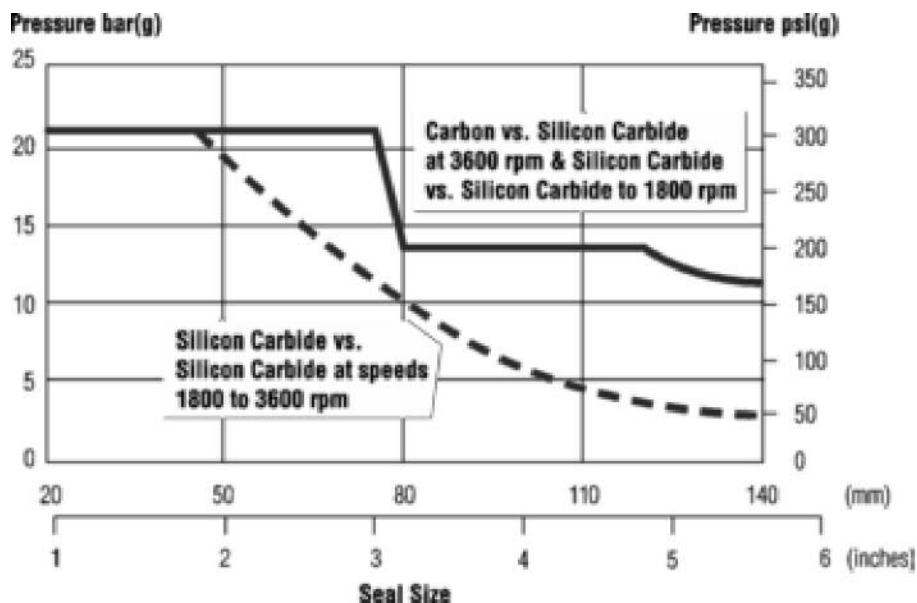
Type 5610 Dimensional Data (inches)

Seal Size/D1 (inches)	D4		D26	L12	L23	L39	L56	L90	L91	L92	M	N	
	D2	Min.											Max.
1.000	1.375	1.445	1.889	4.000	1.989	1.353	1.954	0.531	2.000	0.160	0.035	0.525	2.805
1.125	1.500	*	2.015	4.125	2.062	1.446	2.062	0.531	2.125	0.125	*	0.525	2.933
1.250	1.625	*	2.294	4.250	2.062	1.446	2.062	0.531	2.125	0.125	*	0.525	3.213
1.375	1.750	*	2.421	4.375	2.062	1.446	2.062	0.531	2.125	0.125	*	0.525	3.338
1.500	1.937	2.007	2.680	4.875	2.156	1.487	2.125	0.593	2.187	0.156	0.031	0.525	3.599
1.625	2.062	2.132	2.812	5.000	2.156	1.487	2.125	0.593	2.187	0.156	0.031	0.562	3.766
1.750	2.170	2.240	2.918	5.250	2.156	1.487	2.125	0.593	2.187	0.156	0.031	0.562	3.875
1.875	2.312	2.382	2.918	5.250	2.156	1.487	2.125	0.593	2.187	0.156	0.031	0.562	3.875
2.000	2.437	2.507	3.015	5.500	2.375	1.601	2.312	1.063	2.375	0.187	0.062	0.562	4.000
2.125	2.562	2.632	3.360	5.859	2.375	1.601	2.312	0.593	2.375	0.187	0.062	0.687	4.469
2.250	2.687	2.757	3.485	6.500	2.375	1.601	2.312	0.593	2.375	0.187	0.062	0.687	4.566
2.375	2.812	2.882	3.610	6.500	2.484	1.717	2.466	0.625	2.528	0.143	0.018	0.687	4.719
2.500	3.062	*	3.891	6.750	2.484	1.717	2.562	0.625	2.625	0.125	*	0.687	5.000
2.625	3.312	*	4.062	6.750	2.500	1.625	2.500	0.625	2.562	0.125	*	0.687	5.170
2.750	3.312	*	4.062	6.750	2.500	1.625	2.500	0.625	2.562	0.125	*	0.687	5.170
2.875	3.375	*	4.186	7.000	2.500	1.725	2.500	0.625	2.562	0.125	*	0.687	5.312
3.000	3.625	*	4.469	7.750	2.500	1.787	2.562	0.685	2.625	0.125	*	0.812	5.720
3.125	3.750	3.853	4.600	7.875	2.562	1.593	2.562	**	2.687	0.125	*	0.812	5.845
3.250	3.750	3.853	4.600	7.437	2.562	1.593	2.510	**	2.635	0.177	0.052	0.812	5.845
3.375	4.000	4.125	4.850	8.125	2.562	1.593	2.562	**	2.687	0.125	*	0.812	6.095
3.500	4.125	4.250	4.975	8.250	2.562	1.593	2.562	**	2.687	0.125	*	0.812	6.220
3.625	4.218	4.343	5.100	8.375	2.562	1.593	2.562	**	2.687	0.125	*	0.687	6.250
3.750	4.343	4.468	5.199	8.750	2.562	1.593	2.562	**	2.687	0.125	*	0.687	6.770
3.875	4.468	4.593	5.375	8.750	2.562	1.593	2.562	**	2.687	0.125	*	0.812	6.636
4.000	4.593	4.718	5.500	9.000	2.562	1.593	2.562	**	2.687	0.125	*	0.812	6.761
4.125	4.718	4.843	5.625	9.000	2.562	1.593	2.562	**	2.687	0.125	*	0.812	6.886
4.250	4.843	4.968	5.750	9.250	2.562	1.593	2.562	**	2.687	0.125	*	0.812	7.011
4.500	5.093	5.218	6.000	9.500	2.562	1.593	2.562	**	2.687	0.125	*	0.812	7.261
4.750	5.343	5.468	6.313	10.375	2.562	1.593	2.562	**	2.687	0.125	*	0.812	7.574
5.000	5.843	5.968	7.260	12.000	2.953	1.749	3.043	**	3.168	0.125	*	0.812	10.000
5.250	6.093	6.218	7.510	12.250	2.953	1.749	3.043	**	3.168	0.125	*	0.812	10.250
5.500	6.343	6.468	8.000	12.687	2.953	1.749	3.043	**	3.168	0.125	*	0.937	10.500

*Not applicable. Completely outside mounted.

**L56 not applicable. Refer to L23 for sizes over 3".

Basic Pressure Rating



The basic pressure rating is for a standard seal, as shown in the typical arrangement, when installed according to the criteria given in this data sheet and generally accepted industrial practices.

The basic pressure rating assumes stable operation at the speeds indicated on the above chart in a clean, cool, lubricating, nonvolatile liquid with an adequate flush rate. When used with the multiplier factors, the basic pressure rating can be adjusted to provide a conservative estimate of the dynamic pressure rating. For process services outside this range or a more accurate assessment of the dynamic pressure rating, contact John Crane for more information.

Multiplier Factors

	Selection Considerations	Multiplier Factor
Sealed Fluid Lubricity <small>(applies to Silicon Carbide vs. Silicon Carbide only)</small>	Petrol/Gasoline, Kerosene, or Better Water and Aqueous Solutions (<176°F/80°C)	x 1.00
	Flashing Hydrocarbons*	x 0.75
		x 0.60
Sealed Fluid Temperature <small>(applies to Carbon vs. Silicon Carbide)</small>	Up to 175°F/80°C	x 1.00
	From 175°F to 250°F/80°C to 120°C	x 0.90
	From 250°F to 355°F/120°C to 180°C	x 0.80
	Above 350°F/180°C	x 0.65

*The ratio of sealed pressure to vapor pressure must be greater than 1.5, otherwise consult John Crane. If the specific gravity is less than 0.60, consult John Crane.

Example for Determining Pressure Rating Limits:

Seal: 2"/50.8mm diameter Type 5610

Product: aqueous solution

Face materials: silicon carbide vs. silicon carbide

Operating temperature: 175°F/80°C

Operating speed: 2950 rpm

Using the pressure rating limits graph, the maximum pressure would be 268 psi(g)/18.5 bar(g).

From the multiplier factors chart, apply the multipliers for the specific service requirements to determine the maximum operating pressure for the application:

$$268 \text{ psi(g)/18.5 bar(g)} \times 0.75 \times 1 = 201 \text{ psi(g)/13.9 bar(g)}$$

The maximum operating pressure for this 2"/50.8mm Type 5610 is 201 psi(g)/13.9 bar(g).

Materials of Construction

SEAL COMPONENTS	MATERIALS	
	Description	Standard
Face/Primary Ring	Resin-Impregnated Carbon	Sintered Silicon Carbide Nickel Binder Tungsten Carbide
Seat/Mating Ring	Sintered Silicon Carbide	Nickel Binder Tungsten Carbide
Sleeve Gland Plate Collar Retainer Drive Ring Anti-Extrusion Ring	316 Stainless Steel	Alloy 20CB3 SS (UNS N8020) Alloy C-276 (UNS N10276) Titanium
O-ring	Fluoroelastomer Ethylene Propylene	Perfluoroelastomer Buna-N Neoprene
Gland Gasket	Glass-Filled PTFE	—
Spring	Alloy C-276 (UNS N10276)	—
Quench Bushing (5610Q)	Resin-Impregnated Carbon	—

Application Criteria

The Type 5610 and 5610Q cartridge seals may be customized for specific installations after review and evaluation by John Crane. The following data is needed to evaluate the proposed service:

- Make and model of equipment
- Shaft or sleeve OD
- Seal cavity dimensions
- Speed
- Quench fluid (if applicable)
- Process fluid
 - Specific gravity
 - Box pressure
 - Vapor pressure
 - Temperature
 - Viscosity



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 Tel: 65-6518-1800
 Fax: 65-6518-1803

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. It is dangerous to smoke while handling products made from PTFE. Old and new PTFE products must not be incinerated. ISO 9001 and ISO14001 Certified, details available on request.

Fairbanks Nijhuis
Paint Specifications

Above Ground Coating

- **Coating Manufacturer** Davis Industrial Coatings
- **Surface Preparation** SSPC-SP6, Commercial Blast Cleaning.
- **Prime Coat** Modified Alkyd Enamel
- **Number of Coats** Two (2)
- **Dry Film Thickness** 3 to 5 mils
- **Color** Pentair Blue
- **Surfaces to be coated** Exterior of Discharge Head
Exposed portions of the Packing Box

Below Ground Coating

- **Coating Manufacturer** Tnemec
- **Surface Preparation** SSPC-SP6, Commercial Blast Cleaning
- **Prime Coat** Series N140 Pota-Pox
- **Number of Coats** Two (2)
- **Dry Film Thickness** 4 to 6 mils
- **Color** 35GR – Black
- **Surfaces to be coated** Interior & Exterior of Bowl Assembly
Interior & Exterior of Column
Interior of Discharge Head
Exposed portions of the Packing Box

Suction Can Coating

- **Coating Manufacturer** Tnemec
- **Surface Preparation** SSPC-SP6, Commercial Blast Cleaning
- **Prime Coat** Series N140 Pota-Pox
- **Number of Coats** Two (2)
- **Dry Film Thickness** 4 to 6 mils
- **Color** 35GR – Black
- **Surfaces to be coated** Interior & Exterior of Suction Can



Davis Paint Company

1311 IRON STREET • N. KANSAS CITY, MISSOURI 64116
P.O. BOX 7589 • (816) 471-4447
www.davispaint.com

HIGH SOLIDS FAST DRY ENAMEL PENTAIR BLUE 4-5725

PHYSICAL PROPERTIES:

Weight Gallon:	9.88 ± 0.2 lbs/gal
Weight Solids:	64.7 ± 2%
Volume Solids:	48.4 ± 2%
Coverage: @ 1 Dry Mil:	776 sq. ft./gallon
VOC:	418 g/l; 3.49 lb/gal
Viscosity:	35-45" #4 Ford Cup @ 77°F
Gloss @ 60°:	85+
Cure Time (Based on 70° F. & 50% R.H.):	
To Touch:	60 minutes
To Recoat:	0-1 hours, or after 96 hours
Recommended Thinner:	Butyl acetate for cleanup and reduction to spray
Temperature Resistance:	Continuous 150° F., Intermittent 200° F.

WARNING! FLAMMABLE! FOR INDUSTRIAL USE ONLY! Keep away from heat and open flame. Avoid prolonged contact with skin and breathing of vapor or spray mist. Do not take internally. Close container after each use. Use only with adequate ventilation. Use respiratory devices and other personal protective equipment required by OSHA 29CFR 1910. KEEP OUT OF REACH OF CHILDREN. For specific safety requirements, refer to the Material Safety Data Sheet.

LIMITATION OF LIABILITY: To the best of our knowledge, the technical data contained herein is true and accurate at the date of issuance, but is subject to change without prior notice. We make no guarantee of any kind, express or implied, including merchantability and fitness for particular purposes. Liability, if any, is limited to replacement of the product or refund of the purchase price. Labor, or cost of labor, and other consequential damages are hereby excluded.

02-15



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HIGH SOLIDS FAST DRY ENAMEL

DESCRIPTION:

High Solids Fast Dry Enamel is an alkyd enamel for general industrial finishing of farm machinery, tanks, electrical equipment, heavy duty equipment and a variety of other products that require a high performance coating. Fast Dry Enamel exhibits excellent color and gloss retention, flexibility, hardness and corrosion resistance.

SPECIAL CAUTIONS:

Do not apply Fast Dry Enamel when surface, air or material temperature is below 40°F. Surface must be dry and at least 5°F above the dew point.

SURFACE PREPARATION:

GENERAL - Surfaces to be finished must be clean, dry and free of dirt, oil or any contamination that would adversely affect adhesion, protective properties or appearance of the coating. Abrasive blasting is an effective method of cleaning steel surfaces and removing mill scale, rust and previous coatings.

IRON, STEEL AND FERROUS METAL - For optimum adhesion and corrosion resistance, metal should be cleaned and phosphate treated or primed with Davis Fast Dry Metal Primer.

ALUMINUM & GALVANIZED METAL - For optimum adhesion chemically etch or prime with Vinyl Wash Primer.

PREVIOUSLY FINISHED SURFACES - Scaling and peeling paint must be removed by wirebrushing, sanding or scraping. Rusting metal should be cleaned and spot primed with Fast Dry Primer.

MIXING & THINNING:

Stir each container thoroughly prior to use. Material is packaged at a viscosity requiring little or no reduction for application by airless spray equipment. Conventional air spray, air-assist airless, dip or turbo may require up to a 25% reduction (4 parts paint to 1 part solvent by volume) with aromatic solvent.

Aromatic solvents include toluene, xylene, and SC-100. For cool weather conditions (below 65°F) use toluene or xylene. For normal temperatures (65-80°F) use xylene. For temperatures above 80°F use xylene or SC-100. Never use solvents such as VM&P naphtha, mineral spirits or reclaimed thinner. This product may also be thinned with ketone (MEK) or ester solvents (i.e. n-butyl acetate). Addition of solvent will increase VOC.

To store partially used container, pour a small amount of the recommended thinner over the surface. Do not stir. Replace lid securely. Store away from heat or open flame. Mix thoroughly before reusing.

CLEAN UP:

Use xylene, aromatic solvent or MEK for cleaning guns and equipment.



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APPLICATION:

Material can be applied by conventional air, air-assist airless, airless, dip or more advanced application equipment such as turbo disk or bell. This product may also be applied with electrostatic and/or heated equipment. Not recommended for brush or roller application over large areas. Small touchup areas may be brushed. Use the following recommendations as an application guide:

CONVENTIONAL AIR SPRAY:

Air Cap	66PF
Fluid Nozzle	63
Needle	63
Air Pressure	50-60 psi
Fluid Pressure	10-20 psi

AIR ASSIST-AIRLESS SPRAY:

Tip	0.009-0.013"
Fluid Pressure	300-600 psi
Air Pressure	10-25 psi
Pump/tip Filter	100 Mesh

AIRLESS SPRAY:

Tip	0.011-0.015"
Fan	50° (10-12 inch fan)
Pressure	1200-1800 psi
Pump/tip Filter	100 Mesh

For dip, flowcoat or turbo application, use the viscosity range 25-35" #2 Zahn as a starting point. For hot spray applications it is recommended to stay in the 90-140°F range.

APPLICATION RATE:

Application rate will vary depending on texture, configuration and porosity of surfaces on which coating is applied. Rough or porous surfaces will require more paint. At an application rate of 500 square feet per gallon, 3.2 mils wet, the resulting dry film thickness is approximately 1.5 mils on smooth surface. A dry film thickness of 1.0-2.0 mils is recommended

DRYING:

Optimum drying conditions are 60°F to 90°F (16°C to 32°C) at 50% R.H. Lower temperatures and high humidity will slow dry. Surface must be dry and at least 5°F above the dew point.

Dry to Touch	60 Minutes
To Recoat	Between 0-1 hours or after 96 hours

This product may also be force cured to enhance dry. Temperatures in the range of 110-180°F may be utilized to accelerate solvent evaporation and speed oxidation.

WARNING! FLAMMABLE! FOR INDUSTRIAL USE ONLY! Keep away from heat and open flame. Avoid prolonged contact with skin and breathing of vapor or spray mist. Do not take internally. Close container after each use. Use only with adequate ventilation. Use respiratory devices and other personal protective equipment required by OSHA 29CFR 1910. KEEP OUT OF REACH OF CHILDREN. For specific safety requirements, refer to the Material Safety Data Sheet.

LIMITATION OF LIABILITY: To the best of our knowledge, the technical data contained herein is true and accurate at the date of issuance, but is subject to change without prior notice. We make no guarantee of any kind, express or implied, including merchantability and fitness for particular purposes. Liability, if any, is limited to replacement of the product or refund of the purchase price. Labor, or cost of labor, and other consequential damages are hereby excluded.



POTA-POX® PLUS SERIES N140

PRODUCT PROFILE

- GENERIC DESCRIPTION** Polyamidoamine Epoxy
- COMMON USAGE** Innovative potable water coating which offers high-build edge protection and allows for application at a wide range of temperatures (down to 35°F or 2°C with 44-700 Accelerator). For use on the interior and exterior of steel or concrete tanks, reservoirs, pipes, valves, pumps and equipment in potable water service.
- COLORS** 1211 Red, 1255 Beige, 00WH Tnemec White, 15BL Tank White, 35GR Black and 39BL Delft Blue. **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.
- SPECIAL QUALIFICATIONS** Certified by **NSF International** in accordance with **ANSI/NSF Std. 61**. Ambient air cured Series N140 (with or without 44-700 Epoxy Accelerator) is qualified for use on tanks and reservoirs of 1,000 gallons (3,785 L) capacity or greater, pipes 18 inches (46 cm) in diameter or greater, valves four (4) inches (10 cm) in diameter or greater and fittings four (4) inches (10 cm) in diameter or greater. Conforms to **AWWA D 102 Inside Systems No. 1 and No. 2** (with or without 44-700). Conforms to **AWWA C 210** (without 44-700). Contact your Tnemec representative for systems and additional information. A two-coat system at 4.0-6.0 dry mils (100-150 dry microns) per coat passes the performance requirements of MIL-PRF-4556F for fuel storage. Reference the "Search Listings" section of the NSF website at www.nsf.org for details on the maximum allowable DFT.
- PERFORMANCE CRITERIA** Extensive test data available. Contact your Tnemec representative for specific test results.

COATING SYSTEM

- SURFACER/FILLER/PATCHER** 215, 217, 218
- PRIMERS** Self-priming, 22, 91-H₂O, 94-H₂O, L140, L140F, N140F, V140, V140F, 141
- TOPCOATS** **Interior:** Series 22, FC22, L140, L140F, N140, N140F, V140, V140F, 141, 406.
Exterior: Series 27, 66, L69, L69F, N69, N69F, V69, V69F, 72, 73, L140, L140F, N140, N140F, V140, V140F, 156, 157, 161, 175, 180, 181, 446, 740, 750, 1028, 1029, 1074, 1074U, 1075, 1075U, 1077, 1078, 1080, 1081. Refer to COLORS on applicable topcoat data sheets for additional information. **Note:** The following recoat times apply for Series N140: Immersion Service—Surface must be scarified by blasting with fine abrasive after 60 days. Atmospheric Service—After 60 days, scarification or an epoxy tie-coat is required. When topcoating with Series 740 or 750, recoat time for N140 is 21 days. Contact your Tnemec representative for specific recommendations.

SURFACE PREPARATION

- PRIMED STEEL** **Immersion Service:** Scarify the epoxy prime coat surface by abrasive blasting with fine abrasive before topcoating if it has been exterior exposed for 60 days or longer and N140 is the specified topcoat.
- STEEL** **Immersion Service:** SSPC-SP10/NACE 2 Near-White Blast Cleaning with a minimum angular anchor profile of 1.5 mils. **Non-Immersion Service:** SSPC-SP6/NACE 3 Commercial Blast Cleaning with a minimum angular anchor profile of 1.5 mils.
- 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. Fill all holes, pits, voids and cracks with 215, 217 or 218.
- ALL SURFACES** Must be clean, dry and free of oil, grease and other contaminants.

TECHNICAL DATA

- VOLUME SOLIDS** 67.0 ± 2.0% (mixed—A, B & 44-700 Epoxy Accelerator) †
- RECOMMENDED DFT** 2.0 to 10.0 mils (50 to 225 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)	5 hours	7 hours	7 days
80°F (27°C)	7 hours	9 hours	7 days
70°F (21°C)	9 hours	12 hours	7 days
60°F (16°C)	16 hours	22 hours	9 to 12 days
50°F (10°C)	24 hours	32 hours	12 to 14 days

Curing time varies with surface temperature, air movement, humidity and film thickness. **Note:** For valve applications allow 14 days cure at 75°F (24°C) prior to immersion. For pipe applications allow 30 days cure at 75°F (24°C) prior to immersion. **Ventilation:** When used in enclosed areas, provide adequate ventilation during application and cure. **Note:** Refer to product listing on www.nsf.org for specific potable water return to service information. **Note:** For faster curing and low temperature applications, add No. 44-700 Epoxy Accelerator, see separate product data sheet for cure information.

- VOLATILE ORGANIC COMPOUNDS** **Unthinned:** 2.4 lbs/gallon (285 grams/litre)
Thinned 5% (#60): 2.6 lbs/gallon (311 grams/litre)
Thinned 10% (#4): 2.8 lbs/gallon (334 grams/litre) †
- HAPS** **Unthinned:** 2.4 lbs/gal solids **Thinned 5% (#60):** 2.4 lbs/gal solids
Thinned 10% (#4): 3.3 lbs/gal solids
- THEORETICAL COVERAGE** 1,070 mil sq ft/gal (27.2 m²/L at 25 microns). See APPLICATION for coverage rates. †
- NUMBER OF COMPONENTS** Two: Part A (amine) and Part B (epoxy) — One (Part A) to one (Part B) by volume.

POTA-POX® PLUS | SERIES N140

PACKAGING	5 gallon (18.9L) pails and 1 gallon (3.79L) cans - Order in multiples of 2. Reference 44-700 Epoxy Accelerator product data sheet for its packaging information.
NET WEIGHT PER GALLON	12.66 ± 0.25 lbs (5.82 ± .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	Part A: 82°F (28°C) Part B: 80°F (27°C) 44-700: None
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 reach of children.

APPLICATION

COVERAGE RATES	Dry MILS (Microns)	Wet MILS (Microns)	Sq Ft/Gal (m ² /Gal)
Suggested	6.0 (150)	9.0 (230)	179 (16.6)
Minimum	2.0 (50)	3.0 (75)	537 (49.9)
Maximum	10.0 (225)	15.0 (375)	107 (10.0)

Note: Roller or brush application requires two or more coats to obtain recommended film thickness. Allow for overspray and surface irregularities. Wet 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. Reference the "Search Listings" section of the NSF website at www.nsf.org for details on the maximum allowable DFT. †

- 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 with No. 4 Thinner or thin up to 5% or 1/4 pint (190 mL) per gallon with No. 60 Thinner. For airless spray, roller or brush, thin up to 5% or 1/4 pint (190 mL) per gallon. **Caution: Series N140 NSF certification is based on thinning with No. 4 or No. 60 Thinner for tanks and only No. 60 Thinner for pipe, valves and fittings.** Use of any other thinner voids ANSI/NSF Std. 61 certification.

POT LIFE

Without 44-700 6 hours at 50°F (10°C) 4 hours at 75°F (24°C) 1 hour at 100°F (38°C)
With 44-700 2 hours at 50°F (10°C) 1 hour at 75°F (24°C) 30 minutes at 100°F (38°C)

SPRAY LIFE

Without 44-700: 1 hour at 77°F (25°C) With 44-700: 30 minutes at 75°F (24°C)
Note: Spray application after listed times will adversely affect ability to achieve recommended dry film thickness.

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)

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)

Low temperatures or longer hoses require higher pot pressure. Use appropriate tip/atomizing pressure for equipment, applicator technique and weather conditions.
Roller: Use 3/8" or 1/2" (9.5 mm to 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

Without 44-700: Min. 50°F (10°C), Max. 135°F (57°C) With 44-700: Min. 35°F (2°C), Max. 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.

NIDEC MOTOR CORPORATION

8050 WEST FLORISSANT AVE.
ST. LOUIS, MO 63136



DATE: 7/20/2022

P.O. NO.: 12572178
Order/Line NO.: 22701184 SO 100

TO: PENTAIR FLOW TECHNOLOGIES LLC
400 REGENCY FOREST DRIVE
SUITE 300
CARY, NC, 27518

ATTN: SHILO

Model Number: NA
Catalog Number:
VHS Weather Protected
CONF,MOTOR,VHS WPI

REVISIONS:
(NONE)

**ALL DOCUMENTS HEREIN ARE CONSIDERED CERTIFIED BY NIDEC MOTOR CORPORATION.
THANK YOU FOR YOUR ORDER AND THE OPPORTUNITY TO SERVE YOU.**

Features:

HOLD PRODUCTION
Horsepower 00050.00~00000.00 ~ KW: 37.3
Enclosure WPI
Poles 04~00 ~ RPM: 1800~0
Frame Size 326~TP
Phase/Frequency/Voltage.. 3~060~230/460
Winding Type Random Wound
Service Factor 1.15
Insulation Class Class "F" ~ Insulife 2000
Altitude In Feet (Max) .. 3300 Ft.(1000 M) ~ +40 C
Efficiency Class Premium Efficiency
Application Unknown
Inverter Duty NEMA MG1 Part 31
Customer Part Number FMB0913483A01
16.5" Base ~ Coupling Size: 1-1/4" Bore, 1/4" Key
Non-Reverse Ratchet ~ Steady Bushing
Pricebook Thrust Value (lbs).. 5700
Customer Down Thrust (lbs) ... 1017
Customer Shutoff Thrust (lbs). 1382
Up Thrust (lbs): ~
Inverter Duty Rating Details:
Load Type (Base Hz & Below) .. Variable Torque
Speed Range (Base Hz & Below). 10:1
VFD Service Factor 1.00
Temperature Rise (Sine Wave): "B" Rise @ 1.0 SF (Resist)
Starting Method Direct-On-Line Start
Duty Cycle Continuous Duty
Efficiency Value 94.5 % ~ Typical
Load Inertia: NEMA ~ Standard Inertia: 232.00 LB-FT²
Number Of Starts Per Hour: NEMA
Motor Type Code RUI
Rotor Inertia (LB-FT²) 8.69 LB-FT²
Qty. of Bearings PE (Shaft) 1
Qty. of Bearings SE (OPP) 1
Bearing Number PE (Shaft) 6211-J
Bearing Number SE (OPP) 7220 BEP

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

NIDEC MOTOR CORPORATION

8050 WEST FLORISSANT AVE.
ST. LOUIS, MO 63136



DATE: 7/20/2022

P.O. NO.: 12572178
Order/Line NO.: 22701184 SO 100

TO: PENTAIR FLOW TECHNOLOGIES LLC
400 REGENCY FOREST DRIVE
SUITE 300
CARY, NC, 27518

ATTN:SHILO

Model Number: NA
Catalog Number:
VHS Weather Protected
CONF,MOTOR,VHS WPI

REVISIONS:
(NONE)

**ALL DOCUMENTS HEREIN ARE CONSIDERED CERTIFIED BY NIDEC MOTOR CORPORATION.
THANK YOU FOR YOUR ORDER AND THE OPPORTUNITY TO SERVE YOU.**

Accessories:

Counter CW Rotation FODE
Aegis Ground Ring (SGR)
Special Balance
Multiple ID Plates Requested
Thermostats - Normally Closed
Lubrication Instruction Plate
Shipping Tag Information:
FMB0913483A01
12572178
10

USE THE DATA PROVIDED BELOW TO SELECT THE APPROPRIATE DIMENSION PRINT

Horsepower	50
Pole(s)	04
Voltage(s)	460-230
Frame Size	326TP
Outlet Box AF	4.25
Outlet Box AA	3.00

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

CERTIFIED MOTOR PERFORMANCE DATA

MOTOR MANUFACTURER: NIDEC MOTOR CORPORATION **DATE:** 7/20/2022

PENTAIR PURCHASE ORDER #: 12572178 **PENTAIR TAG #:** FMB0913483A01

PERFORMANCE DATA BASED ON STANDARD RULES OF: X IEEE X ASA X NEMA

HP	SYNCHRONOUS SPEED (RPM)	FULL LOAD * SPEED (RPM)	FRAME NUMBER	TYPE	ENCLOSURE
50	1800	1780	326TP	RUI	WPI

*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 <u>X</u> _____ RESIS. _____ THERM.	SERVICE FACTOR	NEMA KVA/HP CODE	NEMA DESIGN
			FULL LOAD	LOCKED ROTOR					
3	60	460/230	57/113	357/715	F	80 DEG C AT 1.00 SF	1.15	G	B

GUARANTEED EFFICIENCY			POWER FACTOR			TORQUE AT FULL VOLTAGE		
FULL LOAD	3/4 LOAD	1/2 LOAD	FULL LOAD	3/4 LOAD	1/2 LOAD	FULL LOAD TORQUE AT FULL LOAD SPEED (LB.FT)	LOCKED STARTING	PULLOUT BREAKDOWN
							PERCENT OF FULL LOAD	
93.6	93.6	92.4	87.8	86.3	81.0	147.5	191	251

VSS VHS NRR SRC HORIZ

BEARINGS:

Drive End Lubrication:

Oil Grease

Opposite End Lubrication:

Oil Grease 3 QT/2.8 L

PAINT: (Attach Technical Data Sheets)

Factory Standard

Other _____

MOTOR NO.: 22701184

MOTOR WEIGHT: 675 LBS

ROTATION: BI-DIRECTIONAL CW CCW

Certified by: Sharon Concoro Date: 7/20/2022 Revision # 0

Accessory Data

Motor Manufacturer: NIDEC MOTOR CORPORATION Date: 7/20/2022

Pentair Purchase Order #: 12572178 Pentair Tag #: FMB0913483A01

	Required	Not Required	Description
Space Heaters:	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Watts: _____ Voltage: _____
Thermostats:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Type: <input type="checkbox"/> N.O. <input checked="" type="checkbox"/> N.C.
Thermistors:	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Make & Model: _____ Trip Range: _____ <input type="checkbox"/> relay not Supplied <input type="checkbox"/> relay supplied: Type: <input type="checkbox"/> factory set <input type="checkbox"/> field adjustable <input type="checkbox"/> wiring diagram/cut sheet attached. Ref.: _____
Winding RTD's:	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Quantity Per Motor: _____ Make & Model: _____ Construction/OHM Rating: _____ <input type="checkbox"/> relay not Supplied <input type="checkbox"/> relay supplied: Type: <input type="checkbox"/> factory set <input type="checkbox"/> field adjustable <input type="checkbox"/> wiring diagram/cut sheet attached. Ref.: _____
Bearing RTD's:	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Quantity _____ Make & Model: _____ Construction/OHM Rating: _____ <input type="checkbox"/> relay not Supplied <input type="checkbox"/> relay supplied: Type: <input type="checkbox"/> factory set <input type="checkbox"/> field adjustable <input type="checkbox"/> wiring diagram/cut sheet attached. Ref.: _____
Vibration Sensor:	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Make & Model: _____ <input type="checkbox"/> relay not Supplied <input type="checkbox"/> relay supplied: Type: <input type="checkbox"/> factory set <input type="checkbox"/> field adjustable <input type="checkbox"/> wiring diagram/cut sheet attached. Ref.: _____
Tests:	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> Short commercial, unwitnessed <input type="checkbox"/> Short commercial, witnessed <input type="checkbox"/> Calibration Test, unwitnessed <input type="checkbox"/> Complete initial, unwitnessed <input type="checkbox"/> Complete initial, witnessed <input type="checkbox"/> Sound test, unwitnessed <input type="checkbox"/> Bump Test, unwitnessed <input type="checkbox"/> Vibration Test, unwitnessed <input type="checkbox"/> Polarization Index, unwitnessed <input type="checkbox"/> Reed Critical Test, unwitnessed <input type="checkbox"/> IEEE841

Certified by: Sharon Corcora Date: 7/20/2022 Revision #: 0

Accessory Data

Motor Manufacturer: NIDEC MOTOR CORPORATION

Date: 7/20/2022

Pentair Purchase Order #: 12572178

Pentair Tag #: FMB0913483A01

Features:

- Enclosure WPI
- Winding Type Random Wound
- Service Factor 1.15
- Insulation Class Class "F" ~ Insulife 2000
- Altitude In Feet (Max) .. 3300 Ft.(1000 M) ~ +40 C
- Efficiency Class Premium Efficiency
- Inverter Duty NEMA MG1 Part 31
- 16.5" Base ~ Coupling Size: 1-1/4" Bore, 1/4" Key
- Non-Reverse Ratchet ~ Steady Bushing
- Pricebook Thrust Value (lbs).. 5700
- Customer Down Thrust (lbs) ... 1017
- Customer Shutoff Thrust (lbs). 1382
- Inverter Duty Rating Details:
- Load Type (Base Hz & Below) .. Variable Torque
- Speed Range (Base Hz & Below). 10:1
- VFD Service Factor 1.00
- Temperature Rise (Sine Wave): "B" Rise @ 1.0 SF (Resist)
- Starting Method Direct-On-Line Start
- Duty Cycle Continuous Duty
- Efficiency Value 94.5 % ~ Typical
- Load Inertia: NEMA ~ Standard Inertia: 232.00 LB-FT2

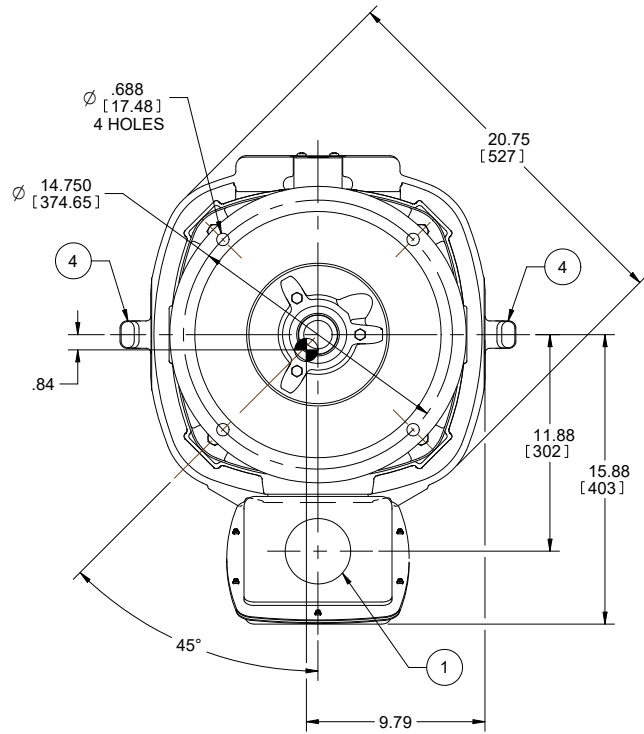
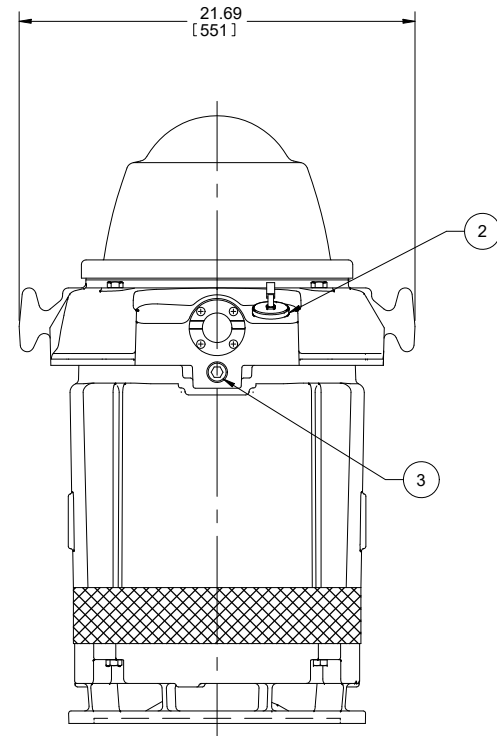
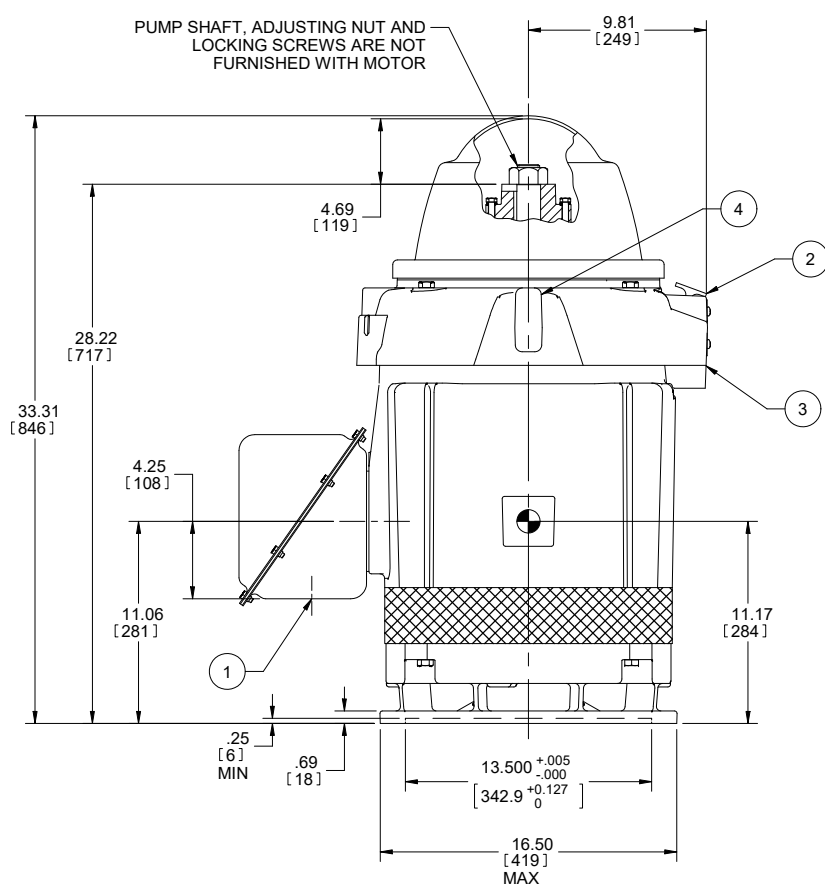
Accessories:

- Aegis Ground Ring (SGR)
- Special Balance
- Thermostats - Normally Closed
- Lubrication Instruction Plate
- Shipping Tag Information:
- FMB0913483A01
- 12572178
- 10

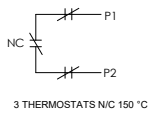
Certified by: Sharon Concoro

Date: 7/20/2022

Revision #: 0



- NOTES:**
- 1) MAIN BOX FOR MOTOR POWER LEADS, 3.00" CONNECTION.
BOX VOLUME: 470 CU. IN. [7702 CU. CM.]
 - 2) FILL: TOP OIL AND BOTTOM GREASE.
 - 3) DRAINS: TOP OIL AND BOTTOM GREASE.
 - 4) MOTOR LIFTING LUGS.
 - 5) ROTATION: COUNTER CLOCKWISE, WHEN FACING OPPOSITE DRIVE END.
 - 6) BEARINGS: LOWER 6211-J
UPPER 7220 BEP
 - 7) DENOTES CENTER OF GRAVITY
 - 8) ALL ROUGH DIMENSION MAY VARY .25" DUE TO CASTING AND/OR FABRICATION VARIATIONS.
 - 9) LARGEST MOTOR WIDTH.
 - 10) CONDUIT OPENINGS MAY BE LOCATED IN STEPS OF 90° REGARDLESS OF LOCATION.
STANDARD AS SHOWN WITH CONDUIT OPENING DOWN.
 - 12) TOLERANCES SHOWN IN INCHES ONLY.
 - 13) TAG: FMB0913483A01
12572178
LINE 10
 - 14) THERMOSTATS



3 THERMOSTATS N/C 150 °C

USER INFORMATION	
CUSTOMER: PENTAIR FLOW TECHNOLOGIES	
CUSTOMER P/N: FMB0913483A01	
P.O: 12572178	
REF. ORDER #: 22701184-100	

TOLERANCES	
FACE RUNOUT	.007 T.I.R.
PERMISSIBLE ECCENTRICITY OF MOUNTING RABBET	.007 T.I.R.
TOLERANCES ON "AK" DIMENSION	+.005/- .000

CERTIFIED FOR CONSTRUCTION

RATING		REVISION DESCRIPTION:	UNITS	TITLE	FRAME	TYPE
50 HP [37.3 KW], 1800 RPM 230/460V, 3Ø, 60HZ		NEW	DUAL	DIMENSION PRINT	326TP	RUI
ENCLOSURE		WPI				
BEARINGS		SEE (6)				
LUBRICATION		SEE (2 AND 3)				
ROTATION FACING O.D.E.		CCW				
NET WEIGHT (±10%)		675 LBS [306.18 KG]				
ISSUED BY		APPROVED BY		REVISION DATE		
L. ARROYO		M. ZAMBRANO		07-JUL-22		
DWG NO.		REV		SHEET NUMBER		DWG SIZE
09-3419-33		-		1 OF 1		C



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

NAMEPLATE DATA

CATALOG NUMBER: <input style="width: 100%;" type="text"/>	NAMEPLATE PART #: <input style="width: 100%; border: 1px solid black;" type="text" value="422707-005"/>
MODEL <input style="width: 100%;" type="text"/> FR <input style="width: 100%; border: 1px solid black;" type="text" value="326TP"/>	TYPE <input style="width: 100%; border: 1px solid black;" type="text" value="RUI"/> ENCL <input style="width: 100%; border: 1px solid black;" type="text" value="WPI"/>
SHAFT END BRG <input style="width: 100%; border: 1px solid black;" type="text" value="6211-J - QTY 1"/>	OPP END BRG <input style="width: 100%; border: 1px solid black;" type="text" value="7220 BEP - QTY 1"/>
PH <input style="width: 100%; border: 1px solid black;" type="text" value="3"/> MAX AMB <input style="width: 100%; border: 1px solid black;" type="text" value="40 C"/>	ID# <input style="width: 100%; border: 1px solid black;" type="text" value="(ref: Order#: 22701184, Type: SO, Line#: 100)"/>
INSUL CLASS <input style="width: 100%; border: 1px solid black;" type="text" value="F"/> Asm. Pos. <input style="width: 100%;" type="text"/>	DUTY <input style="width: 100%; border: 1px solid black;" type="text" value="CONT"/>
HP <input style="width: 100%; border: 1px solid black;" type="text" value="50"/> RPM <input style="width: 100%; border: 1px solid black;" type="text" value="1780"/>	HP <input style="width: 100%;" type="text"/> RPM <input style="width: 100%;" type="text"/>
VOLTS <input style="width: 100%; border: 1px solid black;" type="text" value="460"/> <input style="width: 100%; border: 1px solid black;" type="text" value="230"/>	VOLTS <input style="width: 100%;" type="text"/> <input style="width: 100%;" type="text"/>
FL AMPS <input style="width: 100%; border: 1px solid black;" type="text" value="57.0"/> <input style="width: 100%; border: 1px solid black;" type="text" value="113.0"/>	FL AMPS <input style="width: 100%;" type="text"/> <input style="width: 100%;" type="text"/>
SF AMPS <input style="width: 100%; border: 1px solid black;" type="text" value="65.0"/> <input style="width: 100%; border: 1px solid black;" type="text" value="131.0"/>	SF AMPS <input style="width: 100%;" type="text"/> <input style="width: 100%;" type="text"/>
SF <input style="width: 100%; border: 1px solid black;" type="text" value="1.15"/> DESIGN <input style="width: 100%; border: 1px solid black;" type="text" value="B"/> CODE <input style="width: 100%; border: 1px solid black;" type="text" value="G"/>	SF <input style="width: 100%;" type="text"/> DESIGN <input style="width: 100%;" type="text"/> CODE <input style="width: 100%;" type="text"/>
NEMA NOM EFFICIENCY <input style="width: 100%; border: 1px solid black;" type="text" value="94.5"/> NOM PF <input style="width: 100%; border: 1px solid black;" type="text" value="87.8"/> KiloWatt <input style="width: 100%; border: 1px solid black;" type="text" value="37.30"/>	NEMA NOM EFFICIENCY <input style="width: 100%;" type="text"/> NOM PF <input style="width: 100%;" type="text"/>
GUARANTEED EFFICIENCY <input style="width: 100%; border: 1px solid black;" type="text" value="93.6"/> MAX KVAR <input style="width: 100%;" type="text"/> HZ <input style="width: 100%; border: 1px solid black;" type="text" value="60"/>	GUARANTEED EFFICIENCY <input style="width: 100%;" type="text"/> MAX KVAR <input style="width: 100%;" type="text"/> HZ <input style="width: 100%;" type="text"/>

HAZARDOUS LOCATION DATA (IF APPLICABLE):

DIVISION <input style="width: 100%;" type="text"/>	CLASS I <input style="width: 100%;" type="text"/>	GROUP I <input style="width: 100%;" type="text"/>
TEMP CODE <input style="width: 100%;" type="text"/>	CLASS II <input style="width: 100%;" type="text"/>	GROUP II <input style="width: 100%;" type="text"/>



VFD DATA (IF APPLICABLE):

VOLTS <input style="width: 100%; border: 1px solid black;" type="text" value="460"/> <input style="width: 100%; border: 1px solid black;" type="text" value="230"/>	AMPS <input style="width: 100%; border: 1px solid black;" type="text" value="59.9"/> <input style="width: 100%; border: 1px solid black;" type="text" value="118.7"/>
TORQUE 1 <input style="width: 100%; border: 1px solid black;" type="text" value="147.50LB-FT"/>	TORQUE 2 <input style="width: 100%;" type="text"/>
VFD LOAD TYPE 1 <input style="width: 100%; border: 1px solid black;" type="text" value="VT/PWM"/>	VFD LOAD TYPE 2 <input style="width: 100%;" type="text"/>
VFD HERTZ RANGE 1 <input style="width: 100%; border: 1px solid black;" type="text" value="6-60"/>	VFD HERTZ RANGE 2 <input style="width: 100%;" type="text"/>
VFD SPEED RANGE 1 <input style="width: 100%; border: 1px solid black;" type="text" value="180-1800"/>	VFD SPEED RANGE 2 <input style="width: 100%;" type="text"/>
SERVICE FACTOR <input style="width: 100%; border: 1px solid black;" type="text" value="1.00"/>	FL SLIP <input style="width: 100%;" type="text"/>
NO. POLES <input style="width: 100%;" type="text"/>	MAGNETIZING AMPS <input style="width: 100%;" type="text"/>
VECTOR MAX RPM <input style="width: 100%;" type="text"/>	Encoder PPR <input style="width: 100%;" type="text"/>
Radians / Seconds <input style="width: 100%;" type="text"/>	Encoder Volts <input style="width: 100%;" type="text"/>

TEAO DATA (IF APPLICABLE):

HP (AIR OVER) <input style="width: 100%;" type="text"/>	HP (AIR OVER M/S) <input style="width: 100%;" type="text"/>	RPM (AIR OVER) <input style="width: 100%;" type="text"/>	RPM (AIR OVER M/S) <input style="width: 100%;" type="text"/>
FPM AIR VELOCITY <input style="width: 100%;" type="text"/>	FPM AIR VELOCITY M/S <input style="width: 100%;" type="text"/>	FPM AIR VELOCITY SEC <input style="width: 100%;" type="text"/>	

ADDITIONAL NAMEPLATE DATA:

Decal / Plate	WD=109145	Customer PN	FMB0913483A01
Notes		Non Rev Ratchet	NRR
Max Temp Rise	80C RISE/RES@1.00SF	OPP/Upper Oil Cap	3 QT/2.8 L
Thermal (WDG)	OVER TEMP PROT 2	SHAFT/Lower Oil Cap	GREASE
Altitude		Usable At	
Regulatory Notes		Regulatory Compliance	
COS		Marine Duty	
Balance	0.08 IN/SEC	Arctic Duty	
3/4 Load Eff.	94.6	Inrush Limit	
Motor Weight (LBS)	675	Direction of Rotation	
Sound Level		Special Note 1	
Vertical Thrust (LBS)	5700	Special Note 2	
Thrust Percentage	100% HT	Special Note 3	
Bearing Life		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	
380V 50 Hz Max Amps		SH Watts	
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	
Heater in C/B Voltage		Heater in C/B Watts	
Zone 2 Group		Division 2 Service Factor	
Note 1		Note 2	
Note 3		Note 4	
Note 5		Note 6	
Note 7		Note 8	
Note 9		Note 10	
Note 11		Note 12	
Note 13		Note 14	
Note 15		Note 16	
Note 17		Note 18	
Note 19		Note 20	
Note 21		Note 22	

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.

MOTOR PERFORMANCE

MODEL NO.	CATALOG NO.	PHASE	TYPE	FRAME
NA	NA	3	RUI	326TP
ORDER NO.	22701184		LINE NO.	100
MPI:			98315	98316
HP:			50	50
POLES:			4	4
VOLTS:			460	230
HZ:			60	60
SERVICE FACTOR:			1.15	1.15
EFFICIENCY (%):				
	S.F.		93.8	93.8
	FULL		94.5	94.5
	3/4		94.6	94.6
	1/2		94	94
	1/4		90.9	90.9
POWER FACTOR (%):				
	S.F.		87.9	87.9
	FULL		87.8	87.8
	3/4		86.3	86.3
	1/2		81	81
	1/4		63.8	63.8
	NO LOAD		6.8	6.8
	LOCKED ROTOR		37.5	37.5
AMPS:				
	S.F.		65	131
	FULL		57	113
	3/4		43	86
	1/2		31	61
	1/4		20.2	40
	NO LOAD		15	30
	LOCKED ROTOR		357	715
NEMA CODE LETTER			G	G
NEMA DESIGN LETTER			B	B
FULL LOAD RPM			1780	1780
NEMA NOMINAL / EFFICIENCY (%)			94.5	94.5
GUARANTEED EFFICIENCY (%)			93.6	93.6
MAX KVAR			10.2	10.2
AMBIENT (°C)			40	40
ALTITUDE (FASL)			3300	3300
SAFE STALL TIME-HOT (SEC)			26	26
SOUND PRESSURE (DBA @ 1M)			65	65
TORQUES:				
	BREAKDOWN{% F.L.}		251	251
	LOCKED ROTOR{% F.L.}		191	191
	FULL LOAD{LB-FT}		147.5	147.5

NEMA Nominal and Guaranteed Efficiencies are up to 3,300 feet above sea level and 25 ° C ambient.

The Above Data Is Typical, Sinewave Power Unless Noted Otherwise

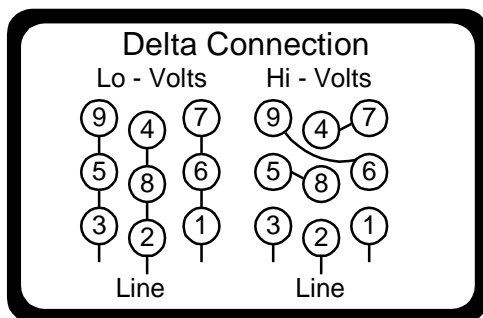
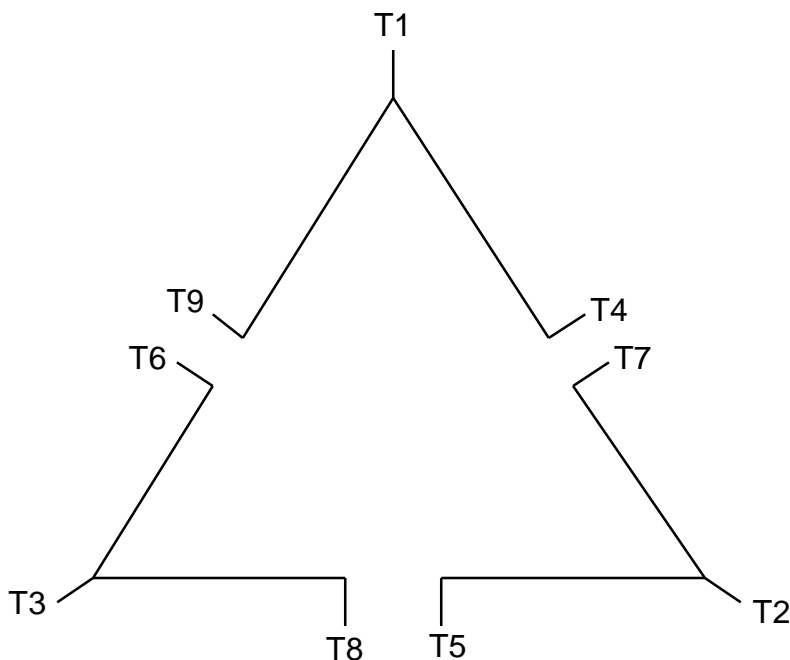
NIDEC MOTOR CORPORATION
ST. LOUIS, MO





A109145

Motor Wiring Diagram 9 Lead, Dual Voltage (DELTA Conn.)



