



>ClydeUnion Pumps