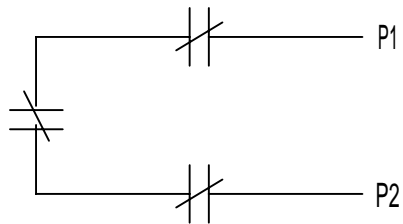
To reverse direction of rotation interchange connections L1 and L2.

Each lead may have one or more cables comprising that lead.
In such case each cable will be marked with the appropriate lead number.

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



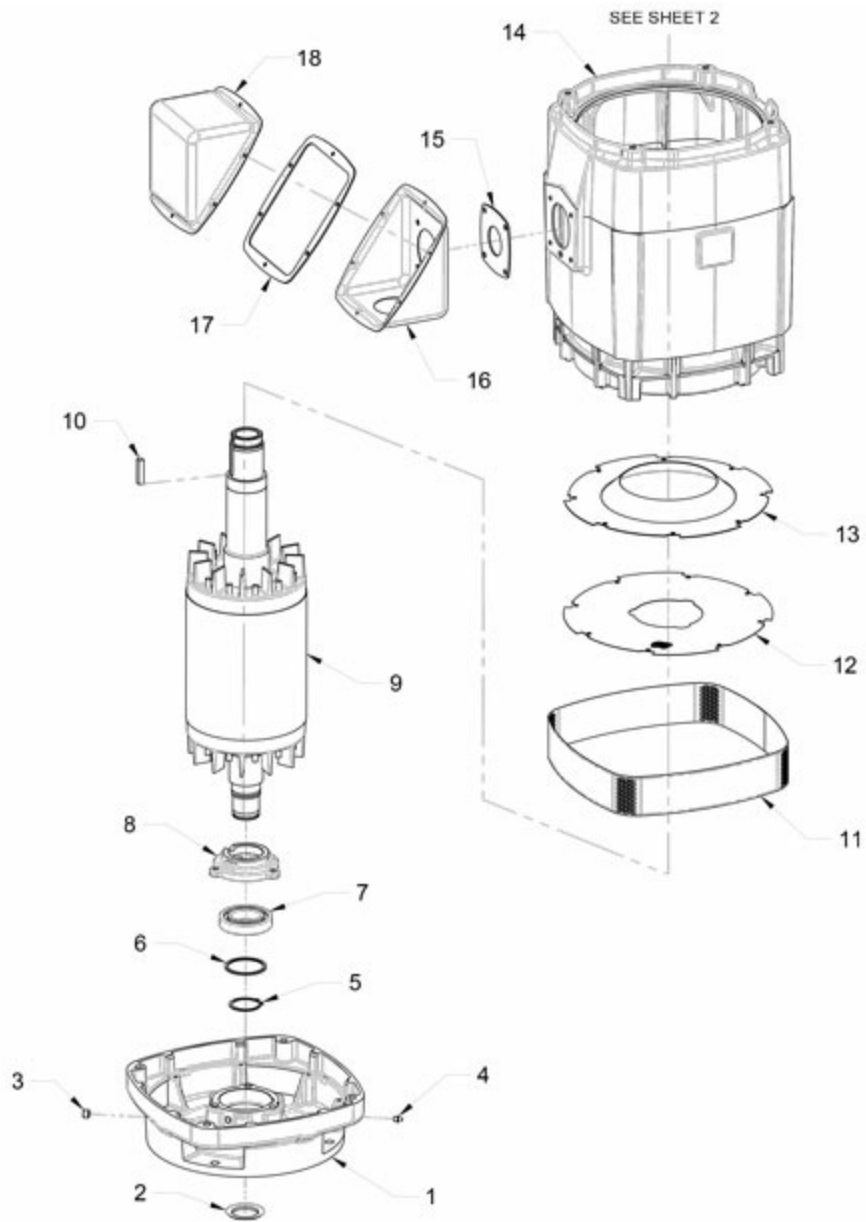
NOTE: THERMOSTATS LEADS MAY BE LOCATED IN EITHER THE MAIN OUTLET BOX OR IF SO EQUIPPED, AN AUXILIARY BOX.

ACCESSORY LISTING
QTY-3 N.C. THERMOSTATS

REVISION DESCRIPTION FOR: MISC	SCALE	UNITS	TITLE		NIDEC MOTOR CORPORATION
STL0211 - UPDATED FORMAT .	NONE	IN	CUSTOMER CONNECTION DIAGRAM		
	TOLERANCES ON DIMENSIONS (UNLESS OTHERWISE SPECIFIED)		ISSUED BY	APPROVED BY	REVISION DATE
MATERIAL:	<u>INCHES</u>	<u>mm</u>	R. KING	C. CADE	24-FEB-11
---	ANGLES X°= ±1°		CODE	DWG NO.	REV
				0834066	G
					SHEET NUMBER
					1 OF 1
					DWG SIZE
					A

RENEWAL PARTS

FRAME 320 TO 400
TYPES: RU, RUE, RUEI, RUS, RUSI

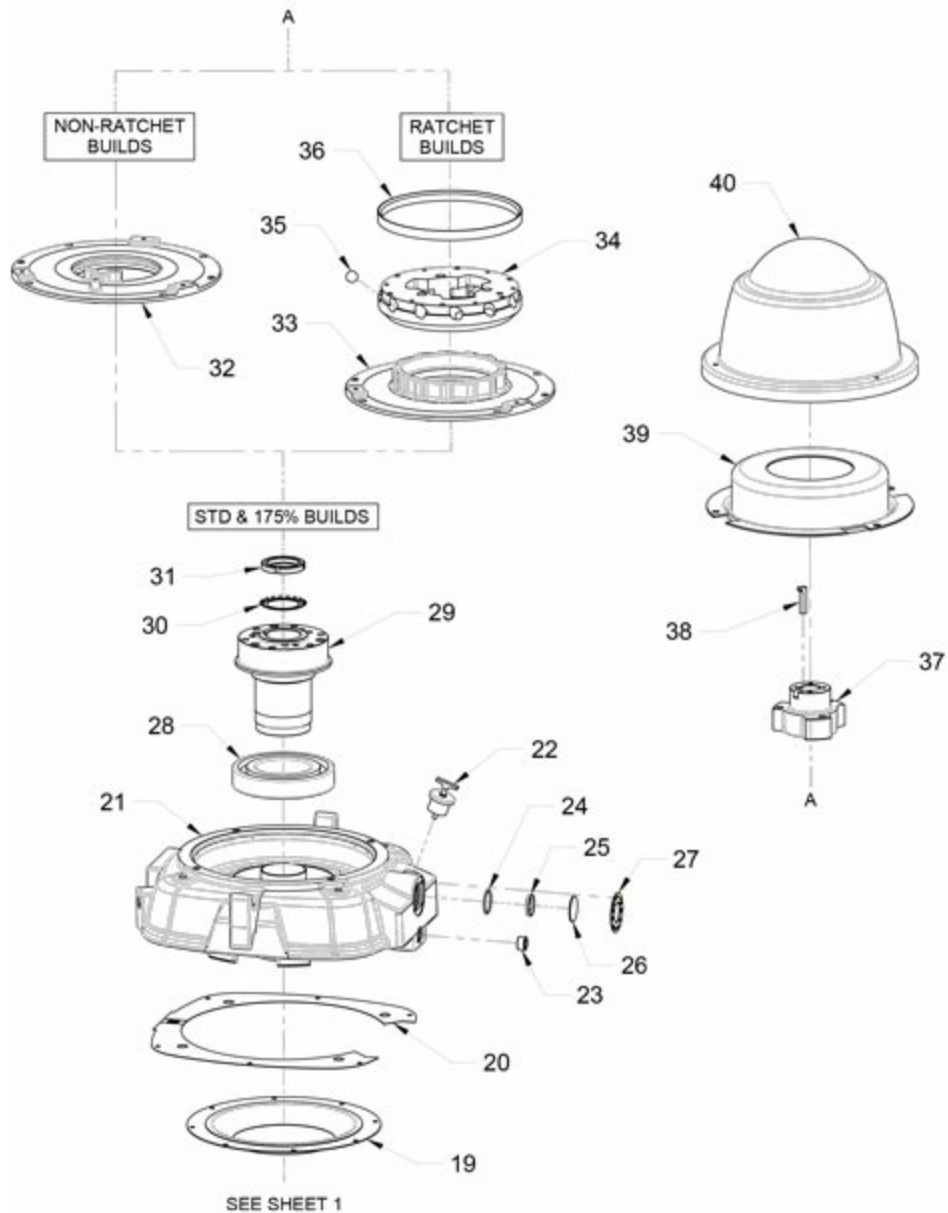


BEARINGS:
Refer to motor nameplate for the bearing numbers.

PRICES:
Parts stocking distributors: refer to renewal parts numerical index. All Others: refer to your nearest parts distributor.
reference: Renewal Parts Section 700 - 270

RENEWAL PARTS

FRAME 320 TO 400
TYPES: RU, RUE, RUEI, RUS, RUSI



BEARINGS:
Refer to motor nameplate for the bearing numbers.

PRICES:
Parts stocking distributors: refer to renewal parts numerical index. All Others: refer to your nearest parts distributor.
reference: Renewal Parts Section 700 - 270

RENEWAL PARTS

FRAME 320 TO 400
TYPES: RU, RUE, RUEI, RUS, RUSI

ITEM NO.	QTY.	NAME OF PART	ITEM NO.	QTY.	NAME OF PART
1	1	Lower Bracket	21	1	Upper Bracket
2	1	Water Deflector	22	1	Oil Fill Plug (Expanding)
3	1	Pipe Plug	23	1	Upper Plug (Oil Drain)
4	1	Zerk Fitting Grease	24	1	O-Ring Sight Gauge Window
5	1	Spacer Washer	25	1	Deflector Sight Gauge Window
6	1	Snap Ring	26	1	Glass Sight Gauge Window
7	1	Lower Bearing	27	1	Cover Sight Gauge Window
8	1	Lower Bearing Cap	28	-	Upper Bearing (Qty 1 or 2)
9	1	Rotor Assembly	29	1	Bearing Mount
10	1	Key	30	1	Upper Lockwasher
11	1	Lower Screen Intake (External)	31	1	Upper Lock Nut
12	1	Lower Screen Intake (Internal)	32	1	Dust Cover (Only on Units Without Ratchet)
13	1	Lower Air Deflector	33	1	Ratchet Adaptor (Only on Units With Ratchet)
14	1	Stator Assembly	34	1	Stationary Ratchet (Only on Units With Ratchet)
15	1	Gasket Outlet Box (Frame and Box)	35	1	Ratchet Ball (Only on Units With Ratchet)
16	1	Outlet Base	36	1	Ball Retaining Ring (Only on Units With Ratchet)
17	1	Gasket Outlet Box (Base and Cover)	37	1	Thrust Coupling (Only on Hollowshaft)
18	1	Cover Outlet Box	38	1	Gib Key (Only on Hollowshaft)
19	1	Upper Air Deflector	39	1	Upper Baffle
20	1	Upper Screen	40	1	Canopy Cap

BEARINGS:

Refer to motor nameplate for the bearing numbers.

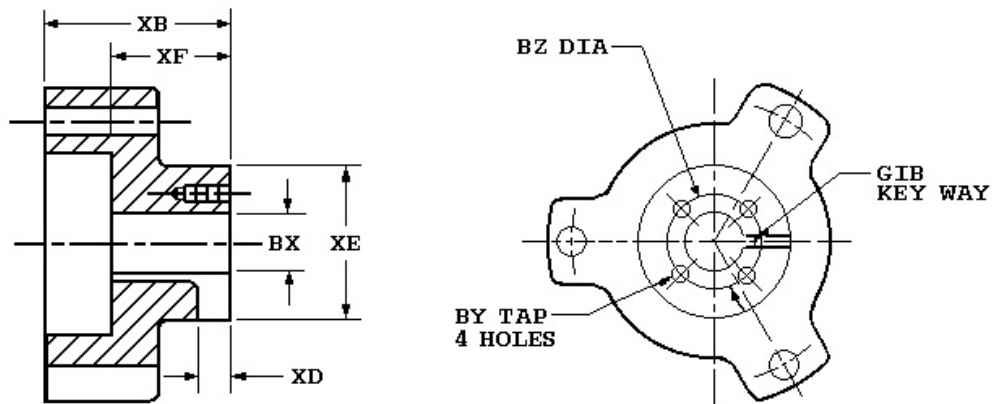
PRICES:

Parts stocking distributors: refer to renewal parts numerical index. All Others: refer to your nearest parts distributor.

reference: Renewal Parts Section 700 - 270

Vertical HOLLOSHAFT Coupling Dimensions

Standard Coupling Dimensions



Coupling Part Number	162458
BX Nominal	1 1/4
Actual Bore	1.251
BY	1/4-20
BZ	1 3/4
XB	2 15/16
XD	17/32
XE	2 7/8
XF	1 15/16
SQ. KEY	1/4

Notes:

1. All Rough casting dimensions may vary by 0.25" due to casting variations.
2. All tapped holes are Unified National Course, Right Hand thread.
3. Coupling bore dimension "BX" is machined with a tolerance of - .000", +.001" up to 1.50" bore inclusive. Larger bores: -.000", +.002".



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TYPICAL REED CRITICAL FREQUENCY DATA

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: 326TP Type: RUI

REED CRITICAL FREQUENCY:	57	HZ
CENTER OF GRAVITY:	13	IN
DEFLECTION @ CENTER OF GRAVITY:	0.00301	IN
UNIT WEIGHT:	675	LBS
BASE DIAMETER:	ALL	IN
TOLERANCE ON RCF VALUE:	10%	
DATE:	7/20/2022	



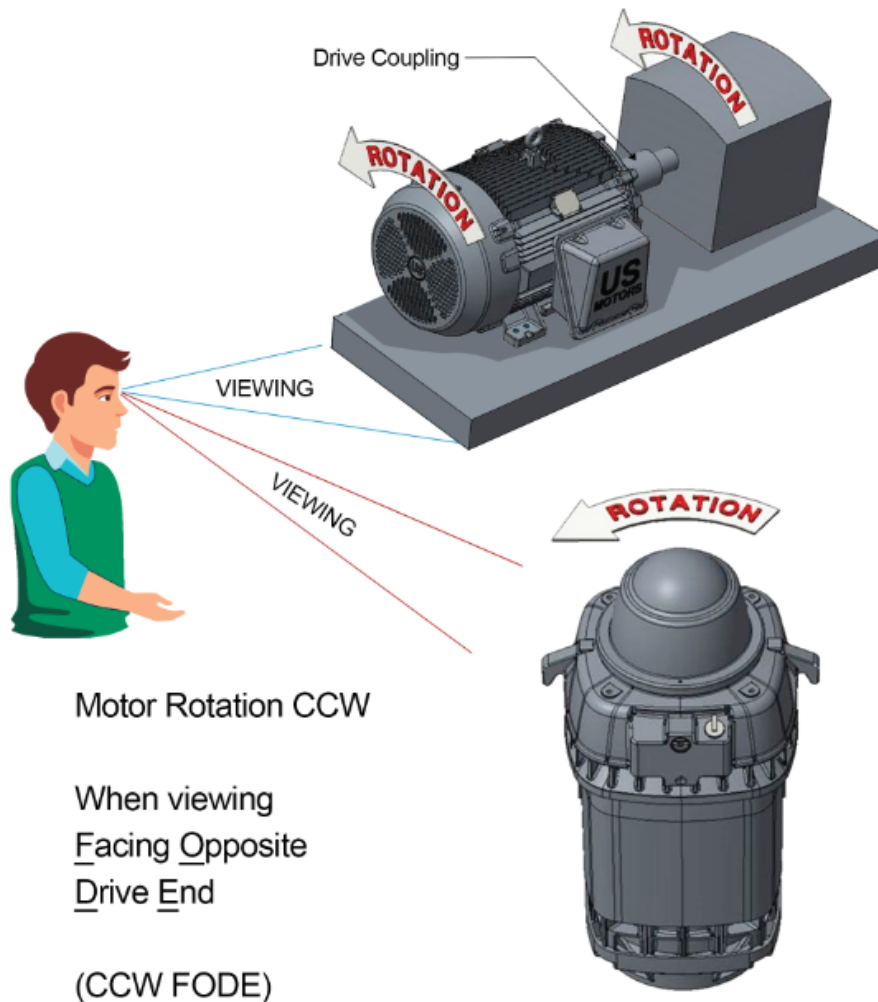
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DIRECTION OF ROTATION

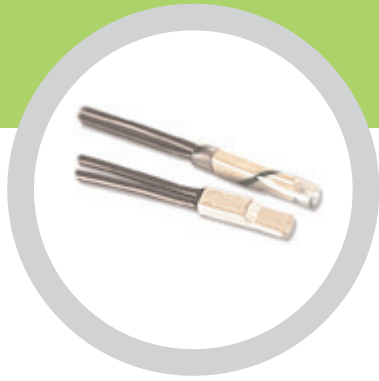
This motor is unidirectional and can only be operated in one direction to ensure proper cooling.

The motor will be supplied with the industry standard CCW (counter clockwise) rotation as shown below. CW rotation is available upon request.



NIDEC MOTOR CORPORATION
ST. LOUIS, MISSOURI

80-289



9700

Thermal Protector for Motor/Fluorescent ballasts and Temperature Sensing Controls

The Klixon® 9700 protector is a field proven miniature protector developed to protect shaded pole and permanent split capacitor motors, fluorescent ballasts, solenoids, transformers and other electrical equipment against overheating.

In addition to being small and lightweight, the unit is both temperature and current sensitive. Since the 9700 is sealed to withstand varnish dipping, it can be mounted directly in windings where it can best sense the true temperature of the electrical equipment. As a result, over-temperature protection is assured.

Since the case is not electrically insulated, the protector is furnished with a durable Mylar insulating sleeve. Shrinkable and non-shrinkable sleeves are available.

Technical Characteristics

Purpose of control:	thermal motor protector (TMP) thermal ballast protector (TBP) thermal cut-out (TCO)
Contact capacity:	250VAC 13A for TCO 250VAC 2A for TBP
Temperature range:	60°C to 150°C for TCO and TMP 60°C to 135°C for TBP
Tolerance on Open temp:	+/- 5K or +/- 8K
Automatic action:	Type 3C for TMP Type 2C for TBP and TCO
Operating time:	Continuous
Pollution situation:	Normal
Extent of sensing element:	Whole control
PTI of the insulation:	175
Enclosure protection degree:	IP00

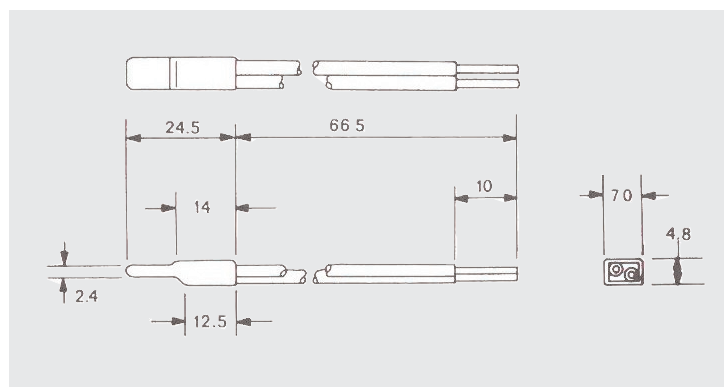
KEY BENEFITS

Miniature size-compact design assures ease of installation

Precision Calibration-temperature calibrated and inspected in controlled ambients for dependable consistent performance

Snapaction-positive make and break assured with proven Klixon® strip disc...contact pressure at open temperature eliminates nuisance trips due to vibration

Sealed steel case-withstands impregnation and baking...maybe varnish dipped...prevents changes in calibration during installation





9700 X X YY - ZZZZ

Z : Wire Lead and sleeve
Serial number is assigned for each lead and sleeve configuration, i.e. wire type, length, AWG#, stripped length, sleeve type, and length.

Y : Operating temperature and actuation disc material
Serial number is assigned for each desired temperature and resistance rating.

Nominal operating temperature	Resistance of actuation disc (ohms/cm ²)				
	30	250	850	100	475
	Temperature code				
60	56	57	58	59	60
80	91	92	93	94	95
90	21	22	23	24	25
100	26	27	28	29	30
110	36	37	38	39	40
120	1	2	3	4	5
130	11	12	13	14	15
140	66	67	68	69	70
150	46	47	48	49	50

This is a typical temperature code. There is a temperature code at each 5°C in a step from 60 to 150°C.

X : Open Temperature tolerance
: +/- 5K
2: +/- 8K

Example :
9700K01-215
Bimetal of 30ohms/cm²,
120°C operating temperature,
+/-5K tolerance with
AWG#18(UL3343 125°C-600V)
66.7mm length leads,
thick 0.15mm, dia. 6.9mm,
length 34mm, Mylar sleeve.

X : Contact material combination

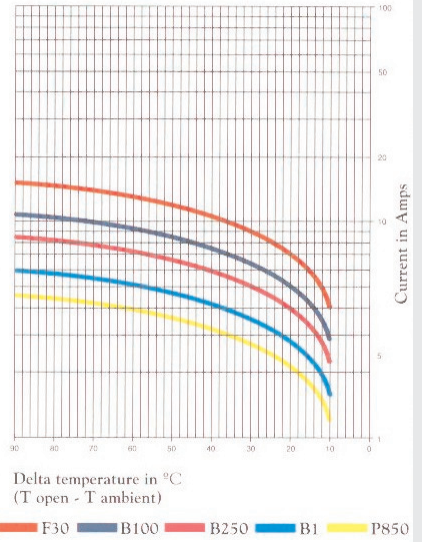
Code	Stationary contact	Movable contact
L	Steel + Fine silver	Steel + copper + Silver Cadmium oxide
K	Ag-Ni + Silver Cadmium oxide	Steel + copper + Silver Cadmium oxide
H	Brass + Fine silver	Steel + copper + Silver Cadmium oxide
P	Ag-Ni + Fine silver	Steel + Fine silver
S	Brass + Fine silver	Steel + Copper + Ag-Ni

Type "S" is set up for Cadmium-free contact

9700 : Device Identification

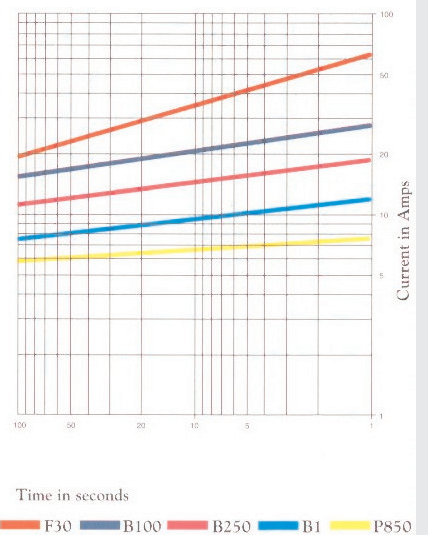
Ultimate trip current vs ambient temperature

Approx., to be used only for selecting samples for verification tests



Average first cycle tripping time vs current 25°C. ambient

Approx., to be used only for selecting samples for verification tests



Certifications

Agency	File number	Standard	Note
UL	E 15962	UL2111	Motor protector
ENEC	2014531.10	EN60730-2-9	Thermal cut-out
ENEC	2014531.10	EN60730-2-2	Thermal motor protector
ENEC	2014531.10	EN60730-2-3	Thermal ballast protector
CQC	CQC0200	2001344	

TECHNICAL / SALES SUPPORT

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Internet: www.sensata.com

Email: info-cpe@list.sensata.com



VFD-Driven Motors Are at Risk of Electrical Bearing Damage!

Motors operated by variable frequency drives (VFD) are vulnerable to VFD-induced shaft voltage and bearing currents that can cause premature bearing failure - often in as little as 3 months!

VFDs induce destructive shaft voltage that can discharge through motor bearings, burning bearing grease and reducing its effectiveness. Through electrical discharge machining (EDM), these discharges can also cause pitting, frosting, and fluting damage to the motor's bearings and eventual bearing failure. The result is costly repairs, downtime, and lost production.

Protect Motor Bearings With AEGIS® Shaft Grounding Rings

By channeling harmful VFD-induced shaft current away from bearings and safely to ground, AEGIS® Shaft Grounding Rings protect motors from costly bearing damage.

Bearing Protection Best Practices

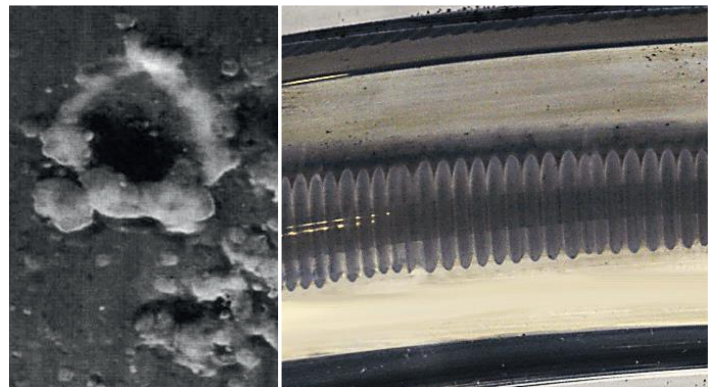
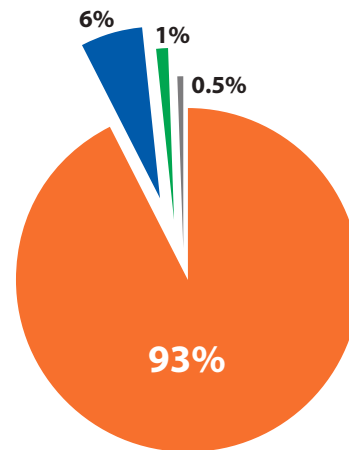
The AEGIS® Motor Repair Handbook details best practices for protecting VFD-driven motors from electrical bearing damage and preventing costly repairs, downtime and lost production.

Learn about:

- Bearing currents and shaft voltage
- AEGIS® technology
- Shaft voltage testing
- Installation best practices

For detailed recommendations, refer to the AEGIS® Bearing Protection Handbook. An essential reference, the Handbook is available free at

www.est-aegis.com/handbook



Prevent EDM Pitting and Fluting Damage

AEGIS® Shaft Grounding Ring Options



Standard Mounting Clamps (-1)

Shaft diameters: 0.311" to 6.02"
3 to 4 mounting clamps, 6-32 x 1/4" cap screws and washers



Split Ring (-1A4)

Shaft diameter: 0.311" to 6.02"
4 to 6 mounting clamps, 6-32 x 1/4" cap screws and washers
Installs without decoupling motor



Bolt Through Mounting (-3FH)

Shaft diameters: 0.311" to 6.02", 6-32 x 1/2" flat head screws
2 mounting holes up to shaft size 3.395"
4 mounting holes for larger sizes



Conductive Epoxy Mounting (-0AW, -0A4W)

Shaft diameters: 0.311" to 6.02"
Solid and Split Ring
Conductive Epoxy Included



Press Fit Mounting (-0A6)

Shaft diameters: 0.311" to 6.02"
Clean dry 0.004" press fit
Custom sizes available



uKIT with Universal Mounting Bracket

Sized for NEMA and IEC frame motors
Solid and Split Ring
Can be mounted with hardware or conductive epoxy



AEGIS® PRO Series

AEGIS® PROSL, PROSLR, PROMAX, PROMR



AEGIS® Shaft Voltage Tester™

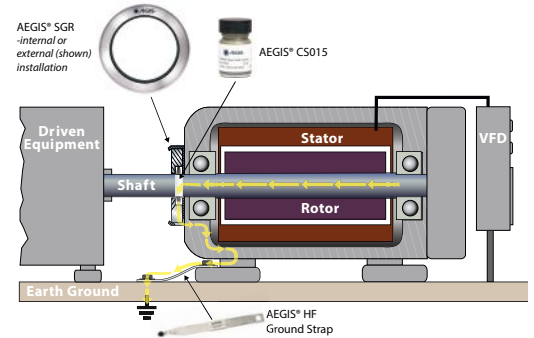
100 MHz Digital Oscilloscope, 10:1 probe with SVP tip for measuring voltages on a rotating shaft
AEGIS® One-Touch™ instant image capture



Accessories

HFGS - AEGIS® High-Frequency Ground Strap
CS015 - AEGIS® Colloidal Silver Shaft Coating
EP2400 - AEGIS® Conductive Epoxy

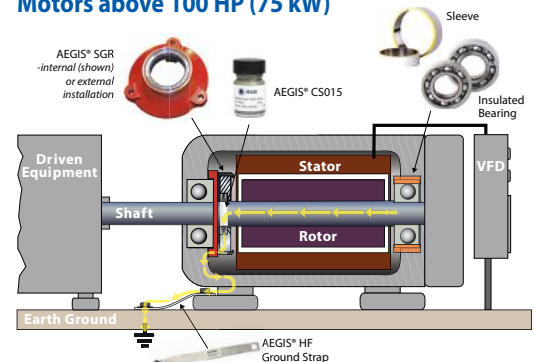
Motors up to and including 100 HP (75 kW)



Install AEGIS® Shaft Grounding Ring – either internally or externally – on drive end or the non-drive end of motor.

Product recommendation: AEGIS® SGR

Motors above 100 HP (75 kW)



- Drive End: Install AEGIS® Shaft Grounding Ring - Internally on the back of the bearing cap or externally on the motor end bracket.
- Non-Drive End: Isolate bearing housing with insulated sleeve or coating or use insulated ceramic or hybrid bearing to disrupt circulating currents.

Product recommendation:

LV Motors up to 500HP: AEGIS® SGR

LV Motors over 500HP: AEGIS® PRO Series

MV Motors: AEGIS® PRO Series



Standard
Paint
Specification

For

EM Gray

**NIDEC MOTOR CORPORATION
USEM DE MEXICO SA DE CV
Apodaca, Nuevo León, México**

CONTENTS

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

1.0 Scope

Nidec Motor Corporation in Apodaca, Nuevo Leon. Has selected enamel paint from "OSEL." 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 Apodaca, Nuevo Leon 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. Foundry to apply primer (approved by plant). Film Thickness: 1 to 3 mils.

- B. Prime all castings, in plant, if they have not been primed by the foundry.

Primer Dequimsa # DQ-PR-150

- C. All parts are to be cleaned prior to priming or finish painting as follows:
 - 1. If parts are dirty – wash and rise in parts washer.
 - 2. If parts are dusty – sandblast
 - 3. Thoroughly dry all parts prior to priming or finish painting. Primer must be applied immediately after cleaning and drying process.

4.0 Cast Aluminum.

Priming is not required on cast aluminum or fiberglass parts. Oxidation must be removed from aluminum parts with a solvent prior to finish painting.

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. 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: Foundry's

Alternate Primer Vendors:

AIR DRY PREMIER
ROBINSON CHEMICAL
COATINGS.
14-G-205

SHERWIN-WILLIAMS GRAY
ALKYD B50AZ6
KEM KROMIK
UNIVERSAL METAL
PRIMER

B. Standard Finish Paint

NMC P/N 138538
EM GRAY
VENDOR: PINTURAS OSEL
FORMULA #4588-B GRAY (LOW GLOSS)

VOC: ~ 3.6 lbs per gallon

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 on 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 Nidec Motor Corporation 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 of the 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

Should a motor supplied with a self-release coupling become uncoupled, the motor and pump must be stationary and all power locked out before manually re-coupling.

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).

WARNING

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.

⚠ WARNING

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		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).

Table 3
Nidec Motor Corporation Recommended Oil Viscosities

Use chart below when "no" special lubrication plate is attached to the motor

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	-15°C thru 40°C (5-104°F)	32	Mineral or Synthetic	
			41°C thru 50°C (105-122°F)	68	Synthetic Only	
-15°C thru 40°C (5-104°F)	404 thru 447		32	Mineral or Synthetic		
			41°C thru 50°C (105-122°F)	68	Synthetic Only	
Totally Enclosed or Explosion proof	449 thru 5811		1801-3600	-15°C thru 40°C (104°F)	32	Synthetic Only
			1800 & below		68	Synthetic Only
		All	41°C thru 50°C (105-122°F)	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	-15°C thru 25°C (5-77°F)	68	Mineral or Synthetic
			6°C thru 40°C (42-104°F)	150	
			41°C thru 50°C (105-122°F)		
Totally Enclosed or Explosion proof	449 and larger		-15°C thru 25°C (5-77°F)	68	Mineral or Synthetic
			6°C thru 40°C (42-104°F)	150	Synthetic Only
			41°C thru 50°C (105-122°F)	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	Cetus 32 Hipersyn	GST Turbine Oil 68	Cetus 32 Hipersyn	R & O Machine Oil 150	Cetus 32 Hipersyn
Conoco Oil Co.	Hydroclear Turbine Oil 32	Syncon 32	Hydroclear Turbine Oil 32	Syncon 32	Hydroclear AW Hyd. Fluid 150	N/A
ExxonMobil	DTE Oil Light, Teresstic 32	SHC 624	DTE Oil Heavy Medium, Teresstic 68	SHC 626	DTE Oil Extra Heavy, Teresstic 150	SHC 629
Phillips Petroleum Co.	Magnus 32	Syndustrial "E" 32	Magnus 68	Syndustrial "E" 68	Magnus 150	N/A
Shell Oil Co.	Tellus S2 MX 32	Tellus HD Oil AW SHF 32	Tellus S2 MX 68	Tellus HD Oil AW SHF 68	Morlina S3 BA 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	
HV, EV, JV, RV			
5000	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
5808-5810	HU, HV-4	24	3
5807-5811	EU, JU, EV-4, JV-4	37	4
5812	JU, JV4	41	4
5813	RU, RV-4	48	4
6808-6810	HU, HV-4	70	3
6808-6810	HV (Bow Thruster)	Grease	Grease
6808-6810	HV (Other Than Bow Thruster)	70	3
6812	JU, JV4	48	7
6813	RU, RV4	45	7
8000	RU, RV-4	70	6
	RV	Grease	Grease
9600	RU, RV-4	95	13
	RV	Grease	Grease
6812	JU, JV4	48	7
6813	RU, RV4	41	7

General Information for Integral Horsepower (IHP) Motors on Variable Frequency Drives (VFDs)

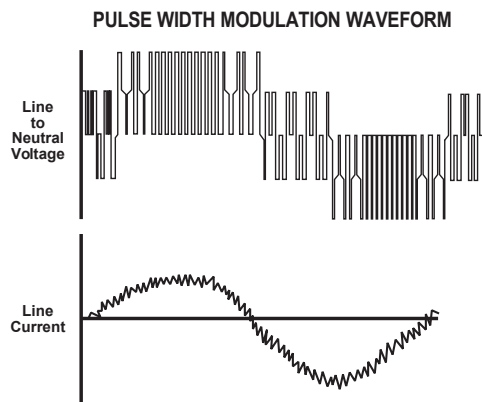
Variable Frequency Drives (VFD)

A VFD is a type of controller used to vary the speed of an electric motor. The VFD takes a fixed AC voltage and frequency and allows it to be adjusted in order to get different speeds from the motor. Motor speed can be varied by changing the frequency of the input power waveform. The equation below shows how the frequency affects the speed of a three phase induction motor.

$$\text{Speed} = \frac{120 * \text{Fundamental Input Frequency}}{\text{Number of Motor Poles}}$$

How does a VFD work?

A VFD takes the fixed frequency and voltage sine wave from the power grid or power station and puts it through a few steps in order to allow the VFD user to vary the frequency and in turn control the motor speed. First it rectifies the AC power into DC Power. Because of this step, a term commonly used instead of VFD is inverter. This only describes one step of what the VFD does to the power waveform. Once rectified into a DC voltage the drive sends the power through a set of transistors or switches. These switches can take the DC waveform and by opening and closing at certain speeds and durations can create an output waveform that mimics the sine wave that is required to drive a three phase electric motor. The output wave form is known as a Pulse Width Modulation (PWM) waveform because the waveform is created by multiple pulses of the switches at short intervals.



What variables should be considered when deciding whether to power a motor with a VFD?

VFD compatibility with motors is complex. As a result, many variables must be considered when determining the suitability of a particular motor for use with a VFD. These variables include:

- Torque requirements (Constant or Variable)
- Speed Range
- Line / System Voltage
- Cable length between the VFD and the motor
- Drive switching (carrier) frequency
- Motor construction

- VFD dv/dt - winding end turn differential in voltage versus differential in time
- High temperatures or high humidity
- Grounding system

Wider speed ranges, higher voltages, higher switching frequencies, insufficient grounding and increased cable lengths all add to the severity of the application and, therefore, the potential for premature motor failure.

How does a VFD affect the motor?

There are many things to consider when a motor is powered using a VFD or PWM power. When a motor is powered by a PWM waveform the motor windings very often see a large differential voltage, either from phase to phase or turn to turn. When the voltage differential becomes large enough it creates a reaction at the molecular level that converts available oxygen into O₃. This phenomenon is called partial discharge or corona. This reaction creates energy in the form of light and heat. This energy has a corrosive effect on the varnish used to protect the motor windings. PWM waveforms can also magnify shaft voltages which lead to arcing across the bearing and causing premature bearing failure. Corrective action must be taken to mitigate these issues that arise when using an electric motor with a VFD.

How do I protect the motor?

Nidec Motor Corporation (NMC) has developed specific motor designs to decrease the harmful affects that a VFD can have on a motor. NMC's INVERTER GRADE[®] insulation system is the first line of defense against corona and phase to phase faults that can be common when a motor is powered using a PWM waveform. The INVERTER GRADE[®] insulation system is standard on all of NMC's Inverter Duty products. Along with the INVERTER GRADE[®] insulation, thermostats are installed as a minimum protection against over heating the motor. Special consideration must also be given to bearings in motors powered by VFD's. In order to create a low resistance path to ground for built up shaft voltages a shaft grounding device can be used. On larger horsepower motors an insulated bearing system should be used in conjunction with the shaft grounding device when installed, to force the stray shaft voltages to ground. The bearing failures are more prominent on motors with thrust handling bearings. NMC has created an Inverter Duty vertical motor line that not only uses the INVERTER GRADE[®] insulation system, but that also comes standard with a shaft grounding device. On motors that are 100 HP and greater the thrust bearing is also insulated for additional protection.

What does "Inverter Duty" mean?

An Inverter Duty motor should describe a motor that helps mitigate potential failure modes of a motor that is powered by a VFD. Inverter duty motor windings should be able to withstand the voltage spikes per NEMA MG1 Part 31.4.4.2 and protect against overheating when the motor is run at slow speeds. On thrust handling bearings it is apparent that the bearings require additional protection. Inverter Duty vertical motors should have a shaft grounding device to protect the motor bearings from fluting due to voltage discharge through the bearing. On larger motors (100HP and larger) the shaft should also be electrically isolated from the frame in order to aid the shaft grounding ring in discharging the shaft voltages to ground.

*This information applies only to Integral Horsepower (IHP) motors as defined on the Agency Approval page, under UL[®] & CSA[®] listings where indicated.

Thermal Overloads and Single Phase Motors

Motors with thermal overloads installed may not operate properly on a VFD. The current carrying thermal overload is designed for sine wave power. Operation on a VFD may cause nuisance tripping or potentially not protect the motor as would be expected on line power. Thermostats or thermistors installed in the motor and connected properly to the VFD may provide suitable thermal overload protection when operating on a VFD. (consult codes for installation requirements)

Single phase motors and other fractional horsepower ratings are not designed to be operated on a VFD. Within Nidec Motor Corporation standard products, all motors NEMA[®] 48 frame (5.5" diameter) and smaller are not suitable for VFD applications. Three phase 56 and 143/145 frame applications should be noted on the catalog price page; or if in doubt ask a Nidec Motor Corporation technical representative for recommendations on compatibility with a VFD.

Slow Speed Motors

Motors with a base design of slower than six poles require special consideration regarding VFD sizing and minimizing harmonic distortion created at the motor terminals due to cable installation characteristics. Additional external PWM waveform filters and shielded motor cables designed for PWM power may be required to provide acceptable motor life. Harmonic distortion on the output waveform should be kept to a minimum level (less than 10%) mismatch impedance.

690V Applications

Motors that are rated for 690VAC and that will be powered by 690VAC PWM VFDs require the use of an external filter to limit peak voltage spikes and the use of an INVERTER GRADE[®] motor. Where available, an alternative to using an output filter is to upgrade to a 2300V insulation system.

Low Voltage TITAN[®] Motors

When using 449 frame and larger motors on PWM type VFDs consider the use of an external filter and shielded motor cables designed for PWM power to minimize harmonic distortion and peak voltages at the motor terminals. Harmonic distortion on the output waveform should be kept to a minimum level (less than 10%).

Bearing Currents Related to PWM Waveforms

Protection of the motor bearings from shaft currents caused by common mode voltages is becoming a standard feature on Inverter Duty motor products. Some installations may be prone to a voltage discharge condition through the motor bearings called Electrical Discharge Machining (EDM) or fluting. Vertical HOLLOWSHAFT and HOSTILE DUTY World Motor come with grounding devices installed as standard. EDM damage is related to characteristics of the PWM waveform, and the VFD programming, and installations factors.

Bearing Protection on Inverter Duty Vertical Motors

All U.S. MOTORS[®] brand "Inverter Duty" vertical products have a shaft grounding system that allows damaging shaft currents a low resistance path to ground. **Bearings on vertical motors fed by VFD power without this bearing protection are not covered under any warranty.** All other bearing failure is covered per NMC's standard warranty. An electric motor repair shop approved to service U.S. MOTORS[®] brand motors must verify that the cause of the bearing failure was not due to EDM damage.

Guideline For Insulated Anti-Friction Bearings

Bearing insulation is required to prevent circulating shaft currents which can damage bearings. Circulating shaft current can be caused by use of improper power and/or ground cables, improper grounding systems and higher switching frequencies. Finding and correcting the external condition(s) is the responsibility of the system designer or specifying engineer. To prevent circulating shaft current in motors with anti-friction bearings, Nidec Motor Corporation's standard practice is to insulate the non-drive end bearing.

Adjustable Speed Drives produce a common mode voltage condition. To interrupt common mode voltage on induction motors of all sizes, NEMA MG1-2018 Part 31 recommends insulating both bearings. In cases where both anti-friction bearings are insulated, the system designer or specifying engineer should determine whether to apply one or more of the following options to prevent or reduce shaft currents: sinewave filters, line reactors or mechanical devices, such as shaft grounding or an insulated half coupling. Motors with shaft grounding devices are not suitable for installation in hazardous locations unless housed in an enclosure suitable for the specified Division (or Zone), Class and Group(s).

Multiple Motors on a Single VFD

Special considerations are required when multiple motors are powered from a single VFD unit. Most VFD manufacturers can provide guidelines for proper motor thermal considerations and starting/stopping of motors. Cable runs from the VFD and each motor can create conditions that will cause extra stress on the motor winding. Filters may be required at the motor to provide maximum motor life.

Grounding and Cable Installation Guidelines

Proper output winding and grounding practices can be instrumental in minimizing motor related failures caused by PWM waveform characteristics and installation factors. VFD manufacturers typically provide detailed guidelines on the proper grounding of the motor to the VFD and output cable routing. Cabling manufacturers provide recommended cable types for PWM installations and critical information concerning output wiring impedance and capacitance to ground.

Integrated Motor and Inverter

By integrating the motor and inverter at NMC's manufacturing facility, many of the motor compatibility problems are minimized or eliminated. During the manufacturing process, the motor is matched to the inverter characteristics which ensures the winding temperature and torque levels meet the design specification. Since the inverter output wiring to the motor is nearly eliminated, bearing currents are rarely experienced. When the unit is properly grounded, reducing the output cable lengths in conjunction with an inverter grade insulation system and low factory setting of the switching frequency of the inverter drive, results in low risk of voltage peaks produced by the PWM waveform.

Vertical Motors on VFDs

Vertical motors operated on VFD power present unique conditions that may require consideration by the user or installation engineer:

- Locked rotor and drive tripping caused by non-reversing-ratchet operation at low motor speeds. It is not recommended to operate motors at less than 1/4 of synchronous speed. If slow speeds are required contact NMC engineering.
- Unexpected / unacceptable system vibration and or noise levels caused by the torque pulsation characteristics of the PWM waveform, a system critical frequency falling inside the variable speed range of the process or the added harmonic content of the PWM waveform exciting a system component
- Application related problems related to the controlled acceleration/deceleration and torque of the motor on VFD power and the building of system pressure/ load.
- The impact the reduction of pump speed has on the down thrust reflected to the pump motor and any minimum thrust requirements of the motor bearings
- Water hammer during shutdown damaging the non-reversing ratchet

Humidity and Non-operational Conditions

The possible build-up of condensation inside the motor due to storage in an uncontrolled environment or non-operational periods in an installation, can lead to an increased rate of premature winding or bearing failures when combined with the stresses associated with PWM waveform characteristics. Moisture and condensation in and on the motor winding over time can provide tracking paths to ground, lower the resistance of the motor winding to ground, and lower the Corona Inception Voltage (CIV) level of the winding.

Proper storage and maintenance guidelines are important to minimize the potential of premature failures. Space heaters or trickle voltage heating methods are the common methods for drying out a winding that has low resistance readings. **Damage caused by these factors are not covered by the limited warranty provided for the motor unless appropriate heating methods are properly utilized during non-operational periods and prior to motor start-up.**

NEMA[®] Application Guide for AC Adjustable Speed Drive Systems: <http://www.nema.org/stds/acadjustable.cfm#download>

* This information applies only to Integral Horsepower (IHP) motors as defined on the Agency Approval page, under UL[®] & CSA[®] listings where indicated.

Warranty Guidelines for Integral Horsepower (IHP)* Motors on Variable Frequency Drives

Warranty Guidelines

The information in the following section refers to the motor and drive application guidelines and limitations for warranty.

Hazardous Location Motors

Use of a variable frequency drive with the motors in this catalog, intended for use in hazardous locations, is only approved for Division 1, Class I, Group D hazardous location motors with a T2B temperature code, with a limitation of 2:1 constant torque or 10:1 variable torque output. **No other stock hazardous location motors are inherently suitable for operation with a variable frequency drive.** If other requirements are needed, including non-listed Division 2, please contact your Nidec Motor Corporation territory manager to conduct an engineering inquiry.

575 Volt Motors

575 volt motors can be applied on Inverters when output filters are used. Contact the drive manufacturer for filter selection and installation requirements.

Applying INVERTER GRADE® Insulated Motors on Variable Frequency Drives (2, 4, 6 pole)

The products within this catalog labeled “Inverter Duty” or “Vector Duty” are considered INVERTER GRADE® insulated motors. INVERTER GRADE® motors exceed the NEMA® MG-1 Part 31 standard. Nidec Motor Corporation provides a three-year limited warranty on all NEMA® frame INVERTER GRADE® insulated motors and allows long cable runs between the motor and the VFD (limited to 400 feet without output filters). Cable distance can be further limited by hot and humid environments and VFD manufacturers cable limits. These motors may be appropriate for certain severe inverter applications or when the factors relating to the end use application are undefined (such as spares).

Nidec Motor Corporation’s U.S. Motors® brand is available in the following INVERTER GRADE® insulated motors:

- Inverter Duty NEMA® frame motors good for 20:1 Variable Torque & 5:1 Constant Torque, including Vertical Type RUSI (10:1 V.T.)
- Inverter Duty motors rated for 20:1 Constant Torque
- ACCU-Torq® and Vector Duty Motors with full torque to 0 Speed or 5000:1
- 841 Plus® NEMA® Frame Motors

Applying Premium Efficient motors (that do not have INVERTER GRADE® insulation) on Variable Frequency Drives (2, 4, 6 pole)

Premium efficient motors without INVERTER GRADE insulation meet minimum NEMA® MG-1, Section IV, Part 31.4.4.2. These motors can be used with Variable Frequency Drives (with a reduced warranty period) under the following parameters:

- On NEMA® frame 447 and smaller motors, 20:1 speed rating on variable torque loads & 4:1 speed range on constant torque loads.
- On TITAN® 449 and larger frame motors, 10:1 speed rating on variable torque loads.

- On TITAN® frame motors, inquiry required for suitability on constant torque loads.

Cable distances are for reference only and can be further limited by hot and humid environments (refer to Table 1). Refer to specific VFD

Table 1 - Cable Distances			
Maximum Cable Distance VFD to Motor			
Switching Frequency	460 Volt	230 Volt	380 Volt
3 KHz	127 ft	400 ft	218 ft
6 KHz	90 ft	307 ft	154 ft
9 KHz	73 ft	251 ft	126 ft
12 KHz	64 ft	217 ft	109 ft
15 KHz	57 ft	194 ft	98 ft
20 KHz	49 ft	168 ft	85 ft

manufacturers cable limits. Refer to the Motor/ Inverter Compatibility page for special consideration of vertical motor bearings.

Warranty Period Clarifications and Exceptions

Standard Energy Efficient Exclusion

Applying Standard & Energy Efficient Motors on Variable Frequency Drives is not recommended. VFD related failures on standard and energy efficient motors will not be covered under warranty.

Vertical Motor Windings

Premium efficient vertical motors without INVERTER GRADE® insulation that are installed using the criteria described in this document and applied in the correct applications shall have a warranty while powered by a VFD for 12 months from date of installation or 18 months from date of manufacturing whichever comes first. See limited warranty page for horizontal motor warranty periods.

Bearing Exclusion for Thrust Handling Bearings

Bearings used in premium efficient vertical motors, and all thrust handling bearings, that are powered by VFDs without shaft grounding devices or insulated bearings (when required) will not be covered under any warranty for damages caused from being powered by a VFD. All other bearing failure is covered per NMC’s standard warranty. An electric motor repair shop approved to service U.S. MOTORS® brand motors must verify that the cause of the bearing failure was not due to Electrical Discharge Machining.

Medium Voltage and Slow Speed Considerations

Motors that are rated above 700 VAC or that are eight pole and slower require special consideration and installation and are not covered under the warranty guidelines in this document. Motors that are rated above 700VAC have special cable length and voltage differential issues that are specific to the VFD type and manufacture. The motor construction and cost may vary dramatically depending on the VFD topology and construction. Contact your NMC representative with VFD manufacturer name and model type for application and motor construction considerations. Motors that are designed eight pole and slower also require special installation and filters per the drive manufacturer.

* This information applies only to Integral Horsepower (IHP) motors as defined on the Agency Approval page, under UL® & CSA® listings where indicated.



FAIRBANKS NIJHUIS™

October 17, 2022

Hayes Pump, Inc.
66 Old Power Mill Road
West Concord, MA 01742

Attn: Craig Huff

Subject: Purchase Order Number: 132657
Sales Order Number: 53113215
Project: 0913484

To Whom It May Concern:

The submittal data for the above order is attached. This 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: fmproduct@pentair.com

cc:

Enclosures: (1) pdf submittal

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
Marsh Road Water Pump Station
Hudson, NH

Supplier: Hayes Pump, Inc.
66 Old Power Mill Road
West Concord, MA 01742

Manufacturer:

Pump: Fairbanks Nijhuis
3601 Fairbanks Ave.
Kansas City, Kansas 66106-0906
(913) 371-5000

Project Number: 0913484

Sales Order Number: 53113215

Quantity: 1

Pump Size & Model: 12E 7100AW

Motor: Nidec
P. O. Box 3946
St. Louis, MO 63136
(314) 553-2878

1. **Comment:** Setting Plan to include the 6" height of the concrete slab. The total length from the centerline of the discharge to the centerline of the suction should be 8.0 FT with dimension from top of can to centerline of the suction 87.5"

Response: Confirmed, See Revised Submittal

1. **Comment:** I'm missed this requirement during the order entry process, per but the contract drawing M001, the distance from the bottom of the pump station slab to the centerline of the suction can inlet needs to be 5'-6". (See below screenshot of section view.) This translates to distance of 81.5" from top of can to the suction centerline, and 8.0 FT from discharge connection centerline to suction inlet centerline. Please adjust overall can lengths for both project #'s 0913483 & 0913484 as needrd to accommodate this suction inlet location, and revise the setting plans and can dimensional drawings accordingly.

Response: Confirmed, See Revised Submittal

2. **Comment:** Please advise if the type CT and/or type D discharge heads are provided with pressure gauge tap, either at the top of the flange or other location

Response: Confirmed, Pressure Gauge tap is Provided on the Discharge Head

Fairbanks Nijhuis
Table Of Contents

Pump:

Included Features	IF-7100
Technical Clarifications	CE-5000
Performance Curve.....	0913484C
Pump Setting Plan	0913484SP1
Suction Can Setting Plan.....	0913484SP2
Material Specifications	ML-7100
Assembly Drawings	
Bowl Assembly	0913484AB
Column & Shaft.....	0913484AC
Discharge Head.....	0913484AH
Shaft Seal	0913484AS
Pump Technical Data.....	TD-7100
Critical Speed Calculations	16 Pages
Mechanical Seal Data	5 Pages
Paint Specifications.....	PC-1000

Driver:

Performance Data.....	FM013
Certification & Accessory Data	FM015
Dimensions	1 Page
Vertical Hollowshaft Coupling Dimensions	1 Page
Lubrication	4 Pages
Silicone Rubber Space Heaters.....	2 Pages
Heater Connection Diagram	970798
Klixon Miniature Protector.....	2 Pages
Connection Diagram	834066
Paint Specifications	5 Pages
Wiring Diagram	1 Page

Fairbanks Nijhuis
Included Features

- Potable Water Application – None NSF Certified
- Variable Speed Operation
- Suction Can
- Pump Shipped Assembled
- 12E, 6 Stage Flanged Bowl Assembly
- Suction Bell & Threaded Discharge Case
- Dynamically Balanced 316 Stainless Steel Impellers
- 416 Stainless Steel Collet Impeller Fasteners
- 316 Stainless Steel Impeller Wear Ring
- Stainless Steel Bowl Wear Ring
- 8" Flanged Column with 1-3/16" Open Line Shaft
- 416 Stainless Steel Line Shaft and Coupling
- 304 Stainless Steel Top Shaft Sleeve
- 16-1/2 x 6 Type "D" Above Ground Discharge Head
- 175 Lb. Seal Box
- Mechanical Seal John Crane 5610
- 416 Stainless Steel Drive Shaft
- 416 Stainless Steel Pump Shaft
- Certified Non-Witness Performance Test
- Curve Approval Required Prior to Shipment
- Test Logs Required

Fairbanks Nijhuis
Technical Clarifications & Exceptions

1. Refer also to clarifications that may be included on the vendor submittal.

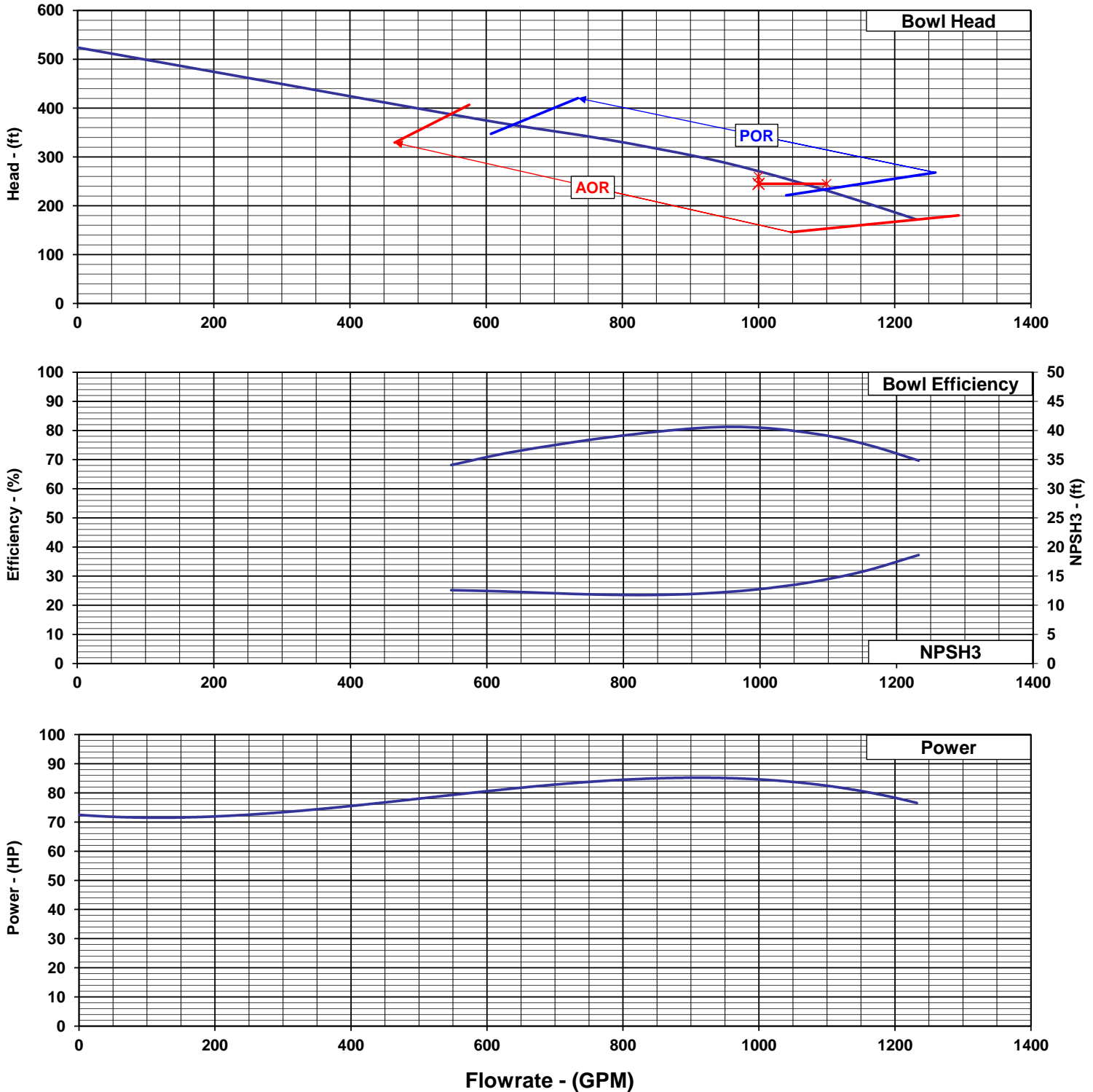
12E Submittal Curve



FAIRBANKS NIJHUIS™

CURVE NUMBER:	0913484C	SPEED	1785 RPM	DRIVER	100 HP	DIAMETER	AS REQ'D	SPHERE	0.75"	GUARANTEED VALUES							
REV.	0	STAGES	6	IMPELLER	STD	DATE	7/1/2022	BY	WSF	FLOW	1000	HEAD	245	BOWL EFF	----	HP	----
THIS CURVE IS BASED ON THE ACTUAL TEST PERFORMANCE OF A SIMILAR PUMP. ONLY THE INDICATED POINT(S) IS GUARANTEED.										----	----	----	----				
										----	----	----	----				
										----	----	----	----				

Acceptance Grade 1U per ANSI/HI 14.6.3.4.

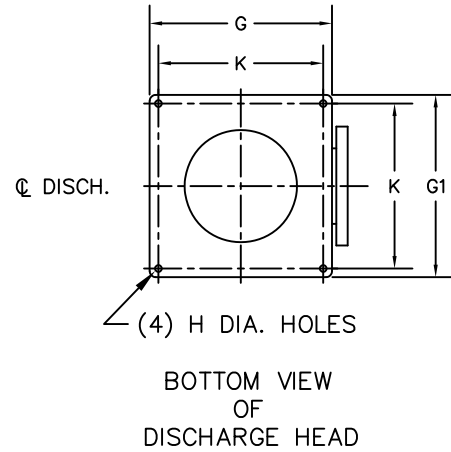
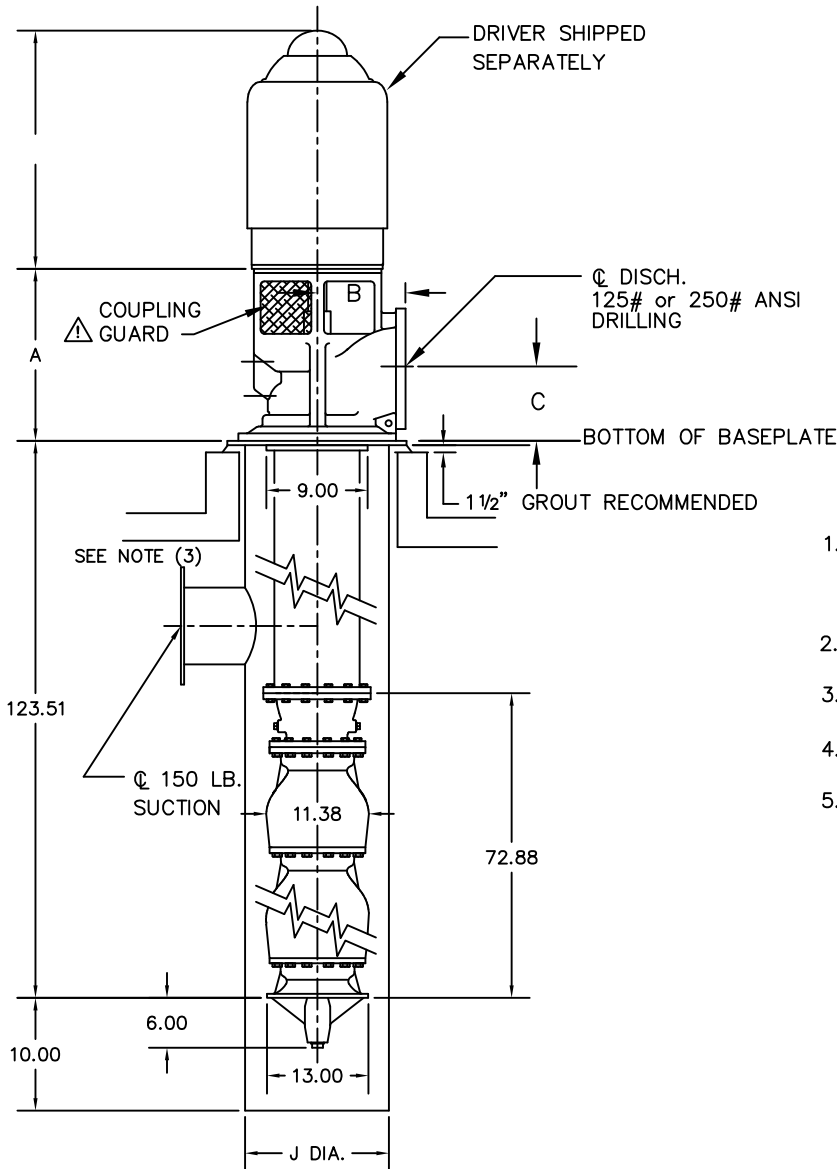


⚠ WARNING

DO NOT OPERATE THIS MACHINE WITHOUT PROTECTIVE GUARD IN PLACE. ANY OPERATION OF THIS MACHINE WITHOUT PROTECTIVE GUARD CAN RESULT IN SEVERE BODILY INJURY.

DISCHARGE HEAD DIMENSIONS

HEAD SIZE	A	B	C	F	G	G1	H	K
16 1/2 x 6	21 1/2	10 1/4	8 1/2	7/8	20 1/2	20	7/8	16 13/16

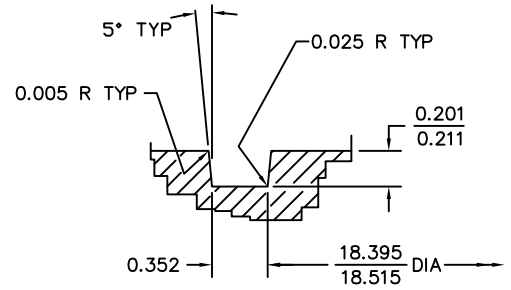
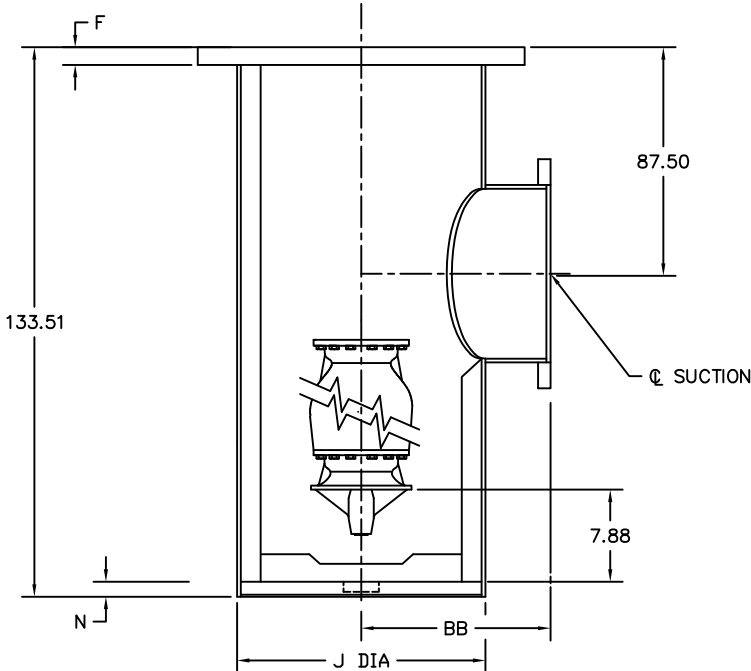
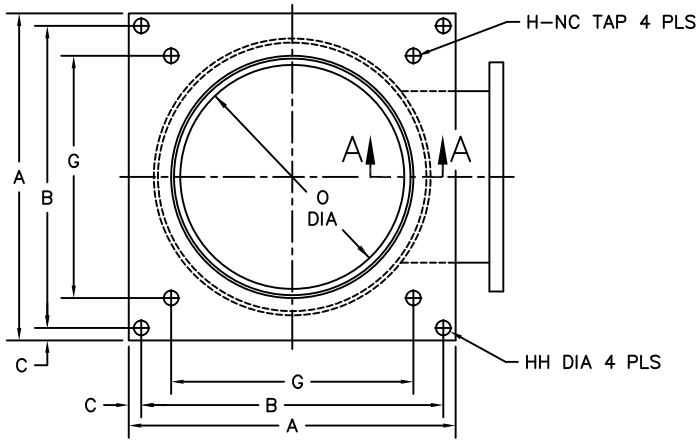


1. THIS DRAWING NOT FOR CONSTRUCTION OR INSTALLATION UNLESS CERTIFIED. DIMENSIONS SHOWN ARE TYPICAL AND MAY VARY DUE TO VARIOUS TOLERANCES.
2. SUCTION CAN MUST BE SUPPORTED ON ALL 4 SIDES AND GROUTED IN PLACE.
3. SEE SHEET 2 OF 2 FOR ADDITIONAL POT DIMENSIONS
4. CUSTOMER TO VERIFY OR ADVISE OVERALL LENGTH PRIOR TO OR AT RELEASE.
5. BOTTOM 2 HOLES ON THE DISCHARGE FLANGE ARE TAPPED WHEN 250# FLANGE IS SELECTED.

● CONTRACTOR TO ADVISE Ø INLET ELEVATION.

REV. 1 - OAL WAS 92.00 - JEA 10/4/22
REV. 2 - OAL WAS 117.50 - JEA 10/17/22

CUSTOMER HAYES PUMP INC.					P.O. 132657		
JOB NAME MARSH ROAD WATER PUMP STATION							
PUMP SIZE & MODEL 12E 7100AW		STAGES 6	GPM 1000	TDH 245	RPM 1800	ROT CCW	SETTING PLAN MODEL 7100 PUMP TYPE "D" SURFACE DISCHARGE HEAD
MOTOR NIDEC	HP 100	FRAME 404TP	PHASE 3	HERTZ 60	VOLTS 230/460	ENCL WPI	
CERTIFIED FOR PROJECT: 0913484		CERTIFIED BY JEA			DATE 7/11/22	DWG. NO. 0913484SP1	



18 1/2" O-RING GROOVE
SECTION A-A

1. THIS DRAWING NOT FOR CONSTRUCTION OR INSTALLATION UNLESS CERTIFIED. DIMENSIONS SHOWN ARE TYPICAL AND MAY VARY DUE TO VARIOUS TOLERANCES.
2. SUCTION CAN FLANGE MUST BE SUPPORTED ON ALL FOUR (4) SIDES AND GROUTED IN PLACE.
3. CUSTOMER TO VERIFY OR ADVISE OVERALL LENGTH PRIOR TO OR AT RELEASE.

4. SUCTION PRESSURE LIMITED TO 40 PSI.

SUCTION CAN DIMENSIONS												
CAN SIZE	J DIA	O-RING SIZE	A	B	C	F	G	H	N	O	BB	HH
18	18	18 1/2	27	22	2 1/2	1 1/2	16 23/32	3/4"-10	2 1/8	17 3/8	12 1/2	7/8

150# SUCTION FLG. DIM.					
NOM. SIZE	FLG. DIA.	FLG. THK.	NO. BOLTS	HOLE SIZE	B.C. DIA
12	19	1 1/4	12	1	17

REV. 1 - OAL WAS 102.00 AND C.L. DOWN WAS 11.00 - JEA 10/4/22
 REV. 2 - OAL WAS 127.50 AND C.L. DOWN WAS 81.50 - JEA 10/17/22

CUSTOMER HAYES PUMP INC.				P.O. NO. 132657			
JOB NAME MARSH ROAD WATER PUMP STATION				TAG NAME			
PUMP SIZE AND MODEL 12E 7100AW		STAGES 6	GPM 1000	TDH 245	RPM 1800	ROTATION CW	DISCH POS
MOTOR NIDEC		HP 100	FRAME 404TP	PHASE 3	HERTZ 60	VOLTS 230-460	ENCLOSURE WPI
CERTIFIED FOR PROJECT: 0913484				CERTIFIED BY JEA		DATE 7/12/22	
DWG NO 0913484SP2						REV NO 2	

16-1/2" X 6"
"D" Head
TURBINE SUCTION
CAN DIMENSIONS

Fairbanks Nijhuis
Material Specifications

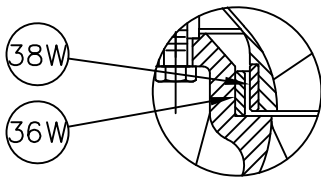
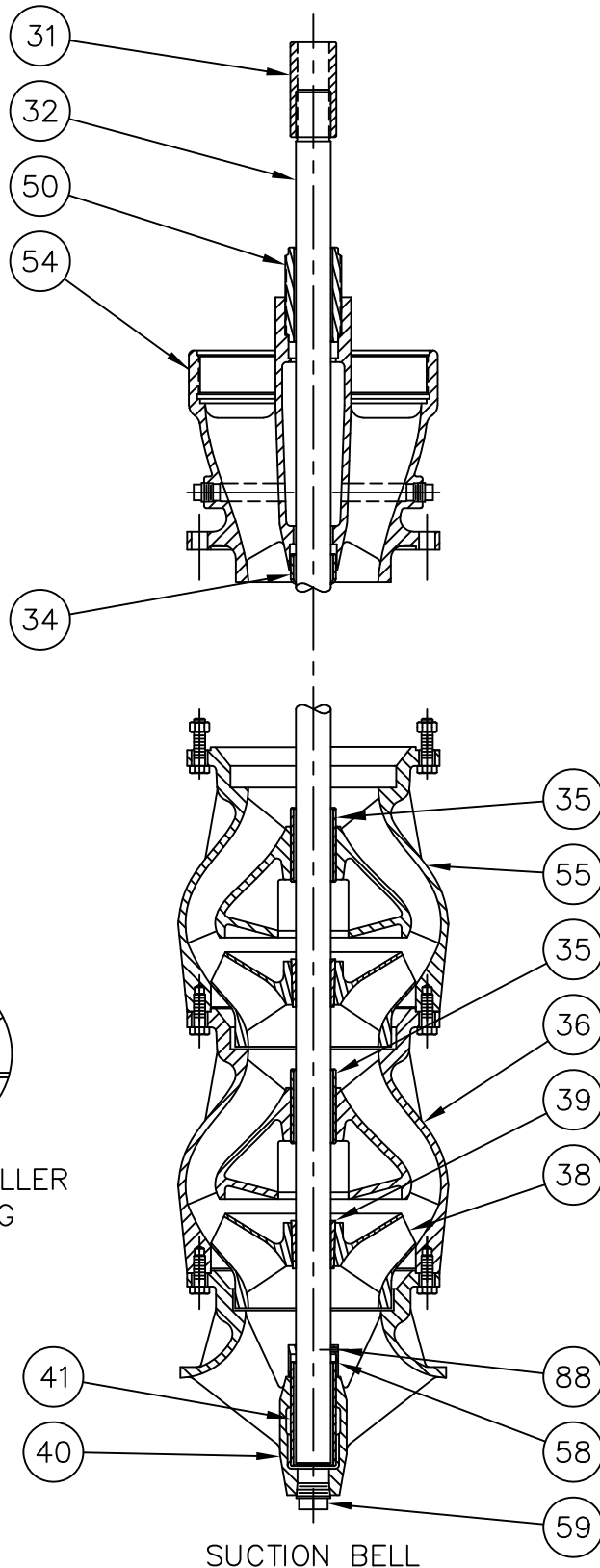
<u>Item</u>	<u>Description</u>	<u>Material</u>	<u>Specification¹</u>
1	Top Shaft Adjusting Nut	Steel	A108 Gr. 12114
6	Water Slinger	Rubber	Neoprene
7	Discharge Head	Cast Iron	A48 Class 30
11	Gasket	Tag Board	F104
13	Top Shaft Sleeve	Stainless Steel	AISI 304 SSTL.
16	Column Flange Gasket	Tag Board	F104
17	Seal Box	Cast Iron	A48 Class 30
17A	Seal Box Bushing	Bismuth Bronze	C89835
19A	Motor Shaft	Steel	AISI 1045
19B	Top Shaft	Stainless Steel	A582 S41600 MOD
21	Top Column	Steel	A53 & A36 ¹
23	Line Shaft	Stainless Steel	A582 S41600 MOD
25	Bearing Retainer	SST or Bronze	Mfg. Option
26	Bearing	Neoprene	Commercial
29	Shaft Sleeve	Stainless Steel	AISI 304
30	Column	Steel	A53 & A36 ¹
31	Shaft Coupling	Steel ²	A108 Grade 12L14
32	Pump Shaft	Stainless Steel	A582 S41600 MOD
34	Top Bowl Bearing	Bronze	B505 Alloy 932
35	Inter Bowl Bearing	Bronze	B505 Alloy 932
36	Inter Bowl	Cast Iron ³	A48 Class 30
36W	Bowl Wear Ring	Stainless Steel	A743 CA-40 MOD
38	Impeller	Stainless Steel	A743 GR CF-8M
38W	Impeller Wear Ring	Stainless Steel	A743 GR CF-8M
39	Drive Collet	Stainless Steel	A582 S41600
40	Suction Bell	Cast Iron	A48 Class 30
41	Suction Bearing	Bronze	B505 Alloy 932
50	Connector Bearing	Bronze	B505 Alloy 932
54	Discharge Case	Cast Iron	A48 Class 30
55	Top Inter Bowl	Cast Iron ³	A48 Class 30
58	Sand Collar	Bronze	B505 C93200
59	Suction Bowl Plug	Cast Iron	Commercial
88	Set Screw	Stainless Steel	18-8 SSTL.
456	Mechanical Seal	---	Commercial
	Bowl Bolting	Steel	Commercial
	Column Bolting	Steel	Commercial
	Discharge Head Bolting	Steel	Commercial

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

² Pump Shaft Coupling is Stainless Steel, ASTM A582 S41600

³ Bowls are coated Cast Iron

THREADED COLUMN



BOWL & IMPELLER
WEAR RING

SUCTION BELL

FLANGED BOWL ASSEMBLY
12E
OPEN LINESHAFT



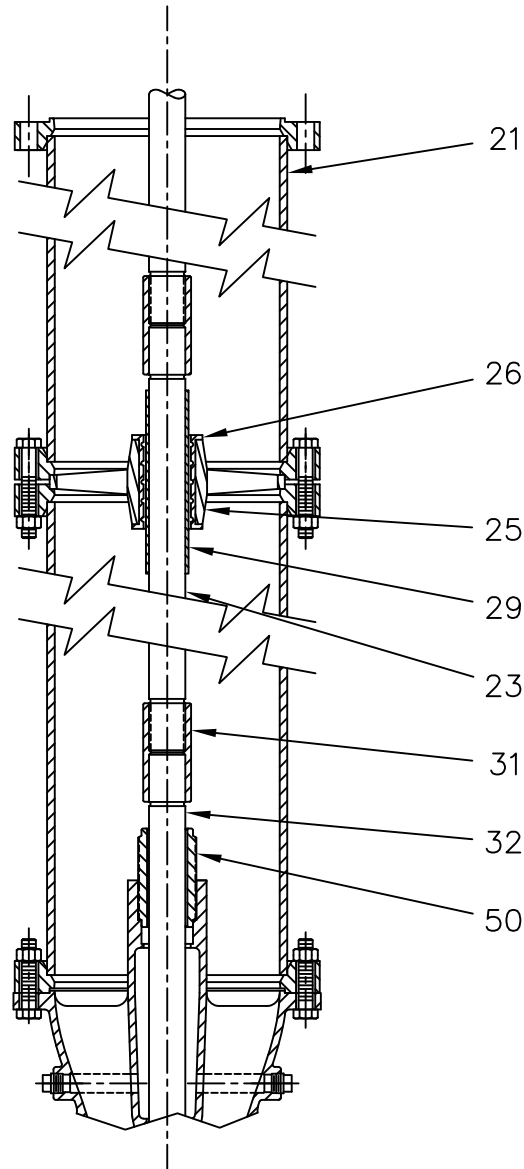
DWG NO 0913484AB REV NO 0



WARNING

ALWAYS BE SURE LIFTING EQUIPMENT IS OF ADEQUATE SIZE TO PREVENT POSSIBLE SERIOUS PERSONAL INJURY OR DAMAGE TO THE EQUIPMENT.

SEE MECHANICAL SEAL
DETAIL



FLANGED COLUMN

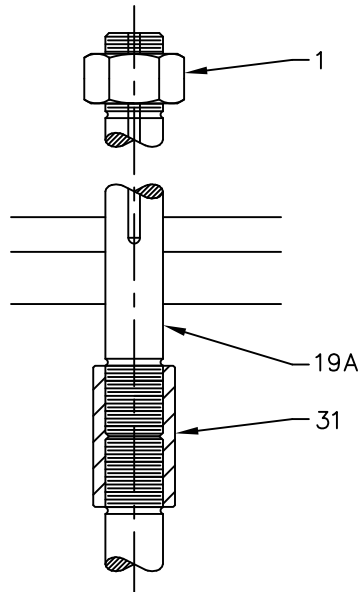
NOTES:

- (1) COLUMN SECTIONS ARE TO BE LIFTED BY EYEBOLTS OR "COLUMN CLAMPS" (SUPPLIED BY OTHERS).
- (2) COLUMN, AND SHAFT ASSEMBLIES SHOULD BE SECURED TOGETHER BY ROPE SLINGS OR OTHER SUITABLE MEANS.
- (3) BEARING CENTERS (MAX)
TOP: 6.5'
INTER: 5'
COLUMN & SHAFT LENGTHS (MAX): 10'
SHAFT PROJECTION: 17.5"
- (4) REFER TO TECHNICAL DATA PAGE FOR OTHER DIMENSIONS AND WEIGHTS.

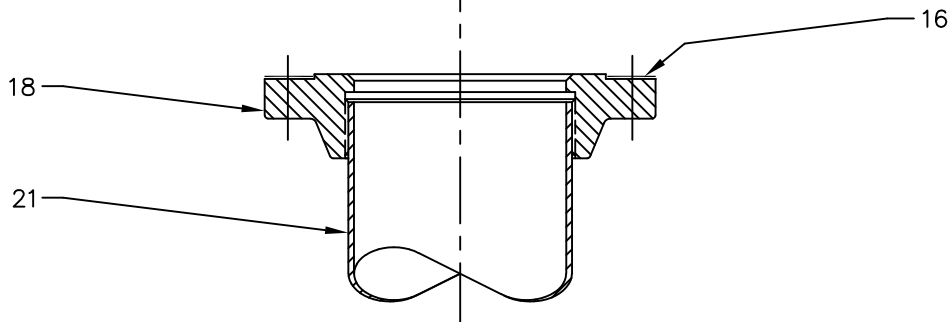
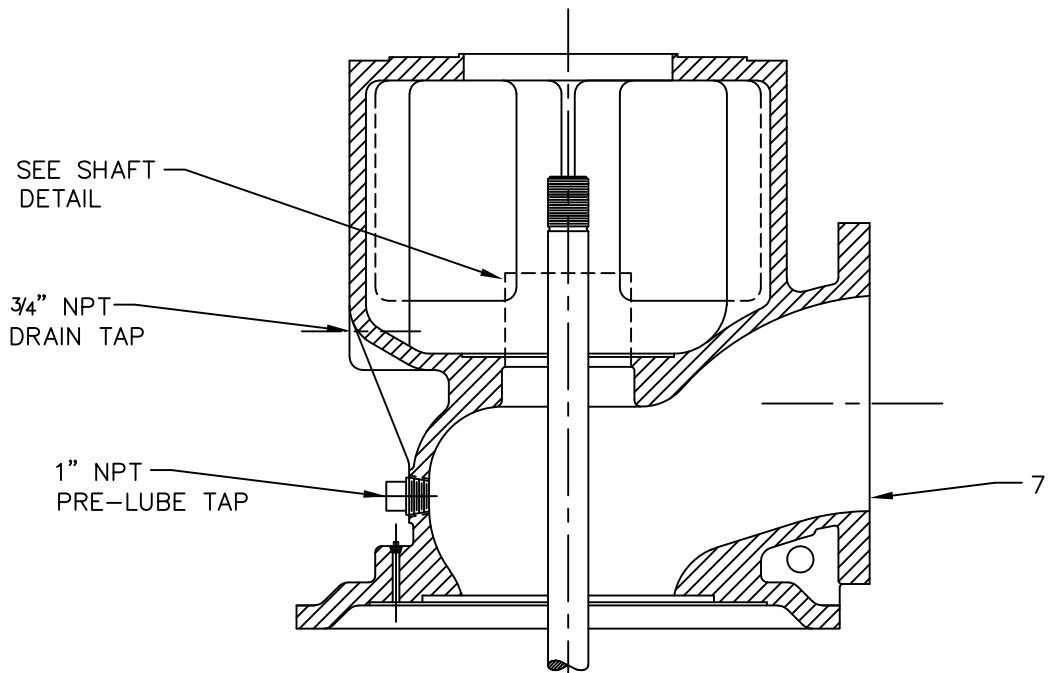
OPEN LINESHAFT
COLUMN SECTIONS



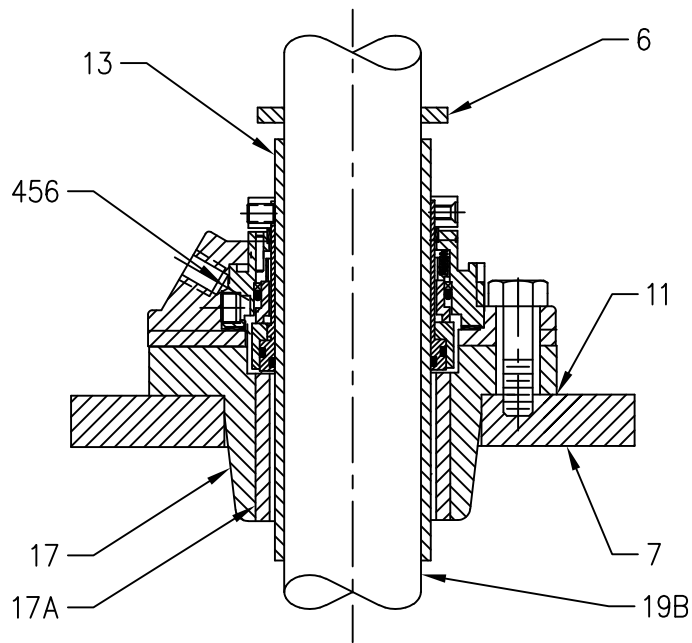
DWG NO 0913484AC REV NO 0



VERTICAL HOLLOW
SHAFT DRIVER



ASSEMBLY
TYPE "D" DISCHARGE HEAD



OUTSIDE CARTRIDGE
 MECHANICAL SEAL ASSEMBLY
 CRANE 5610

MECHANICAL SEALS
 WITH OPTIONAL SHAFT SLEEVE

Fairbanks Nijhuis
Technical Data⁴

Bowl Assembly

Bowl Size	12E
Pump Shaft Diameter.....	1.938
Bowl Weight, First Stage, Lbs.....	410
Bowl Weight, Each Additional Stage Lbs.....	145
Allowable Shaft Stretch.....	0.375
Maximum Working Pressure, Standard Material PSI	400
Maximum Hydro Pressure, Standard Material PSI.....	600
Impeller	
Impeller Eye Area In ²	25.5
Rotor Wt. Per Stage K _A , Lbs.....	31
Maximum Sphere Size	0.75
Thrust Factor K _T Lbs./Ft.	9.4
WK ² Lbs.-Ft ²	1.3
Running Position (Above Bowl Seat).....	0.125
Maximum Clearances	
Bowl Bearings.....	0.010
Wear Ring.....	0.023

Column

Nominal Size.....	8
Schedule	30
Outside Diameter.....	8.625
Wall Thickness.....	0.277
Weight Per Foot, Lbs./Ft.....	24.7
Flange OD	11.75
Flange Weight (Each) Lbs.	17.98

Line Shaft

Size	1-1/4
Weight Per Foot (Lbs./Ft.)	4.18
Shaft Coupling Weight (Lbs.).....	1.6
Shaft Sleeve Thickness	0.093

Sealing Box

Inside Diameter of Box.....	2-3/16
Depth of Box	1-5/8
Outside Diameter of Sleeve.....	1-7/16
Max Bearing Clearances	
Lineshaft	0.025
Sealing Box.....	0.020

Discharge Head

Size & Type.....	16-1/2 X 6
Type	D
Maximum Discharge Pressure, PSI	
250 Lb. Flange.....	400
Weight, Including Packing Box, Lbs.	487

⁴ Values shown are in inches unless otherwise noted.

Lateral Natural Frequency Analysis

Project Name: Marsh Road Water Pump Station
Sales Order Number: 53113215
Project Number: 0913484
Pump Model: 12E
Revision: 0

Prepared By: Billy Faltas
Engineer

Date Prepared: 7/29/2022

Lateral Natural Frequency Analysis

Ref: 0913484LC PG1

Revision: 0

Analysis Conclusion

All structural natural frequencies are outside of the required separation margin. There should be no excessive vibration due to structural resonance when the pump is operated within the specified operating region.

Summary of Results For Pump and Motor Assembly

The X direction natural frequency is outside of the required separation margin.

The Y direction natural frequency is outside of the required separation margin.

ω_{1x}	= 2709	RPM
ω_{1y}	= 2827	RPM
Min Speed	= 1080	RPM
Max Speed	= 1780	RPM
ω_{1x} Percentage of Min Speed	= 251%	
ω_{1x} Percentage of Max Speed	= 152%	
ω_{1y} Percentage of Min Speed	= 262%	
ω_{1y} Percentage of Max Speed	= 159%	

Required Margin = 20%

Summary of Results For Column Assembly

The natural frequency is outside of the required separation margin.

ω_1	= 796	RPM
Minimum Speed	= 1080	RPM
Maximum Speed	= 1780	RPM
ω_1 Percentage of Min Speed	= 74%	
ω_1 Percentage of Max Speed	= 45%	

Required Margin = 20%

Lateral Natural Frequency Analysis

Ref: 0913484LC PG2

Revision: 0

Summary of Analysis Method For Pump and Motor Assembly

Analysis is performed in accordance with ANSI/HI 9.6.8-2014. The above floor portion of the pump was analyzed as a cantilever beam to find its first, or lowest, natural frequency. The foundation was assumed to be rigid. The discharge pipe was assumed to add no support to the pump. The beam was given a non-constant stiffness along its length to model the changing geometry. To reflect the non-symmetry of the problem, two axes were analyzed with each axis having a different stiffness. The Y-axis is parallel to the discharge pipe centerline. The X-axis is perpendicular to the Y-axis. A numerical method was used to find the deflection, D , at the free end of the beam.

The first natural frequency is given by the equation, $\omega_1 = \frac{187.7}{\sqrt{D}}$, where ω is the natural frequency in RPM.

In order to model the motor's effect on the system, the motor's equivalent moment of inertia was calculated using the data supplied by the motor manufacturer and the equation for deflection of a cantilever beam with a constant moment of inertia.

$$I = \frac{FL^3}{3Ey} \quad in^4$$

Where I is the equivalent moment of inertia of the motor, F (lb) is the weight of the motor, L (in) is the height of the motor's center of gravity relative to its base, E (psi) is the modulus of elasticity of the pump material, and y (in) is the deflection of the motor at its center of gravity.

Summary of Results For Pump and Motor Assembly

The X direction natural frequency is outside of the required separation margin.

The Y direction natural frequency is outside of the required separation margin.

$\omega_{1x} = 2709$ RPM

$\omega_{1y} = 2827$ RPM

Min Speed = 1080 RPM

Max Speed = 1780 RPM

ω_{1x} Percentage of Min Speed = 251%

ω_{1x} Percentage of Max Speed = 152%

ω_{1y} Percentage of Min Speed = 262%

ω_{1y} Percentage of Max Speed = 159%

Required Margin = 20%

Lateral Natural Frequency Analysis

Ref: 0913484LC PG3

Revision: 0

Inputs For Pump and Motor Assembly

Pump

Type of Discharge Head = D
 Discharge Head Size = 16-1/2 x 6
 Variable Speed Application = Yes
 Discharge Head Height = 21.5 in
 Discharge Head Weight = 487 lbs
 Elastic Modulus = 15000000 psi

Motor

Motor Weight = 1110 lbs
 Motor Center of Gravity = 18 in
 Motor Deflection at Center of Gravity = 0.00348 in
 Motor Reed Critical Frequency = 54 Hz

Operating Conditions

Minimum Operating Speed = 1080 RPM
 Maximum Operating Speed = 1780 RPM
 Required Separation Margin = 20%

Calculations For Pump and Motor Assembly

Motor Moment of Inertia

$I = 41.34 \text{ in}^4$

$$I = \frac{FL^3}{3Ey} \text{ in}^4$$

Height

Discharge Head Height plus Motor CG = 39.5 in

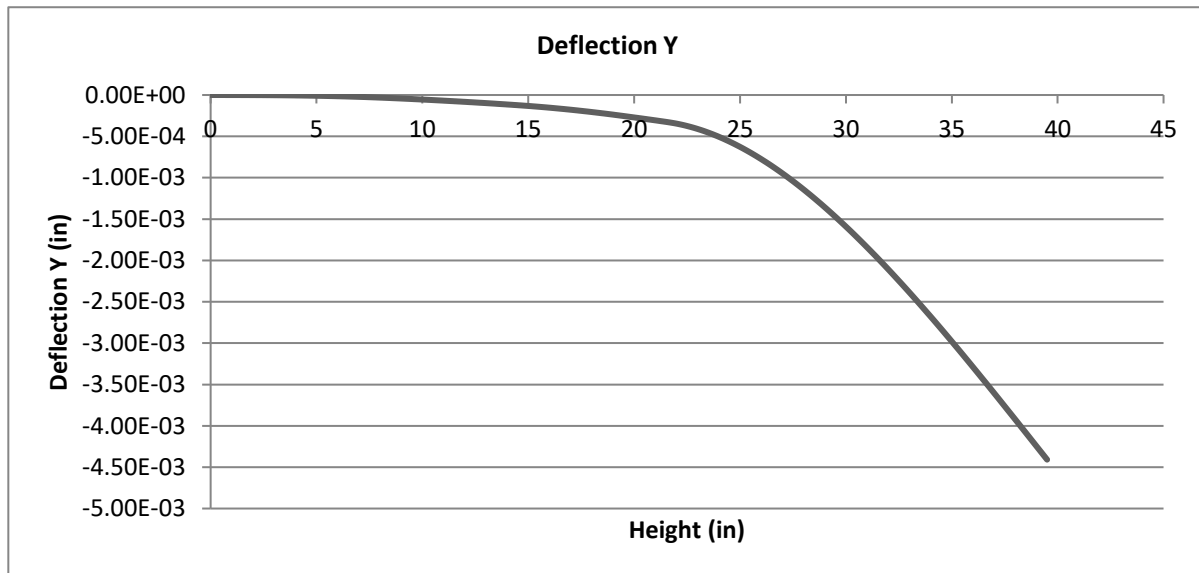
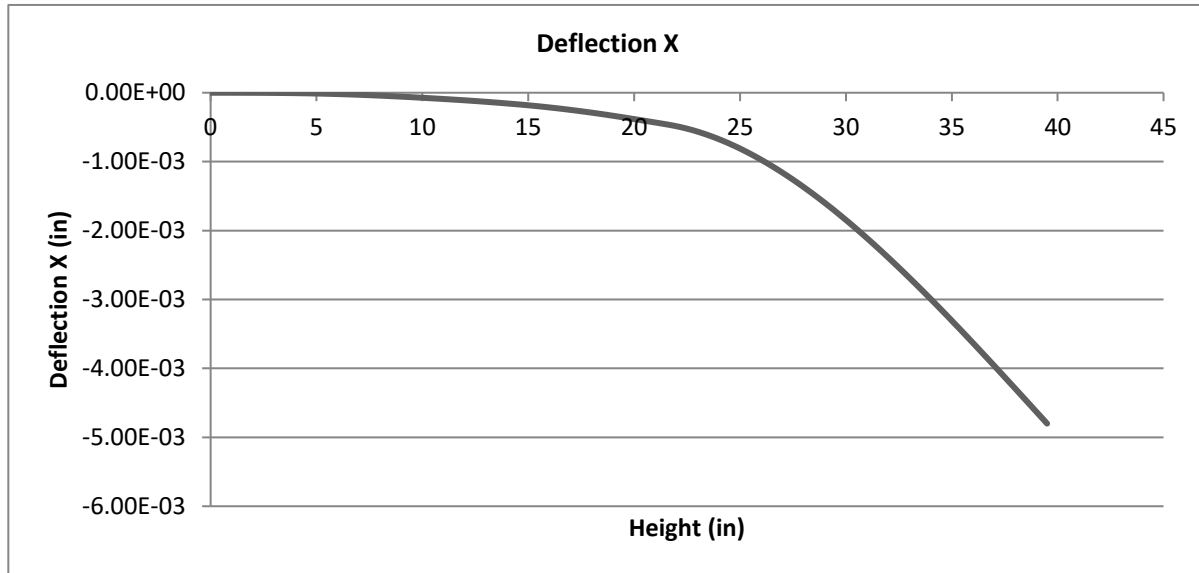
Lateral Natural Frequency Analysis

Ref: 0913484LC PG4

Revision: 0

Calculations Continued

A plot of the deflection of the pump and motor assembly obtained from the numerical results is shown below.



Deflection at 39.5in X

$$D_x = 0.0048 \text{ in}$$

Deflection at 39.5in Y

$$D_y = 0.00441 \text{ in}$$

Lateral Natural Frequency Analysis

Ref: 0913484LC PG5

Revision: 0

Calculations Continued

Natural Frequency

$$\omega_{1x} = 2709 \quad \text{RPM}$$

$$\omega_{1x} \text{ Percentage of Min Speed} = 251\%$$

$$\omega_{1x} \text{ Percentage of Max Speed} = 152\%$$

$$\omega_1 = \frac{187.7}{\sqrt{D}}$$

$$\omega_{1y} = 2827 \quad \text{RPM}$$

$$\omega_{1y} \text{ Percentage of Min Speed} = 262\%$$

$$\omega_{1y} \text{ Percentage of Max Speed} = 159\%$$

Required Margin = 20%

Lateral Natural Frequency Analysis

Ref: 0913484LC PG6

Revision: 0

Summary of Analysis Method For Column Assembly

Analysis is performed in accordance with ANSI/HI 9.6.8-2014. The below floor portion of the pump was analyzed as a cantilever beam to find its first, or lowest, natural frequency. The foundation was assumed to be rigid. The beam was given a non-constant stiffness along its length to model the changing geometry. A numerical method was used to find the deflection, D , at the free end of the beam.

The first natural frequency is given by the equation, $\omega_1 = \frac{187.7}{\sqrt{D}}$, where ω is the natural frequency.

Summary of Results For Column Assembly

The natural frequency is outside of the required separation margin.

$\omega_1 = 796$ RPM

Minimum Speed = 1080 RPM

Maximum Speed = 1780 RPM

ω_1 Percentage of Min Speed = 74%

ω_1 Percentage of Max Speed = 45%

Required Margin = 20%

Lateral Natural Frequency Analysis

Ref: 0913484LC PG7

Revision: 0

Inputs For Column Assembly

Pump

Pump Model = 12E
 Number of Stages = 6
 Pump Length = 92.00 in
 Bowl Assembly Length = 72.88 in
 Bowl Assembly Weight = 1135 lbs
 Bowl Assembly Elastic Modulus = 14500000 psi
 Column Size = 8 in
 Column Elastic Modulus = 30000000 psi

Operating Conditions

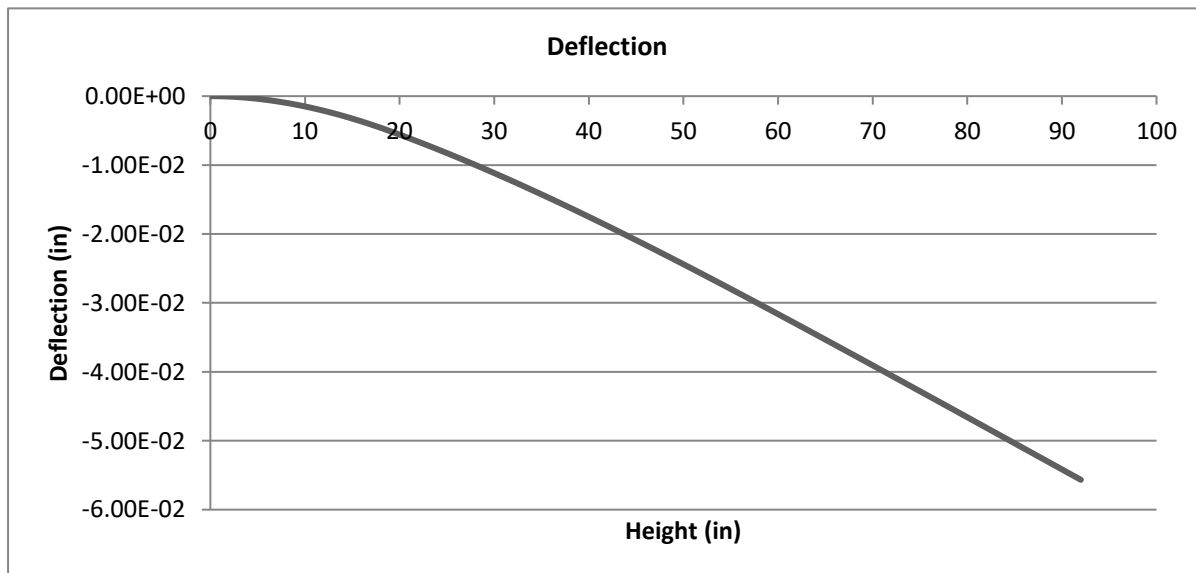
Minimum Speed = 1080 RPM
 Maximum Speed = 1780 RPM
 Required Margin = 20%

Calculations For Column Assembly

Column Length = 19.12 in
 Column Weight Per Foot = 24.70 lbs/ft
 Column Moment of Inertia = 63.35 in⁴

$$Inertia = \frac{\pi}{64} (OD^4 - ID^4)$$

A plot of the deflection of the pump obtained from the numerical results is shown below.



Deflection at 92in

D = 0.0557 in

Lateral Natural Frequency Analysis

Ref: 0913484LC PG8

Revision: 0

Calculations Continued

Natural Frequency

$$\omega_1 = 796$$

RPM

$$\omega_1 = \frac{187.7}{\sqrt{D}}$$

ω_1 Percentage of Min Speed = 74%

ω_1 Percentage of Max Speed = 45%

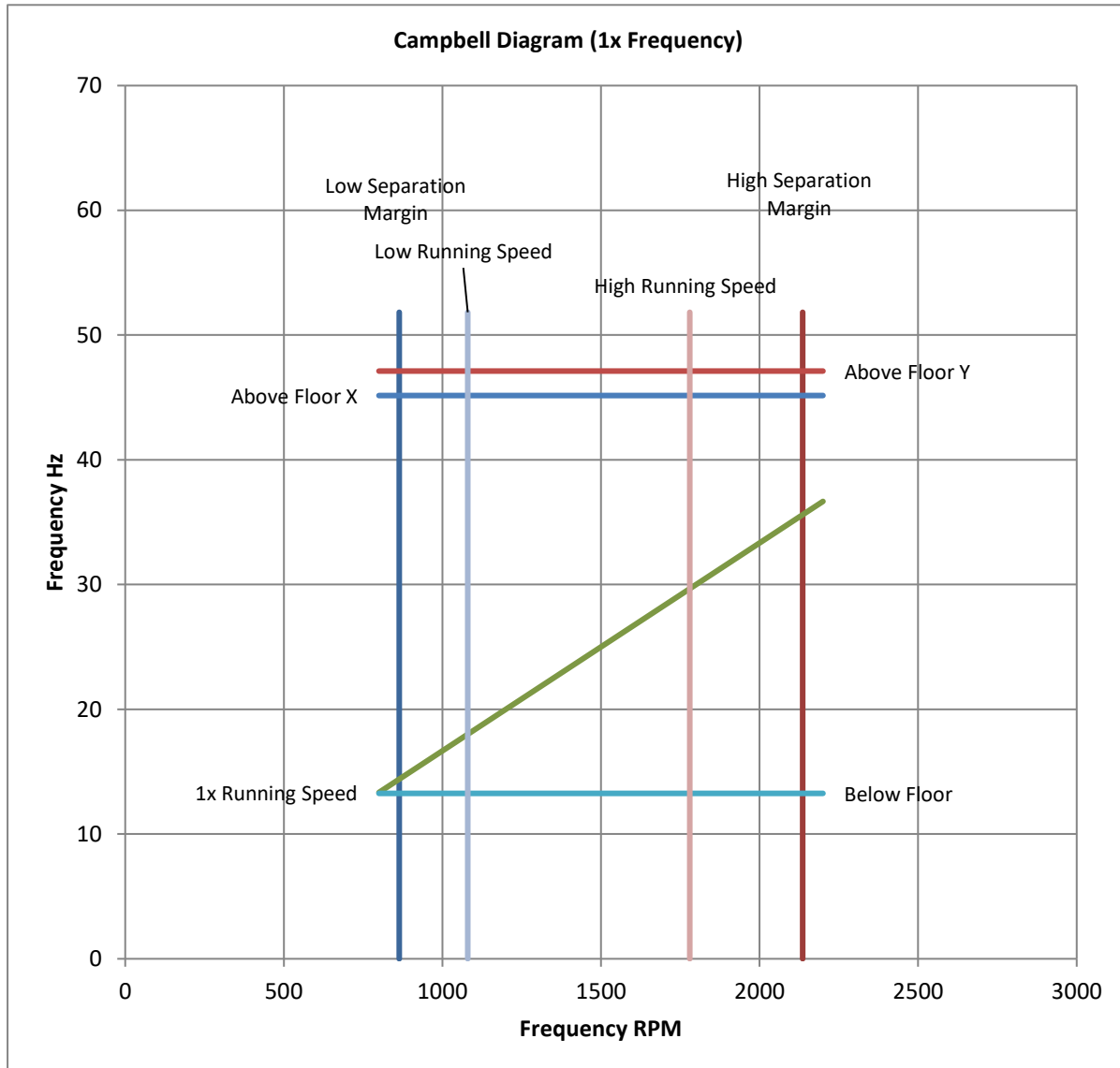
Required Margin = 20%

Lateral Natural Frequency Analysis

Ref: 0913484LC PG9

Revision: 0

A Campbell diagram provides a visual method to verify no resonance conditions will occur when operating a pump over its operating speed range. The diagram is constructed by plotting frequency in Hz versus frequency in RPM. Common excitation frequencies are shown as diagonal lines. The natural frequencies of the pump are shown as horizontal lines. A resonance condition is likely to occur when a horizontal line crosses a diagonal line within the operating speed range.



Rotor Torsional Natural Frequency Analysis

Project Name: Marsh Road Water Pump Station
Sales Order Number: 53113215
Project Number: 0913484
Pump Model: 12E
Revision: 0

Prepared By: Billy Faltas
Engineer

Date Prepared: 7/29/2022

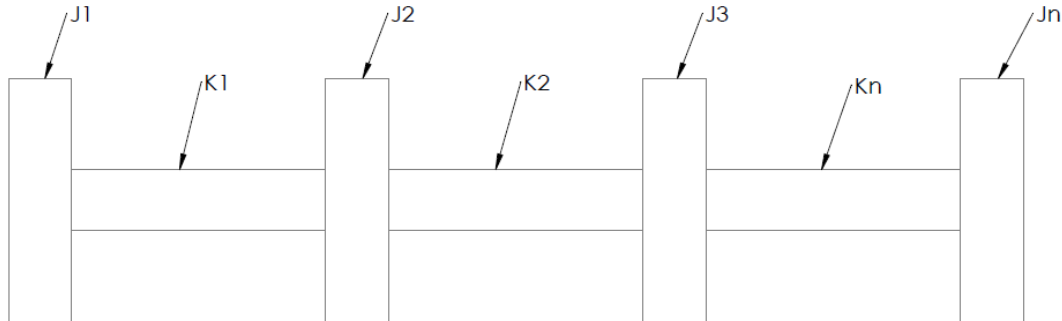
Rotor Torsional Natural Frequency Analysis

Ref: 0913484TC PG1

Revision: 0

Summary of Analysis Method

Analysis is performed in accordance with ANSI/HI 9.6.8-2014. The torsional natural frequencies were calculated using Holzer's method. A diagram of the system is shown below.



Where J_1 and J_2 are the masses of the motor and coupling, respectively. K_1 is the motor shaft stiffness and K_2 is the line shaft stiffness above the top most impeller. J_3 is mass of the top most impeller. K_n is the stiffness of the pump shaft between each impeller stage and J_n is the mass of each impeller below the top impeller.

Summary of Results

A torsional natural frequency in the separation margin was found. A steady state torsional stress analysis will be performed to verify safe operation of the pump rotor.

The torsional natural frequency associated with the highest amount of torque is shown below.

$\omega = 1207$ RPM Required Margin = 20%

Min Speed = 1080 RPM Min Vane Pass = 37800 RPM

Max Speed = 1780 RPM Max Vane Pass = 62300 RPM

ω Percentage of Min Speed = 112%

ω Percentage of Min Vane Pass = 3%

ω Percentage of Max Speed = 68%

ω Percentage of Max Vane Pass = 2%

Although there is a torsional natural frequency in the operating range, the torsional stress analysis showed that there will be no adverse affect on the life of the pump.

Shaft Stress = 4145 psi

Allowable Stress = 8125 psi

Factor of Safety = 1.96

Rotor Torsional Natural Frequency Analysis

Ref: 0913484TC PG2

Revision: 0

Inputs

Rotor Inertias

WR ² ₁ = 17.00	lb-ft ²
WR ² ₂ = 0.00	lb-ft ²
WR ² ₃ = 1.30	lb-ft ²
WR ² _n = 1.30	lb-ft ²

Shafting

K ₁ = 6.65E+04	in-lb/rad
K ₂ = 6.49E+04	in-lb/rad
Kn = 1.59E+06	in-lb/rad

Pump

Model = 12E
Number of Stages = 6
Number of Impeller Vanes = 5
Number of Bowl Vanes = 7

Operating Conditions

Minimum Speed = 1080	RPM
Maximum Speed = 1780	RPM
Separation Margin = 20%	

Calculations

Rotor Masses

J ₁ = 6.34	in-lb-sec ⁴
J ₂ = 0.00	in-lb-sec ⁴
J ₃ = 0.48	in-lb-sec ⁴
J _n = 0.48	in-lb-sec ²

$$J = \frac{144 \frac{\text{in}^2}{\text{ft}^2}}{386.4 \frac{\text{in}}{\text{sec}^2}}$$

Vane Pass

Min Vane Pass = 37800	RPM
Max Vane Pass = 62300	RPM

Torsional Natural Frequencies

The lowest torsional natural frequencies calculated are reported below.

ω ₁ = 1207	RPM
ω ₂ = 9064	RPM
ω ₃ = 17348	RPM
ω ₄ = 24492	RPM
ω ₅ = 29981	RPM
ω ₆ = 33432	RPM
ω ₇ = 91003	RPM

Rotor Torsional Natural Frequency Analysis

Ref: 0913484TC PG3

Revision: 0

Calculations Continued

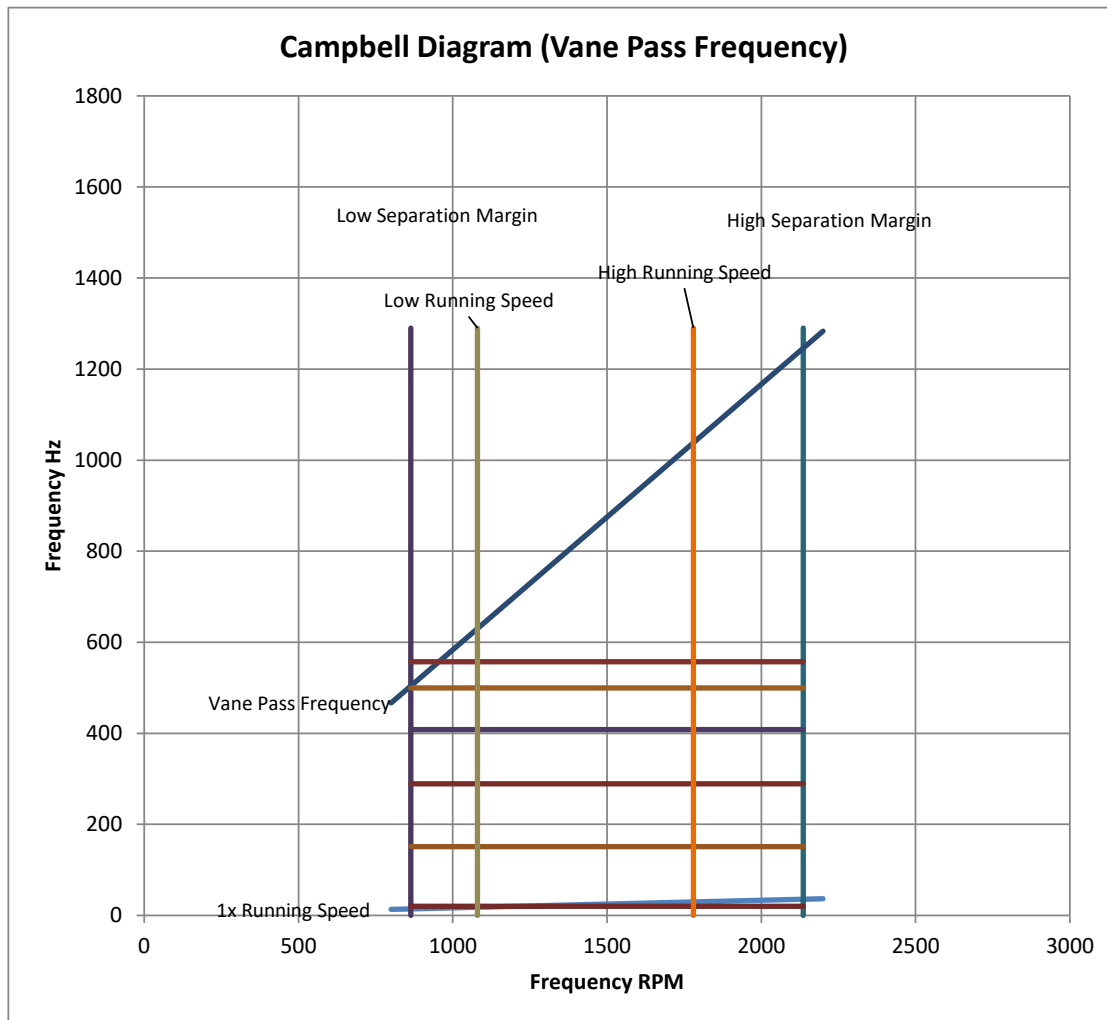
ω_1 % of Min Speed =	112%
ω_1 % of Max Speed =	68%
ω_1 % of Min Vane Pass =	3%
ω_1 % of Max Vane Pass =	2%
ω_2 % of Min Speed =	839%
ω_2 % of Max Speed =	509%
ω_2 % of Min Vane Pass =	24%
ω_2 % of Max Vane Pass =	15%
ω_3 % of Min Speed =	1606%
ω_3 % of Max Speed =	975%
ω_3 % of Min Vane Pass =	46%
ω_3 % of Max Vane Pass =	28%
ω_4 % of Min Speed =	2268%
ω_4 % of Max Speed =	1376%
ω_4 % of Min Vane Pass =	65%
ω_4 % of Max Vane Pass =	39%
ω_5 % of Min Speed =	2776%
ω_5 % of Max Speed =	1684%
ω_5 % of Min Vane Pass =	79%
ω_5 % of Max Vane Pass =	48%
ω_6 % of Min Speed =	3096%
ω_6 % of Max Speed =	1878%
ω_6 % of Min Vane Pass =	88%
ω_6 % of Max Vane Pass =	54%
ω_7 % of Min Speed =	8426%
ω_7 % of Max Speed =	5113%
ω_7 % of Min Vane Pass =	241%
ω_7 % of Max Vane Pass =	146%

Rotor Torsional Natural Frequency Analysis

Ref: 0913484TC PG4

Revision: 0

A Campbell diagram provides a visual method to verify no resonance conditions will occur when operating a pump over its operating speed range. The diagram is constructed by plotting frequency in Hz versus frequency in RPM. Common excitation frequencies are shown as diagonal lines. The torsional natural frequencies of the pump are shown as horizontal lines. A resonance condition is likely to occur when a horizontal line crosses a diagonal line within the operating speed range. For clarity two different Hz frequency scales are shown below.



Rotor Torsional Natural Frequency Analysis

Ref: 0913484TC PG5

Revision: 0

In order to verify that the torsional natural frequency will have no adverse effects on the life of the pump a torsional stress analysis of the shafting was performed.

Inputs

Natural Frequency = 1207	RPM
Running Speed = 1207	RPM
Motor HP = 100	HP
Motor Speed = 1800	RPM
Shaft Minimum Diameter = 1.25	in
Shaft Ultimate Tensile Strength = 100000	psi
Fatigue Stress Failure Criteria	ASME Section III
Torque Amplification Factor = 1	%

Calculations

Torque = 1589.614	in-lb	$Torque(in - lb) = \frac{63000HP}{RPM} \cdot (1 + TAF)$
-------------------	-------	---

Polar Moment of Inertia = 0.24	in ⁴	$Polar\ Moment\ of\ Inertia = \frac{\pi Shaft\ Diameter^4}{32}$
--------------------------------	-----------------	---

Shaft Stress = 4145	psi	$Stress = \frac{Torque \cdot Shaft\ Radius}{Polar\ Moment\ of\ Inertia}$
---------------------	-----	--

Allowable Stress = 8125	psi
-------------------------	-----

Factor of Safety = 1.96	$Factor\ of\ Safety = \frac{Allowable\ Stress}{Shaft\ Stress}$
-------------------------	--

Conclusion

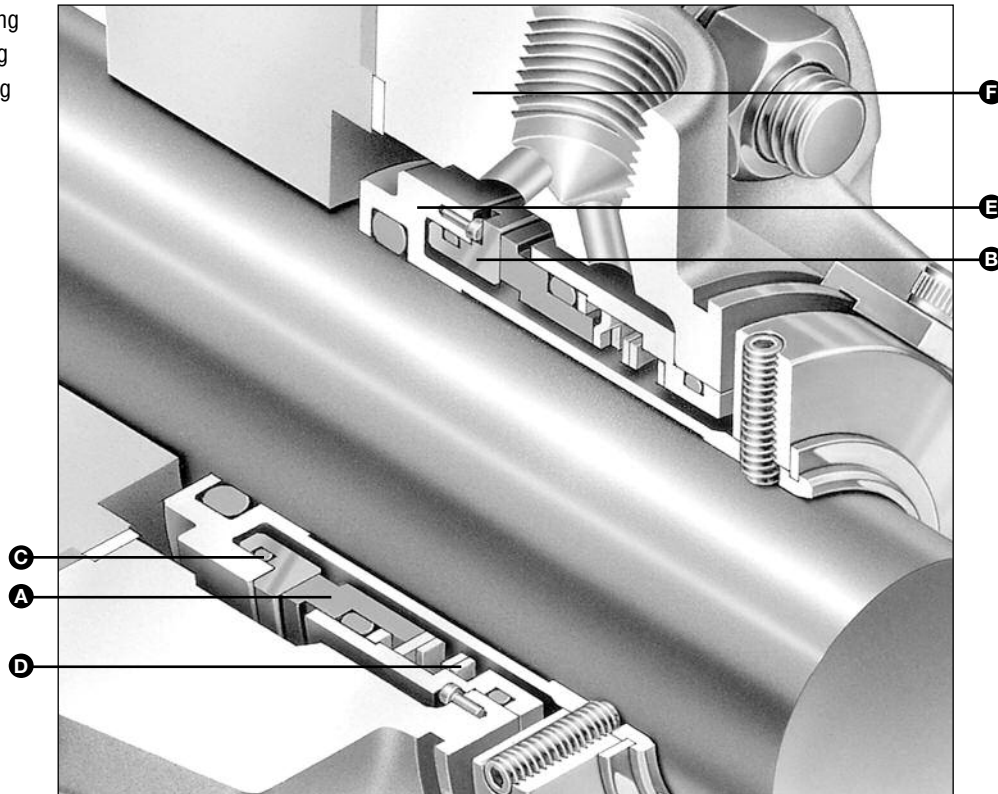
Although there is a torsional natural frequency in the operating range, the torsional stress analysis showed that there will be no adverse affect on the life of the pump.

TYPE 5610/5610Q

SINGLE O-RING SEALS

Technical Specification

- A – Face/Primary Ring
- B – Seat/Mating Ring
- C – Secondary O-ring
- D – Nonclogging Wave Spring
- E – Sleeve
- F – Gland



Product Description

The 5600 Series is a modular cartridge seal family that includes interchangeable elastomer bellows, metal bellows, and elastomer O-ring pusher seal designs.

- Type 5610 and 5610Q single seal arrangements incorporate an elastomer O-ring as the secondary sealing member
- A common seal head/mating ring set, utilized throughout all versions, is reversible to allow rotating seat/mating ring or rotating seal head operation, and is interchangeable with metal bellows seal heads
- Seal has an optional quench gland (5610Q) with carbon ring throttle bushing

Performance Capabilities

- Temperature: -20°F to 400°F/-30°C to 205°C
- Pressure: up to 3.000"/75mm: 300 psi(g)/21 bar(g) max.
75mm/3.000" and over: 200 psi(g)/13 bar(g) max.
- Speed: up to 5000 fpm/25 m/s
- End play/axial float allowance: 0.005"/0.13mm
- Runout/out of squareness: 0.002"/0.05mm

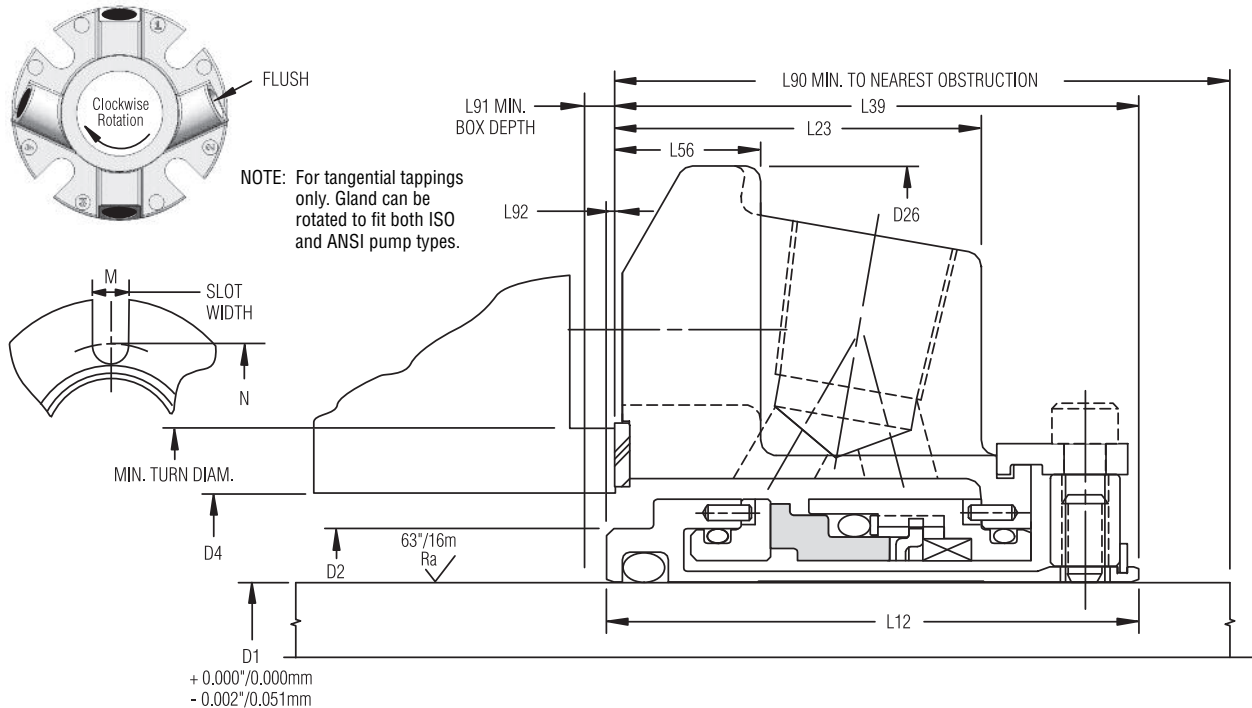
Design Features

- Reversible seal head
- Fits ANSI B73.1M, ISO 3069 and DIN 24960 seal chambers
- Optimized primary ring design for greater reliability
- Nonclogging wave spring outside the product

TYPE 5610/5610Q

SINGLE O-RING SEALS

Type 5610 Typical Arrangement



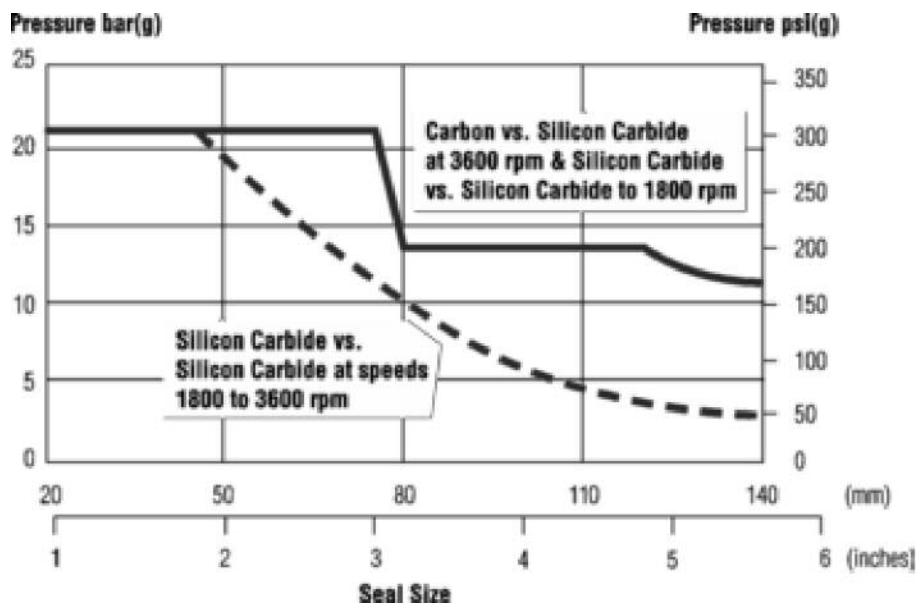
Type 5610 Dimensional Data (inches)

Seal Size/D1 (inches)	D4		D26	L12	L23	L39	L56	L90	L91	L92	M	N	
	D2	Min.											Max.
1.000	1.375	1.445	1.889	4.000	1.989	1.353	1.954	0.531	2.000	0.160	0.035	0.525	2.805
1.125	1.500	*	2.015	4.125	2.062	1.446	2.062	0.531	2.125	0.125	*	0.525	2.933
1.250	1.625	*	2.294	4.250	2.062	1.446	2.062	0.531	2.125	0.125	*	0.525	3.213
1.375	1.750	*	2.421	4.375	2.062	1.446	2.062	0.531	2.125	0.125	*	0.525	3.338
1.500	1.937	2.007	2.680	4.875	2.156	1.487	2.125	0.593	2.187	0.156	0.031	0.525	3.599
1.625	2.062	2.132	2.812	5.000	2.156	1.487	2.125	0.593	2.187	0.156	0.031	0.562	3.766
1.750	2.170	2.240	2.918	5.250	2.156	1.487	2.125	0.593	2.187	0.156	0.031	0.562	3.875
1.875	2.312	2.382	2.918	5.250	2.156	1.487	2.125	0.593	2.187	0.156	0.031	0.562	3.875
2.000	2.437	2.507	3.015	5.500	2.375	1.601	2.312	1.063	2.375	0.187	0.062	0.562	4.000
2.125	2.562	2.632	3.360	5.859	2.375	1.601	2.312	0.593	2.375	0.187	0.062	0.687	4.469
2.250	2.687	2.757	3.485	6.500	2.375	1.601	2.312	0.593	2.375	0.187	0.062	0.687	4.566
2.375	2.812	2.882	3.610	6.500	2.484	1.717	2.466	0.625	2.528	0.143	0.018	0.687	4.719
2.500	3.062	*	3.891	6.750	2.484	1.717	2.562	0.625	2.625	0.125	*	0.687	5.000
2.625	3.312	*	4.062	6.750	2.500	1.625	2.500	0.625	2.562	0.125	*	0.687	5.170
2.750	3.312	*	4.062	6.750	2.500	1.625	2.500	0.625	2.562	0.125	*	0.687	5.170
2.875	3.375	*	4.186	7.000	2.500	1.725	2.500	0.625	2.562	0.125	*	0.687	5.312
3.000	3.625	*	4.469	7.750	2.500	1.787	2.562	0.685	2.625	0.125	*	0.812	5.720
3.125	3.750	3.853	4.600	7.875	2.562	1.593	2.562	**	2.687	0.125	*	0.812	5.845
3.250	3.750	3.853	4.600	7.437	2.562	1.593	2.510	**	2.635	0.177	0.052	0.812	5.845
3.375	4.000	4.125	4.850	8.125	2.562	1.593	2.562	**	2.687	0.125	*	0.812	6.095
3.500	4.125	4.250	4.975	8.250	2.562	1.593	2.562	**	2.687	0.125	*	0.812	6.220
3.625	4.218	4.343	5.100	8.375	2.562	1.593	2.562	**	2.687	0.125	*	0.687	6.250
3.750	4.343	4.468	5.199	8.750	2.562	1.593	2.562	**	2.687	0.125	*	0.687	6.770
3.875	4.468	4.593	5.375	8.750	2.562	1.593	2.562	**	2.687	0.125	*	0.812	6.636
4.000	4.593	4.718	5.500	9.000	2.562	1.593	2.562	**	2.687	0.125	*	0.812	6.761
4.125	4.718	4.843	5.625	9.000	2.562	1.593	2.562	**	2.687	0.125	*	0.812	6.886
4.250	4.843	4.968	5.750	9.250	2.562	1.593	2.562	**	2.687	0.125	*	0.812	7.011
4.500	5.093	5.218	6.000	9.500	2.562	1.593	2.562	**	2.687	0.125	*	0.812	7.261
4.750	5.343	5.468	6.313	10.375	2.562	1.593	2.562	**	2.687	0.125	*	0.812	7.574
5.000	5.843	5.968	7.260	12.000	2.953	1.749	3.043	**	3.168	0.125	*	0.812	10.000
5.250	6.093	6.218	7.510	12.250	2.953	1.749	3.043	**	3.168	0.125	*	0.812	10.250
5.500	6.343	6.468	8.000	12.687	2.953	1.749	3.043	**	3.168	0.125	*	0.937	10.500

*Not applicable. Completely outside mounted.

**L56 not applicable. Refer to L23 for sizes over 3".

Basic Pressure Rating



The basic pressure rating is for a standard seal, as shown in the typical arrangement, when installed according to the criteria given in this data sheet and generally accepted industrial practices.

The basic pressure rating assumes stable operation at the speeds indicated on the above chart in a clean, cool, lubricating, nonvolatile liquid with an adequate flush rate. When used with the multiplier factors, the basic pressure rating can be adjusted to provide a conservative estimate of the dynamic pressure rating. For process services outside this range or a more accurate assessment of the dynamic pressure rating, contact John Crane for more information.

Multiplier Factors

	Selection Considerations	Multiplier Factor
Sealed Fluid Lubricity <small>(applies to Silicon Carbide vs. Silicon Carbide only)</small>	Petrol/Gasoline, Kerosene, or Better Water and Aqueous Solutions (<176°F/80°C)	x 1.00
	Flashing Hydrocarbons*	x 0.75
		x 0.60
Sealed Fluid Temperature <small>(applies to Carbon vs. Silicon Carbide)</small>	Up to 175°F/80°C	x 1.00
	From 175°F to 250°F/80°C to 120°C	x 0.90
	From 250°F to 355°F/120°C to 180°C	x 0.80
	Above 350°F/180°C	x 0.65

*The ratio of sealed pressure to vapor pressure must be greater than 1.5, otherwise consult John Crane. If the specific gravity is less than 0.60, consult John Crane.

Example for Determining Pressure Rating Limits:

Seal: 2"/50.8mm diameter Type 5610

Product: aqueous solution

Face materials: silicon carbide vs. silicon carbide

Operating temperature: 175°F/80°C

Operating speed: 2950 rpm

Using the pressure rating limits graph, the maximum pressure would be 268 psi(g)/18.5 bar(g).

From the multiplier factors chart, apply the multipliers for the specific service requirements to determine the maximum operating pressure for the application:

$$268 \text{ psi(g)/18.5 bar(g)} \times 0.75 \times 1 = 201 \text{ psi(g)/13.9 bar(g)}$$

The maximum operating pressure for this 2"/50.8mm Type 5610 is 201 psi(g)/13.9 bar(g).

Materials of Construction

SEAL COMPONENTS	MATERIALS	
	Description	Standard
Face/Primary Ring	Resin-Impregnated Carbon	Sintered Silicon Carbide Nickel Binder Tungsten Carbide
Seat/Mating Ring	Sintered Silicon Carbide	Nickel Binder Tungsten Carbide
Sleeve Gland Plate Collar Retainer Drive Ring Anti-Extrusion Ring	316 Stainless Steel	Alloy 20CB3 SS (UNS N8020) Alloy C-276 (UNS N10276) Titanium
O-ring	Fluoroelastomer Ethylene Propylene	Perfluoroelastomer Buna-N Neoprene
Gland Gasket	Glass-Filled PTFE	—
Spring	Alloy C-276 (UNS N10276)	—
Quench Bushing (5610Q)	Resin-Impregnated Carbon	—

Application Criteria

The Type 5610 and 5610Q cartridge seals may be customized for specific installations after review and evaluation by John Crane. The following data is needed to evaluate the proposed service:

- Make and model of equipment
- Shaft or sleeve OD
- Seal cavity dimensions
- Speed
- Quench fluid (if applicable)
- Process fluid
 - Specific gravity
 - Box pressure
 - Vapor pressure
 - Temperature
 - Viscosity



North America	Europe	Latin America	Middle East & Africa	Asia Pacific
United States of America	United Kingdom	Brazil	United Arab Emirates	Singapore
Tel: 1-847-967-2400	Tel: 44-1753-224000	Tel: 55-11-3371-2500	Tel: 971-481-27800	Tel: 65-6518-1800
Fax: 1-847-967-3915	Fax: 44-1753-224224	Fax: 55-11-3371-2599	Fax: 971-488-62830	Fax: 65-6518-1803

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. It is dangerous to smoke while handling products made from PTFE. Old and new PTFE products must not be incinerated. ISO 9001 and ISO14001 Certified, details available on request.

Fairbanks Nijhuis
Paint Specifications

Above Ground Coating

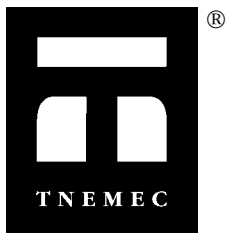
- **Coating Manufacturer** Davis Industrial Coatings & Tnemec
- **Surface Preparation** SSPC-SP6, Commercial Blast Cleaning.
- **Prime Coat** Series 20
Number of Coats One
Dry Film Thickness 3 to 5 mils
Color 15BL Tank White
Surfaces to be coated Exterior of Discharge Head
Exposed portions of the Packing Box
- **Finish Coat** Modified Alkyd Enamel
Number of Coats One
Dry Film Thickness 3 to 5 mils
Color Pentair Blue
Surfaces to be coated Exterior of Discharge Head
Exposed portions of the Packing Box

Below Ground Coating

- **Coating Manufacturer** Tnemec
- **Surface Preparation** SSPC-SP6, Commercial Blast Cleaning
- **Prime Coat** Series N140 Pota-Pox
Number of Coats One
Dry Film Thickness 4 to 6 mils
Color 35GR – Black
Surfaces to be coated Interior & Exterior of Bowl Assembly
Interior & Exterior of Column
Interior of Discharge Head
Exposed portions of the Packing Box
- **Finish Coat** Series N140 Pota-Pox
Number of Coats One
Dry Film Thickness 4 to 6 mils
Color 35GR – Black
Surfaces to be coated Interior & Exterior of Bowl Assembly
Interior & Exterior of Column
Interior of Discharge Head
Exposed portions of the Packing Box

Suction Can Coating


- **Coating Manufacturer** Tnemec
- **Surface Preparation** SSPC-SP6, Commercial Blast Cleaning
- **Prime Coat** Series N140 Pota-Pox
Number of Coats Two
Dry Film Thickness 8 to 12 mils
Color 35GR – Black
Surfaces to be coated Interior & Exterior of Suction Can



PRODUCT PROFILE

GENERIC DESCRIPTION	Polyamide Epoxy
COMMON USAGE	Industry standard for potable water epoxy coatings for nearly 30 years. Known for its forgiving application characteristics in adverse and varied conditions, and for its benchmark performance.
COLORS	1211 Red, 1255 Beige, AA90 White, 15BL Tank White, 39BL Delft Blue. 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.
SPECIAL QUALIFICATIONS	Certified by NSF International in accordance with ANSI/NSF Std. 61 . Ambient air cured Series 20 is qualified for use on the interior of potable water storage tanks and reservoirs of 1,000 gallons (3785 L) capacity or greater. Force-cured Series 20 is qualified for tanks of 100 gallons (378 L) or greater. Conforms to AWWA D 102 Inside Systems No. 1 and No. 2 . Contact your Tnemec representative for approved systems and additional information on potential uses.
PERFORMANCE CRITERIA	Extensive test data available. Contact your Tnemec representative for specific test results.

COATING SYSTEM

PRIMERS	Self-priming, FC20, 91-H ₂ O. Note: 91-H ₂ O is ANSI/NSF Std. 61 certified by  as a primer for Series 20. Refer to the 91-H ₂ O product data sheet for additional information.
TOPCOATS	Interior: Series 20, FC20, N140, N140F, 264, 265 Exterior: Series 20, FC20, 66, N69, 73, N140, 161, 175, 700, 1074, 1075. Note: When topcoating with Series 700, an intermediate coat of Series 73 or 1075 is required. Refer to COLORS on applicable topcoat data sheets for additional information.

SURFACE PREPARATION

STEEL	Immersion Service: SSPC-SP10 Near-White Blast Cleaning Non-Immersion Service: SSPC-SP6 Commercial Blast Cleaning
PRIMED SURFACES	Immersion Service: Scarify the Series 20 or FC20 prime coat by brush-blasting with fine abrasive before topcoating if it has been exterior exposed for 60 days or longer.
CAST/DUCTILE IRON	Contact your Tnemec representative or Tnemec Technical Services.
CONCRETE	Allow new concrete to cure for 28 days. Abrasive blast referencing SSPC-SP13/NACE 6 Surface Preparation of Concrete and Tnemec's Surface Preparation and Application Guide. Holes, pits, voids and cracks should be filled with 63-1500 Filler and Surfer.
ALL SURFACES	Must be clean, dry and free of oil, grease, chalk and other contaminants.

TECHNICAL DATA

VOLUME SOLIDS*	56.0 ± 2.0% (mixed)		
RECOMMENDED DFT	Primer: 3.0 to 5.0 mils (75 to 125 microns) per coat. Intermediate, Topcoat: 4.0 to 6.0 mils (100 to 150 microns) per coat. Note: Number of coats and thickness requirements will vary with substrate, application method and exposure. Contact your Tnemec representative.		
CURING TIME	Temperature	To Handle	To Recoat
	75°F (24°C)	10 hours	12 hours
			Immersion
			7 days
	Curing time varies with surface temperature, air movement, humidity and film thickness.		
	Force Cure (Temperatures shown are for substrate.)		
	1st Coat	24 hours at 75°F (24°C)	
	2nd Coat	Flash 2 to 4 hours at 75°F (24°C), followed with 24 hours at 150°F (66°C), plus 24 hours at 75°F (24°C)	
VOLATILE ORGANIC COMPOUNDS*	Unthinned	Thinned 10%	
	3.06 lbs/gallon (366 grams/litre)	3.41 lbs/gallon (408 grams/litre)	
THEORETICAL COVERAGE*	898 mil sq ft/gal (22.0 m ² /L at 25 microns). See APPLICATION for coverage rates.		
NUMBER OF COMPONENTS	Two: Part A and Part B		
PACKAGING	5 gallon (18.9L) pails and 1 gallon (3.79L) cans — Order in multiples of 2.		
NET WEIGHT PER GALLON*	12.50 ± 0.25 lbs (5.7 ± .11 kg) (mixed)		

Published technical data and instructions are subject to change without notice. The online catalog at www.tnemec.com should be referenced for the most current technical data and instructions or you may contact your Tnemec representative for current technical data and instructions.
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TECHNICAL DATA *continued*

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 at recommended storage temperature. Part B: 12 months at recommended storage temperature.	
FLASH POINT - SETA	Part A: 82°F (28°C)	Part B: 64°F (18°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*

	Primer			Intermediate / Topcoat		
	Dry Mills (Microns)	Wet Mills (Microns)	Sq Ft/Gal (m ² /Gal)	Dry Mills (Microns)	Wet Mills (Microns)	Sq Ft/Gal (m ² /Gal)
Suggested (1)	4.0 (100)	7.0 (180)	225 (20.9)	5.0 (125)	9.0 (230)	180 (16.7)
Minimum	3.0 (75)	5.5 (140)	299 (27.8)	4.0 (100)	7.0 (180)	225 (20.9)
Maximum	5.0 (125)	9.0 (230)	180 (16.7)	6.0 (150)	10.5 (265)	150 (13.9)

(1) Note: Roller or brush application requires two or more coats to obtain recommended film thickness. 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 Power mix contents of each container, making sure no pigment remains on the bottom. Pour a measured amount of Part B into a clean container large enough to hold both components. Add an equal volume of Part A to Part B while under agitation. Continue agitation until the two components are thoroughly mixed. Do not use mixed material beyond pot life limits. **Note:** Both components must be above 50°F (10°C) prior to mixing. For application to surfaces between 50°F to 60°F (10°C to 16°C), allow mixed material to stand thirty (30) minutes and restir before using. For optimum application properties, blended components should be above 60°F (16°C). Mixing ratio is one (Part A) to one (Part B) by volume.

POT LIFE THINNING 20 hours at 50°F (10°C) 10 hours at 77°F (25°C) 4 hours at 100°F (38°C)
Use No. 4 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. **Caution:** Series 20 NSF certification is based on thinning with No. 4 Thinner. Use of any other thinner voids ANSI/NSF Std. 61 certification.

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 won't cure below minimum surface temperature.

APPLICATION EQUIPMENT

Air Spray

Gun	Fluid Tip	Air Cap	Air Hose ID	Mat'l Hose ID	Atomizing Pressure	Pot Pressure
DeVilbiss MBC or JGA	E	765 or 78	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)	1800-3000 psi (124-207 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.

Plural Component Spray: Contact your Tnemec representative or Tnemec Technical Services.

Roller: Roller application optional when environmental restrictions do not allow spraying. Use 3/8" or 1/2" (9.5 mm or 12.7 mm) synthetic nap covers.

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

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. FOR INDUSTRIAL USE ONLY.



Davis Paint Company

1311 IRON STREET • N. KANSAS CITY, MISSOURI 64116
P.O. BOX 7589 • (816) 471-4447
www.davispaint.com

HIGH SOLIDS FAST DRY ENAMEL PENTAIR BLUE 4-5725

PHYSICAL PROPERTIES:

Weight Gallon:	9.88 ± 0.2 lbs/gal
Weight Solids:	64.7 ± 2%
Volume Solids:	48.4 ± 2%
Coverage: @ 1 Dry Mil:	776 sq. ft./gallon
VOC:	418 g/l; 3.49 lb/gal
Viscosity:	35-45" #4 Ford Cup @ 77°F
Gloss @ 60°:	85+
Cure Time (Based on 70° F. & 50% R.H.):	
To Touch:	60 minutes
To Recoat:	0-1 hours, or after 96 hours
Recommended Thinner:	Butyl acetate for cleanup and reduction to spray
Temperature Resistance:	Continuous 150° F., Intermittent 200° F.

WARNING! FLAMMABLE! FOR INDUSTRIAL USE ONLY! Keep away from heat and open flame. Avoid prolonged contact with skin and breathing of vapor or spray mist. Do not take internally. Close container after each use. Use only with adequate ventilation. Use respiratory devices and other personal protective equipment required by OSHA 29CFR 1910. KEEP OUT OF REACH OF CHILDREN. For specific safety requirements, refer to the Material Safety Data Sheet.

LIMITATION OF LIABILITY: To the best of our knowledge, the technical data contained herein is true and accurate at the date of issuance, but is subject to change without prior notice. We make no guarantee of any kind, express or implied, including merchantability and fitness for particular purposes. Liability, if any, is limited to replacement of the product or refund of the purchase price. Labor, or cost of labor, and other consequential damages are hereby excluded.

02-15



Davis Paint Company

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www.davispaint.com

HIGH SOLIDS FAST DRY ENAMEL

DESCRIPTION:

High Solids Fast Dry Enamel is an alkyd enamel for general industrial finishing of farm machinery, tanks, electrical equipment, heavy duty equipment and a variety of other products that require a high performance coating. Fast Dry Enamel exhibits excellent color and gloss retention, flexibility, hardness and corrosion resistance.

SPECIAL CAUTIONS:

Do not apply Fast Dry Enamel when surface, air or material temperature is below 40°F. Surface must be dry and at least 5°F above the dew point.

SURFACE PREPARATION:

GENERAL - Surfaces to be finished must be clean, dry and free of dirt, oil or any contamination that would adversely affect adhesion, protective properties or appearance of the coating. Abrasive blasting is an effective method of cleaning steel surfaces and removing mill scale, rust and previous coatings.

IRON, STEEL AND FERROUS METAL - For optimum adhesion and corrosion resistance, metal should be cleaned and phosphate treated or primed with Davis Fast Dry Metal Primer.

ALUMINUM & GALVANIZED METAL - For optimum adhesion chemically etch or prime with Vinyl Wash Primer.

PREVIOUSLY FINISHED SURFACES - Scaling and peeling paint must be removed by wirebrushing, sanding or scraping. Rusting metal should be cleaned and spot primed with Fast Dry Primer.

MIXING & THINNING:

Stir each container thoroughly prior to use. Material is packaged at a viscosity requiring little or no reduction for application by airless spray equipment. Conventional air spray, air-assist airless, dip or turbo may require up to a 25% reduction (4 parts paint to 1 part solvent by volume) with aromatic solvent.

Aromatic solvents include toluene, xylene, and SC-100. For cool weather conditions (below 65°F) use toluene or xylene. For normal temperatures (65-80°F) use xylene. For temperatures above 80°F use xylene or SC-100. Never use solvents such as VM&P naphtha, mineral spirits or reclaimed thinner. This product may also be thinned with ketone (MEK) or ester solvents (i.e. n-butyl acetate). Addition of solvent will increase VOC.

To store partially used container, pour a small amount of the recommended thinner over the surface. Do not stir. Replace lid securely. Store away from heat or open flame. Mix thoroughly before reusing.

CLEAN UP:

Use xylene, aromatic solvent or MEK for cleaning guns and equipment.



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APPLICATION:

Material can be applied by conventional air, air-assist airless, airless, dip or more advanced application equipment such as turbo disk or bell. This product may also be applied with electrostatic and/or heated equipment. Not recommended for brush or roller application over large areas. Small touchup areas may be brushed. Use the following recommendations as an application guide:

CONVENTIONAL AIR SPRAY:

Air Cap	66PF
Fluid Nozzle	63
Needle	63
Air Pressure	50-60 psi
Fluid Pressure	10-20 psi

AIR ASSIST-AIRLESS SPRAY:

Tip	0.009-0.013"
Fluid Pressure	300-600 psi
Air Pressure	10-25 psi
Pump/tip Filter	100 Mesh

AIRLESS SPRAY:

Tip	0.011-0.015"
Fan	50° (10-12 inch fan)
Pressure	1200-1800 psi
Pump/tip Filter	100 Mesh

For dip, flowcoat or turbo application, use the viscosity range 25-35" #2 Zahn as a starting point. For hot spray applications it is recommended to stay in the 90-140°F range.

APPLICATION RATE:

Application rate will vary depending on texture, configuration and porosity of surfaces on which coating is applied. Rough or porous surfaces will require more paint. At an application rate of 500 square feet per gallon, 3.2 mils wet, the resulting dry film thickness is approximately 1.5 mils on smooth surface. A dry film thickness of 1.0-2.0 mils is recommended

DRYING:

Optimum drying conditions are 60°F to 90°F (16°C to 32°C) at 50% R.H. Lower temperatures and high humidity will slow dry. Surface must be dry and at least 5°F above the dew point.

Dry to Touch	60 Minutes
To Recoat	Between 0-1 hours or after 96 hours

This product may also be force cured to enhance dry. Temperatures in the range of 110-180°F may be utilized to accelerate solvent evaporation and speed oxidation.

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POTA-POX® PLUS SERIES N140

PRODUCT PROFILE

GENERIC DESCRIPTION	Polyamidoamine Epoxy
COMMON USAGE	Innovative potable water coating which offers high-build edge protection and allows for application at a wide range of temperatures (down to 35°F or 2°C with 44-700 Accelerator). For use on the interior and exterior of steel or concrete tanks, reservoirs, pipes, valves, pumps and equipment in potable water service.
COLORS	1211 Red, 1255 Beige, 00WH Tnemec White, 15BL Tank White, 35GR Black and 39BL Delft Blue. 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.
SPECIAL QUALIFICATIONS	Certified by NSF International in accordance with ANSI/NSF Std. 61 . Ambient air cured Series N140 (with or without 44-700 Epoxy Accelerator) is qualified for use on tanks and reservoirs of 1,000 gallons (3,785 L) capacity or greater, pipes 18 inches (46 cm) in diameter or greater, valves four (4) inches (10 cm) in diameter or greater and fittings four (4) inches (10 cm) in diameter or greater. Conforms to AWWA D 102 Inside Systems No. 1 and No. 2 (with or without 44-700). Conforms to AWWA C 210 (without 44-700). Contact your Tnemec representative for systems and additional information. A two-coat system at 4.0-6.0 dry mils (100-150 dry microns) per coat passes the performance requirements of MIL-PRF-4556F for fuel storage. Reference the "Search Listings" section of the NSF website at www.nsf.org for details on the maximum allowable DFT.
PERFORMANCE CRITERIA	Extensive test data available. Contact your Tnemec representative for specific test results.

COATING SYSTEM

SURFACER/FILLER/PATCHER	215, 217, 218
PRIMERS	Self-priming, 22, 91-H ₂ O, 94-H ₂ O, L140, L140F, N140F, V140, V140F, 141
TOPCOATS	Interior: Series 22, FC22, L140, L140F, N140, N140F, V140, V140F, 141, 406. Exterior: Series 27, 66, L69, L69F, N69, N69F, V69, V69F, 72, 73, L140, L140F, N140, N140F, V140, V140F, 156, 157, 161, 175, 180, 181, 446, 740, 750, 1028, 1029, 1074, 1074U, 1075, 1075U, 1077, 1078, 1080, 1081. Refer to COLORS on applicable topcoat data sheets for additional information. Note: The following recoat times apply for Series N140: Immersion Service—Surface must be scarified by blasting with fine abrasive after 60 days. Atmospheric Service—After 60 days, scarification or an epoxy tie-coat is required. When topcoating with Series 740 or 750, recoat time for N140 is 21 days. Contact your Tnemec representative for specific recommendations.

SURFACE PREPARATION

PRIMED STEEL	Immersion Service: Scarify the epoxy prime coat surface by abrasive blasting with fine abrasive before topcoating if it has been exterior exposed for 60 days or longer and N140 is the specified topcoat.
STEEL	Immersion Service: SSPC-SP10/NACE 2 Near-White Blast Cleaning with a minimum angular anchor profile of 1.5 mils. Non-Immersion Service: SSPC-SP6/NACE 3 Commercial Blast Cleaning with a minimum angular anchor profile of 1.5 mils.
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. Fill all holes, pits, voids and cracks with 215, 217 or 218.
ALL SURFACES	Must be clean, dry and free of oil, grease and other contaminants.

TECHNICAL DATA

VOLUME SOLIDS	67.0 ± 2.0% (mixed—A, B & 44-700 Epoxy Accelerator) †
RECOMMENDED DFT	2.0 to 10.0 mils (50 to 225 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)	5 hours	7 hours	7 days
80°F (27°C)	7 hours	9 hours	7 days
70°F (21°C)	9 hours	12 hours	7 days
60°F (16°C)	16 hours	22 hours	9 to 12 days
50°F (10°C)	24 hours	32 hours	12 to 14 days

Curing time varies with surface temperature, air movement, humidity and film thickness. **Note:** For valve applications allow 14 days cure at 75°F (24°C) prior to immersion. For pipe applications allow 30 days cure at 75°F (24°C) prior to immersion. **Ventilation:** When used in enclosed areas, provide adequate ventilation during application and cure. **Note:** Refer to product listing on www.nsf.org for specific potable water return to service information. **Note:** For faster curing and low temperature applications, add No. 44-700 Epoxy Accelerator, see separate product data sheet for cure information.

VOLATILE ORGANIC COMPOUNDS	Unthinned: 2.4 lbs/gallon (285 grams/litre) Thinned 5% (#60): 2.6 lbs/gallon (311 grams/litre) Thinned 10% (#4): 2.8 lbs/gallon (334 grams/litre) †
HAPS	Unthinned: 2.4 lbs/gal solids Thinned 5% (#60): 2.4 lbs/gal solids Thinned 10% (#4): 3.3 lbs/gal solids
THEORETICAL COVERAGE	1,070 mil sq ft/gal (27.2 m ² /L at 25 microns). See APPLICATION for coverage rates. †
NUMBER OF COMPONENTS	Two: Part A (amine) and Part B (epoxy) — One (Part A) to one (Part B) by volume.

POTA-POX® PLUS | SERIES N140

PACKAGING	5 gallon (18.9L) pails and 1 gallon (3.79L) cans - Order in multiples of 2. Reference 44-700 Epoxy Accelerator product data sheet for its packaging information.
NET WEIGHT PER GALLON	12.66 ± 0.25 lbs (5.82 ± .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	Part A: 82°F (28°C) Part B: 80°F (27°C) 44-700: None
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 reach of children.

APPLICATION

COVERAGE RATES	Dry MILS (Microns)	Wet MILS (Microns)	Sq Ft/Gal (m ² /Gal)
Suggested	6.0 (150)	9.0 (230)	179 (16.6)
Minimum	2.0 (50)	3.0 (75)	537 (49.9)
Maximum	10.0 (225)	15.0 (375)	107 (10.0)

Note: Roller or brush application requires two or more coats to obtain recommended film thickness. Allow for overspray and surface irregularities. Wet 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. Reference the "Search Listings" section of the NSF website at www.nsf.org for details on the maximum allowable DFT. †

- 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 with No. 4 Thinner or thin up to 5% or 1/4 pint (190 mL) per gallon with No. 60 Thinner. For airless spray, roller or brush, thin up to 5% or 1/4 pint (190 mL) per gallon. **Caution: Series N140 NSF certification is based on thinning with No. 4 or No. 60 Thinner for tanks and only No. 60 Thinner for pipe, valves and fittings.** Use of any other thinner voids ANSI/NSF Std. 61 certification.

POT LIFE Without 44-700 6 hours at 50°F (10°C) 4 hours at 75°F (24°C) 1 hour at 100°F (38°C)
With 44-700 2 hours at 50°F (10°C) 1 hour at 75°F (24°C) 30 minutes at 100°F (38°C)

SPRAY LIFE Without 44-700: 1 hour at 77°F (25°C) With 44-700: 30 minutes at 75°F (24°C)

Note: Spray application after listed times will adversely affect ability to achieve recommended dry film thickness.

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)

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)

Low temperatures or longer hoses require higher pot pressure. Use appropriate tip/atomizing pressure for equipment, applicator technique and weather conditions.

Roller: Use 3/8" or 1/2" (9.5 mm to 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 Without 44-700: Min. 50°F (10°C), Max. 135°F (57°C) With 44-700: Min. 35°F (2°C), Max. 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.

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NIDEC MOTOR CORPORATION

8050 WEST FLORISSANT AVE.
ST. LOUIS, MO 63136



DATE: 7/20/2022

P.O. NO.: 12572179
Order/Line NO.: 22701183 SO 100

TO: PENTAIR FLOW TECHNOLOGIES LLC
400 REGENCY FOREST DRIVE
SUITE 300
CARY, NC, 27518

ATTN: SHILO

Model Number: NA
Catalog Number:
VHS Weather Protected
CONF,MOTOR,VHS WPI

REVISIONS:
(NONE)

**ALL DOCUMENTS HEREIN ARE CONSIDERED CERTIFIED BY NIDEC MOTOR CORPORATION.
THANK YOU FOR YOUR ORDER AND THE OPPORTUNITY TO SERVE YOU.**

Features:

HOLD PRODUCTION
Horsepower 00100.00~00000.00 ~ KW: 74.6
Enclosure WPI
Poles 04~00 ~ RPM: 1800~0
Frame Size 404~TP
Phase/Frequency/Voltage.. 3~060~230/460
Winding Type Random Wound
Service Factor 1.15
Insulation Class Class "F" ~ Insulife 2000
Altitude In Feet (Max) .. 3300 Ft.(1000 M) ~ +40 C
Efficiency Class Premium Efficiency
Application Unknown
Inverter Duty NEMA MG1 Part 31
Customer Part Number FMB0913484A01
16.5" Base ~ Coupling Size: 1-1/4" Bore, 1/4" Key
Non-Reverse Ratchet ~ Steady Bushing
Pricebook Thrust Value (lbs).. 6700
Customer Down Thrust (lbs) ... 2523
Customer Shutoff Thrust (lbs). 3444
Up Thrust (lbs): ~
Inverter Duty Rating Details:
Load Type (Base Hz & Below) .. Variable Torque
Speed Range (Base Hz & Below). 10:1
VFD Service Factor 1.00
Temperature Rise (Sine Wave): "B" Rise @ 1.0 SF (Resist)
Starting Method Direct-On-Line Start
Duty Cycle Continuous Duty
Efficiency Value 95.4 % ~ Typical
Load Inertia: NEMA ~ Standard Inertia: 441.00 LB-FT²
Number Of Starts Per Hour: NEMA
Motor Type Code RUI
Rotor Inertia (LB-FT²) 17.0 LB-FT²
Qty. of Bearings PE (Shaft) 1
Qty. of Bearings SE (OPP) 1
Bearing Number PE (Shaft) 6212-J
Bearing Number SE (OPP) 7222 BEM

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

NIDEC MOTOR CORPORATION

8050 WEST FLORISSANT AVE.
ST. LOUIS, MO 63136



DATE: 7/20/2022

P.O. NO.: 12572179
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TO: PENTAIR FLOW TECHNOLOGIES LLC
400 REGENCY FOREST DRIVE
SUITE 300
CARY, NC, 27518

ATTN:SHILO

Model Number: NA
Catalog Number:
VHS Weather Protected
CONF,MOTOR,VHS WPI

REVISIONS:
(NONE)

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THANK YOU FOR YOUR ORDER AND THE OPPORTUNITY TO SERVE YOU.**

Accessories:

Counter CW Rotation FODE
Aegis Ground Ring (SGR)
Insul. Bearing- Upper Bracket
Special Balance
Multiple ID Plates Requested
Thermostats - Normally Closed
Lubrication Instruction Plate
Shipping Tag Information:
FMB0913484A01
12572179
10

USE THE DATA PROVIDED BELOW TO SELECT THE APPROPRIATE DIMENSION PRINT

Horsepower	100
Pole(s)	04
Voltage(s)	460-230
Frame Size	404TP
Outlet Box AF	4.25
Outlet Box AA	3.00

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CERTIFIED MOTOR PERFORMANCE DATA

MOTOR MANUFACTURER: NIDEC MOTOR CORPORATION **DATE:** 7/20/2022

PENTAIR PURCHASE ORDER #: 12572179 **PENTAIR TAG #:** FMB0913484A01

PERFORMANCE DATA BASED ON STANDARD RULES OF: X IEEE X ASA X NEMA

HP	SYNCHRONOUS SPEED (RPM)	FULL LOAD * SPEED (RPM)	FRAME NUMBER	TYPE	ENCLOSURE
100	1800	1785	404TP	RUI	WPI

*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		X _____ RESIS. _____ THERM.			
3	60	460/230	114/228	725/1474.9	F	80 DEG C AT 1.00 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		
94.5	94.5	94.1	86.3	84.5	78.5	294.3	186	230

VSS VHS NRR SRC HORIZ

BEARINGS:

Drive End Lubrication:

Oil Grease

Opposite End Lubrication:

Oil Grease 5 QT/4.7 L

PAINT: (Attach Technical Data Sheets)

Factory Standard
 Other _____

MOTOR NO.: 22701183

MOTOR WEIGHT: 1110 LBS

ROTATION: BI-DIRECTIONAL CW CCW

Certified by: Sharon Concoro Date: 7/20/2022 Revision # 0

Accessory Data

Motor Manufacturer: NIDEC MOTOR CORPORATION Date: 7/20/2022

Pentair Purchase Order #: 12572179 Pentair Tag #: FMB0913484A01

	Required	Not Required	Description
Space Heaters:	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Watts: _____ Voltage: _____
Thermostats:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Type: <input type="checkbox"/> N.O. <input checked="" type="checkbox"/> N.C.
Thermistors:	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Make & Model: _____ Trip Range: _____ <input type="checkbox"/> relay not Supplied <input type="checkbox"/> relay supplied: Type: <input type="checkbox"/> factory set <input type="checkbox"/> field adjustable <input type="checkbox"/> wiring diagram/cut sheet attached. Ref.: _____
Winding RTD's:	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Quantity Per Motor: _____ Make & Model: _____ Construction/OHM Rating: _____ <input type="checkbox"/> relay not Supplied <input type="checkbox"/> relay supplied: Type: <input type="checkbox"/> factory set <input type="checkbox"/> field adjustable <input type="checkbox"/> wiring diagram/cut sheet attached. Ref.: _____
Bearing RTD's:	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Quantity _____ Make & Model: _____ Construction/OHM Rating: _____ <input type="checkbox"/> relay not Supplied <input type="checkbox"/> relay supplied: Type: <input type="checkbox"/> factory set <input type="checkbox"/> field adjustable <input type="checkbox"/> wiring diagram/cut sheet attached. Ref.: _____
Vibration Sensor:	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Make & Model: _____ <input type="checkbox"/> relay not Supplied <input type="checkbox"/> relay supplied: Type: <input type="checkbox"/> factory set <input type="checkbox"/> field adjustable <input type="checkbox"/> wiring diagram/cut sheet attached. Ref.: _____
Tests:	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> Short commercial, unwitnessed <input type="checkbox"/> Short commercial, witnessed <input type="checkbox"/> Calibration Test, unwitnessed <input type="checkbox"/> Complete initial, unwitnessed <input type="checkbox"/> Complete initial, witnessed <input type="checkbox"/> Sound test, unwitnessed <input type="checkbox"/> Bump Test, unwitnessed <input type="checkbox"/> Vibration Test, unwitnessed <input type="checkbox"/> Polarization Index, unwitnessed <input type="checkbox"/> Reed Critical Test, unwitnessed <input type="checkbox"/> IEEE841

Certified by: Sharon Corcoro Date: 7/20/2022 Revision #: 0

Accessory Data

Motor Manufacturer: NIDEC MOTOR CORPORATION

Date: 7/20/2022

Pentair Purchase Order #: 12572179

Pentair Tag #: FMB0913484A01

Features:

Enclosure WPI
Winding Type Random Wound
Service Factor 1.15
Insulation Class Class "F" ~ Insulife 2000
Altitude In Feet (Max) .. 3300 Ft.(1000 M) ~ +40 C
Efficiency Class Premium Efficiency
Inverter Duty NEMA MG1 Part 31
16.5" Base ~ Coupling Size: 1-1/4" Bore, 1/4" Key
Non-Reverse Ratchet ~ Steady Bushing
Pricebook Thrust Value (lbs).. 6700
Customer Down Thrust (lbs) ... 2523
Customer Shutoff Thrust (lbs). 3444
Inverter Duty Rating Details:
Load Type (Base Hz & Below) .. Variable Torque
Speed Range (Base Hz & Below). 10:1
VFD Service Factor 1.00
Temperature Rise (Sine Wave): "B" Rise @ 1.0 SF (Resist)
Starting Method Direct-On-Line Start
Duty Cycle Continuous Duty
Efficiency Value 95.4 % ~ Typical
Load Inertia: NEMA ~ Standard Inertia: 441.00 LB-FT2

Accessories:

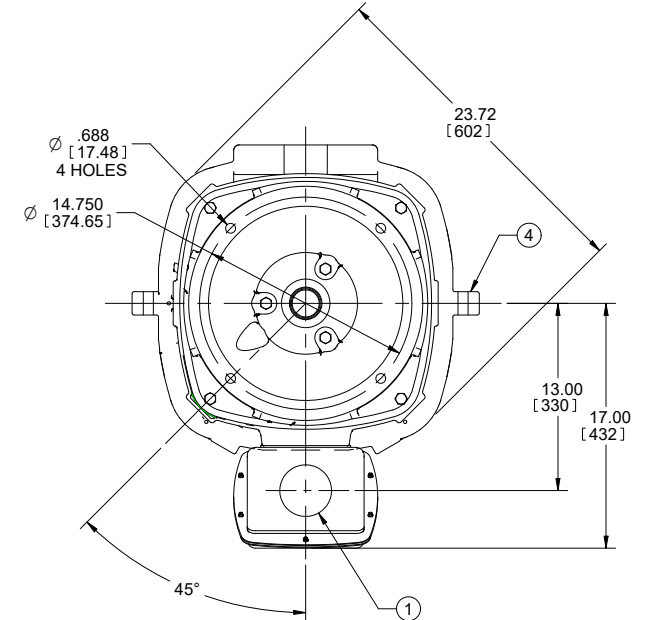
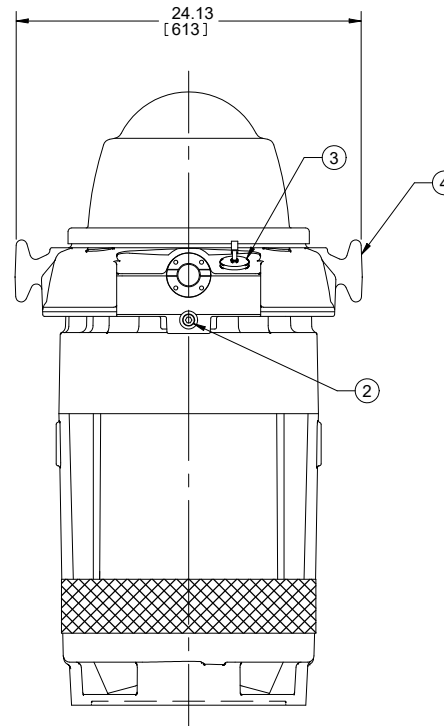
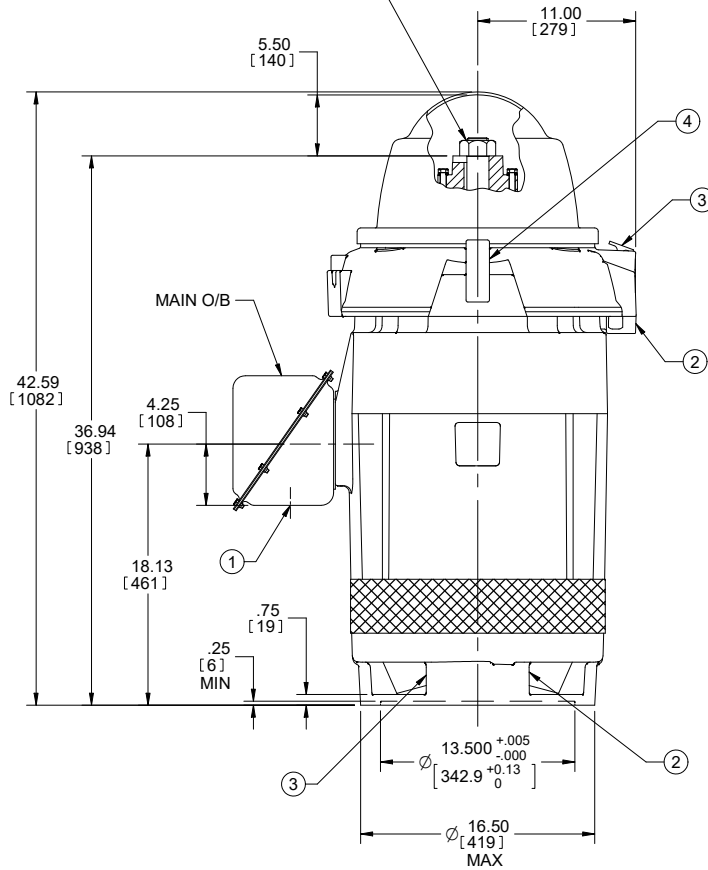
Counter CW Rotation FODE
Aegis Ground Ring (SGR)
Insul. Bearing- Upper Bracket
Special Balance
Thermostats - Normally Closed
Lubrication Instruction Plate
Shipping Tag Information:
FMB0913484A01
12572179
10

Certified by: Sharon Concoro

Date: 7/20/2022

Revision #: 0

PUMP SHAFT, ADJUSTING NUT AND LOCKING SCREWS ARE NOT FURNISHED WITH MOTOR



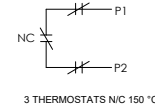
USER INFORMATION	
CUSTOMER: PENTAIR FLOW TECHNOLOGIES LLC	
CUSTOMER P/N: FMB0913484A01	
P.O: 12572179	
REF. ORDER #: 22701183-100	

TOLERANCES	IN	MM
FACE RUNOUT	.007 T.I.R.	.18 T.I.R.
PERMISSIBLE ECCENTRICITY OF MOUNTING RABBET	.007 T.I.R.	.18 T.I.R.
MAXIMUM SHAFT END PLAY	.010	.25

NOTES:

- 1) MAIN BOX FOR MOTOR POWER LEADS, 3.00" CONDUIT CONNECTION. BOX VOLUME: 470 CU. IN. [7702 CU. CM.]
- 2) DRAINS: TOP OIL AND BOTTOM GREASE.
- 3) FILL: TOP OIL AND BOTTOM GREASE.
- 4) MOTOR LIFTING LUGS.
- 5) ROTATION: COUNTER CLOCKWISE, WHEN FACING OPPOSITE DRIVE END.
- 6) BEARINGS: LOWER -6212-J (BALL GUIDE BEARING)
UPPER - QTY (1) 7222 BEM (ANGULAR CONTACT DRIVE BEARINGS)
- 7) TAG: FMB0913484A01
12572179
LINE 10
- 8) ALL ROUGH DIMENSIONS MAY VARY BY .25" DUE TO CASTING AND/OR FABRICATION VARIATIONS.
- 9) CONDUIT BOX OPENING MAY BE LOCATED IN STEPS OF 90° REGARDLESS OF LOCATION. STANDARD AS SHOWN WITH CONDUIT OPENING DOWN.
- 10) CLASS F INSULATION, S.F. = 1.15

- 11) AEGIS GROUNDING RING ON BEARING CAP.
- 12) GROUNDING LUG ON OUTLET BOX.
- 13) INSULATED UPPER BRACKET BEARING.
- 14) THERMOSTATS.



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

CERTIFIED FOR CONSTRUCTION

RATING		100 HP [74.6 KW], 1800 RPM 230/460 V, 3Ø, 60HZ	REVISION DESCRIPTION:	UNITS DUAL	TITLE DIMENSION PRINT	FRAME 404TP	TYPE RUI
ENCLOSURE	WPI	NEW					
BEARINGS	SEE (6)						
LUBRICATION	SEE (2 AND 3)						
ROTATION FACING O.D.E.	CCW						
NET WEIGHT (±10%)	1110 LBS [504 KG]						
ISSUED BY: L. ARROYO					APPROVED BY: M. ZAMBRANO	REVISION DATE: 07-JUL-22	
DWG NO. 09-3415-58					REV	SHEET NUMBER	DWG SIZE
					-	1 OF 1	C

NAMEPLATE DATA

CATALOG NUMBER: <input style="width: 100%;" type="text"/>	NAMEPLATE PART #: <input style="width: 100%; border: 1px solid black;" type="text" value="422707-005"/>
MODEL <input style="width: 100%;" type="text"/> FR <input style="width: 100%; border: 1px solid black;" type="text" value="404TP"/>	TYPE <input style="width: 100%; border: 1px solid black;" type="text" value="RUI"/> ENCL <input style="width: 100%; border: 1px solid black;" type="text" value="WPI"/>
SHAFT END BRG <input style="width: 100%; border: 1px solid black;" type="text" value="6212-J - QTY 1"/>	OPP END BRG <input style="width: 100%; border: 1px solid black;" type="text" value="7222 BEM - QTY 1"/>
PH <input style="width: 100%; border: 1px solid black;" type="text" value="3"/> MAX AMB <input style="width: 100%; border: 1px solid black;" type="text" value="40 C"/>	ID# <input style="width: 100%; border: 1px solid black;" type="text" value="(ref: Order#: 22701183, Type: SO, Line#: 100)"/>
INSUL CLASS <input style="width: 100%; border: 1px solid black;" type="text" value="F"/> Asm. Pos. <input style="width: 100%;" type="text"/>	DUTY <input style="width: 100%; border: 1px solid black;" type="text" value="CONT"/>
HP <input style="width: 100%; border: 1px solid black;" type="text" value="100"/> RPM <input style="width: 100%; border: 1px solid black;" type="text" value="1785"/>	HP <input style="width: 100%;" type="text"/> RPM <input style="width: 100%;" type="text"/>
VOLTS <input style="width: 100%; border: 1px solid black;" type="text" value="460"/> <input style="width: 100%; border: 1px solid black;" type="text" value="230"/>	VOLTS <input style="width: 100%;" type="text"/> <input style="width: 100%;" type="text"/>
FL AMPS <input style="width: 100%; border: 1px solid black;" type="text" value="114.0"/> <input style="width: 100%; border: 1px solid black;" type="text" value="228.0"/>	FL AMPS <input style="width: 100%;" type="text"/> <input style="width: 100%;" type="text"/>
SF AMPS <input style="width: 100%; border: 1px solid black;" type="text" value="131.0"/> <input style="width: 100%; border: 1px solid black;" type="text" value="263.0"/>	SF AMPS <input style="width: 100%;" type="text"/> <input style="width: 100%;" type="text"/>
SF <input style="width: 100%; border: 1px solid black;" type="text" value="1.15"/> DESIGN <input style="width: 100%; border: 1px solid black;" type="text" value="B"/> CODE <input style="width: 100%; border: 1px solid black;" type="text" value="G"/>	SF <input style="width: 100%;" type="text"/> DESIGN <input style="width: 100%;" type="text"/> CODE <input style="width: 100%;" type="text"/>
NEMA NOM EFFICIENCY <input style="width: 100%; border: 1px solid black;" type="text" value="95.4"/> NOM PF <input style="width: 100%; border: 1px solid black;" type="text" value="86.3"/> KiloWatt <input style="width: 100%; border: 1px solid black;" type="text" value="74.60"/>	NEMA NOM EFFICIENCY <input style="width: 100%;" type="text"/> NOM PF <input style="width: 100%;" type="text"/>
GUARANTEED EFFICIENCY <input style="width: 100%; border: 1px solid black;" type="text" value="94.5"/> MAX KVAR <input style="width: 100%;" type="text"/> HZ <input style="width: 100%; border: 1px solid black;" type="text" value="60"/>	GUARANTEED EFFICIENCY <input style="width: 100%;" type="text"/> MAX KVAR <input style="width: 100%;" type="text"/> HZ <input style="width: 100%;" type="text"/>

HAZARDOUS LOCATION DATA (IF APPLICABLE):

DIVISION <input style="width: 100%;" type="text"/>	CLASS I <input style="width: 100%;" type="text"/>	GROUP I <input style="width: 100%;" type="text"/>
TEMP CODE <input style="width: 100%;" type="text"/>	CLASS II <input style="width: 100%;" type="text"/>	GROUP II <input style="width: 100%;" type="text"/>



VFD DATA (IF APPLICABLE):

VOLTS <input style="width: 100%; border: 1px solid black;" type="text" value="460"/> <input style="width: 100%; border: 1px solid black;" type="text" value="230"/>	AMPS <input style="width: 100%; border: 1px solid black;" type="text" value="119.7"/> <input style="width: 100%; border: 1px solid black;" type="text" value="239.4"/>
TORQUE 1 <input style="width: 100%; border: 1px solid black;" type="text" value="294.30LB-FT"/>	TORQUE 2 <input style="width: 100%;" type="text"/>
VFD LOAD TYPE 1 <input style="width: 100%; border: 1px solid black;" type="text" value="VT/PWM"/>	VFD LOAD TYPE 2 <input style="width: 100%;" type="text"/>
VFD HERTZ RANGE 1 <input style="width: 100%; border: 1px solid black;" type="text" value="6-60"/>	VFD HERTZ RANGE 2 <input style="width: 100%;" type="text"/>
VFD SPEED RANGE 1 <input style="width: 100%; border: 1px solid black;" type="text" value="180-1800"/>	VFD SPEED RANGE 2 <input style="width: 100%;" type="text"/>
SERVICE FACTOR <input style="width: 100%; border: 1px solid black;" type="text" value="1.00"/>	FL SLIP <input style="width: 100%;" type="text"/>
NO. POLES <input style="width: 100%;" type="text"/>	MAGNETIZING AMPS <input style="width: 100%;" type="text"/>
VECTOR MAX RPM <input style="width: 100%;" type="text"/>	Encoder PPR <input style="width: 100%;" type="text"/>
Radians / Seconds <input style="width: 100%;" type="text"/>	Encoder Volts <input style="width: 100%;" type="text"/>

TEAO DATA (IF APPLICABLE):

HP (AIR OVER) <input style="width: 100%;" type="text"/>	HP (AIR OVER M/S) <input style="width: 100%;" type="text"/>	RPM (AIR OVER) <input style="width: 100%;" type="text"/>	RPM (AIR OVER M/S) <input style="width: 100%;" type="text"/>
FPM AIR VELOCITY <input style="width: 100%;" type="text"/>	FPM AIR VELOCITY M/S <input style="width: 100%;" type="text"/>	FPM AIR VELOCITY SEC <input style="width: 100%;" type="text"/>	

ADDITIONAL NAMEPLATE DATA:

Decal / Plate	WD=109145	Customer PN	FMB0913484A01
Notes		Non Rev Ratchet	NRR
Max Temp Rise	80C RISE/RES@1.00SF	OPP/Upper Oil Cap	5 QT/4.7 L
Thermal (WDG)	OVER TEMP PROT 2	SHAFT/Lower Oil Cap	GREASE
Altitude		Usable At	
Regulatory Notes		Regulatory Compliance	
COS		Marine Duty	
Balance	0.08 IN/SEC	Arctic Duty	
3/4 Load Eff.	95.5	Inrush Limit	
Motor Weight (LBS)	1110	Direction of Rotation	
Sound Level		Special Note 1	
Vertical Thrust (LBS)	6700	Special Note 2	
Thrust Percentage	100% HT	Special Note 3	
Bearing Life		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	
380V 50 Hz Max Amps		SH Watts	
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	
Heater in C/B Voltage		Heater in C/B Watts	
Zone 2 Group		Division 2 Service Factor	
Note 1		Note 2	
Note 3		Note 4	
Note 5		Note 6	
Note 7		Note 8	
Note 9		Note 10	
Note 11		Note 12	
Note 13		Note 14	
Note 15		Note 16	
Note 17		Note 18	
Note 19		Note 20	
Note 21		Note 22	

NIDEC MOTOR CORPORATION
ST. LOUIS, MO

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



MOTOR PERFORMANCE

MODEL NO.	CATALOG NO.	PHASE	TYPE	FRAME
NA	NA	3	RUI	404TP
ORDER NO.	22701183		LINE NO.	100
MPI:			141574	141575
HP:			100	100
POLES:			4	4
VOLTS:			460	230
HZ:			60	60
SERVICE FACTOR:			1.15	1.15
EFFICIENCY (%):				
S.F.			94.8	94.8
FULL			95	95
3/4			95.5	95.5
1/2			95.1	95.1
1/4			92.4	92.4
POWER FACTOR (%):				
S.F.			86.4	86.4
FULL			86.3	86.3
3/4			84.5	84.5
1/2			78.5	78.5
1/4			59.7	59.7
NO LOAD			5.1	5.1
LOCKED ROTOR			32.9	32.9
AMPS:				
S.F.			131	263
FULL			114	228
3/4			87	174
1/2			63	126
1/4			42	85
NO LOAD			32.8	65.5
LOCKED ROTOR			725	1474.9
NEMA CODE LETTER			G	G
NEMA DESIGN LETTER			B	B
FULL LOAD RPM			1785	1785
NEMA NOMINAL / EFFICIENCY (%)			95.4	95.4
GUARANTEED EFFICIENCY (%)			94.5	94.5
MAX KVAR			22.2	22.2
AMBIENT (°C)			40	40
ALTITUDE (FASL)			3300	3300
SAFE STALL TIME-HOT (SEC)			25	25
SOUND PRESSURE (DBA @ 1M)			70	70
TORQUES:				
BREAKDOWN{% F.L.}			230	230
LOCKED ROTOR{% F.L.}			186	186
FULL LOAD{LB-FT}			294.3	294.3

NEMA Nominal and Guaranteed Efficiencies are up to 3,300 feet above sea level and 25 ° C ambient.

The Above Data Is Typical, Sinewave Power Unless Noted Otherwise

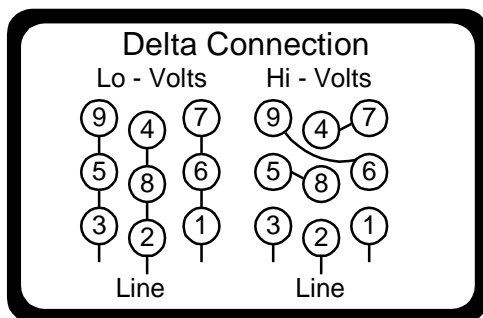
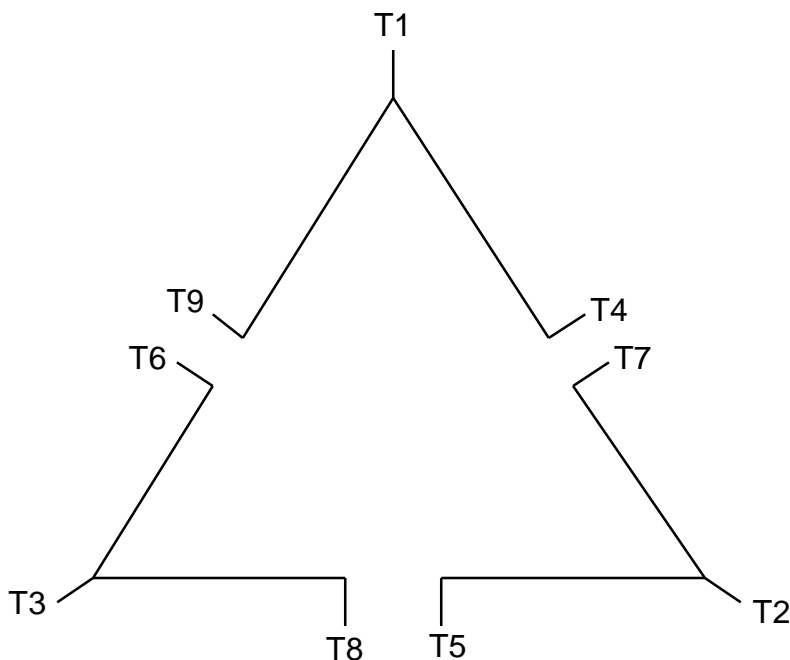
NIDEC MOTOR CORPORATION
ST. LOUIS, MO





A109145

Motor Wiring Diagram 9 Lead, Dual Voltage (DELTA Conn.)



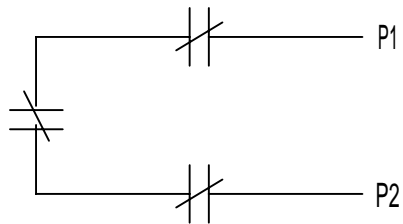
To reverse direction of rotation interchange connections L1 and L2.

Each lead may have one or more cables comprising that lead.
In such case each cable will be marked with the appropriate lead number.

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



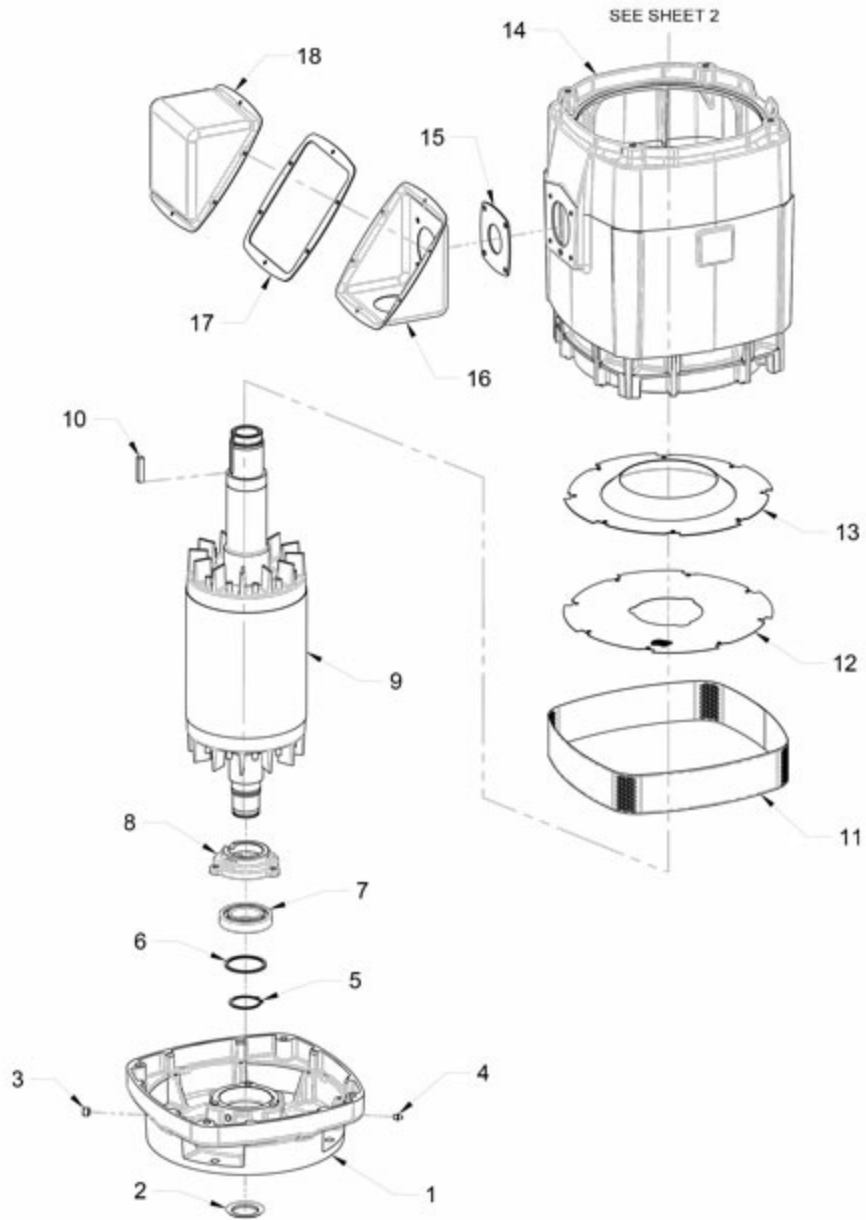
NOTE: THERMOSTATS LEADS MAY BE LOCATED IN EITHER THE MAIN OUTLET BOX OR IF SO EQUIPPED, AN AUXILIARY BOX.

ACCESSORY LISTING
QTY-3 N.C. THERMOSTATS

REVISION DESCRIPTION FOR: MISC	SCALE	UNITS	TITLE		NIDEC MOTOR CORPORATION
STL0211 - UPDATED FORMAT .	NONE	IN	CUSTOMER CONNECTION DIAGRAM		
	TOLERANCES ON DIMENSIONS (UNLESS OTHERWISE SPECIFIED)		ISSUED BY	APPROVED BY	REVISION DATE
MATERIAL:	<u>INCHES</u>	<u>mm</u>	R. KING	C. CADE	24-FEB-11
---	ANGLES X°= ±1°		CODE	DWG NO.	REV
				0834066	G
					SHEET NUMBER
					1 OF 1
					DWG SIZE
					A

RENEWAL PARTS

FRAME 400
TYPES: RU, RUE, RUEI, RUS, RUSI

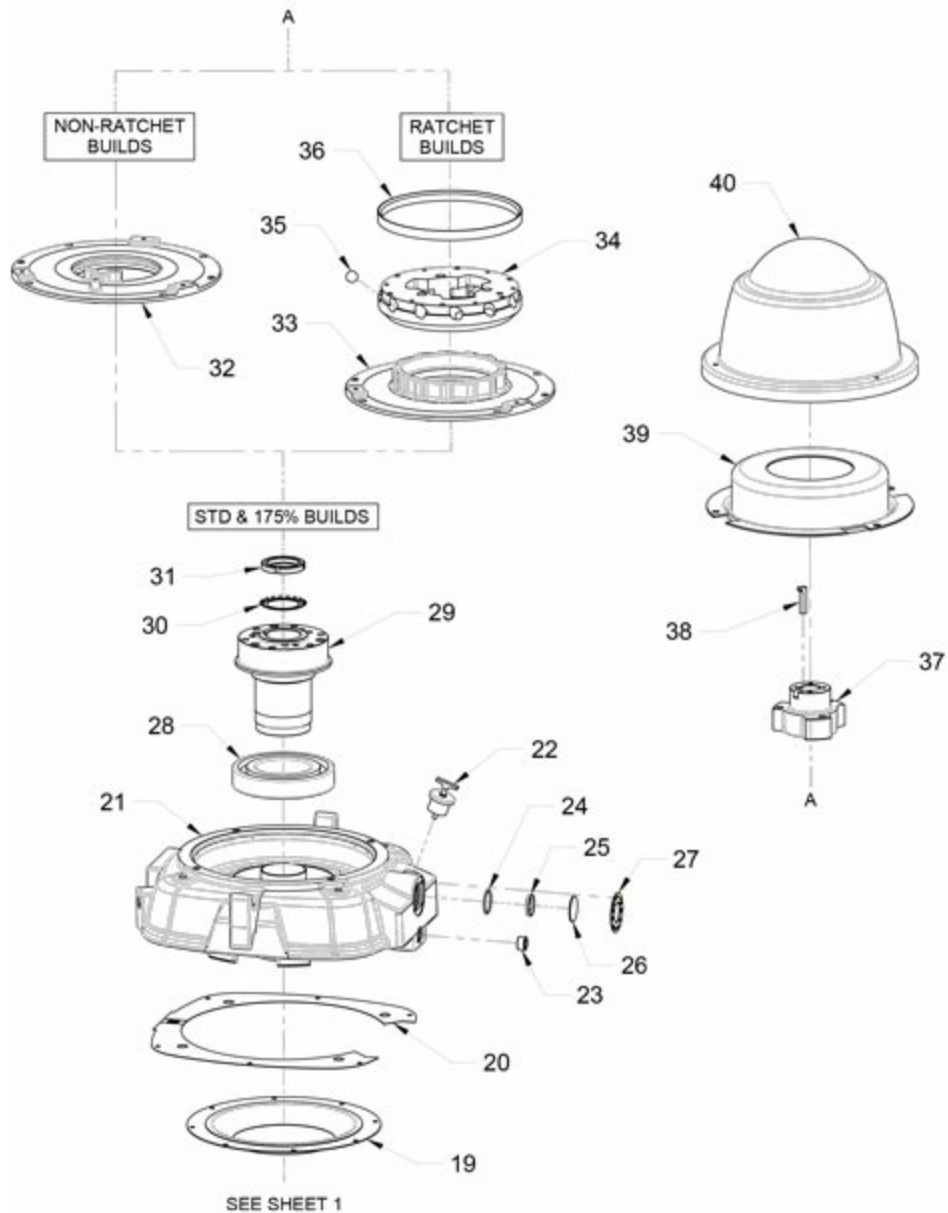


BEARINGS:
Refer to motor nameplate for the bearing numbers.

PRICES:
Parts stocking distributors: refer to renewal parts numerical index. All Others: refer to your nearest parts distributor.
reference: Renewal Parts Section 700 - 270

RENEWAL PARTS

FRAME 400
TYPES: RU, RUE, RUEI, RUS, RUSI



BEARINGS:
Refer to motor nameplate for the bearing numbers.

PRICES:
Parts stocking distributors: refer to renewal parts numerical index. All Others: refer to your nearest parts distributor.
reference: Renewal Parts Section 700 - 270

RENEWAL PARTS

FRAME 400
TYPES: RU, RUE, RUEI, RUS, RUSI

ITEM NO.	QTY.	NAME OF PART	ITEM NO.	QTY.	NAME OF PART
1	1	Lower Bracket	21	1	Upper Bracket
2	1	Water Deflector	22	1	Oil Fill Plug (Expanding)
3	1	Pipe Plug	23	1	Upper Plug (Oil Drain)
4	1	Zerk Fitting Grease	24	1	O-Ring Sight Gauge Window
5	1	Spacer Washer	25	1	Deflector Sight Gauge Window
6	1	Snap Ring	26	1	Glass Sight Gauge Window
7	1	Lower Bearing	27	1	Cover Sight Gauge Window
8	1	Lower Bearing Cap	28	-	Upper Bearing (Qty 1 or 2)
9	1	Rotor Assembly	29	1	Bearing Mount
10	1	Key	30	1	Upper Lockwasher
11	1	Lower Screen Intake (External)	31	1	Upper Lock Nut
12	1	Lower Screen Intake (Internal)	32	1	Dust Cover (Only on Units Without Ratchet)
13	1	Lower Air Deflector	33	1	Ratchet Adaptor (Only on Units With Ratchet)
14	1	Stator Assembly	34	1	Stationary Ratchet (Only on Units With Ratchet)
15	1	Gasket Outlet Box (Frame and Box)	35	1	Ratchet Ball (Only on Units With Ratchet)
16	1	Outlet Base	36	1	Ball Retaining Ring (Only on Units With Ratchet)
17	1	Gasket Outlet Box (Base and Cover)	37	1	Thrust Coupling (Only on Hollowshaft)
18	1	Cover Outlet Box	38	1	Gib Key (Only on Hollowshaft)
19	1	Upper Air Deflector	39	1	Upper Baffle
20	1	Upper Screen	40	1	Canopy Cap

BEARINGS:

Refer to motor nameplate for the bearing numbers.

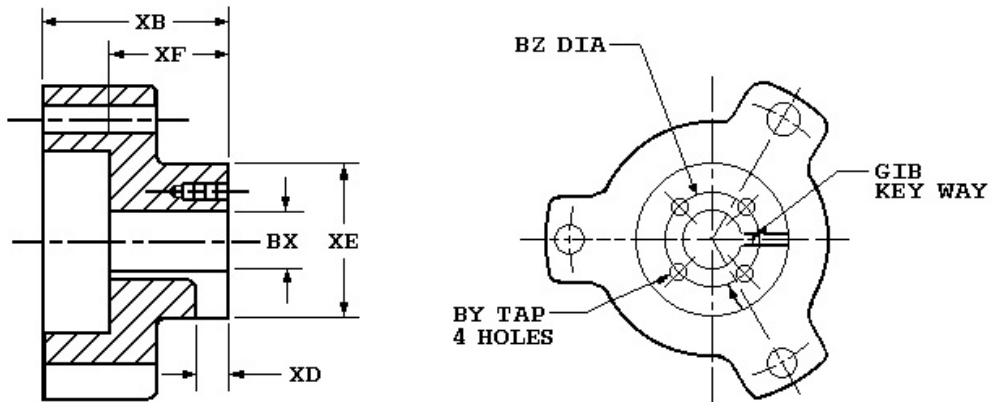
PRICES:

Parts stocking distributors: refer to renewal parts numerical index. All Others: refer to your nearest parts distributor.

reference: Renewal Parts Section 700 - 270

Vertical HOLLOSHAFT Coupling Dimensions

Standard Coupling Dimensions



Coupling Part Number	707806
BX Nominal	1 1/4
Actual Bore	1.251
BY	1/4-20
BZ	1 3/4
XB	3 13/32
XD	13/32
XE	3 1/8
XF	3 1/8
SQ. KEY	1/4

Notes:

1. All Rough casting dimensions may vary by 0.25" due to casting variations.
2. All tapped holes are Unified National Course, Right Hand thread.
3. Coupling bore dimension "BX" is machined with a tolerance of - .000", +.001" up to 1.50" bore inclusive. Larger bores: -.000", +.002".



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TYPICAL REED CRITICAL FREQUENCY DATA

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: 404TP Type: RUI

REED CRITICAL FREQUENCY:	54	HZ
CENTER OF GRAVITY:	18	IN
DEFLECTION @ CENTER OF GRAVITY:	0.00348	IN
UNIT WEIGHT:	1110	LBS
BASE DIAMETER:	ALL	IN
TOLERANCE ON RCF VALUE:	10%	
DATE:	7/20/2022	



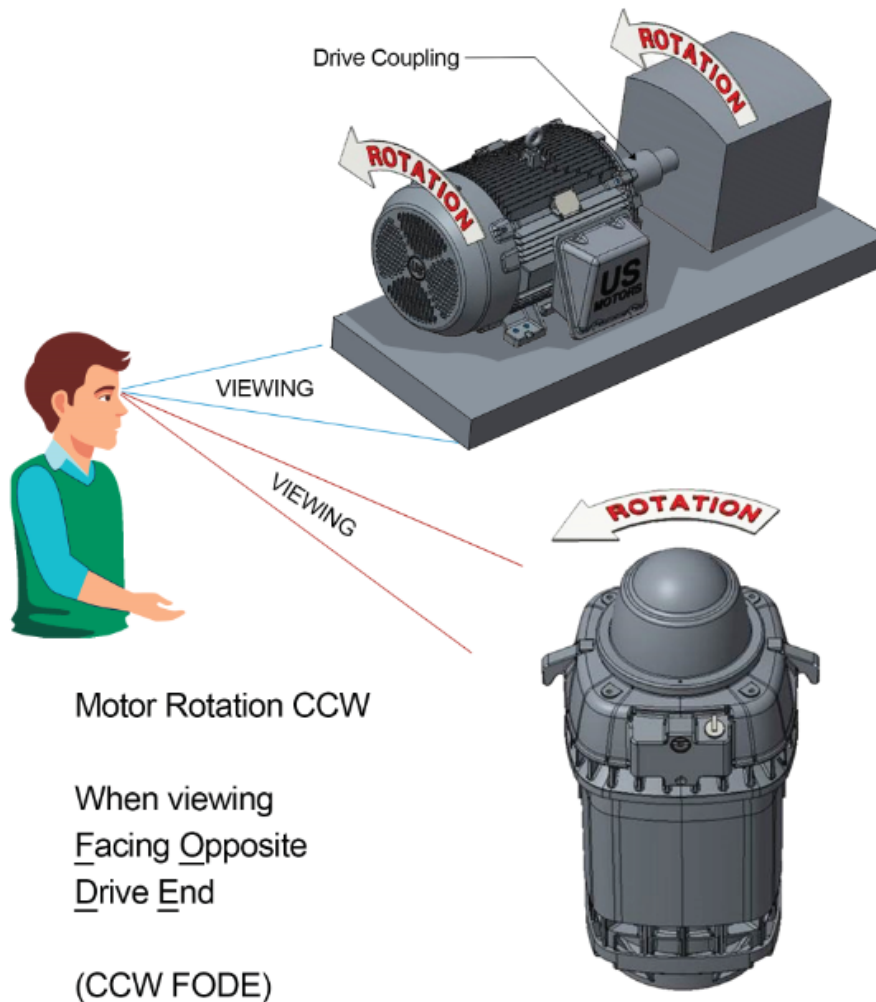
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DIRECTION OF ROTATION

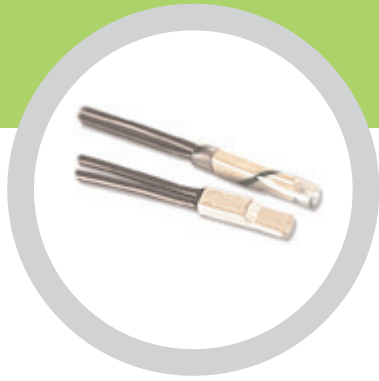
This motor is unidirectional and can only be operated in one direction to ensure proper cooling.

The motor will be supplied with the industry standard CCW (counter clockwise) rotation as shown below. CW rotation is available upon request.



NIDEC MOTOR CORPORATION
ST. LOUIS, MISSOURI

80-289



9700

Thermal Protector for Motor/Fluorescent ballasts and Temperature Sensing Controls

The Klixon® 9700 protector is a field proven miniature protector developed to protect shaded pole and permanent split capacitor motors, fluorescent ballasts, solenoids, transformers and other electrical equipment against overheating.

In addition to being small and lightweight, the unit is both temperature and current sensitive. Since the 9700 is sealed to withstand varnish dipping, it can be mounted directly in windings where it can best sense the true temperature of the electrical equipment. As a result, over-temperature protection is assured.

Since the case is not electrically insulated, the protector is furnished with a durable Mylar insulating sleeve. Shrinkable and non-shrinkable sleeves are available.

Technical Characteristics

Purpose of control:	thermal motor protector (TMP) thermal ballast protector (TBP) thermal cut-out (TCO)
Contact capacity:	250VAC 13A for TCO 250VAC 2A for TBP
Temperature range:	60°C to 150°C for TCO and TMP 60°C to 135°C for TBP
Tolerance on Open temp:	+/- 5K or +/- 8K
Automatic action:	Type 3C for TMP Type 2C for TBP and TCO
Operating time:	Continuous
Pollution situation:	Normal
Extent of sensing element:	Whole control
PTI of the insulation:	175
Enclosure protection degree:	IP00

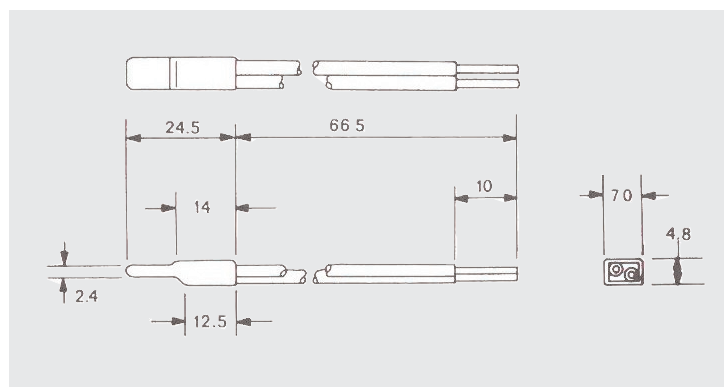
KEY BENEFITS

Miniature size-compact design assures ease of installation

Precision Calibration-temperature calibrated and inspected in controlled ambients for dependable consistent performance

Snapaction-positive make and break assured with proven Klixon® strip disc...contact pressure at open temperature eliminates nuisance trips due to vibration

Sealed steel case-withstands impregnation and baking...maybe varnish dipped...prevents changes in calibration during installation





9700 X X YY - ZZZZ

Z : Wire Lead and sleeve
Serial number is assigned for each lead and sleeve configuration, i.e. wire type, length, AWG#, stripped length, sleeve type, and length.

Y : Operating temperature and actuation disc material
Serial number is assigned for each desired temperature and resistance rating.

Nominal operating temperature	Resistance of actuation disc (ohms/cm ²)				
	30	250	850	100	475
	Temperature code				
60	56	57	58	59	60
80	91	92	93	94	95
90	21	22	23	24	25
100	26	27	28	29	30
110	36	37	38	39	40
120	1	2	3	4	5
130	11	12	13	14	15
140	66	67	68	69	70
150	46	47	48	49	50

This is a typical temperature code. There is a temperature code at each 5°C in a step from 60 to 150°C.

X : Open Temperature tolerance
: +/- 5K
2: +/- 8K

Example :
9700K01-215
Bimetal of 30ohms/cm²,
120°C operating temperature,
+/-5K tolerance with
AWG#18(UL3343 125°C-600V)
66.7mm length leads,
thick 0.15mm, dia. 6.9mm,
length 34mm, Mylar sleeve.

X : Contact material combination

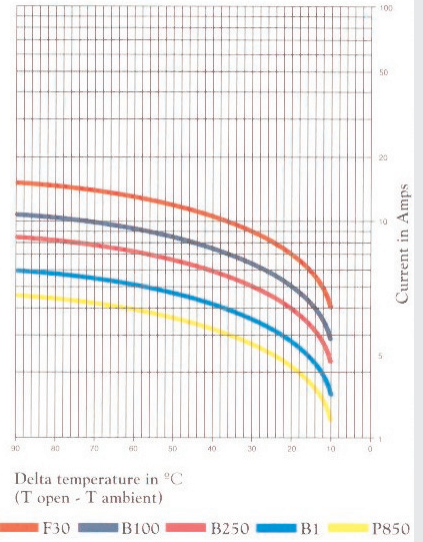
Code	Stationary contact	Movable contact
L	Steel + Fine silver	Steel + copper + Silver Cadmium oxide
K	Ag-Ni + Silver Cadmium oxide	Steel + copper + Silver Cadmium oxide
H	Brass + Fine silver	Steel + copper + Silver Cadmium oxide
P	Ag-Ni + Fine silver	Steel + Fine silver
S	Brass + Fine silver	Steel + Copper + Ag-Ni

Type "S" is set up for Cadmium-free contact

9700 : Device Identification

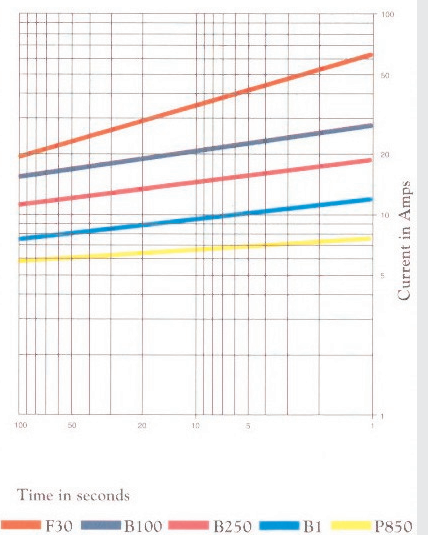
Ultimate trip current vs ambient temperature

Approx., to be used only for selecting samples for verification tests



Average first cycle tripping time vs current 25°C. ambient

Approx., to be used only for selecting samples for verification tests



Certifications

Agency	File number	Standard	Note
UL	E 15962	UL2111	Motor protector
ENEC	2014531.10	EN60730-2-9	Thermal cut-out
ENEC	2014531.10	EN60730-2-2	Thermal motor protector
ENEC	2014531.10	EN60730-2-3	Thermal ballast protector
CQC	CQC0200	2001344	

TECHNICAL / SALES SUPPORT

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Internet: www.sensata.com

Email: info-cpe@list.sensata.com



VFD-Driven Motors Are at Risk of Electrical Bearing Damage!

Motors operated by variable frequency drives (VFD) are vulnerable to VFD-induced shaft voltage and bearing currents that can cause premature bearing failure - often in as little as 3 months!

VFDs induce destructive shaft voltage that can discharge through motor bearings, burning bearing grease and reducing its effectiveness. Through electrical discharge machining (EDM), these discharges can also cause pitting, frosting, and fluting damage to the motor's bearings and eventual bearing failure. The result is costly repairs, downtime, and lost production.

Protect Motor Bearings With AEGIS® Shaft Grounding Rings

By channeling harmful VFD-induced shaft current away from bearings and safely to ground, AEGIS® Shaft Grounding Rings protect motors from costly bearing damage.

Bearing Protection Best Practices

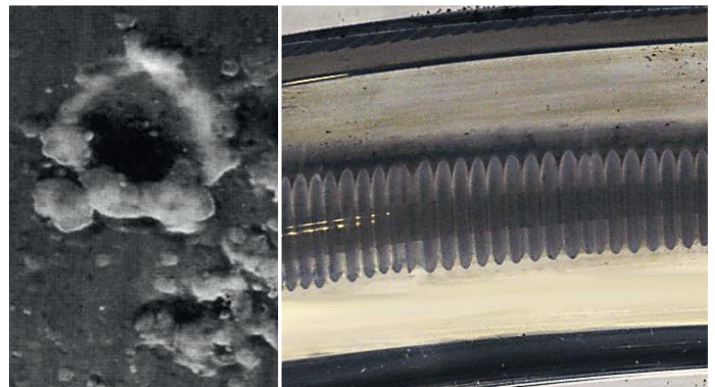
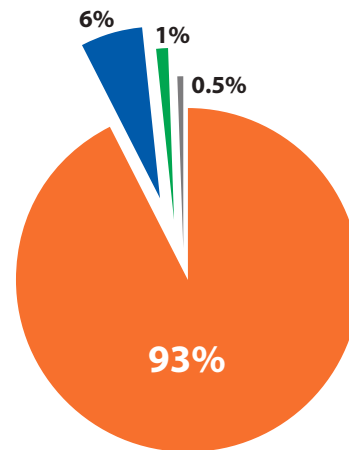
The AEGIS® Motor Repair Handbook details best practices for protecting VFD-driven motors from electrical bearing damage and preventing costly repairs, downtime and lost production.

Learn about:

- Bearing currents and shaft voltage
- AEGIS® technology
- Shaft voltage testing
- Installation best practices

For detailed recommendations, refer to the AEGIS® Bearing Protection Handbook. An essential reference, the Handbook is available free at

www.est-aegis.com/handbook



Prevent EDM Pitting and Fluting Damage

AEGIS® Shaft Grounding Ring Options



Standard Mounting Clamps (-1)

Shaft diameters: 0.311" to 6.02"
3 to 4 mounting clamps, 6-32 x 1/4" cap screws and washers



Split Ring (-1A4)

Shaft diameter: 0.311" to 6.02"
4 to 6 mounting clamps, 6-32 x 1/4" cap screws and washers
Installs without decoupling motor



Bolt Through Mounting (-3FH)

Shaft diameters: 0.311" to 6.02", 6-32 x 1/2" flat head screws
2 mounting holes up to shaft size 3.395"
4 mounting holes for larger sizes



Conductive Epoxy Mounting (-0AW, -0A4W)

Shaft diameters: 0.311" to 6.02"
Solid and Split Ring
Conductive Epoxy Included



Press Fit Mounting (-0A6)

Shaft diameters: 0.311" to 6.02"
Clean dry 0.004" press fit
Custom sizes available



uKIT with Universal Mounting Bracket

Sized for NEMA and IEC frame motors
Solid and Split Ring
Can be mounted with hardware or conductive epoxy



AEGIS® PRO Series

AEGIS® PROSL, PROSLR, PROMAX, PROMR



AEGIS® Shaft Voltage Tester™

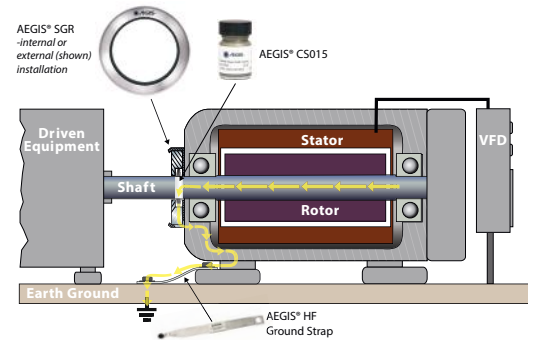
100 MHz Digital Oscilloscope, 10:1 probe with SVP tip for measuring voltages on a rotating shaft
AEGIS® One-Touch™ instant image capture



Accessories

HFGS - AEGIS® High-Frequency Ground Strap
CS015 - AEGIS® Colloidal Silver Shaft Coating
EP2400 - AEGIS® Conductive Epoxy

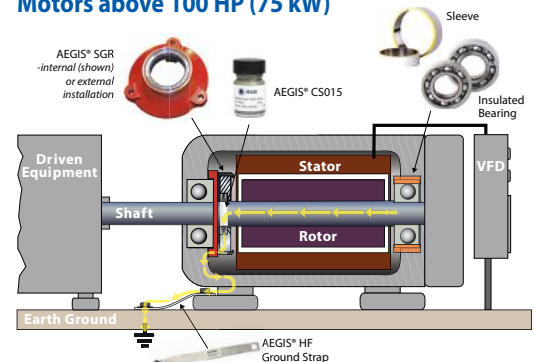
Motors up to and including 100 HP (75 kW)



Install AEGIS® Shaft Grounding Ring – either internally or externally – on drive end or the non-drive end of motor.

Product recommendation: AEGIS® SGR

Motors above 100 HP (75 kW)



- Drive End: Install AEGIS® Shaft Grounding Ring - Internally on the back of the bearing cap or externally on the motor end bracket.
- Non-Drive End: Isolate bearing housing with insulated sleeve or coating or use insulated ceramic or hybrid bearing to disrupt circulating currents.

Product recommendation:

LV Motors up to 500HP: AEGIS® SGR

LV Motors over 500HP: AEGIS® PRO Series

MV Motors: AEGIS® PRO Series



Standard
Paint
Specification

For

EM Gray

**NIDEC MOTOR CORPORATION
USEM DE MEXICO SA DE CV
Apodaca, Nuevo León, México**

CONTENTS

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

1.0 Scope

Nidec Motor Corporation in Apodaca, Nuevo Leon. Has selected enamel paint from "OSEL." 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 Apodaca, Nuevo Leon 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. Foundry to apply primer (approved by plant). Film Thickness: 1 to 3 mils.

- B. Prime all castings, in plant, if they have not been primed by the foundry.

Primer Dequimsa # DQ-PR-150

- C. All parts are to be cleaned prior to priming or finish painting as follows:
 - 1. If parts are dirty – wash and rise in parts washer.
 - 2. If parts are dusty – sandblast
 - 3. Thoroughly dry all parts prior to priming or finish painting. Primer must be applied immediately after cleaning and drying process.

4.0 Cast Aluminum.

Priming is not required on cast aluminum or fiberglass parts. Oxidation must be removed from aluminum parts with a solvent prior to finish painting.

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. 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: Foundry's

Alternate Primer Vendors:

AIR DRY PREMIER
ROBINSON CHEMICAL
COATINGS.
14-G-205

SHERWIN-WILLIAMS GRAY
ALKYD B50AZ6
KEM KROMIK
UNIVERSAL METAL
PRIMER

B. Standard Finish Paint

NMC P/N 138538
EM GRAY
VENDOR: PINTURAS OSEL
FORMULA #4588-B GRAY (LOW GLOSS)

VOC: ~ 3.6 lbs per gallon

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 on 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 Nidec Motor Corporation 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 of the 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

Should a motor supplied with a self-release coupling become uncoupled, the motor and pump must be stationary and all power locked out before manually re-coupling.

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).

WARNING

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.

⚠ WARNING

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		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).

Table 3
Nidec Motor Corporation Recommended Oil Viscosities

Use chart below when "no" special lubrication plate is attached to the motor

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	-15°C thru 40°C (5-104°F)	32	Mineral or Synthetic	
			41°C thru 50°C (105-122°F)	68	Synthetic Only	
-15°C thru 40°C (5-104°F)	404 thru 447		32	Mineral or Synthetic		
			41°C thru 50°C (105-122°F)	68	Synthetic Only	
Totally Enclosed or Explosion proof	449 thru 5811		1801-3600	-15°C thru 40°C (104°F)	32	Synthetic Only
			1800 & below		68	Synthetic Only
		All	41°C thru 50°C (105-122°F)	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	-15°C thru 25°C (5-77°F)	68	Mineral or Synthetic
			6°C thru 40°C (42-104°F)	150	
			41°C thru 50°C (105-122°F)		
Totally Enclosed or Explosion proof	449 and larger		-15°C thru 25°C (5-77°F)	68	Mineral or Synthetic
			6°C thru 40°C (42-104°F)	150	Synthetic Only
			41°C thru 50°C (105-122°F)	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	Cetus 32 Hipersyn	GST Turbine Oil 68	Cetus 32 Hipersyn	R & O Machine Oil 150	Cetus 32 Hipersyn
Conoco Oil Co.	Hydroclear Turbine Oil 32	Syncon 32	Hydroclear Turbine Oil 32	Syncon 32	Hydroclear AW Hyd. Fluid 150	N/A
ExxonMobil	DTE Oil Light, Teresstic 32	SHC 624	DTE Oil Heavy Medium, Teresstic 68	SHC 626	DTE Oil Extra Heavy, Teresstic 150	SHC 629
Phillips Petroleum Co.	Magnus 32	Syndustrial "E" 32	Magnus 68	Syndustrial "E" 68	Magnus 150	N/A
Shell Oil Co.	Tellus S2 MX 32	Tellus HD Oil AW SHF 32	Tellus S2 MX 68	Tellus HD Oil AW SHF 68	Morlina S3 BA 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	
HV, EV, JV, RV			
5000	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
5808-5810	HU, HV-4	24	3
5807-5811	EU, JU, EV-4, JV-4	37	4
5812	JU, JV4	41	4
5813	RU, RV-4	48	4
6808-6810	HU, HV-4	70	3
6808-6810	HV (Bow Thruster)	Grease	Grease
6808-6810	HV (Other Than Bow Thruster)	70	3
6812	JU, JV4	48	7
6813	RU, RV4	45	7
8000	RU, RV-4	70	6
	RV	Grease	Grease
9600	RU, RV-4	95	13
	RV	Grease	Grease
6812	JU, JV4	48	7
6813	RU, RV4	41	7

General Information for Integral Horsepower (IHP) Motors on Variable Frequency Drives (VFDs)

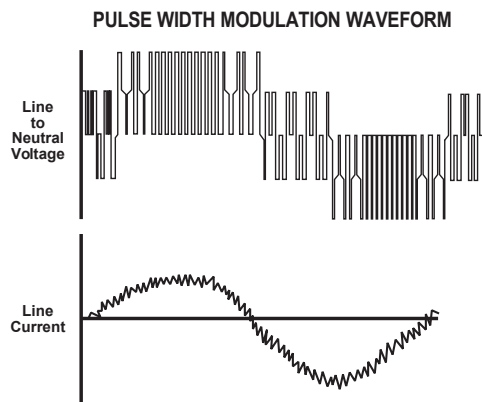
Variable Frequency Drives (VFD)

A VFD is a type of controller used to vary the speed of an electric motor. The VFD takes a fixed AC voltage and frequency and allows it to be adjusted in order to get different speeds from the motor. Motor speed can be varied by changing the frequency of the input power waveform. The equation below shows how the frequency affects the speed of a three phase induction motor.

$$\text{Speed} = \frac{120 * \text{Fundamental Input Frequency}}{\text{Number of Motor Poles}}$$

How does a VFD work?

A VFD takes the fixed frequency and voltage sine wave from the power grid or power station and puts it through a few steps in order to allow the VFD user to vary the frequency and in turn control the motor speed. First it rectifies the AC power into DC Power. Because of this step, a term commonly used instead of VFD is inverter. This only describes one step of what the VFD does to the power waveform. Once rectified into a DC voltage the drive sends the power through a set of transistors or switches. These switches can take the DC waveform and by opening and closing at certain speeds and durations can create an output waveform that mimics the sine wave that is required to drive a three phase electric motor. The output wave form is known as a Pulse Width Modulation (PWM) waveform because the waveform is created by multiple pulses of the switches at short intervals.



What variables should be considered when deciding whether to power a motor with a VFD?

VFD compatibility with motors is complex. As a result, many variables must be considered when determining the suitability of a particular motor for use with a VFD. These variables include:

- Torque requirements (Constant or Variable)
- Speed Range
- Line / System Voltage
- Cable length between the VFD and the motor
- Drive switching (carrier) frequency
- Motor construction

- VFD dv/dt - winding end turn differential in voltage versus differential in time
- High temperatures or high humidity
- Grounding system

Wider speed ranges, higher voltages, higher switching frequencies, insufficient grounding and increased cable lengths all add to the severity of the application and, therefore, the potential for premature motor failure.

How does a VFD affect the motor?

There are many things to consider when a motor is powered using a VFD or PWM power. When a motor is powered by a PWM waveform the motor windings very often see a large differential voltage, either from phase to phase or turn to turn. When the voltage differential becomes large enough it creates a reaction at the molecular level that converts available oxygen into O₃. This phenomenon is called partial discharge or corona. This reaction creates energy in the form of light and heat. This energy has a corrosive effect on the varnish used to protect the motor windings. PWM waveforms can also magnify shaft voltages which lead to arcing across the bearing and causing premature bearing failure. Corrective action must be taken to mitigate these issues that arise when using an electric motor with a VFD.

How do I protect the motor?

Nidec Motor Corporation (NMC) has developed specific motor designs to decrease the harmful affects that a VFD can have on a motor. NMC's INVERTER GRADE[®] insulation system is the first line of defense against corona and phase to phase faults that can be common when a motor is powered using a PWM waveform. The INVERTER GRADE[®] insulation system is standard on all of NMC's Inverter Duty products. Along with the INVERTER GRADE[®] insulation, thermostats are installed as a minimum protection against over heating the motor. Special consideration must also be given to bearings in motors powered by VFD's. In order to create a low resistance path to ground for built up shaft voltages a shaft grounding device can be used. On larger horsepower motors an insulated bearing system should be used in conjunction with the shaft grounding device when installed, to force the stray shaft voltages to ground. The bearing failures are more prominent on motors with thrust handling bearings. NMC has created an Inverter Duty vertical motor line that not only uses the INVERTER GRADE[®] insulation system, but that also comes standard with a shaft grounding device. On motors that are 100 HP and greater the thrust bearing is also insulated for additional protection.

What does "Inverter Duty" mean?

An Inverter Duty motor should describe a motor that helps mitigate potential failure modes of a motor that is powered by a VFD. Inverter duty motor windings should be able to withstand the voltage spikes per NEMA MG1 Part 31.4.4.2 and protect against overheating when the motor is run at slow speeds. On thrust handling bearings it is apparent that the bearings require additional protection. Inverter Duty vertical motors should have a shaft grounding device to protect the motor bearings from fluting due to voltage discharge through the bearing. On larger motors (100HP and larger) the shaft should also be electrically isolated from the frame in order to aid the shaft grounding ring in discharging the shaft voltages to ground.

*This information applies only to Integral Horsepower (IHP) motors as defined on the Agency Approval page, under UL[®] & CSA[®] listings where indicated.

Thermal Overloads and Single Phase Motors

Motors with thermal overloads installed may not operate properly on a VFD. The current carrying thermal overload is designed for sine wave power. Operation on a VFD may cause nuisance tripping or potentially not protect the motor as would be expected on line power. Thermostats or thermistors installed in the motor and connected properly to the VFD may provide suitable thermal overload protection when operating on a VFD. (consult codes for installation requirements)

Single phase motors and other fractional horsepower ratings are not designed to be operated on a VFD. Within Nidec Motor Corporation standard products, all motors NEMA[®] 48 frame (5.5" diameter) and smaller are not suitable for VFD applications. Three phase 56 and 143/145 frame applications should be noted on the catalog price page; or if in doubt ask a Nidec Motor Corporation technical representative for recommendations on compatibility with a VFD.

Slow Speed Motors

Motors with a base design of slower than six poles require special consideration regarding VFD sizing and minimizing harmonic distortion created at the motor terminals due to cable installation characteristics. Additional external PWM waveform filters and shielded motor cables designed for PWM power may be required to provide acceptable motor life. Harmonic distortion on the output waveform should be kept to a minimum level (less than 10%) mismatch impedance.

690V Applications

Motors that are rated for 690VAC and that will be powered by 690VAC PWM VFDs require the use of an external filter to limit peak voltage spikes and the use of an INVERTER GRADE[®] motor. Where available, an alternative to using an output filter is to upgrade to a 2300V insulation system.

Low Voltage TITAN[®] Motors

When using 449 frame and larger motors on PWM type VFDs consider the use of an external filter and shielded motor cables designed for PWM power to minimize harmonic distortion and peak voltages at the motor terminals. Harmonic distortion on the output waveform should be kept to a minimum level (less than 10%).

Bearing Currents Related to PWM Waveforms

Protection of the motor bearings from shaft currents caused by common mode voltages is becoming a standard feature on Inverter Duty motor products. Some installations may be prone to a voltage discharge condition through the motor bearings called Electrical Discharge Machining (EDM) or fluting. Vertical HOLLOWSHAFT and HOSTILE DUTY World Motor come with grounding devices installed as standard. EDM damage is related to characteristics of the PWM waveform, and the VFD programming, and installations factors.

Bearing Protection on Inverter Duty Vertical Motors

All U.S. MOTORS[®] brand "Inverter Duty" vertical products have a shaft grounding system that allows damaging shaft currents a low resistance path to ground. **Bearings on vertical motors fed by VFD power without this bearing protection are not covered under any warranty.** All other bearing failure is covered per NMC's standard warranty. An electric motor repair shop approved to service U.S. MOTORS[®] brand motors must verify that the cause of the bearing failure was not due to EDM damage.

Guideline For Insulated Anti-Friction Bearings

Bearing insulation is required to prevent circulating shaft currents which can damage bearings. Circulating shaft current can be caused by use of improper power and/or ground cables, improper grounding systems and higher switching frequencies. Finding and correcting the external condition(s) is the responsibility of the system designer or specifying engineer. To prevent circulating shaft current in motors with anti-friction bearings, Nidec Motor Corporation's standard practice is to insulate the non-drive end bearing.

Adjustable Speed Drives produce a common mode voltage condition. To interrupt common mode voltage on induction motors of all sizes, NEMA MG1-2018 Part 31 recommends insulating both bearings. In cases where both anti-friction bearings are insulated, the system designer or specifying engineer should determine whether to apply one or more of the following options to prevent or reduce shaft currents: sinewave filters, line reactors or mechanical devices, such as shaft grounding or an insulated half coupling. Motors with shaft grounding devices are not suitable for installation in hazardous locations unless housed in an enclosure suitable for the specified Division (or Zone), Class and Group(s).

Multiple Motors on a Single VFD

Special considerations are required when multiple motors are powered from a single VFD unit. Most VFD manufacturers can provide guidelines for proper motor thermal considerations and starting/stopping of motors. Cable runs from the VFD and each motor can create conditions that will cause extra stress on the motor winding. Filters may be required at the motor to provide maximum motor life.

Grounding and Cable Installation Guidelines

Proper output winding and grounding practices can be instrumental in minimizing motor related failures caused by PWM waveform characteristics and installation factors. VFD manufacturers typically provide detailed guidelines on the proper grounding of the motor to the VFD and output cable routing. Cabling manufacturers provide recommended cable types for PWM installations and critical information concerning output wiring impedance and capacitance to ground.

Integrated Motor and Inverter

By integrating the motor and inverter at NMC's manufacturing facility, many of the motor compatibility problems are minimized or eliminated. During the manufacturing process, the motor is matched to the inverter characteristics which ensures the winding temperature and torque levels meet the design specification. Since the inverter output wiring to the motor is nearly eliminated, bearing currents are rarely experienced. When the unit is properly grounded, reducing the output cable lengths in conjunction with an inverter grade insulation system and low factory setting of the switching frequency of the inverter drive, results in low risk of voltage peaks produced by the PWM waveform.

Vertical Motors on VFDs

Vertical motors operated on VFD power present unique conditions that may require consideration by the user or installation engineer:

- Locked rotor and drive tripping caused by non-reversing-ratchet operation at low motor speeds. It is not recommended to operate motors at less than 1/4 of synchronous speed. If slow speeds are required contact NMC engineering.
- Unexpected / unacceptable system vibration and or noise levels caused by the torque pulsation characteristics of the PWM waveform, a system critical frequency falling inside the variable speed range of the process or the added harmonic content of the PWM waveform exciting a system component
- Application related problems related to the controlled acceleration/deceleration and torque of the motor on VFD power and the building of system pressure/ load.
- The impact the reduction of pump speed has on the down thrust reflected to the pump motor and any minimum thrust requirements of the motor bearings
- Water hammer during shutdown damaging the non-reversing ratchet

Humidity and Non-operational Conditions

The possible build-up of condensation inside the motor due to storage in an uncontrolled environment or non-operational periods in an installation, can lead to an increased rate of premature winding or bearing failures when combined with the stresses associated with PWM waveform characteristics. Moisture and condensation in and on the motor winding over time can provide tracking paths to ground, lower the resistance of the motor winding to ground, and lower the Corona Inception Voltage (CIV) level of the winding.

Proper storage and maintenance guidelines are important to minimize the potential of premature failures. Space heaters or trickle voltage heating methods are the common methods for drying out a winding that has low resistance readings. **Damage caused by these factors are not covered by the limited warranty provided for the motor unless appropriate heating methods are properly utilized during non-operational periods and prior to motor start-up.**

NEMA[®] Application Guide for AC Adjustable Speed Drive Systems: <http://www.nema.org/stds/acadjustable.cfm#download>

* This information applies only to Integral Horsepower (IHP) motors as defined on the Agency Approval page, under UL[®] & CSA[®] listings where indicated.

Warranty Guidelines for Integral Horsepower (IHP)* Motors on Variable Frequency Drives

Warranty Guidelines

The information in the following section refers to the motor and drive application guidelines and limitations for warranty.

Hazardous Location Motors

Use of a variable frequency drive with the motors in this catalog, intended for use in hazardous locations, is only approved for Division 1, Class I, Group D hazardous location motors with a T2B temperature code, with a limitation of 2:1 constant torque or 10:1 variable torque output. **No other stock hazardous location motors are inherently suitable for operation with a variable frequency drive.** If other requirements are needed, including non-listed Division 2, please contact your Nidec Motor Corporation territory manager to conduct an engineering inquiry.

575 Volt Motors

575 volt motors can be applied on Inverters when output filters are used. Contact the drive manufacturer for filter selection and installation requirements.

Applying INVERTER GRADE® Insulated Motors on Variable Frequency Drives (2, 4, 6 pole)

The products within this catalog labeled “Inverter Duty” or “Vector Duty” are considered INVERTER GRADE® insulated motors. INVERTER GRADE® motors exceed the NEMA® MG-1 Part 31 standard. Nidec Motor Corporation provides a three-year limited warranty on all NEMA® frame INVERTER GRADE® insulated motors and allows long cable runs between the motor and the VFD (limited to 400 feet without output filters). Cable distance can be further limited by hot and humid environments and VFD manufacturers cable limits. These motors may be appropriate for certain severe inverter applications or when the factors relating to the end use application are undefined (such as spares).

Nidec Motor Corporation’s U.S. Motors® brand is available in the following INVERTER GRADE® insulated motors:

- Inverter Duty NEMA® frame motors good for 20:1 Variable Torque & 5:1 Constant Torque, including Vertical Type RUSI (10:1 V.T.)
- Inverter Duty motors rated for 20:1 Constant Torque
- ACCU-Torq® and Vector Duty Motors with full torque to 0 Speed or 5000:1
- 841 Plus® NEMA® Frame Motors

Applying Premium Efficient motors (that do not have INVERTER GRADE® insulation) on Variable Frequency Drives (2, 4, 6 pole)

Premium efficient motors without INVERTER GRADE insulation meet minimum NEMA® MG-1, Section IV, Part 31.4.4.2. These motors can be used with Variable Frequency Drives (with a reduced warranty period) under the following parameters:

- On NEMA® frame 447 and smaller motors, 20:1 speed rating on variable torque loads & 4:1 speed range on constant torque loads.
- On TITAN® 449 and larger frame motors, 10:1 speed rating on variable torque loads.

- On TITAN® frame motors, inquiry required for suitability on constant torque loads.

Cable distances are for reference only and can be further limited by hot and humid environments (refer to Table 1). Refer to specific VFD

Table 1 - Cable Distances			
Maximum Cable Distance VFD to Motor			
Switching Frequency	460 Volt	230 Volt	380 Volt
3 KHz	127 ft	400 ft	218 ft
6 KHz	90 ft	307 ft	154 ft
9 KHz	73 ft	251 ft	126 ft
12 KHz	64 ft	217 ft	109 ft
15 KHz	57 ft	194 ft	98 ft
20 KHz	49 ft	168 ft	85 ft

manufacturers cable limits. Refer to the Motor/ Inverter Compatibility page for special consideration of vertical motor bearings.

Warranty Period Clarifications and Exceptions

Standard Energy Efficient Exclusion

Applying Standard & Energy Efficient Motors on Variable Frequency Drives is not recommended. VFD related failures on standard and energy efficient motors will not be covered under warranty.

Vertical Motor Windings

Premium efficient vertical motors without INVERTER GRADE® insulation that are installed using the criteria described in this document and applied in the correct applications shall have a warranty while powered by a VFD for 12 months from date of installation or 18 months from date of manufacturing whichever comes first. See limited warranty page for horizontal motor warranty periods.

Bearing Exclusion for Thrust Handling Bearings

Bearings used in premium efficient vertical motors, and all thrust handling bearings, that are powered by VFDs without shaft grounding devices or insulated bearings (when required) will not be covered under any warranty for damages caused from being powered by a VFD. All other bearing failure is covered per NMC’s standard warranty. An electric motor repair shop approved to service U.S. MOTORS® brand motors must verify that the cause of the bearing failure was not due to Electrical Discharge Machining.

Medium Voltage and Slow Speed Considerations

Motors that are rated above 700 VAC or that are eight pole and slower require special consideration and installation and are not covered under the warranty guidelines in this document. Motors that are rated above 700VAC have special cable length and voltage differential issues that are specific to the VFD type and manufacture. The motor construction and cost may vary dramatically depending on the VFD topology and construction. Contact your NMC representative with VFD manufacturer name and model type for application and motor construction considerations. Motors that are designed eight pole and slower also require special installation and filters per the drive manufacturer.

* This information applies only to Integral Horsepower (IHP) motors as defined on the Agency Approval page, under UL® & CSA® listings where indicated.



HAYES PUMP, INC.
66 Old Powder Mill Road
West Concord, MA 01742
PH: 978-369-8800

SUBMITTAL DATA

JOB NAME:	Marsh Road Water Pump Station
	Hudson, NH
ENGINEER:	Weston & Sampson
	Reading, MA
REFERENCE:	Section 43 21 13.13, Pages 6-12, Part 2.02 – VFD’s
	Pump #1 – 15 HP, Pump #2 & #3 – 50 HP, and Pump #4 – 100 HP
QUANTITY:	Four (4) VFD’s

DESCRIPTION

MANUFACTURER:	Danfoss	MODEL:	VLT Aqua Drive FC 202
---------------	---------	--------	-----------------------

1.) Drive Selections

- P-1 – 15 HP – Size P11K – 21.0 amps
- P-2 & P-3 – 50 HP – Size P37K – 65.0 amps
- P-4 – 100 HP – Size P75K – 130.0 amps

2.) Drive Configuration

Each drive will be furnished with NEMA 12 wall mounted enclosure including:

- Fused disconnect switch mounted on enclosure exterior
- Amp ratings as specified per 43 21 13.14-7, 2.02.A.7
- HIM keypad mounted on enclosure exterior
- Hand-off-auto selection via keypad pushbuttons
- Manual speed adjustment via keypad up/down pushbuttons
- Input for external 4-20 mA analog speed single from station SCADA controller
- Input for remote start-stop signal
- Output contacts for remote indication of run status and VFD fault
- Specified keypad display monitoring functions
- Specified VFD protection features

ENGINEERING
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New generation VLT® AQUA Drive. World beating cost efficiency

100% dedicated to water applications from 0.25 kW to 2 MW.

30%

cost reduction in 1st
year compared with
next best alternative



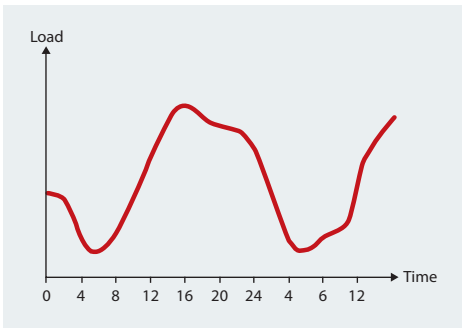
www.danfoss.com/aquadrive

VLT®
THE REAL DRIVE

In modern plants, energy savings are just part of the cost equation



Here in Aarhus, Denmark, this wastewater treatment plant has changed the energy picture, based on advanced process control and extensive use of the VLT® AQUA Drive. It is no longer a question of 60% energy savings, but rather of net production of energy from the whole plant.



The considerable daily load variation in water or wastewater treatment plants makes it economically attractive to install control handles on more or less all rotating equipment such as pumps and blowers. The new generation of the VLT® AQUA Drive is the ideal choice for the water industry, giving you precise control and a perfect match for all your applications.

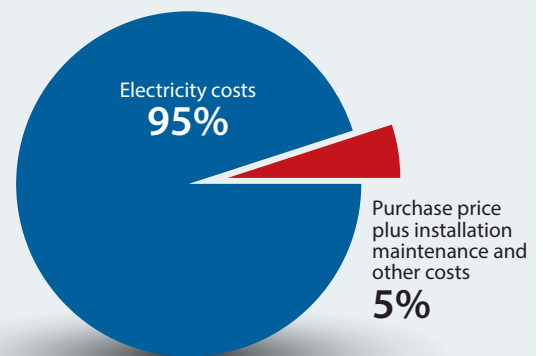
The benefits are obvious:

- Better water quality
- Better asset protection
- Less maintenance costs
- Reduced energy cost
- Higher plant reliability/performance

Small investment – big returns Look at the lifetime savings

Over the last decades, the relative cost of Variable Speed Drives (VSDs) has dropped and energy prices have increased. This makes it more attractive to use VSDs on more or less all rotating equipment. Over the lifetime of the VSD, energy cost is the dominating economical factor. The energy efficiency of the VSD must therefore be a key selection parameter.

The new generation VLT® AQUA Drive's 0.5 to 2% better installed energy efficiency compared with traditional drives is on same level as savings gained by moving from an IE2 to an IE3 motor.





Nothing beats know how and experience

The new generation VLT® AQUA Drive built from the bottom up To deliver the ultimate cost efficiency

The new generation VLT® AQUA Drive is built on a solid foundation of know-how and experience – combine this with Danfoss quality and our global network of local 24/7 service and you get rock solid reliability.

Fits all motors

Danfoss is the world's largest dedicated and motor independent VSD supplier. By keeping at the forefront of control algorithms for new motor technologies, we can always offer you a free choice between motor suppliers.

A powerful combination

Three pillars raise the performance of the VLT® AQUA Drive to new heights: It's our unique combination of energy savings, reduced installation costs and a solid dedication to all your water applications that sets the new generation VLT® AQUA Drive above the competition when it comes to overall lifetime savings.

Up to 30% first-year cost savings

With a combination of powerful new features and functions, the new generation VLT® AQUA Drive can realistically offer first-year cost savings between 10 – 30%, relative to the investment made in the drives, compared to traditional drive solutions.



Market leading energy efficiency

Save up to 25% of investment first year

Our tight focus on energy efficiency at every stage of development including the net efficiency when the new generation VLT® AQUA Drive is installed means that you get a drive that delivers cost savings of up to 25% of investment in the drive in its first year, when compared to traditional VSD solutions. That's the equivalent to the savings gained by choosing an IE 3 motor instead of an IE 2.



Efficiency

5 reasons to choose new VLT® AQUA Drive

1. Energy efficient VSD design
2. Intelligent heat management
3. Automatic adaption to application
4. Energy efficient harmonic mitigation
5. Optimal control of all motors

1. Energy efficient design

The new generation VLT® AQUA Drive's control algorithm and design focuses on reducing heat loss, to maximise energy efficiency.

2. Intelligent heat management

An unique back channel cooling concept transfers up to 90% of heat away from the room. This results in large energy savings on unnecessary air conditioning.

Go to www.danfoss.com for video.

3. Automatic adaption to application

Around 90% of all motors are oversized by more than 10%. AEO functionality can deliver energy savings of around 2% at the 90% load, with typical savings up to 5% over the whole range.

4. Energy efficient harmonic mitigation

Our unique VLT® Low Harmonic Drive with integrated AAF filter delivers an energy efficiency that is 2-3% better than traditional VSD with Active Front End technology. Sleep function at low load secures further energy savings.

5. Optimal control of all motors

The VLT® AQUA Drive's capability to efficiently operate the different motor types in the market, secures you a free choice between motor suppliers. One of the latest developments is for high speed PM motors.

The unique Danfoss VVC+ control technology is ideal for high speed turbo blowers using PM motors, offering from 0.5 to 3% additional installed energy savings compared with using traditional VSDs.

Installation savings and user friendliness

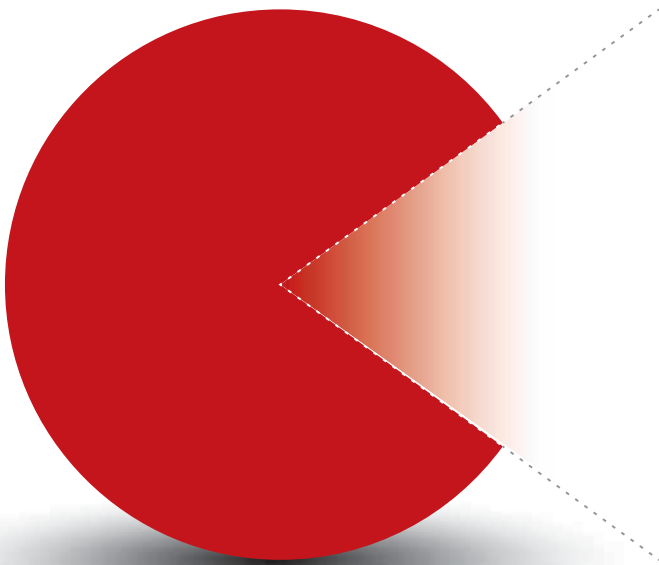
Save up to 20%



Based on our lengthy experience with the first ever dedicated water and wastewater drive on the market, the new generation VLT® AQUA Drive offers very efficient installation and commissioning solutions which, compared to traditional VSDs, offer cost saving of between 10-20%.

Simplicity

8 reasons to choose new VLT® AQUA Drive



1. Less panel space
2. Direct outdoor installation
3. Long cable capability as standard
4. Reduce air conditioning investment
5. Integrated harmonic mitigation
6. Printed circuit board protection as standard
7. Easy commissioning
8. Minimum 10 years' lifetime

1. Less panel space

The unique combination of Danfoss VLT® Low Harmonic Drive with integrated AAF filters, the ability to install the new generation VLT® AQUA Drive side by side and its compact design offer a very space-friendly package when the complete solution is installed.

2. Direct outdoor installation

As standard, Danfoss offers VSD in IP66/NEMA4X. In addition to the convenience of having the VSD close to the pump, for example, this typically reduces cable costs, removes the need for air condition capacity and lowers control room costs.

3. Long cable capability as standard

Without the need for additional components, the VLT® AQUA Drive provides trouble free operation with cable lengths up to 150 m screened and 300 m unscreened.

4. Air conditioning investment reduced by 90%

Unique Danfoss back channel cooling system offers up to 90% reduction in investment for air cooling systems to remove heat from the VSDs.

5. Integrated harmonic mitigation

The VLT® AQUA Drive is delivered with integrated harmonic mitigation solutions to a THDi level of 40% as standard. This saves space and costs while making installation easier.

6. Printed circuit boards protection as standard

From 90 kW the VLT® AQUA Drive comes as standard with 3C3 PCB coating to ensure long lifetime even in harsh wastewater environments.

7. Easy commissioning

Whether it's a 0.25 kW or 2 MW drive you get the same control panel with local language, the new SmartStart function and many other time saving features.

8. Designed for a minimum 10 years' lifetime

With the VLT® AQUA Drive's high quality components, maximum 80% load on components and intelligent heat management reducing dust on PCB's, the need for routine scheduled parts replacements, such as electrolytic capacitors and fans has been removed.

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Selection Guide 0.25 kW – 1.4 MW

VLT® AQUA Drive FC 202 series for a Masterclass Performance



30%

cost saving in the
first year, compared
to traditional drive
systems

drives.danfoss.com

VLT®

VLT® AQUA Drive technical data

Basic unit without extensions

Main supply (L1, L2, L3)	
Supply voltage	1 x 200 – 240 V AC..... 1.1 – 22 kW 1 x 380 – 480 V AC..... 7.5 – 37 kW 3 x 200 – 240 V AC..... 0.25 – 45 kW 3 x 380 – 480 V AC..... 0.37 – 1000 kW 3 x 525 – 600 V AC..... 0.75 – 90 kW 3 x 525 – 690 V AC..... 1.1 – 1400 kW*
Supply frequency	50/60 Hz
Displacement power factor (cos φ) near unity	> 0.98
True power factor (λ)	≥ 0.9
Switching on input supply L1, L2, L3	1–2 times/min.
Harmonic disturbance	Meets EN 61000-3-12

* Up to 2000 kW available on request

Output data (U, V, W)	
Output voltage	0 – 100% of supply voltage
Output frequency (dependent on power size)	0-590 Hz
Switching on output	Unlimited
Ramp times	0.1 – 3600 sec.

Note: VLT® AQUA Drive can provide 110%, 150% or 160% current for 1 minute, dependent on power size and parameter settings. Higher overload rating is achieved by oversizing the drive.

Digital inputs	
Programmable digital inputs	6*
Changeable to digital output	2 (terminal 27, 29)
Logic	PNP or NPN
Voltage level	0 – 24 V DC
Maximum voltage on input	28 V DC
Input resistance, Ri	Approx. 4 kΩ
Scan interval	5 ms

* Two of the inputs can be used as digital outputs.

Analog inputs	
Analogue inputs	2
Modes	Voltage or current
Voltage level	0 to +10 V (scaleable)
Current level	0/4 to 20 mA (scaleable)
Accuracy of analog inputs	Max. error: 0.5% of full scale

Pulse inputs	
Programmable pulse inputs	2*
Voltage level	0 – 24 V DC (PNP positive logic)
Pulse input accuracy (0.1 – 1 kHz)	Max. error: 0.1% of full scale

* Two of the digital inputs can be used for pulse inputs.

Digital outputs	
Programmable digital/pulse outputs	2
Voltage level at digital/frequency output	0 – 24 V DC
Max. output current (sink or source)	40 mA
Maximum output frequency at frequency output	0 to 32 kHz
Accuracy on frequency output	Max. error: 0.1% of full scale

Analogue output	
Programmable analogue outputs	1
Current range at analogue output	0/4 – 20 mA
Max. load to common at analogue output (clamp 30)	500 Ω
Accuracy on analogue output	Max. error: 1% of full scale

Control card	
USB interface	1.1 (Full Speed)
USB plug	Type "B"
RS485 interface	Up to 115 kBaud
Max. load (10 V)	15 mA
Max. load (24 V)	200 mA

Relay output	
Programmable relay outputs	2
Max. terminal load (AC) on 1-3 (break), 1-2 (make), 4-6 (break) power card	240 V AC, 2 A
Max. terminal load (AC) on 4-5 (make) power card	400 V AC, 2 A
Min. terminal load on 1-3 (break), 1-2 (make), 4-6 (break), 4-5 (make) power card	24 V DC 10 mA, 24 V AC 20 mA

Surroundings/external	
Enclosure	IP: 00/20/21/54/55/66 UL Type: Chassis/1/12/4x Outdoor
Vibration test	1.0 g (D, E & F-enclosures: 0.7 g)
Max. relative humidity	5% – 95% (IEC 721-3-3; Class 3K3 (non-condensing) during operation)
Ambient temperature	Up to 55° C (50° C without derating; D-frame 45° C)
Galvanic isolation of all	I/O supplies according to PELV
Aggressive environment	Designed for coated/uncoated 3C3/3C2 (IEC 60721-3-3)

Fieldbus communication	
Standard built-in: FC Protocol Modbus RTU	Optional: VLT® PROFIBUS DP V1 MCA 101 VLT® DeviceNet MCA 104 VLT® PROFINET MCA 120 VLT® EtherNet/IP MCA 121 VLT® Modbus TCP MCA 122

Ambient temperature	
– Electronic thermal motor protection against overload	
– Up to 55° C (50° C without derating; D-frame 45° C)	
– Temperature monitoring of the heatsink ensures that the frequency converter trips in case of overtemperature	
– The frequency converter is protected against short-circuits on motor terminals U, V, W	
– The frequency converter is protected against earth faults on motor terminals U, V, W	
– Protection against mains phase loss	

Application options	
Extend the functionality of the drive with integrated options:	
<ul style="list-style-type: none"> • VLT® General Purpose I/O MCB 101 • VLT® Extended Cascade Controller MCO 101 • VLT® Advanced Cascade Controller MCO 102 • VLT® Sensor Input MCB 114 • VLT® PTC Thermistor Card MCB 112 • VLT® Extended Relay Card MCB 113 • VLT® 24 V External Supply MCB 107 	

Relay and analogue I/O option	
<ul style="list-style-type: none"> • VLT® Relay Card MCB 105 • VLT® Analog I/O MCB109 	

Power options	
Choose from a wide range of external power options for use with our drive in critical networks or applications:	
<ul style="list-style-type: none"> • VLT® Low Harmonic Drive • VLT® Advanced Active Filter • VLT® Advanced Harmonic Filter • VLT® dU/dt filter • VLT® Sine wave filter (LC filter) 	

High power options	
See the VLT® High Power Drive Selection Guide for a complete list.	

PC software tools	
<ul style="list-style-type: none"> • VLT® Motion Control Tool MCT 10 • VLT® Energy Box • VLT® Motion Control Tool MCT 31 	



PRODUCT DETAILS – 131F1417 / EAN: 5702427408388

VLT® AQUA DRIVE FC 202

FC-202P11KT4E55H1XGX1XXSXXXAXBXCXXXDX

Danfoss VLT® AQUA Drive is dedicated to water and wastewater applications. With a wide range of powerful standard and optional features, the VLT® AQUA Drive provides the lowest overall cost of ownership for water and wastewater applications.

[← BACK TO CONFIGURATION](#) [← RETURN TO: CONFIGURATOR HOME](#)

General Information

Configuration Details

Efficiency Data

DrivePro®

Documents

Accessories

Services

CHARACTERISTIC	VALUE
Product Group	VLT® AQUA Drive FC-
Series	202
Power Rating	(P11K) 11 KW / 15 HP
Phase	Three phase
Mains Voltage	380 - 480 VAC
Enclosure	IP55 / Type 12
RFI Filter	(H1) RFI Class A1/B (C1)
Brake - Safe Stop	No brake chopper
LCP	Graphical Loc. Cont. Panel
Coating PCB	Not coated PCB
Mains Option	Mains Disconnect
Adaptation A	Standard Cable Entries
Adaptation B	No adaptation
Software Release	Latest release std. SW.
Software Language Pack	Standard Language Pack
A Option	No A Option
B Option	No B Option
C0 Option MCO	No C0 option

C Option Software	No software option
D Option	No D option
Frame Size	B1
Typecode Part 1	FC-202P11KT4E55H1XGX
Typecode Part 2	1XSXXXXAXBXXXXDX
Product Catalog	Global (Standard)
Power 160% (HO) [KW]	7.5
Power 110% (NO) [KW]	11
Height [mm]	480,0
Width w/ no C options [mm]	242,0
Depth [mm]	260,0
Depth with Option A/B [mm]	260,0
kVA	16.6
Power Loss NO [W]	392
Power Loss NO [W]	392
Power Loss HO [W]	291
Power Loss HO [W]	291
Continuous Current (NO) [A]	24
Intermittent Current (NO) [A]	26.4
Continuous Current (NO) [A]	21
Intermittent Current (NO) [A]	23.1
Continuous Current (HO) [A]	16
Intermittent Current (HO) [A]	25.6
Continuous Current (HO) [A]	14.5
Intermittent Current (HO) [A]	23.2
Calculated Gross Weight	21.800
Calculated Net Weight [kg]	21.500
Vendor	Cannot Determine Vendor
Modelcode01	FC-202P11KT4E55H1XGX
Modelcode02	1XSXXXXAXBXXXXDX

[T4] 3 x 380-480 V AC – normal overload

Type code	Normal overload (110% 1 min/10 min)							Enclosure size				
	Output current				Typical shaft output power	Continu-ous input current	Estimated power loss	Protection rating [IEC/UL]				
	(3 x 380-440 V)		(3 x 441-500 V)					IP20/21	IP21	IP55	IP66	
FC-202	Con. I _N	Inter. I _{MAX} (60 s)	Con. I _N	Inter. I _{MAX} (60 s)	kW @ 400 V	Hp @ 460 V	[A] @ 400 V	[W]	Chassis	Type 1	Type 12	Type 4X
PK37	1.3	1.4	1.2	1.3	0.37	0.5	1.2	35	A2	A2*	A4/A5**	A4/A5**
PK55	1.8	2	1.6	1.8	0.55	0.75	1.6	42	A2	A2*	A4/A5**	A4/A5**
PK75	2.4	2.6	2.1	2.3	0.75	1	2.2	46	A2	A2*	A4/A5**	A4/A5**
P1K1	3	3.3	2.7	3	1.1	1.5	2.7	58	A2	A2*	A4/A5**	A4/A5**
P1K5	4.1	4.5	3.4	3.7	1.5	2	3.7	62	A2	A2*	A4/A5**	A4/A5**
P2K2	5.6	6.2	4.8	5.3	2.2	3	5.0	88	A2	A2*	A4/A5**	A4/A5**
P3K0	7.2	7.9	6.3	6.9	3	4	6.5	116	A2	A2*	A4/A5**	A4/A5**
P4K0	10	11	8.2	9	4	5	9.0	124	A2	A2*	A4/A5**	A4/A5**
P5K5	13	14.3	11	12.1	5.5	7.5	11.7	187	A3	A3*	A5	A5
P7K5	16	17.6	14.5	16	7.5	10	14.4	225	A3	A3*	A5	A5
P11K	24	26.4	21	23.1	11	15	22	392	B3	B1	B1	B1
P15K	27	29.7	27	29.7	15	20	20	392	B3	B1	B1	B1
P18K	37.5	41.3	34	37.4	18.5	25	34	465	B3	B1	B1	B1
P22K	44	48.4	40	44	22	30	40	525	B4	B2	B2	B2
P30K	61	67.1	52	61.6	30	40	55	739	B4	B2	B2	B2
P37K	73	80.3	65	71.5	37	50	66	698	B4	C1	C1	C1
P45K	90	99	80	88	45	60	82	843	C3	C1	C1	C1
P55K	106	117	105	116	55	75	96	1083	C3	C1	C1	C1
P75K	147	162	130	143	75	100	133	1384	C4	C2	C2	C2
P90K	177	195	160	176	90	125	161	1474	C4	C2	C2	C2

* Requires an IP21/Type 1 kit. Available in North America only.

** A4 does not accept any C options

[T4] 3 x 380-480 V AC – high overload

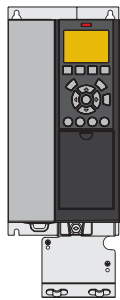
Type code	High overload (160% 1 min/10 min)							Enclosure size				
	Output current				Typical shaft output power	Continu-ous input current	Estimated power loss	Protection rating [IEC/UL]				
	(3 x 380-440 V)		(3 x 441-500 V)					IP20/21	IP21	IP55	IP66	
FC-202	Con. I _N	Inter. I _{MAX} (60 s)	Con. I _N	Inter. I _{MAX} (60 s)	kW @ 400 V	Hp @ 460 V	[A] @ 400 V	[W]	Chassis	Type 1	Type 12	Type 4X
PK37	1.3	2	1.2	1.8	0.37	0.5	1.2	35	A2	A2*	A4/A5**	A4/A5**
PK55	1.8	2.7	1.6	2.4	0.55	0.75	1.6	42	A2	A2*	A4/A5**	A4/A5**
PK75	2.4	3.6	2.1	3.2	0.75	1	2.2	46	A2	A2*	A4/A5**	A4/A5**
P1K1	3	4.5	2.7	4.1	1.1	1.5	2.7	58	A2	A2*	A4/A5**	A4/A5**
P1K5	4.1	6.2	3.4	5.1	1.5	2	3.7	62	A2	A2*	A4/A5**	A4/A5**
P2K2	5.6	8.4	4.8	7.2	2.2	3	5.0	88	A2	A2*	A4/A5**	A4/A5**
P3K0	7.2	10.8	6.3	9.5	3	4	6.5	116	A2	A2*	A4/A5**	A4/A5**
P4K0	10	15	8.2	12.3	4	5	9.0	124	A2	A2*	A4/A5**	A4/A5**
P5K5	13	19.5	11	16.5	5.5	7.5	11.7	187	A3	A3*	A5	A5
P7K5	16	24	14.5	21.8	7.5	10	14.4	225	A3	A3*	A5	A5
P11K	16	25.6	14.5	23.2	7.5	10	14	291	B3	B1	B1	B1
P15K	24	38.4	21	33.6	11	15	22	291	B3	B1	B1	B1
P18K	32	51.2	27	43.2	15	20	29	379	B3	B1	B1	B1
P22K	37.5	60	34	54.4	18.5	25	34	444	B4	B2	B2	B2
P30K	44	70.4	40	64	22	30	40	547	B4	B2	B2	B2
P37K	61	91.5	52	78	30	40	55	570	B4	C1	C1	C1
P45K	73	110	65	97.5	37	50	66	697	C3	C1	C1	C1
P55K	90	135	80	120	45	60	82	891	C3	C1	C1	C1
P75K	106	159	105	158	55	75	96	1022	C4	C2	C2	C2
P90K	147	221	130	195	75	100	133	1232	C4	C2	C2	C2

* Requires an IP21/Type 1 kit. Available in North America only.

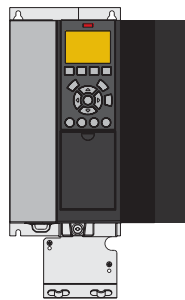
** A4 does not accept any C options

Dimensions enclosure sizes A, B and C

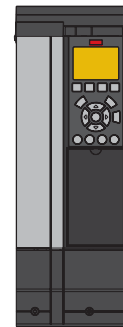
Enclosure size		VLT® AQUA Drive													
		A2		A3		A4	A5	B1	B2	B3	B4	C1	C2	C3	C4
Protection rating [IEC/UL]		IP20 Chassis	IP21 Type 1	IP20 Chassis	IP21 Type 1	IP55/Type 12 IP66/Type 4X		IP21/Type 1 IP55/Type 12 IP66/Type 4X		IP20/Chassis	IP21/Type 1 IP55/Type 12 IP66/Type 4X		IP20/Chassis		
[mm]	Height	268	375	268	375	390	420	480	630	399	520	680	770	550	660
	Height with decoupling plate	374	-	374	-	-	-	-	-	420	595	-	-	630	800
	Width	90	90	130	130	200	242	242	242	165	230	308	370	308	370
	Width with one C option	130	130	170	170	-	242	242	242	205	230	308	370	308	370
	Depth	205	207	205	207	175	200	260	260	249	242	310	335	333	333
	Depth with A, B option	220	222	220	222	175	200	260	260	262	242	310	335	333	333
	Depth with mains disconnect	-	-	-	-	206	224	289	290	-	-	344	378	-	-
[kg]	Weight	4.9	5.3	6	7	9.7	14.2	23	27	12	23.5	45	64	35	50
[in]	Height	10.6	14.8	10.6	14.8	15.4	16.6	18.9	25.6	15.8	20.5	26.8	30.4	21.7	26
	Height with decoupling plate	14.8	-	14.8	-	-	-	-	-	16.6	23.5	-	-	24.8	31.5
	Width	3.6	3.6	5.2	5.2	7.9	9.6	9.6	9.6	6.5	9.1	12.2	14.6	12.2	14.6
	Width with one C option	5.2	5.2	6.7	6.7	-	9.6	9.6	9.6	8.1	9.1	12.2	14.6	12.2	14.6
	Depth	8.1	18.2	8.1	8.2	6.9	7.9	10.3	10.3	9.8	9.6	12.3	13.2	13	13
	Depth with mains disconnect	-	-	-	-	8.2	8.9	11.4	11.5	-	-	13.6	14.9	-	-
	Depth with A, B option	8.7	8.8	8.7	8.8	6.9	7.9	10.3	10.3	10.4	9.6	12.3	13.2	13	13
[lb]	Weight	10.8	11.7	14.6	15.5	21.5	31.5	50.7	59.6	26.5	52	99.3	143.3	77.2	110.2



A3 IP20/Chassis with decoupling plate



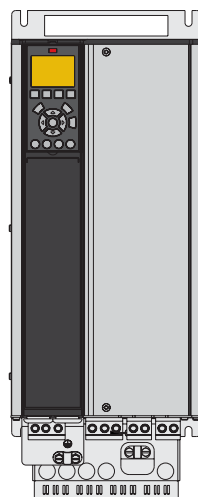
A3 IP20 with option C



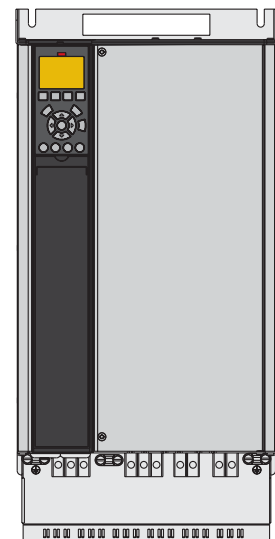
A3 with IP21/Type 12 NEMA 1 Kit



A4 IP55 with mains disconnect



B4 IP20



C3 IP20



PRODUCT DETAILS – 131F2053 / EAN: 5702427415669

VLT® AQUA DRIVE FC 202

FC-202P37KT4E55H1XGX1XXSXXXAXBXCXXXDX

Danfoss VLT® AQUA Drive is dedicated to water and wastewater applications. With a wide range of powerful standard and optional features, the VLT® AQUA Drive provides the lowest overall cost of ownership for water and wastewater applications.

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CHARACTERISTIC	VALUE
Product Group	VLT® AQUA Drive FC-
Series	202
Power Rating	(P37K) 37 KW / 50 HP
Phase	Three phase
Mains Voltage	380 - 480 VAC
Enclosure	IP55 / Type 12
RFI Filter	(H1) RFI Class A1/B (C1)
Brake - Safe Stop	No brake chopper
LCP	Graphical Loc. Cont. Panel
Coating PCB	Not coated PCB
Mains Option	Mains Disconnect
Adaptation A	Standard Cable Entries
Adaptation B	No adaptation
Software Release	Latest release std. SW.
Software Language Pack	Standard Language Pack
A Option	No A Option
B Option	No B Option
C0 Option MCO	No C0 option

C Option Software	No software option
D Option	No D option
Frame Size	C1
Typecode Part 1	FC-202P37KT4E55H1XGX
Typecode Part 2	1XSXXXXAXBXXXXDX
Product Catalog	Global (Standard)
Power 150% (HO) [KW]	30
Power 110% (NO) [KW]	37
Height [mm]	680,0
Width w/ no C options [mm]	308,0
Depth [mm]	310,0
Depth with Option A/B [mm]	310,0
kVA	50.6
Power Loss NO [W]	698
Power Loss NO [W]	698
Power Loss HO [W]	570
Power Loss HO [W]	570
Continuous Current (NO) [A]	73
Intermittent Current (NO) [A]	80.3
Continuous Current (NO) [A]	65
Intermittent Current (NO) [A]	71.5
Continuous Current (HO) [A]	61
Intermittent Current (HO) [A]	91.5
Continuous Current (HO) [A]	52
Intermittent Current (HO) [A]	78
Calculated Gross Weight	40.300
Calculated Net Weight [kg]	40.000
Vendor	Cannot Determine Vendor
Modelcode01	FC-202P37KT4E55H1XGX
Modelcode02	1XSXXXXAXBXXXXDX

[T4] 3 x 380-480 V AC – normal overload

Type code	Normal overload (110% 1 min/10 min)							Enclosure size				
	Output current				Typical shaft output power	Continu-ous input current	Estimated power loss	Protection rating [IEC/UL]				
	(3 x 380-440 V)		(3 x 441-500 V)					IP20/21	IP21	IP55	IP66	
FC-202	Con. I _N	Inter. I _{MAX} (60 s)	Con. I _N	Inter. I _{MAX} (60 s)	kW @ 400 V	Hp @ 460 V	[A] @ 400 V	[W]	Chassis	Type 1	Type 12	Type 4X
PK37	1.3	1.4	1.2	1.3	0.37	0.5	1.2	35	A2	A2*	A4/A5**	A4/A5**
PK55	1.8	2	1.6	1.8	0.55	0.75	1.6	42	A2	A2*	A4/A5**	A4/A5**
PK75	2.4	2.6	2.1	2.3	0.75	1	2.2	46	A2	A2*	A4/A5**	A4/A5**
P1K1	3	3.3	2.7	3	1.1	1.5	2.7	58	A2	A2*	A4/A5**	A4/A5**
P1K5	4.1	4.5	3.4	3.7	1.5	2	3.7	62	A2	A2*	A4/A5**	A4/A5**
P2K2	5.6	6.2	4.8	5.3	2.2	3	5.0	88	A2	A2*	A4/A5**	A4/A5**
P3K0	7.2	7.9	6.3	6.9	3	4	6.5	116	A2	A2*	A4/A5**	A4/A5**
P4K0	10	11	8.2	9	4	5	9.0	124	A2	A2*	A4/A5**	A4/A5**
P5K5	13	14.3	11	12.1	5.5	7.5	11.7	187	A3	A3*	A5	A5
P7K5	16	17.6	14.5	16	7.5	10	14.4	225	A3	A3*	A5	A5
P11K	24	26.4	21	23.1	11	15	22	392	B3	B1	B1	B1
P15K	32	35.2	27	29.7	15	20	29	392	B3	B1	B1	B1
P18K	37.5	41.3	34	37.4	18.5	25	34	465	B3	B1	B1	B1
P22K	44	48.4	40	44	22	30	40	525	B4	B2	B2	B2
P30K	61	67.1	52	61.8	30	40	55	759	B4	B2	B2	B2
P37K	73	80.3	65	71.5	37	50	66	698	B4	C1	C1	C1
P45K	90	99	80	88	45	60	82	842	C3	C1	C1	C1
P55K	106	117	105	116	55	75	96	1083	C3	C1	C1	C1
P75K	147	162	130	143	75	100	133	1384	C4	C2	C2	C2
P90K	177	195	160	176	90	125	161	1474	C4	C2	C2	C2

* Requires an IP21/Type 1 kit. Available in North America only.
 ** A4 does not accept any C options

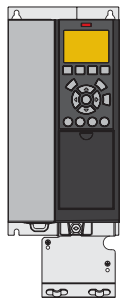
[T4] 3 x 380-480 V AC – high overload

Type code	High overload (160% 1 min/10 min)							Enclosure size				
	Output current				Typical shaft output power	Continu-ous input current	Estimated power loss	Protection rating [IEC/UL]				
	(3 x 380-440 V)		(3 x 441-500 V)					IP20/21	IP21	IP55	IP66	
FC-202	Con. I _N	Inter. I _{MAX} (60 s)	Con. I _N	Inter. I _{MAX} (60 s)	kW @ 400 V	Hp @ 460 V	[A] @ 400 V	[W]	Chassis	Type 1	Type 12	Type 4X
PK37	1.3	2	1.2	1.8	0.37	0.5	1.2	35	A2	A2*	A4/A5**	A4/A5**
PK55	1.8	2.7	1.6	2.4	0.55	0.75	1.6	42	A2	A2*	A4/A5**	A4/A5**
PK75	2.4	3.6	2.1	3.2	0.75	1	2.2	46	A2	A2*	A4/A5**	A4/A5**
P1K1	3	4.5	2.7	4.1	1.1	1.5	2.7	58	A2	A2*	A4/A5**	A4/A5**
P1K5	4.1	6.2	3.4	5.1	1.5	2	3.7	62	A2	A2*	A4/A5**	A4/A5**
P2K2	5.6	8.4	4.8	7.2	2.2	3	5.0	88	A2	A2*	A4/A5**	A4/A5**
P3K0	7.2	10.8	6.3	9.5	3	4	6.5	116	A2	A2*	A4/A5**	A4/A5**
P4K0	10	15	8.2	12.3	4	5	9.0	124	A2	A2*	A4/A5**	A4/A5**
P5K5	13	19.5	11	16.5	5.5	7.5	11.7	187	A3	A3*	A5	A5
P7K5	16	24	14.5	21.8	7.5	10	14.4	225	A3	A3*	A5	A5
P11K	16	25.6	14.5	23.2	7.5	10	14	291	B3	B1	B1	B1
P15K	24	38.4	21	33.6	11	15	22	291	B3	B1	B1	B1
P18K	32	51.2	27	43.2	15	20	29	379	B3	B1	B1	B1
P22K	37.5	60	34	54.4	18.5	25	34	444	B4	B2	B2	B2
P30K	44	70.4	40	64	22	30	40	547	B4	B2	B2	B2
P37K	61	91.5	52	78	30	40	55	570	B4	C1	C1	C1
P45K	73	110	65	97.5	37	50	66	697	C3	C1	C1	C1
P55K	90	135	80	120	45	60	82	891	C3	C1	C1	C1
P75K	106	159	105	158	55	75	96	1022	C4	C2	C2	C2
P90K	147	221	130	195	75	100	133	1232	C4	C2	C2	C2

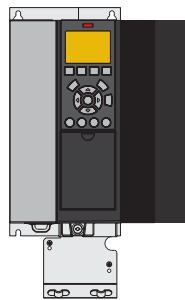
* Requires an IP21/Type 1 kit. Available in North America only.
 ** A4 does not accept any C options

Dimensions enclosure sizes A, B and C

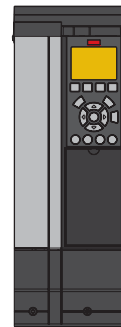
Enclosure size		VLT® AQUA Drive													
		A2		A3		A4	A5	B1	B2	B3	B4	C1	C2	C3	C4
Protection rating [IEC/UL]		IP20 Chassis	IP21 Type 1	IP20 Chassis	IP21 Type 1	IP55/Type 12 IP66/Type 4X	IP21/Type 1 IP55/Type 12 IP66/Type 4X	IP20/Chassis	IP20/Chassis	IP20/Chassis	IP20/Chassis	IP21/Type 1 IP55/Type 12 IP66/Type 4X	IP20/Chassis	IP20/Chassis	
[mm]	Height	268	375	268	375	390	420	480	650	399	520	680	770	550	660
	Height with decoupling plate	374	-	374	-	-	-	-	-	420	595	-	-	630	800
	Width	90	90	130	130	200	242	242	242	165	230	308	370	308	370
	Width with one C option	130	130	170	170	-	242	242	242	205	230	308	370	308	370
	Depth	205	207	205	207	175	200	260	260	249	242	310	335	333	333
	Depth with A, B option	220	222	220	222	175	200	260	260	262	242	310	335	333	333
	Depth with mains disconnect	-	-	-	-	206	224	289	290	-	-	344	378	-	-
[kg]	Weight	4.9	5.3	6	7	9.7	14.2	23	27	12	23.5	45	64	35	50
[in]	Height	10.6	14.8	10.6	14.8	15.4	16.6	18.9	25.6	15.8	20.5	26.8	30.4	21.7	26
	Height with decoupling plate	14.8	-	14.8	-	-	-	-	-	16.6	23.5	-	-	24.8	31.5
	Width	3.6	3.6	5.2	5.2	7.9	9.6	9.6	9.6	6.5	9.1	12.2	14.6	12.2	14.6
	Width with one C option	5.2	5.2	6.7	6.7	-	9.6	9.6	9.6	8.1	9.1	12.2	14.6	12.2	14.6
	Depth	8.1	18.2	8.1	8.2	6.9	7.9	10.3	10.3	9.8	9.6	12.3	13.2	13	13
	Depth with mains disconnect	-	-	-	-	8.2	8.9	11.4	11.5	-	-	13.6	14.9	-	-
	Depth with A, B option	8.7	8.8	8.7	8.8	6.9	7.9	10.3	10.3	10.4	9.6	12.3	13.2	13	13
[lb]	Weight	10.8	11.7	14.6	15.5	21.5	31.5	50.7	59.6	26.5	52	99.3	143.3	77.2	110.2



A3 IP20/Chassis with decoupling plate



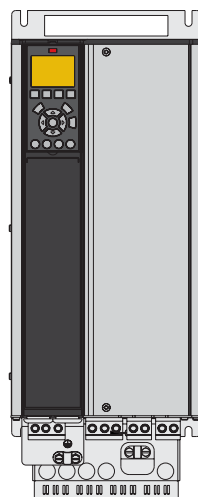
A3 IP20 with option C



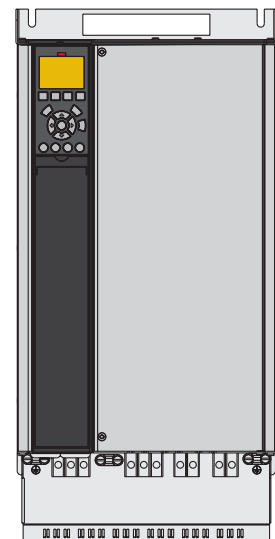
A3 with IP21/Type 12 NEMA 1 Kit



A4 IP55 with mains disconnect



B4 IP20



C3 IP20



PRODUCT DETAILS – 131F2056 / EAN: 5702427415690

VLT® AQUA DRIVE FC 202

FC-202P75KT4E55H1XGX1XXSXXXAXBXCXXXDX

Danfoss VLT® AQUA Drive is dedicated to water and wastewater applications. With a wide range of powerful standard and optional features, the VLT® AQUA Drive provides the lowest overall cost of ownership for water and wastewater applications.

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CHARACTERISTIC	VALUE
Product Group	VLT® AQUA Drive FC-
Series	202
Power Rating	(P75K) 75 KW / 100 HP
Phase	Three phase
Mains Voltage	380 - 480 VAC
Enclosure	IP55 / Type 12
RFI Filter	(H1) RFI Class A1/B (C1)
Brake - Safe Stop	No brake chopper
LCP	Graphical Loc. Cont. Panel
Coating PCB	Not coated PCB
Mains Option	Mains Disconnect
Adaptation A	Standard Cable Entries
Adaptation B	No adaptation
Software Release	Latest release std. SW.
Software Language Pack	Standard Language Pack
A Option	No A Option
B Option	No B Option
C0 Option MCO	No C0 option

C Option Software	No software option
D Option	No D option
Frame Size	C2
Typecode Part 1	FC-202P75KT4E55H1XGX
Typecode Part 2	1XSXXXXAXBXXXXDX
Product Catalog	Global (Standard)
Power 150% (HO) [KW]	55
Power 110% (NO) [KW]	75
Height [mm]	770,0
Width w/ no C options [mm]	370,0
Depth [mm]	335,0
Depth with Option A/B [mm]	335,0
kVA	102
Power Loss NO [W]	1384
Power Loss NO [W]	1384
Power Loss HO [W]	1022
Power Loss HO [W]	1022
Continuous Current (NO) [A]	147
Intermittent Current (NO) [A]	162
Continuous Current (NO) [A]	130
Intermittent Current (NO) [A]	143
Continuous Current (HO) [A]	106
Intermittent Current (HO) [A]	159
Continuous Current (HO) [A]	105
Intermittent Current (HO) [A]	158
Calculated Gross Weight	61.300
Calculated Net Weight [kg]	61.000
Vendor	Cannot Determine Vendor
Modelcode01	FC-202P75KT4E55H1XGX
Modelcode02	1XSXXXXAXBXXXXDX

[T4] 3 x 380-480 V AC – normal overload

Type code	Normal overload (110% 1 min/10 min)							Enclosure size				
	Output current				Typical shaft output power	Continu-ous input current	Estimated power loss	Protection rating [IEC/UL]				
	(3 x 380-440 V)		(3 x 441-500 V)					IP20/21	IP21	IP55	IP66	
Con. I _N	Inter. I _{MAX} (60 s)	Con. I _N	Inter. I _{MAX} (60 s)	kW @ 400 V	Hp @ 460 V	[A] @ 400 V	[W]	Chassis	Type 1	Type 12	Type 4X	
PK37	1.3	1.4	1.2	1.3	0.37	0.5	1.2	35	A2	A2*	A4/A5**	A4/A5**
PK55	1.8	2	1.6	1.8	0.55	0.75	1.6	42	A2	A2*	A4/A5**	A4/A5**
PK75	2.4	2.6	2.1	2.3	0.75	1	2.2	46	A2	A2*	A4/A5**	A4/A5**
P1K1	3	3.3	2.7	3	1.1	1.5	2.7	58	A2	A2*	A4/A5**	A4/A5**
P1K5	4.1	4.5	3.4	3.7	1.5	2	3.7	62	A2	A2*	A4/A5**	A4/A5**
P2K2	5.6	6.2	4.8	5.3	2.2	3	5.0	88	A2	A2*	A4/A5**	A4/A5**
P3K0	7.2	7.9	6.3	6.9	3	4	6.5	116	A2	A2*	A4/A5**	A4/A5**
P4K0	10	11	8.2	9	4	5	9.0	124	A2	A2*	A4/A5**	A4/A5**
P5K5	13	14.3	11	12.1	5.5	7.5	11.7	187	A3	A3*	A5	A5
P7K5	16	17.6	14.5	16	7.5	10	14.4	225	A3	A3*	A5	A5
P11K	24	26.4	21	23.1	11	15	22	392	B3	B1	B1	B1
P15K	32	35.2	27	29.7	15	20	29	392	B3	B1	B1	B1
P18K	37.5	41.3	34	37.4	18.5	25	34	465	B3	B1	B1	B1
P22K	44	48.4	40	44	22	30	40	525	B4	B2	B2	B2
P30K	61	67.1	52	61.6	30	40	55	739	B4	B2	B2	B2
P37K	73	80.3	65	71.5	37	50	66	698	B4	C1	C1	C1
P45K	90	99	80	88	45	60	82	843	C3	C1	C1	C1
P55K	106	117	95	116	55	75	96	1003	C3	C1	C1	C1
P75K	147	162	130	143	75	100	133	1384	C4	C2	C2	C2
P90K	177	195	160	176	90	125	161	1471	C4	C2	C2	C2

* Requires an IP21/Type 1 kit. Available in North America only.
 ** A4 does not accept any C options

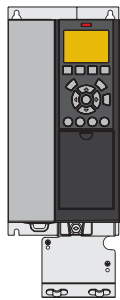
[T4] 3 x 380-480 V AC – high overload

Type code	High overload (160% 1 min/10 min)							Enclosure size				
	Output current				Typical shaft output power	Continu-ous input current	Estimated power loss	Protection rating [IEC/UL]				
	(3 x 380-440 V)		(3 x 441-500 V)					IP20/21	IP21	IP55	IP66	
Con. I _N	Inter. I _{MAX} (60 s)	Con. I _N	Inter. I _{MAX} (60 s)	kW @ 400 V	Hp @ 460 V	[A] @ 400 V	[W]	Chassis	Type 1	Type 12	Type 4X	
PK37	1.3	2	1.2	1.8	0.37	0.5	1.2	35	A2	A2*	A4/A5**	A4/A5**
PK55	1.8	2.7	1.6	2.4	0.55	0.75	1.6	42	A2	A2*	A4/A5**	A4/A5**
PK75	2.4	3.6	2.1	3.2	0.75	1	2.2	46	A2	A2*	A4/A5**	A4/A5**
P1K1	3	4.5	2.7	4.1	1.1	1.5	2.7	58	A2	A2*	A4/A5**	A4/A5**
P1K5	4.1	6.2	3.4	5.1	1.5	2	3.7	62	A2	A2*	A4/A5**	A4/A5**
P2K2	5.6	8.4	4.8	7.2	2.2	3	5.0	88	A2	A2*	A4/A5**	A4/A5**
P3K0	7.2	10.8	6.3	9.5	3	4	6.5	116	A2	A2*	A4/A5**	A4/A5**
P4K0	10	15	8.2	12.3	4	5	9.0	124	A2	A2*	A4/A5**	A4/A5**
P5K5	13	19.5	11	16.5	5.5	7.5	11.7	187	A3	A3*	A5	A5
P7K5	16	24	14.5	21.8	7.5	10	14.4	225	A3	A3*	A5	A5
P11K	16	25.6	14.5	23.2	7.5	10	14	291	B3	B1	B1	B1
P15K	24	38.4	21	33.6	11	15	22	291	B3	B1	B1	B1
P18K	32	51.2	27	43.2	15	20	29	379	B3	B1	B1	B1
P22K	37.5	60	34	54.4	18.5	25	34	444	B4	B2	B2	B2
P30K	44	70.4	40	64	22	30	40	547	B4	B2	B2	B2
P37K	61	91.5	52	78	30	40	55	570	B4	C1	C1	C1
P45K	73	110	65	97.5	37	50	66	697	C3	C1	C1	C1
P55K	90	135	80	120	45	60	82	891	C3	C1	C1	C1
P75K	106	159	105	158	55	75	96	1022	C4	C2	C2	C2
P90K	147	221	130	195	75	100	133	1232	C4	C2	C2	C2

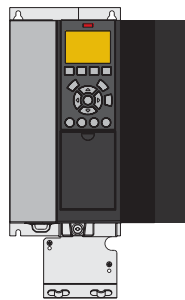
* Requires an IP21/Type 1 kit. Available in North America only.
 ** A4 does not accept any C options

Dimensions enclosure sizes A, B and C

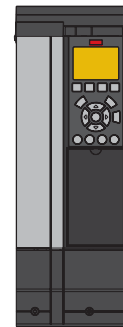
Enclosure size		VLT® AQUA Drive													
		A2		A3		A4	A5	B1	B2	B3	B4	C1	C2	C3	C4
Protection rating [IEC/UL]		IP20 Chassis	IP21 Type 1	IP20 Chassis	IP21 Type 1	IP55/Type 12 IP66/Type 4X	IP21/Type 1 IP55/Type 12 IP66/Type 4X	IP20/ Chassis	IP20/ Chassis	IP20/ Chassis	IP20/ Chassis	IP21/Type 1 IP55/Type 12 IP66/Type 4X	IP20/ Chassis	IP20/ Chassis	IP20/ Chassis
[mm]	Height	268	375	268	375	390	420	480	650	399	520	308	370	550	660
	Height with decoupling plate	374	-	374	-	-	-	-	-	420	595	-	-	630	800
	Width	90	90	130	130	200	242	242	242	165	230	308	370	308	370
	Width with one C option	130	130	170	170	-	242	242	242	205	230	308	370	308	370
	Depth	205	207	205	207	175	200	260	260	249	242	310	335	333	333
	Depth with A, B option	220	222	220	222	175	200	260	260	262	242	310	335	333	333
	Depth with mains disconnect	-	-	-	-	206	224	289	290	-	-	344	378	-	-
[kg]	Weight	4.9	5.3	6	7	9.7	14.2	23	27	12	23.5	45	64	35	50
[in]	Height	10.6	14.8	10.6	14.8	15.4	16.6	18.9	25.6	15.8	20.5	26.8	30.4	21.7	26
	Height with decoupling plate	14.8	-	14.8	-	-	-	-	-	16.6	23.5	-	-	24.8	31.5
	Width	3.6	3.6	5.2	5.2	7.9	9.6	9.6	9.6	6.5	9.1	12.2	14.6	12.2	14.6
	Width with one C option	5.2	5.2	6.7	6.7	-	9.6	9.6	9.6	8.1	9.1	12.2	14.6	12.2	14.6
	Depth	8.1	18.2	8.1	8.2	6.9	7.9	10.3	10.3	9.8	9.6	12.3	13.2	13	13
	Depth with mains disconnect	-	-	-	-	8.2	8.9	11.4	11.5	-	-	13.6	14.9	-	-
	Depth with A, B option	8.7	8.8	8.7	8.8	6.9	7.9	10.3	10.3	10.4	9.6	12.3	13.2	13	13
[lb]	Weight	10.8	11.7	14.6	15.5	21.5	31.5	50.7	59.6	26.5	52	99.3	143.3	77.2	110.2



A3 IP20/Chassis with decoupling plate



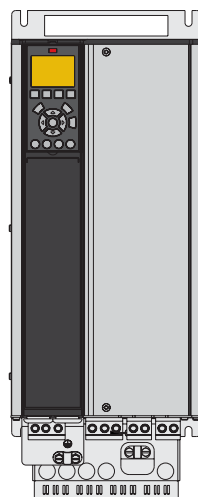
A3 IP20 with option C



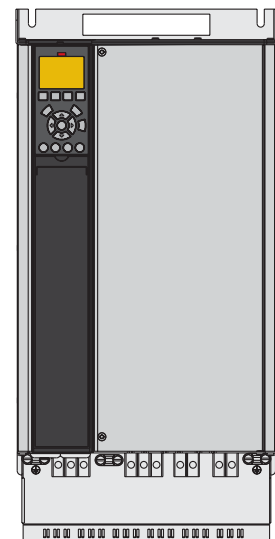
A3 with IP21/Type 12 NEMA 1 Kit



A4 IP55 with mains disconnect



B4 IP20



C3 IP20



HAYES PUMP, INC.

**66 Old Powder Mill Road
West Concord, MA 01742
PH: 978-369-8800
Fax: 978-369-8461**

October 25, 2022

Mr. Elvis Dhima
Town of Hudson
12 Scholl Street
Hudson, NH 03051

REFERENCE: Marsh Road Water Pump Station
Hudson, NH
Pentair Fairbanks Submittals 0913483SR0 & 0913484SR0
Submittal Review Comments

Dear Elvis:

The following are responses to the submittal review comments in your E mail dated 7/28/2022:

1.) Dimensions

Pump and can lengths have been modified to reflect 5 FT – 6 IN dimension from the bottom of the slab to the centerline of the suction inlet as shown on Contract Drawing M001.

2.) Lineshaft Size

Lineshafts have been changed to 1-3/16" diameter.

3.) Discharge Pressure Gauges

Discharge flange is drilled & tapped for pressure gauge connection. Pressure gauges and fittings are not included in our scope of supply. Colonial Instruments in Nashua, NH is a recommended vendor/supplier for these.

4.) Warranty

Warranty provisions detailing one (1) coverage period from date of start-up will be included in O & M documentation.

5.) O & M Manuals

As built O & M manuals will be provided following shipment.

6.) Field Service

Field service for installation inspection, start-up, testing, and training will be provided following installation. The anticipated 2-year time frame is noted.

7.) Factory Performance Test Reports

Pump and motor test results will be submitted for approval prior to shipment.

Please forward this information on to the engineers for review and final approval.

HAYES PUMP, INC.

J. Craig Huff III
Vice President
Contract Sales

Fairbanks Nijhuis
Submittal Data
For
Marsh Road Water Pump Station
Hudson, NH

Supplier: Hayes Pump Inc.
66 Old Power Mill Rd.
West Concord, MA 01742

Manufacturer:

Pump: Fairbanks Nijhuis
3601 Fairbanks Ave.
Kansas City, Kansas 66106-0906
(913) 371-5000

Project Number: 0913483

Sales Order Number: 53113132

Quantity: 2

Pump Size & Model: 10M 7000AW

Motor: Nidec
P. O. Box 3946
St. Louis, MO 63136
(314) 553-2878

1. **Comment:** Setting Plan to include the 6" height of the concrete slab. The total length from the centerline of the discharge to the centerline of the suction should be 8.0 FT with dimension from top of can to centerline of the suction 87.5"

Response: Confirmed, See Revised Submittal

1. **Comment:** I'm missed this requirement during the order entry process, per but the contract drawing M001, the distance from the bottom of the pump station slab to the centerline of the suction can inlet needs to be 5'-6". (See below screenshot of section view.) This translates to distance of 81.5" from top of can to the suction centerline, and 8.0 FT from discharge connection centerline to suction inlet centerline. Please adjust overall can lengths for both project #'s 0913483 & 0913484 as needrd to accommodate this suction inlet location, and revise the setting plans and can dimensional drawings accordingly.

Response: Confirmed, See Revised Submittal

2. **Comment:** For the Project 0913483 10M- 50 HP pumps, please change the lineshaft diameter to 1-3/16".

Response: Confirmed, See Revised Submittal

3. **Comment:** Please advise if the type CT and/or type D discharge heads are provided with pressure gauge tap, either at the top of the flange or other location

Response: Confirmed, Pressure Gauge tap is Provided on the Discharge Head

Fairbanks Nijhuis
Included Features

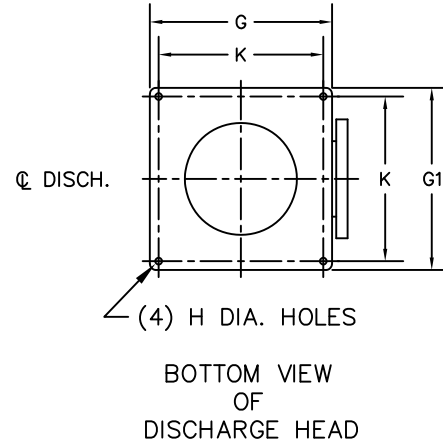
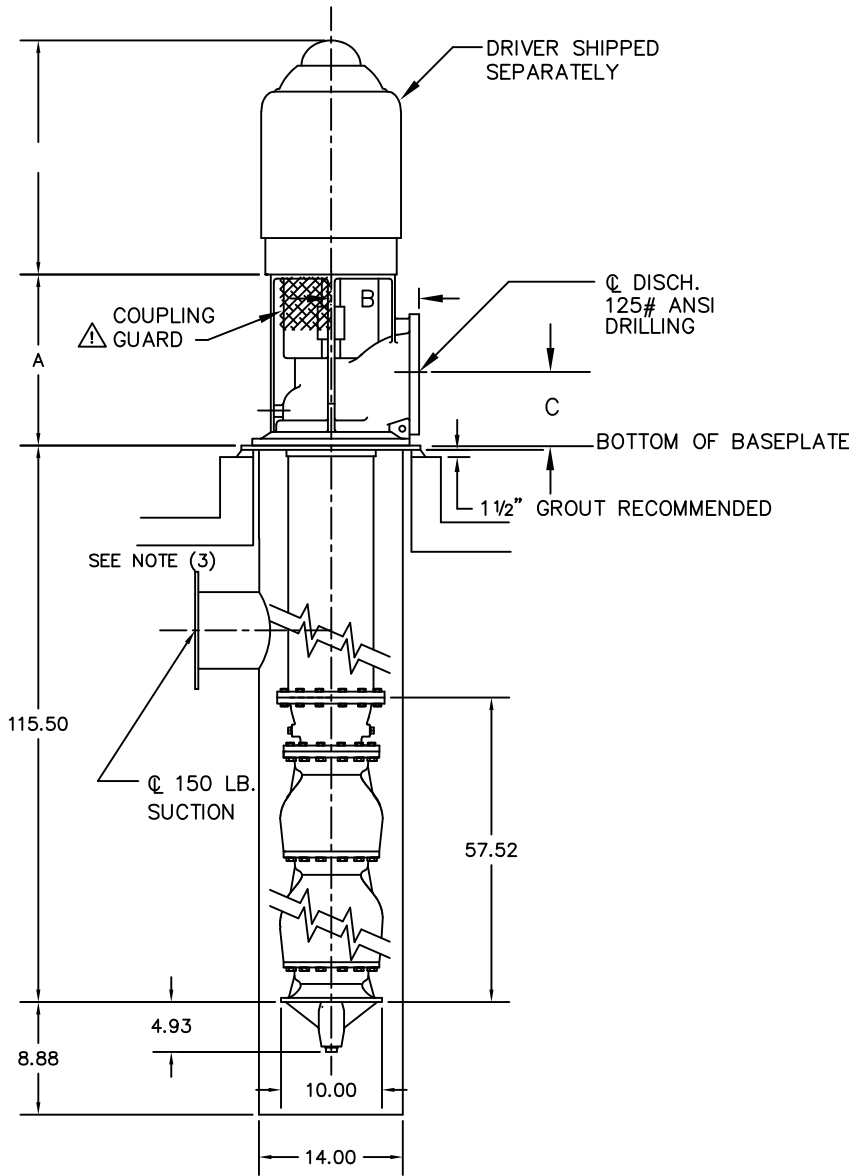
- Potable Water Application – None NSF Certified
- Variable Speed Operation
- 14" Suction Can
- Pump Shipped Assembled
- 10M, 6 Stage Flanged Bowl Assembly
- Suction Bell & Threaded Discharge Case
- Dynamically Balanced 316 Stainless Steel Impellers
- 416 Stainless Steel Collet Impeller Fasteners
- 316 Stainless Steel Impeller Wear Ring
- Stainless Steel Bowl Wear Ring
- 6" Threaded Column with 1-3/16" Open Line Shaft
- 416 Stainless Steel Line Shaft and Coupling
- 304 Stainless Steel Top Shaft Sleeve
- 16-1/2 x 6 Type "CT" Above Ground Discharge Head
- 175 Lb. Seal Box
- Mechanical Seal John Crane 5610
- 416 Stainless Steel Drive Shaft
- 416 Stainless Steel Pump Shaft
- Certified Non-Witness Performance Test
- Curve Approval Required Prior to Shipment
- Test Logs Required
- Critical Speed Calculations

! WARNING

DO NOT OPERATE THIS MACHINE WITHOUT PROTECTIVE GUARD IN PLACE. ANY OPERATION OF THIS MACHINE WITHOUT PROTECTIVE GUARD CAN RESULT IN SEVERE BODILY INJURY.

DISCHARGE HEAD DIMENSIONS

HEAD SIZE	A	B	C	F	G	G1	H	K
16 1/2 x 6	21 1/2	11 3/8	8 1/2	7/8	20 1/2	20	7/8	16 13/16

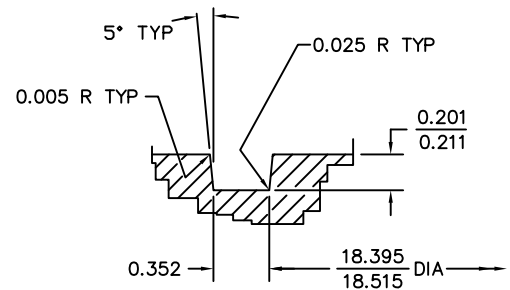
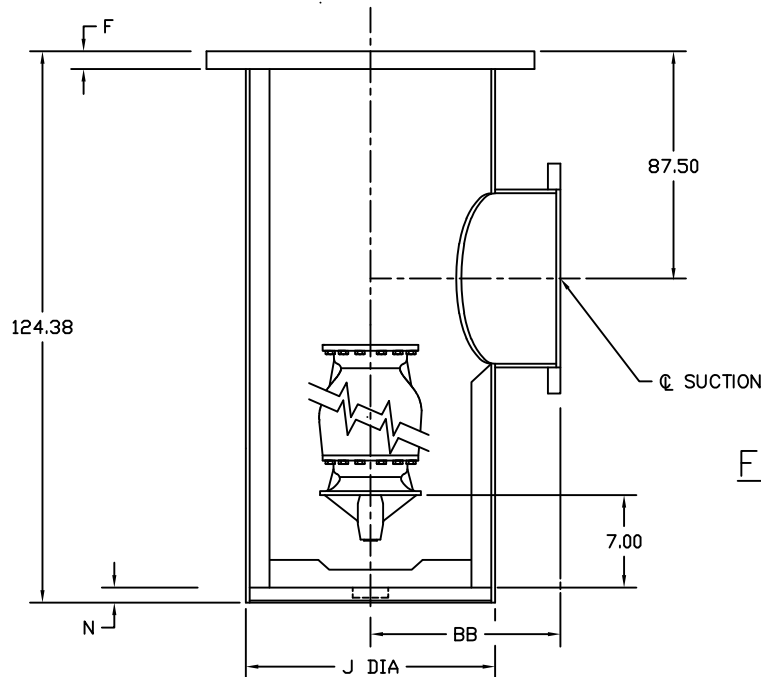
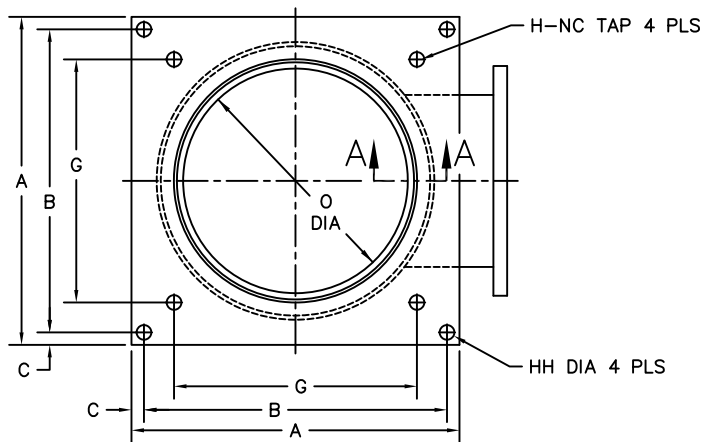


1. THIS DRAWING NOT FOR CONSTRUCTION OR INSTALLATION UNLESS CERTIFIED. DIMENSIONS SHOWN ARE TYPICAL AND MAY VARY DUE TO VARIOUS TOLERANCES.
2. SUCTION CAN MUST BE SUPPORTED ON ALL 4 SIDES AND GROUTED IN PLACE.
3. SEE SHEET 2 OF 2 FOR ADDITIONAL POT DIMENSIONS
4. CUSTOMER TO VERIFY OR ADVISE OVERALL LENGTH PRIOR TO OR AT RELEASE.

○ CONTRACTOR TO ADVISE C INLET ELEVATION.

REV. 1 - OAL WAS 85.75 - JEA 9/27/22
 REV. 2 - OAL WAS 109.50 - JEA 10/17/22

CUSTOMER HAYES PUMP INC.					P.O. 132657		
JOB NAME MARSH ROAD							
PUMP SIZE & MODEL 10M 7000AW		STAGES 6	GPM 550	TDH 240	RPM 1800	ROT CCW	SETTING PLAN MODEL 7000 PUMP TYPE "CT" SURFACE DISCHARGE HEAD
MOTOR NIDEC	HP 50	FRAME 326TP	PHASE 3	HERTZ 60	VOLTS 230-460	ENCL WPI	
CERTIFIED FOR PROJECT: 0913483		CERTIFIED BY JEA			DATE 7/1/22		
DWG. NO. 0913483SP							



18 1/2" O-RING GROOVE
FOR 6"-10" DISCHARGE HEADS
SECTION A-A

1. THIS DRAWING NOT FOR CONSTRUCTION OR INSTALLATION UNLESS CERTIFIED. DIMENSIONS SHOWN ARE TYPICAL AND MAY VARY DUE TO VARIOUS TOLERANCES.
2. SUCTION CAN FLANGE MUST BE SUPPORTED ON ALL FOUR (4) SIDES AND GROUTED IN PLACE.
3. CUSTOMER TO VERIFY OR ADVISE OVERALL LENGTH PRIOR TO OR AT RELEASE.

4. SUCTION PRESSURE LIMITED TO 40 PSI.

SUCTION CAN DIMENSIONS												
CAN SIZE	J DIA	O-RING SIZE	A	B	C	F	G	H	N	O	BB	HH
14	14	18 1/2	25	21	2	1 1/4	16 1/2	3/4"-10	1 7/8	13 1/4	10 7/8	7/8

150# SUCTION FLG. DIM.					
NOM. SIZE	FLG. DIA.	FLG. THK.	NO. BOLTS	HOLE SIZE	B.C. DIA
10	16	1 1/4	12	1	14 1/4

REV. 1 - C.L. DOWN WAS 9.00" & OAL WAS 96.00 - JEA 9/27/22
 REV. 2 - C.L. DOWN WAS 81.50" & OAL WAS 118.38" - JEA 10/17/22

CUSTOMER HAYES PUMP INC.					P.O. NO. 132657		
JOB NAME MARSH ROAD WATER PUMP STATION					TAG NAME		
PUMP SIZE AND MODEL 10M 7000AW		STAGES 6	GPM 550	TDH 240	RPM 1800	ROTATION CW	DISCH POS
MOTOR NIDEC		HP 50	FRAME 326TP	PHASE 3	HERTZ 60	VOLTS 230-460	ENCLOSURE WPI
CERTIFIED FOR PROJECT: 0913483				CERTIFIED BY JEA		DATE 7/1/22	DWG NO 0913483SP2 REV NO 2

16 1/2" X 6"
 "CT" HEAD
 TURBINE SUCTION
 CAN DIMENSIONS

Fairbanks Nijhuis
Submittal Data
For
Marsh Road Water Pump Station
Hudson, NH

Supplier: Hayes Pump, Inc.
66 Old Power Mill Road
West Concord, MA 01742

Manufacturer:

Pump: Fairbanks Nijhuis
3601 Fairbanks Ave.
Kansas City, Kansas 66106-0906
(913) 371-5000

Project Number: 0913484

Sales Order Number: 53113215

Quantity: 1

Pump Size & Model: 12E 7100AW

Motor: Nidec
P. O. Box 3946
St. Louis, MO 63136
(314) 553-2878

1. **Comment:** Setting Plan to include the 6" height of the concrete slab. The total length from the centerline of the discharge to the centerline of the suction should be 8.0 FT with dimension from top of can to centerline of the suction 87.5"

Response: Confirmed, See Revised Submittal

1. **Comment:** I'm missed this requirement during the order entry process, per but the contract drawing M001, the distance from the bottom of the pump station slab to the centerline of the suction can inlet needs to be 5'-6". (See below screenshot of section view.) This translates to distance of 81.5" from top of can to the suction centerline, and 8.0 FT from discharge connection centerline to suction inlet centerline. Please adjust overall can lengths for both project #'s 0913483 & 0913484 as needrd to accommodate this suction inlet location, and revise the setting plans and can dimensional drawings accordingly.

Response: Confirmed, See Revised Submittal

2. **Comment:** Please advise if the type CT and/or type D discharge heads are provided with pressure gauge tap, either at the top of the flange or other location

Response: Confirmed, Pressure Gauge tap is Provided on the Discharge Head

Fairbanks Nijhuis
Included Features

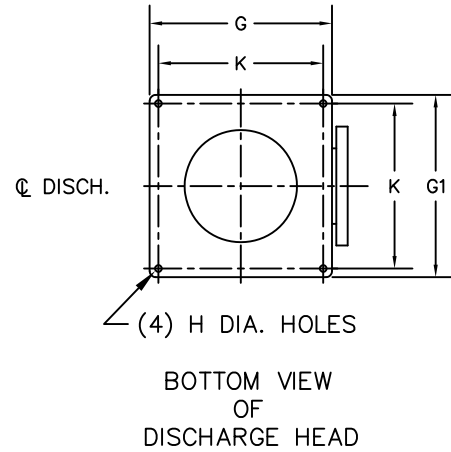
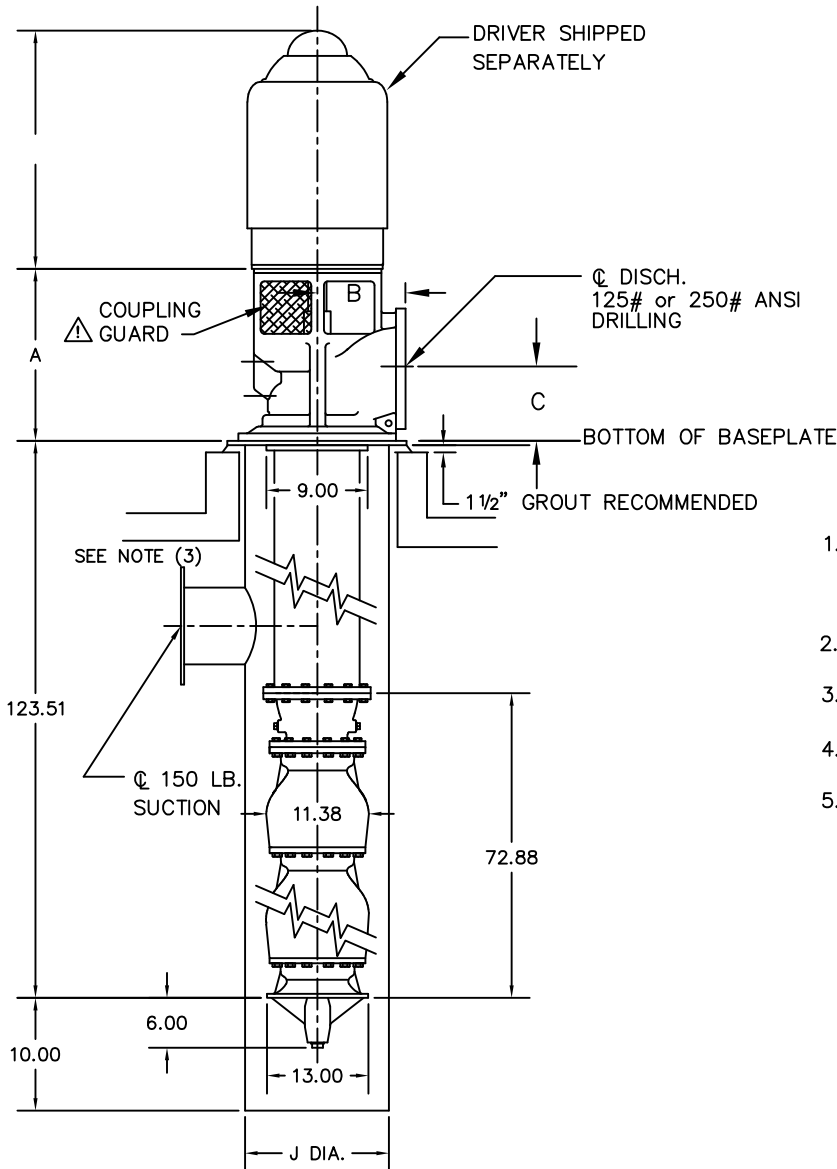
- Potable Water Application – None NSF Certified
- Variable Speed Operation
- Suction Can
- Pump Shipped Assembled
- 12E, 6 Stage Flanged Bowl Assembly
- Suction Bell & Threaded Discharge Case
- Dynamically Balanced 316 Stainless Steel Impellers
- 416 Stainless Steel Collet Impeller Fasteners
- 316 Stainless Steel Impeller Wear Ring
- Stainless Steel Bowl Wear Ring
- 8" Flanged Column with 1-3/16" Open Line Shaft
- 416 Stainless Steel Line Shaft and Coupling
- 304 Stainless Steel Top Shaft Sleeve
- 16-1/2 x 6 Type "D" Above Ground Discharge Head
- 175 Lb. Seal Box
- Mechanical Seal John Crane 5610
- 416 Stainless Steel Drive Shaft
- 416 Stainless Steel Pump Shaft
- Certified Non-Witness Performance Test
- Curve Approval Required Prior to Shipment
- Test Logs Required

⚠ WARNING

DO NOT OPERATE THIS MACHINE WITHOUT PROTECTIVE GUARD IN PLACE. ANY OPERATION OF THIS MACHINE WITHOUT PROTECTIVE GUARD CAN RESULT IN SEVERE BODILY INJURY.

DISCHARGE HEAD DIMENSIONS

HEAD SIZE	A	B	C	F	G	G1	H	K
16 1/2 x 6	21 1/2	10 1/4	8 1/2	7/8	20 1/2	20	7/8	16 13/16

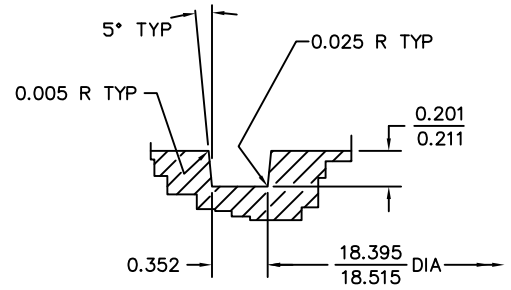
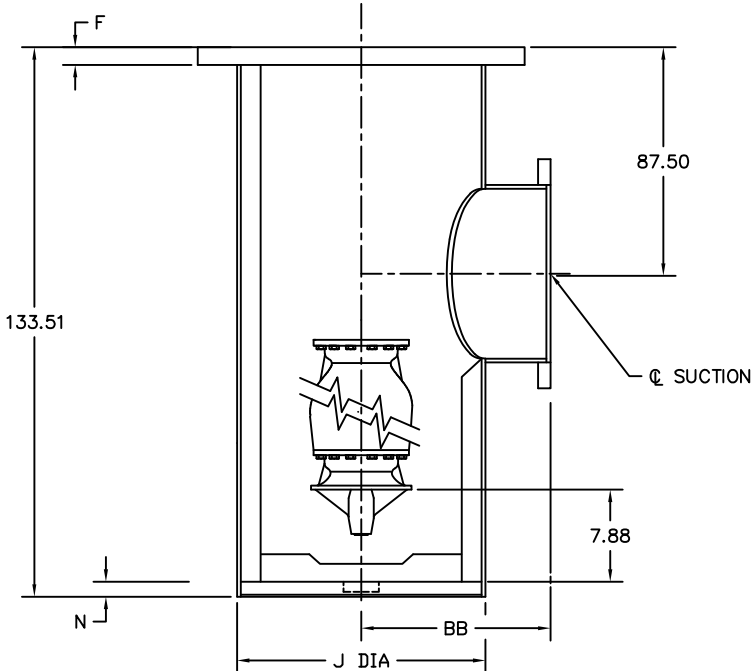
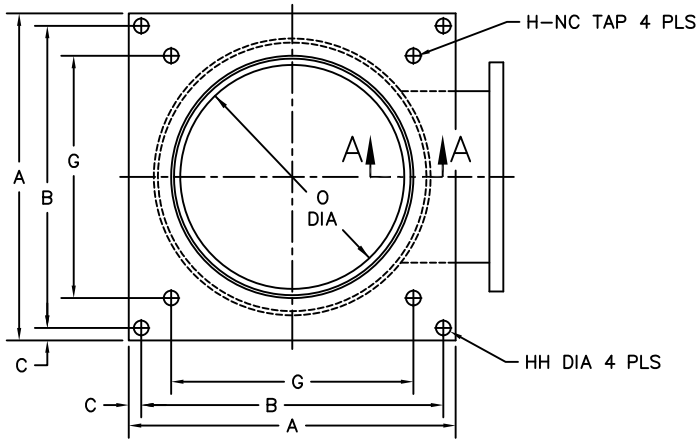


1. THIS DRAWING NOT FOR CONSTRUCTION OR INSTALLATION UNLESS CERTIFIED. DIMENSIONS SHOWN ARE TYPICAL AND MAY VARY DUE TO VARIOUS TOLERANCES.
2. SUCTION CAN MUST BE SUPPORTED ON ALL 4 SIDES AND GROUTED IN PLACE.
3. SEE SHEET 2 OF 2 FOR ADDITIONAL POT DIMENSIONS
4. CUSTOMER TO VERIFY OR ADVISE OVERALL LENGTH PRIOR TO OR AT RELEASE.
5. BOTTOM 2 HOLES ON THE DISCHARGE FLANGE ARE TAPPED WHEN 250# FLANGE IS SELECTED.

● CONTRACTOR TO ADVISE C INLET ELEVATION.

REV. 1 - OAL WAS 92.00 - JEA 10/4/22
 REV. 2 - OAL WAS 117.50 - JEA 10/17/22

CUSTOMER HAYES PUMP INC.					P.O. 132657		
JOB NAME MARSH ROAD WATER PUMP STATION							
PUMP SIZE & MODEL 12E 7100AW		STAGES 6	GPM 1000	TDH 245	RPM 1800	ROT CCW	SETTING PLAN MODEL 7100 PUMP TYPE "D" SURFACE DISCHARGE HEAD
MOTOR NIDEC	HP 100	FRAME 404TP	PHASE 3	HERTZ 60	VOLTS 230/460	ENCL WPI	
CERTIFIED FOR PROJECT: 0913484		CERTIFIED BY JEA			DATE 7/11/22		
DWG. NO. 0913484SP1							



18 1/2" O-RING GROOVE
SECTION A-A

1. THIS DRAWING NOT FOR CONSTRUCTION OR INSTALLATION UNLESS CERTIFIED. DIMENSIONS SHOWN ARE TYPICAL AND MAY VARY DUE TO VARIOUS TOLERANCES.
2. SUCTION CAN FLANGE MUST BE SUPPORTED ON ALL FOUR (4) SIDES AND GROUTED IN PLACE.
3. CUSTOMER TO VERIFY OR ADVISE OVERALL LENGTH PRIOR TO OR AT RELEASE.

4. SUCTION PRESSURE LIMITED TO 40 PSI.

SUCTION CAN DIMENSIONS												
CAN SIZE	J DIA	O-RING SIZE	A	B	C	F	G	H	N	O	BB	HH
18	18	18 1/2	27	22	2 1/2	1 1/2	16 23/32	3/4"-10	2 1/8	17 3/8	12 1/2	7/8

150# SUCTION FLG. DIM.					
NOM. SIZE	FLG. DIA.	FLG. THK.	NO. BOLTS	HOLE SIZE	B.C. DIA
12	19	1 1/4	12	1	17

REV. 1 - OAL WAS 102.00 AND C.L. DOWN WAS 11.00 - JEA 10/4/22
 REV. 2 - OAL WAS 127.50 AND C.L. DOWN WAS 81.50 - JEA 10/17/22

CUSTOMER HAYES PUMP INC.				P.O. NO. 132657			
JOB NAME MARSH ROAD WATER PUMP STATION				TAG NAME			
PUMP SIZE AND MODEL 12E 7100AW		STAGES 6	GPM 1000	TDH 245	RPM 1800	ROTATION CW	DISCH POS
MOTOR NIDEC		HP 100	FRAME 404TP	PHASE 3	HERTZ 60	VOLTS 230-460	ENCLOSURE WPI
CERTIFIED FOR PROJECT: 0913484				CERTIFIED BY JEA		DATE 7/12/22	
DWG NO 0913484SP2						REV NO 2	

16-1/2" X 6"
"D" Head
TURBINE SUCTION
CAN DIMENSIONS



HAYES PUMP, INC.
 66 Old Powder Mill Road
 West Concord, MA 01742
 PH: 978-369-8800

SUBMITTAL DATA

JOB NAME:	Marsh Road Water Pump Station
	Hudson, NH
ENGINEER:	Weston & Sampson
	Reading, MA
REFERENCE:	Contract Drawing M001 – Process Plan
	Pump Schedule – Pump #1 – Jockey Pump
QUANTITY:	One (1) Pump/Motor Unit

PUMP DESCRIPTION

MANUFACTURER:	Pentair Aurora	MODEL:	PVMX20-5	SIZE:	2" x 2"
FLOW (GPM):	120	TDH (FT):	240	SPEED:	3500
CONSTRUCTION:	Cast Iron/Stainless Steel	STUFFING BOX:	Mechanical Seal		
BASEPLATE:	Integral Cast Iron	COUPLING:	Split Rigid Type		
OTHER:	See Next Page for Details				

MOTOR DESCRIPTION

HORSEPOWER:	15	SPEED (RPM):	3600	ENCLOSURE:	TEFC
VOLTAGE:	3/60/230-460	FRAME:	215TC	MANUFACTURER:	Baldor
OTHER:	See Next Page for Details				

ORDER INFORMATION

SOLD TO:	Town of Hudson	P. O. NUMBER	7103-002
	12 School Street		
	Hudson, NH 03051		

HAYES ORDER #:	Not Assigned Yet	BY:	Craig Huff	DATE:	10/24/2022
-----------------------	------------------	------------	------------	--------------	------------

MATERIALS OF CONSTRUCTION

Motor Mounting Bracket	Cast Iron ASTM 65-45-12
Impellers	Stainless Steel AISI 316
Pump Shaft	Stainless Steel AISI 316
Outer Sleeves	Stainless Steel AISI 316
Chambers	Stainless Steel AISI 316
Mechanical Seal	Silicon Carbide vs. Silicon Carbide Faces

SPECIAL REQUIREMENTS

1.) **Operating Conditions**

Submittal includes Pump Data Sheets detailing operating parameters for design conditions of 120 GPM @ 240 FT TDH with nominal efficiency rating of 68.0%.

2.) **Pump Configuration**

Pump will have inline suction and discharge connections with 2" ANSI 250 lb. flanges. Integral base has four (4) 0.56" anchor bolt holes for mounting purposes.

3.) **Mechanical Seal**

Stuffing box will be equipped with cartridge type single inside mechanical seal with face materials as listed above.

4.) **Coupling**

Standard pump motor coupling is two-piece rigid type.

5.) **Motor**

Pump motors will be Baldor catalog #VEM3713T NEMA Premium efficiency, inverter duty rated, TEFC enclosure, vertical with class F insulation.

6.) **Shop Applied Exterior Coating**

Ferrous metal components will be coated with Pentair Aurora standard gloss blue water borne air-dry enamel. Motors will be painted with manufacturer's standard finish.

7.) **Field Service**

An authorized field service representative will perform installation inspection, start-up, testing, and training.

8.) **O & M Manuals**

Installation, operation, and maintenance manuals will be submitted for review and approval following pump approval.

9.) **Accessories Items**

We are providing pump/motor unit ONLY as detailed in this submittal. Other items including anchor bolts, pressure gauges, piping and valves, electrical controls, conduit, wiring, and other appurtenances are **NOT INCLUDED in our scope of supply. These are to be provided BY CONTRACTOR.**



AURORA[®] PVM(X) SERIES VERTICAL MULTISTAGE PUMPS

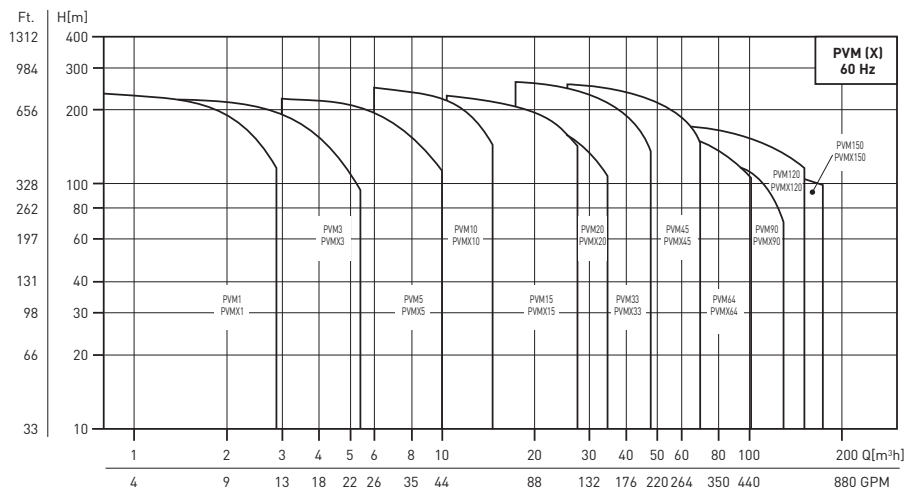


Certified to
NSF/ANSI 61 & 372

PVM(X) 1
through
PVM(X)150
316 SST
Models Only



PVM and PVMX pumps have different size and various numbers of stages to provide the flow and pressure required.



VERTICAL MULTISTAGE PUMPS

ADDED VALUES:



TEFC Motors
Increased protection against weather, dirt and moisture



Cartridge mechanical seal
It can be replaced easily without dismantling the pump

Stainless Steel construction
Impellers and diffusers in AISI 304 (PVM) or AISI 316 (PVMX)

Multiple Connection Options
Flanged, grooved or NPT connections

MADE TO SUPPLY WATER

The PVM and PVMX are vertical in-line multistage pumps with stainless steel stage construction. PVM models are available with flanged/NPT or grooved connections. PVMX models are available in flanged, grooved or NPT connections.

Premium efficiency motors are standard for 230/460V, EPACT efficiency for all other voltages.

Pump shafts are directly coupled to NEMA standard motors.

PENTAIR PVM - TECHNICAL DATA

- ▶ Flow: up to 800 GPM
- ▶ Heads: up to 960 ft
- ▶ Liquid temp: 5°F to 248°F
- ▶ Flanges connection: ANSI Class 150 & Class 250
- ▶ Cartridge mechanical seal: SiC/SiC/EPDM or Viton®
- ▶ Motor: 50/60 Hz
- ▶ EPACT and premium efficient motors available
- ▶ 200 to 575 Volts
- ▶ TEFC enclosures standard for PVM(X)1 – PVM(X)33
- ▶ Up to 100 hp

APPLICATION

- ▶ Water supply
- ▶ Pressure boosting systems
- ▶ Water treatment/ filtration
- ▶ Irrigation
- ▶ High pressure washes
- ▶ Liquid transfer
- ▶ Boiler feed
- ▶ Jockey pumps



Fairbanks Nijhuis®
3501 Fairbanks Avenue, Kansas City, Kansas 66106 • Tel. 913-371-5000
www.FairbanksNijhuis.com

Item number	Pump #1	Size / Stages	/ 5
Quote number	Hudson, NH	Pump speed	3500 rpm

Pump

Qty	Description
-----	-------------

1	PVM(X)20-5
---	------------

Configuration**Pump information****Parameters**

Product Brand: Aurora

Flow: 120 GPM

Head: 240 FT TDH

Stages: 5

Materials of Construction

Potable water NSF 372/61 compliant

Pump material: 316 stainless steel

Pump connection type: Flanged

Driver

Phase: 3

Frequency: 60Hz

Voltage: 230/460

Motor Frame: 215TC

Type: NEMA Premium

Enclosure: TEFC

Item number	: Pump #1	Size	: PVM(X)20-5
Service	: Jockey Pump	Stages	: 5
Quantity	: 1	Based on curve number	: PVM(X)20-5
Quote number	: Hudson, NH	Date last saved	: 09 Oct 2022 4:02 PM

Operating Conditions

Flow, rated	: 120.0 USgpm
Differential head / pressure, rated (requested)	: 240.0 ft
Differential head / pressure, rated (actual)	: 263.7 ft
Suction pressure, rated / max	: 0.00 / 0.00 psi.g
NPSH available, rated	: Ample
Site Supply Frequency	: 60 Hz

Liquid

Liquid type	: Water
Additional liquid description	:
Solids diameter, max	: 0.00 in
Solids diameter limit	: 0.00 in
Solids concentration, by volume	: 0.00 %
Temperature, max	: 68.00 deg F
Fluid density, rated / max	: 1.000 / 1.000 SG
Viscosity, rated	: 1.00 cP
Vapor pressure, rated	: 0.34 psi.a

Performance

Speed criteria	: Synchronous
Speed, rated	: 3500 rpm
Impeller diameter, rated	: PVM(I/X)20-5
Impeller diameter, maximum	: PVM(I/X)20-5
Impeller diameter, minimum	: PVM(I/X)20-5
Efficiency	: 68.66 %
NPSH required / margin required	: 15.17 / 0.00 ft
nq (imp. eye flow) / S (imp. eye flow)	: 33 / 105 Metric units
Minimum Continuous Stable Flow	: 11.00 USgpm
Head, maximum, rated diameter	: 359.9 ft
Head rise to shutoff	: 36.49 %
Flow, best eff. point	: 105.9 USgpm
Flow ratio, rated / BEP	: 113.33 %
Diameter ratio (rated / max)	: 100.00 %
Head ratio (rated dia / max dia)	: 100.00 %
Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 1.00 / 1.00
Selection status	: Acceptable

Material

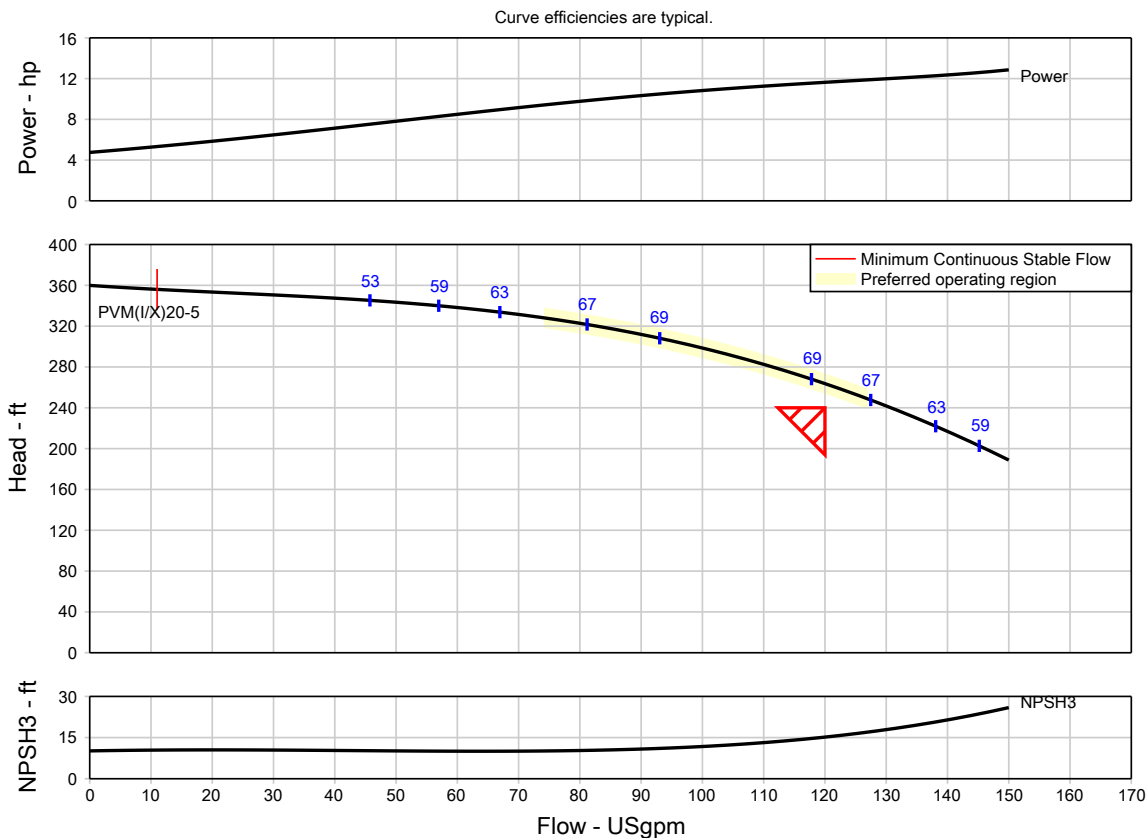
Material selected	: Auto
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Pressure Data

Maximum working pressure	: 155.8 psi.g
Maximum allowable working pressure	: 360.0 psi.g
Maximum allowable suction pressure	: N/A
Hydrostatic test pressure	: N/A

Driver & Power Data (@ Max density)

Driver sizing specification	: Max Power
Margin over specification	: 0.00 %
Service factor	: 1.15 (used)
Power, hydraulic	: 7.99 hp
Power, rated	: 11.63 hp
Power, maximum, rated diameter	: 12.86 hp
Motor rating	: 15.00 hp / 11.19 kW (Fixed)



Item number	: Pump #1	Size	: PVM(X)20-5
Service	: Jockey Pump	Stages	: 5
Quantity	: 1	Speed, rated	: 3500 rpm
Quote number	: Hudson, NH	Frame size	:
		Date last saved	: 09 Oct 2022 4:02 PM

Performance Data

Head, maximum diameter, rated flow	: 263.7 ft
Head, minimum diameter, rated flow	: 263.7 ft
Head, maximum, rated diameter	: 359.9 ft
Efficiency adjustment factor, total	: 1.00
Power adjustment, total	: 0.00 hp
Head adjustment factor, total	: 1.00
Flow adjustment factor, total	: 1.00
NPSH3 adjustment factor, total	: 1.00
NPSH margin dictated by pump supplier	: 0.00 ft
NPSH margin dictated by user	: 0.00 ft
NPSH margin used (added to 'required' values)	: 0.00 ft

Mechanical Limits

Torque, rated power, rated speed	: 0.33 hp/100 rpm
Torque, maximum power, rated speed	: 0.37 hp/100 rpm
Torque, driver power, full load speed	: 0.43 hp/100 rpm
Torque, driver power, rated speed	: 0.43 hp/100 rpm
Torque, pump shaft limit	: 30.00 hp/100 rpm
Radial load, worst case	: -
Radial load limit	: -
Impeller peripheral speed, rated	: -
Impeller peripheral speed limit	: -

Various Performance Data

	Flow (USgpm)	Head (ft)	Efficiency (%)	NPSH3 (ft)	Power (hp)
Shutoff, rated	0.00	359.9	-	-	4.75
Shutoff, maximum	0.00	359.9	-	-	4.75
Minimum Continuous Stable Flow	11.00	356.0	18.56	10.44	5.33
Rated flow, minimum	120.0	263.7	68.66	-	11.63
Rated flow, maximum	120.0	263.7	68.66	-	11.63
BEP flow, rated	105.9	289.5	69.79	12.51	11.09
120% rated flow, rated	144.0	206.0	59.75	23.11	12.54
End of curve, rated	150.0	188.8	55.58	25.92	12.86
End of curve, minimum	150.0	188.8	55.58	25.92	12.86
End of curve, maximum	150.0	188.8	55.58	25.92	12.86
Maximum value, rated	-	359.9	69.79	-	12.86
Maximum value, maximum	-	-	69.79	-	12.86

System differential pressure

Differential pressure, rated flow, rated (psi)	
Differential pressure, shutoff, rated (psi)	
Differential pressure, shutoff, maximum (psi)	

@ Density, rated
@ Density, max

	114.1	114.1
	155.8	155.8
	155.8	155.8

Discharge pressure

Discharge pressure, rated flow, rated (psi.g)	
Discharge pressure, shutoff, rated (psi.g)	
Discharge pressure, shutoff, maximum (psi.g)	

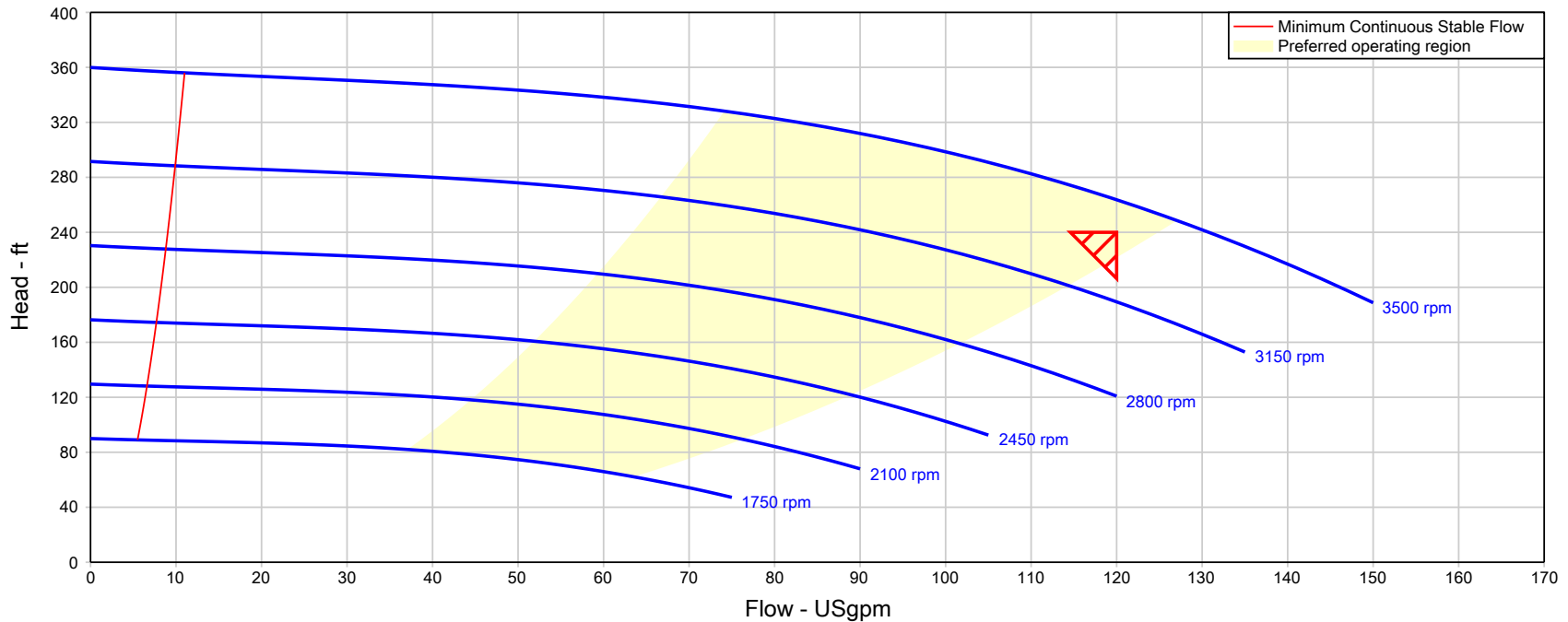
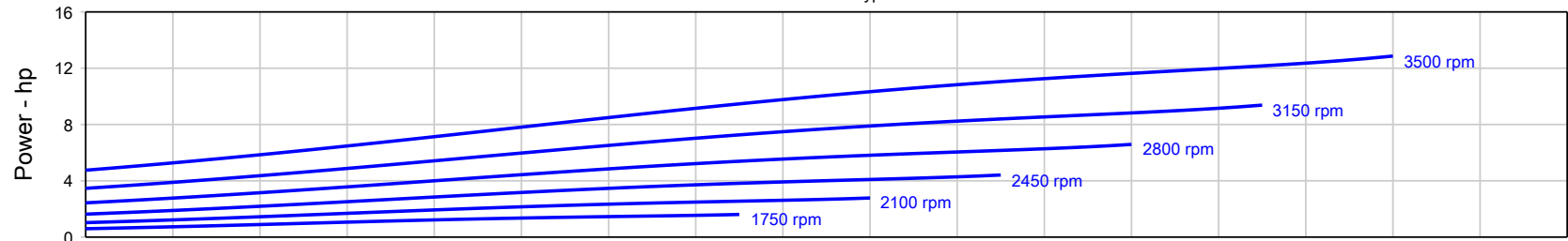
@ Suction pressure, rated	@ Suction pressure, max	@ Suction pressure, rated	@ Suction pressure, max
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	114.1	114.1	114.1	114.1
	155.8	155.8	155.8	155.8
	155.8	155.8	155.8	155.8

Ratios

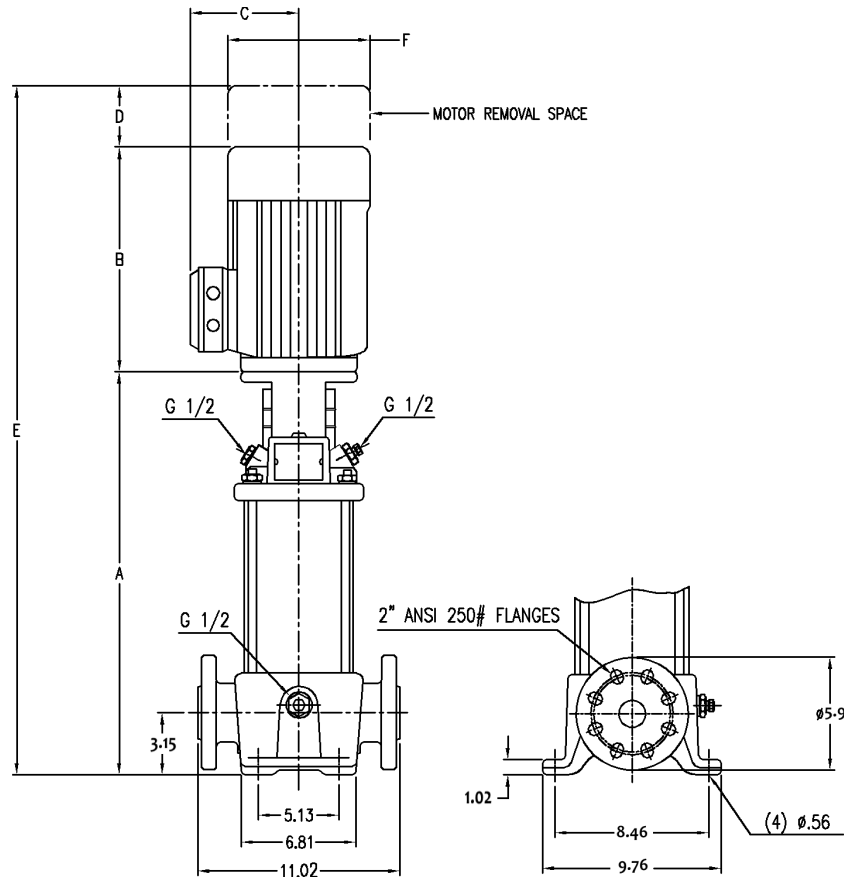
Maximum flow / rated flow, rated	: 125.00 %	Head rated diameter / head minimum diameter, rated flow	: 100.00 %
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Curve efficiencies are typical.



Item number	: Pump #1	Size	: PVM(X)20-5	Flow, rated	: 120.0 USgpm
Service	: Jockey Pump	Stages	: 5	Differential head / pressure, rated	: 240.0 ft
Quantity	: 1	Efficiency	: 68.66 %	Speed, rated	: 3500 rpm
Quote number	: Hudson, NH	Power, rated	: 11.63 hp	Impeller diameter, rated	: 1.00 in
Based on curve number	: PVM(X)20-5	NPSH required	: 15.17 ft	Fluid density, rated / max	: 1.000 / 1.000 SG
Date last saved	: 09 Oct 2022 4:02 PM	Site Supply Frequency	: 60 Hz	Viscosity	: 1.00 cP
		Nominal speed	: 3525 rpm	Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 1.00 / 1.00

General Arrangement Drawing



A	B	C	D	E	F
24.10	20.03	12.94	3.75	47.88	12.94

NOTES:

All dimensions are in inches.

Dimensions shown may vary ± due to normal manufacturing tolerances.

Not for construction, installation, or application purposes unless certified.

Measurements represent the largest number possible for each model using standard efficiency motors.

Pump Data	
Model	PVM(X)20-5
Stages	5
Flow	120.0 USgpm
Head	240.0 ft
Rotation	Right
Liquid Type	Water
Suc/Disch Size	2
Actual Pressure	114.3 psi.g
Ambient Temperature	68.00 deg F
Max Ambient Temperature	32.00 deg F
Liquid Temperature	68.00 deg F
Liquid Temp Rating	68.00 deg F
Connection Suc/Disch	250

Motor Data	
Power	15.00 hp
Phase	3
Hertz	60 Hz
Volts	230/460
RPM	3500 rpm
Frame Size	215TC
Efficiency Rating	NEMA Premium
Enclosure	TEFC

Pump Material Data	
Pump Material	stainless steel
Elastomer	EPDM

Estimated Weights	
Pump	370.9 lb

Certification Correct	
Customer	Town of Hudson, NH
Customer Quote #	1788017
Job Name	Hudson, NH - Marsh Road Water Pump Station
Market	Municipal

	Quote Item #	Pump #1
	Quote Date	09 Oct 2022

PVM(X) VERTICAL MULTISTAGE CENTRIFUGAL PUMPS

HIGH HYDRAULIC EFFICIENCY, MOTOR DESIGNED TO NEMA STANDARDS

The PVM and PVMX are vertical multistage pumps with flanged/NPT or grooved connections.

Stage construction with stainless steel impellers, chambers and pressure casing. Pump shaft and motor shaft of the NEMA-standard motor are directly close coupled.

All pumps are equipped with a cartridge type mechanical seal for easy maintenance.

PVM and PVMX pumps have different pump sizes and various numbers of stages to provide the flow and the pressure required.

APPLICATIONS

- Water supply
- Pressure boosting systems
- Water treatment/filtration
- Irrigation
- High pressure washes
- Liquid transfer
- Firefighting systems
- Boiler feed



PVM(X)

VERTICAL MULTISTAGE CENTRIFUGAL PUMPS

MOTOR

- TEFC motor with enclosed stator and external ventilation
- Main dimensions are in accordance with NEMA standards
- Class B or better insulation
- Maximum environmental temperature 40°C
- Speed of rotation 3500 rpm

Motor Type: 2-pole						
HP	Phase	Voltage	Frame Size	Phase	Voltage	Frame Size
0.5	1	115V/208-230V	56C	3	208-230V/460V	56C
0.75	1	115V/208-230V	56C	3	208-230V/460V	56C
1	1	115V/208-230V	56C	3	208-230V/460V	56C
1.5	1	115V/208-230V	56C	3	208-230V/460V	56C
2	1	115V/208-230V	56C	3	208-230V/460V	56C
3	1	115V/208-230V	182TC	3	208-230V/460V	182TC
5	1	208-230V	213TC	3	208-230V/460V	184TC
7.5	1	208-230V	213TC	3	208-230V/460V	213TC
10	1	208-230V	215TC	3	208-230V/460V	215TC
15	N/A	N/A	N/A	3	208-230V/460V	254TC
20	N/A	N/A	N/A	3	230V/460V	254TC
25	N/A	N/A	N/A	3	230V/460V	284TSC
30	N/A	N/A	N/A	3	230V/460V	284TSC
40	N/A	N/A	N/A	3	230V/460V	284TSC
50	N/A	N/A	N/A	3	230V/460V	326TSC (TEFC)
60	N/A	N/A	N/A	3	230V/460V	364TSC (TEFC)
75	N/A	N/A	N/A	3	230V/460V	365TSC (TEFC)
100	N/A	N/A	N/A	3	230V/460V	405TSC (TEFC)

PVM(X) VERTICAL MULTISTAGE CENTRIFUGAL PUMPS



PRODUCT DATA

60Hz	PVM(X)					
	1	3	5	10	15	20
Nominal Flow – US gpm	10.4	16	30	55	97	106
Flow Range – US gpm	1-20	1.5-30	3-60	5.5-95	9.5-150	11-170
Max. Pressure – psi (ft)	360 (832)	360 (832)	360 (832)	360 (832)	360 (832)	360 (832)
Fluid Temperature – °F (°C)	5°F to + 250°F (-15°C to + 120°C)					
Motor Power – hp	0.5-3	0.5-5	0.75-7.5	0.75-15	2-25	3-25
Version						
PVM: Cast Iron EN 1.4301/AISI 304"	•	•	•	•	•	•
PVMX: Stainless Steel EN 1.4401/AISI 316"	•	•	•	•	•	•
Motor						
Main Connection	Usable at 208V 208-230V/460 (0.5-15 hp); 230V/460V (20-100 hp)					
Insulation class	B					
Ambient temperature	40°C					
PVM Pipe Connection						
Flange/NPT	1-1/4" ANSI 250#/1-1/4" NPT Female	1-1/4" ANSI 250#/1-1/4" NPT Female	1-1/4" ANSI 250#/1-1/4" NPT Female	2" ANSI 250#/2" NPT Female	2" ANSI 250#/2" NPT Female	2" ANSI 250#/2" NPT Female
PVMX Pipe Connection						
Flange	1-1/4 ANSI 250#	1-1/4 ANSI 250#	1-1/4 ANSI 250#	2" ANSI 250#	2" ANSI 250#	2" ANSI 250#
Grooved connection	R¼ DN32	R¼ DN32	R¼ DN32	R2 DN50	R2 DN50	R2 DN50
Mechanical Seals						
SiC/SiC	Standard					
Seals						
EPDM	Standard					
Viton	Optional					

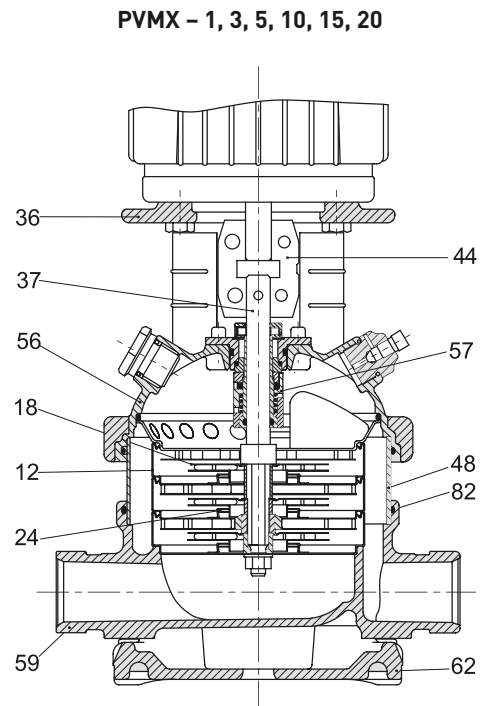
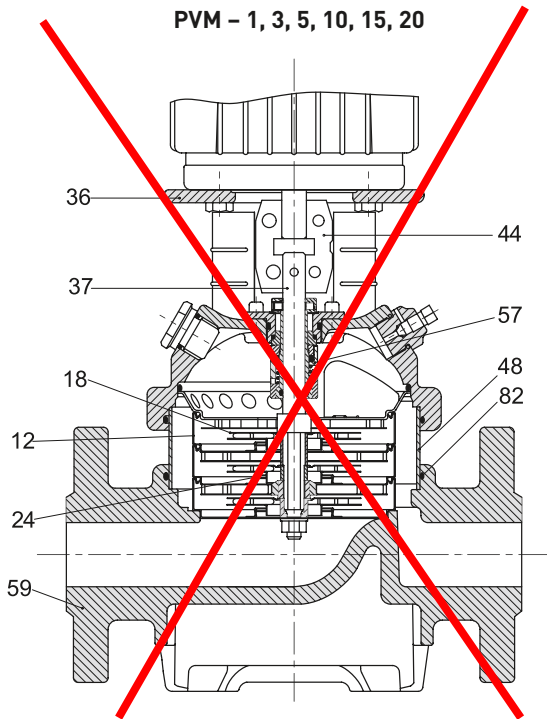
PVM(X)

VERTICAL MULTISTAGE CENTRIFUGAL PUMPS



PUMP CONSTRUCTION

POS.	NAME	MATERIAL	PVM 1, 3, 5, 10, 15, 20	PVMX 1, 3, 5, 10, 15, 20
36	Pump head	Cast iron	EN-GJL-200 ; ASTM 255	EN-GJS-450-10 ; ASTM 65-45-12
56	Pump head cover	Stainless steel	-	1.4401 ; AISI 316
18	Impeller	Stainless steel	1.4301 ; AISI 304	1.4401 ; AISI 316
37	Shaft	Stainless steel	1.4057 ; AISI 431	1.4401 ; AISI 316
48	Outer sleeve	Stainless steel	1.4301 ; AISI 304	1.4401 ; AISI 316
82	O-ring for outer sleeve	Epdm or viton	-	-
12	Chamber	Stainless steel	1.4301 ; AISI 304	1.4401 ; AISI 316
24	Neck Ring	PTFE	-	-
59	Base	Cast iron	EN-GJL-200 ; ASTM 255B	-
		Stainless steel	-	1.4401 ; AISI 316
62	Base plate	Cast iron	-	EN-GJL-200 ; ASTM 255B
44	Coupling	Fe-Cu-C	SINT C11 ; MPIF FC0525	SINT C11 ; MPIF FC0525
57	Mechanical seal	Cartridge type	Sic/Sic Faces with AISI 304 & 316 components	



PVM(X) 20 VERTICAL MULTISTAGE CENTRIFUGAL PUMPS

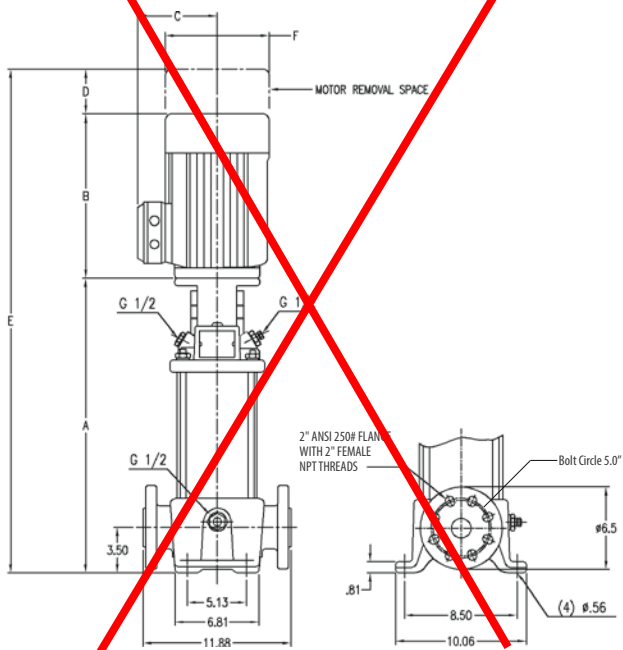


PUMP DIMENSIONS - STANDARD

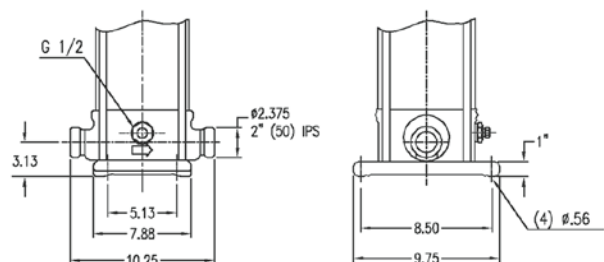
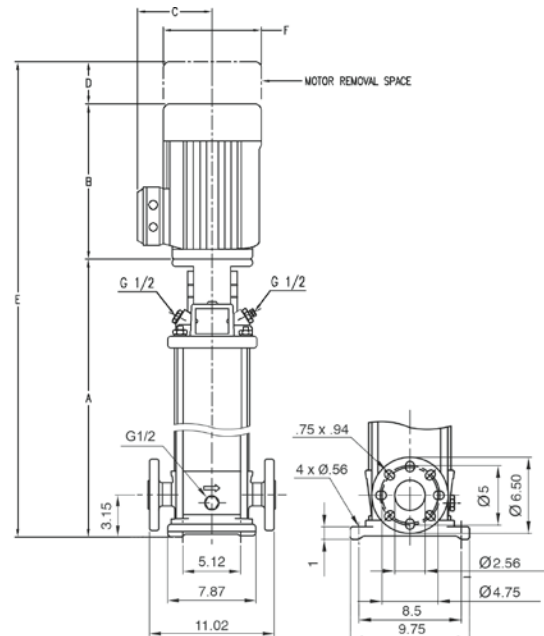
Model Number	Motor HP	Motor Service Factor	Phase	Voltage	Motor Frame	PVM Cast Iron								PVMX Stainless Steel							
						Dimensions in inches						Weight in Lbs		Dimensions in inches						Weight in Lbs	
						A	B	C	D	E	F	Pump End Only	Pump & Motor	A	B	C	D	E	F	Pump End Only	Pump & Motor
PVM20-1	3	1.15	1	115V/208-230V	182TC	16.8	15.4	8.9	2.6	34.8	8.9	66	154	16.8	15.4	8.7	2.6	34.8	8.7	55	143
PVM20-1	3	1.15	3	208-230V/460V	182TC	16.8	13.9	8.9	2.6	33.4	8.9	66	134	16.8	13.9	8.7	2.6	33.4	8.7	55	123
PVM20-2	5	1.15	1	208-230V	213TC	17.0	15.5	9.6	3.1	35.6	9.6	76	193	17.0	15.5	9.6	3.1	35.6	9.6	65	182
PVM20-2	5	1.15	3	208-230V/460V	184TC	17.0	13.9	8.9	2.6	33.6	8.9	76	144	17.0	13.9	8.9	2.6	33.6	8.9	65	133
PVM20-3	7.5	1.15	1	208-230V	213TC	18.8	15.5	8.7	3.1	37.4	8.7	86	203	18.8	15.5	8.7	3.1	37.4	8.7	75	192
PVM20-3	7.5	1.15	3	208-230V/460V	213TC	18.8	15.5	9.6	3.1	37.5	9.6	86	184	18.8	15.5	9.6	3.1	37.5	9.6	75	173
PVM20-4	10	1.15	1	208-230V	215TC	20.5	16.6	9.6	3.1	40.2	9.6	96	231	20.5	16.6	9.6	3.1	40.2	9.6	85	220
PVM20-4	10	1.15	3	208-230V/460V	215TC	20.5	15.5	9.6	3.1	39.2	9.6	96	221	20.5	15.5	9.6	3.1	39.2	9.6	85	210
PVM20-5	15	1.15	3	208-230V/460V	254TC	24.1	20.0	12.9	3.8	47.9	12.9	107	382	24.1	20.0	12.9	3.8	47.9	12.9	96	371
PVM20-6	15	1.15	3	208-230V/460V	254TC	25.9	20.0	12.9	3.8	49.7	12.9	117	392	25.9	20.0	12.9	3.8	49.7	12.9	106	381
PVM20-7	20	1.15	3	230V/460V	254TC	27.7	16.9	10.3	3.8	48.3	10.3	127	352	27.7	16.9	10.3	3.8	48.3	10.3	116	341
PVM20-8	20	1.15	3	230V/460V	254TC	29.5	16.9	10.3	3.8	50.1	10.3	137	362	29.5	16.9	10.3	3.8	50.1	10.3	126	351
PVM20-10	25	1.15	3	230V/460V	284TSC	35.0	20.0	12.9	3.0	58.0	12.9	157	471	35.0	20.0	12.9	3.0	58.0	12.9	146	467

PVM

PVMX



Dual 2" NPT/ 2" ANSI 250# Flanges



NOTE: G1/2 per ISO-228

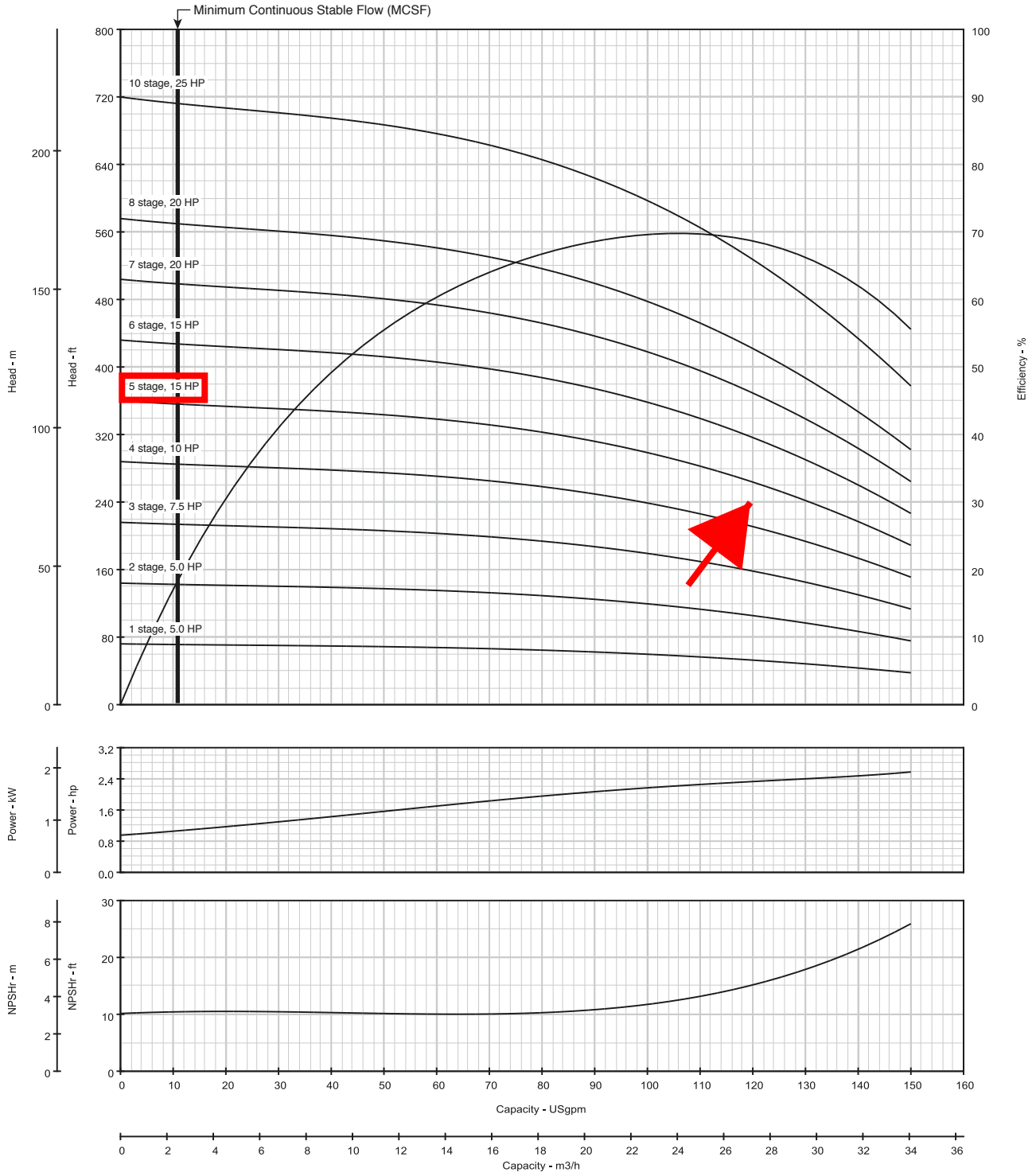
PVM(X) 20

VERTICAL MULTISTAGE CENTRIFUGAL PUMPS

HYDRAULIC PERFORMANCE

Curve PVM(X) 20
Date 10/01/14

Nominal rpm: 3500
Based on fresh water @ 68°F
Maximum working pressure: 360 psi





800 AIRPORT ROAD, NORTH AURORA, ILLINOIS • PH: 630-859-7000 • www.AuroraPump.com

Because we are continuously improving our products and services, Pentair reserves the right to change specifications without prior notice.

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A-02-1078 (11/10/15)

NEMA MOTORS

Product overview

BALDOR • RELIANCE



- Broadest line of NEMA low voltage motors in the industry

Industry's broadest line of NEMA low voltage motors

For nearly 100 years, we have strived to provide customers with the best value and reliability in industrial electric motors. ABB has what it takes to help every industry and application reach new levels of efficiency and energy savings even under the most demanding conditions. Baldor-Reliance® motors are designed to operate reliably no matter how challenging the process or application, and to have low life cycle costs.

Whether it's a motor for harsh, outdoor conditions at a petrochemical plant, or for continuous duty in a distribution center, customers have a variety of choices either from stock or designed to fit specific requirements.

We know there are many options when it comes to buying the products you need. To help maintain your competitive edge, we offer the latest technologies to improve process reliability while driving operating costs to a minimum.

Industry's best product information. ABB offers customers easy and fast access to product information and support via the web, with in-depth product literature, specific model number information packets; complete with spare parts lists, drawings, speed/torques curves and connection diagrams. You may also talk with a customer service representative at your local sales office.



BALDOR® • RELIANCE 

Product Information Packet

VEM3713T

52M 2P TEFC VER 215TC SUPER E

Part Detail							
Revision:	D	Status:	PRD/A	Change #:		Proprietary:	No
Type:	AC	Elec. Spec:	37WGR228	CD Diagram:	CD0180	Mfg Plant:	
Mech. Spec:	37H329	Layout:	37LYH329	Poles:	02	Created Date:	03-14-2019
Base:	N	Eff. Date:	08-11-2022	Leads:	9#14		

Specs			
Catalog Number:	VEM3713T	Heater Indicator:	No Heater
Enclosure:	TEFC	Insulation Class:	F
Frame:	215TC	Inverter Code:	Inverter Ready
Frame Material:	Steel	KVA Code:	J
Motor Letter Type:	Three Phase	Lifting Lugs:	Standard Lifting Lugs
Output @ Frequency:	15.000 HP @ 60 HZ	Locked Bearing Indicator:	Locked Bearing
Synchronous Speed @ Frequency:	3600 RPM @ 60 HZ	Motor Lead Quantity/Wire Size:	9 @ 14 AWG
Voltage @ Frequency:	230.0 V @ 60 HZ	Motor Lead Exit:	Ko Box
	460.0 V @ 60 HZ	Motor Lead Termination:	Flying Leads
XP Class and Group:	None	Motor Type:	3752M
XP Division:	Not Applicable	Mounting Arrangement:	F1
Agency Approvals:	CSA	Power Factor:	89
	CSA EEV	Product Family:	General Purpose
	UR	Pulley End Bearing Type:	Ball
Auxillary Box:	No Auxillary Box	Pulley Face Code:	C-Face
Auxillary Box Lead Termination:	None	Pulley Shaft Indicator:	Standard
Base Indicator:	No Mounting	Rodent Screen:	None
Bearing Grease Type:	Polyrex EM (-20F +300F)	RoHS Status:	ROHS COMPLIANT

Blower:	None	Shaft Extension Location:	Pulley End
Current @ Voltage:	36.800 A @ 208.0 V	Shaft Ground Indicator:	No Shaft Grounding
	34.000 A @ 230.0 V	Shaft Rotation:	Reversible
	17.000 A @ 460.0 V	Shaft Slinger Indicator:	No Slinger
Design Code:	A	Speed Code:	Single Speed
Drip Cover:	No Drip Cover	Motor Standards:	NEMA
Duty Rating:	CONT	Starting Method:	Direct on line
Electrically Isolated Bearing:	Not Electrically Isolated	Thermal Device - Bearing:	None
Feedback Device:	NO FEEDBACK	Thermal Device - Winding:	None
Front Face Code:	Standard	Vibration Sensor Indicator:	No Vibration Sensor
Front Shaft Indicator:	None	Winding Thermal 1:	None
		Winding Thermal 2:	None

Nameplate NP3441LUA

CAT.NO.	VEM3713T				
SPEC	37H329R228G1				
HP	15				
VOLTS	230/460				
AMPS	34/17				
RPM	3500				
FRAME	215TC	HZ	60	PH	3
SF	1.15	CODE	J	DES	A
NEMA NOM. EFF	91	PF	89	CLASS	F
RATING	40C AMB-CONT				
CC	010A	USABLE AT 208V			36.8
ENCL	TEFC	SER			
DE	6307	ODE	6206		
VPWM INVERTER READY					
CT6-60H(10:1)VT3-60H(20:1)					
	50HZ 15HP 190/380V 40.8/20.4A				SF1.0

AC Induction Motor Performance Data

Record # 53380

Typical performance - not guaranteed values

Winding: 37WGR228-R023		Type: 3752M		Enclosure: TEFC	
Nameplate Data			460 V, 60 Hz: High Voltage Connection		
Rated Output (HP)	15	Full Load Torque	22.12 LB-FT		
Volts	230/460	Start Configuration	direct on line		
Full Load Amps	34/17	Breakdown Torque	103 LB-FT		
R.P.M.	3500	Pull-up Torque	40.16 LB-FT		
Hz	60 Phase	3	Locked-rotor Torque	57.59 LB-FT	
NEMA Design Code	A KVA Code	J	Starting Current	150 A	
Service Factor (S.F.)	1.15	No-load Current	5.55 A		
NEMA Nom. Eff.	91 Power Factor	89	Line-line Res. @ 25°C	0.47 Ω	
Rating - Duty	40C AMB-CONT	Temp. Rise @ Rated Load	68°C		
S.F. Amps		Temp. Rise @ S.F. Load	79°C		
		Locked-rotor Power Factor	30.9		
		Rotor inertia	0.474 LB-FT ²		

Load Characteristics 460 V, 60 Hz, 15 HP

% of Rated Load	25	50	75	100	125	150	S.F.
Power Factor	56	78	85	89	90	90	89
Efficiency	86.8	91	91.9	91.4	90.8	89.8	91.3
Speed	3579	3557	3534	3500	3484	3456	3495
Line amperes	6.7	9.57	13.19	17.03	21.12	25.61	19.5

Performance Graph at 460V, 60Hz, 15.0HP Typical performance - Not guaranteed values

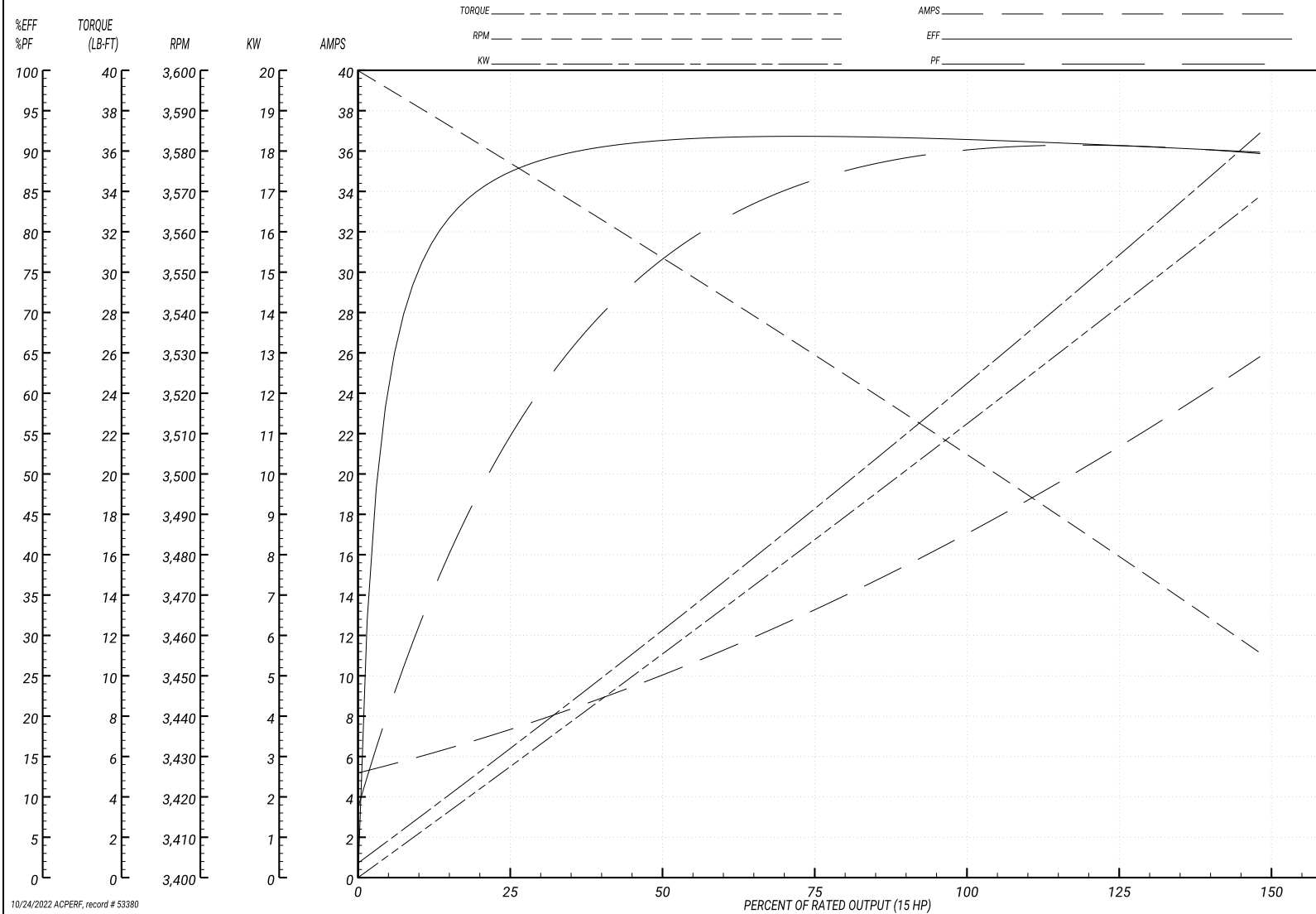
BALDOR ELECTRIC COMPANY

WINDING # 37WGR228

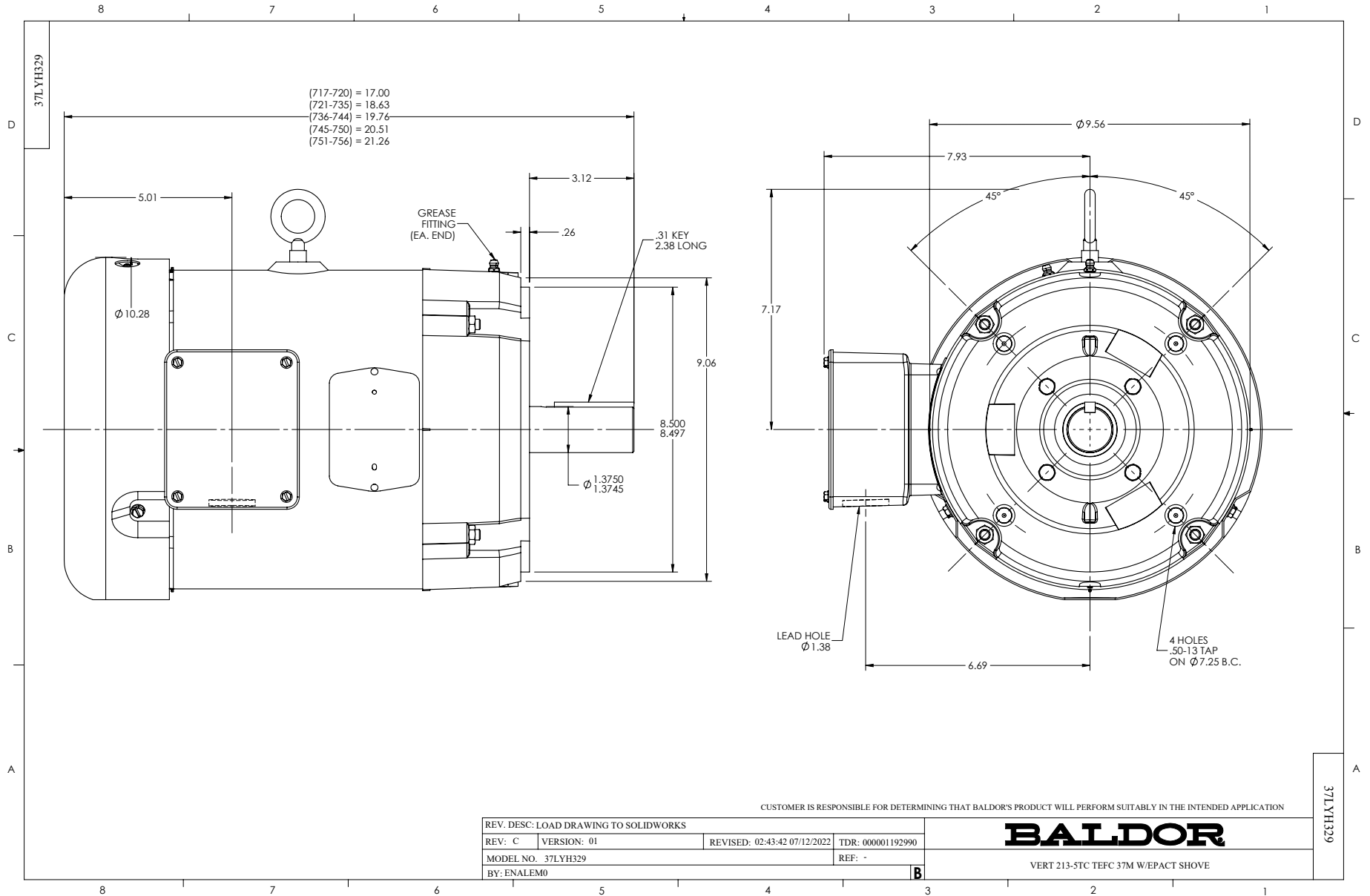
Typical performance - not guaranteed values.

15 HP 3 PH 60 HZ 3500 RPM 460 V 3752M

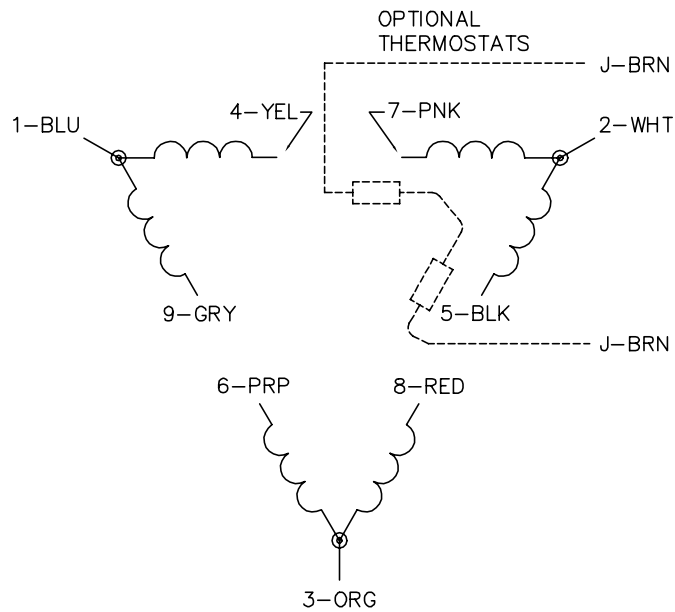
TORQUES(LB-FT): PO=103 PU=40.16 LR=57.59 LRA=150



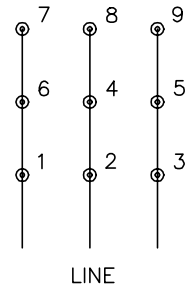
10/24/2022 ACPERF, record # 53380



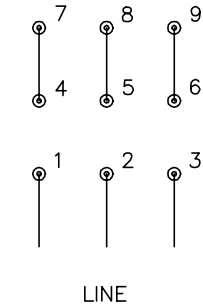
CD0180



LOW VOLTAGE
(2D)



HIGH VOLTAGE
(1D)



NOTES:

1. INTERCHANGE ANY TWO LINE LEADS TO REVERSE ROTATION.
2. OPTIONAL THERMOSTATS ARE PROVIDED WHEN SPECIFIED.
3. ACTUAL NUMBER OF INTERNAL PARALLEL CIRCUITS MAY BE A MULTIPLE OF THOSE SHOWN ABOVE.
4. LEAD COLORS ARE OPTIONAL. LEADS MUST ALWAYS BE NUMBERED AS SHOWN.

CD0180

REV. DESC: ADD CLASS CONN00000007		
REV. LTR: D	VERSION: 01	TDR: 000001099922
FILE: \AAA\00005\148	REVISED: 10:25:29 02/19/2019	BY: ENBRIRO
MTL: -	© □	

BALDOR - RELIANCE®

3PH, DV, 9 LEADS, DELTA CONNECTION

SH 1 of 1

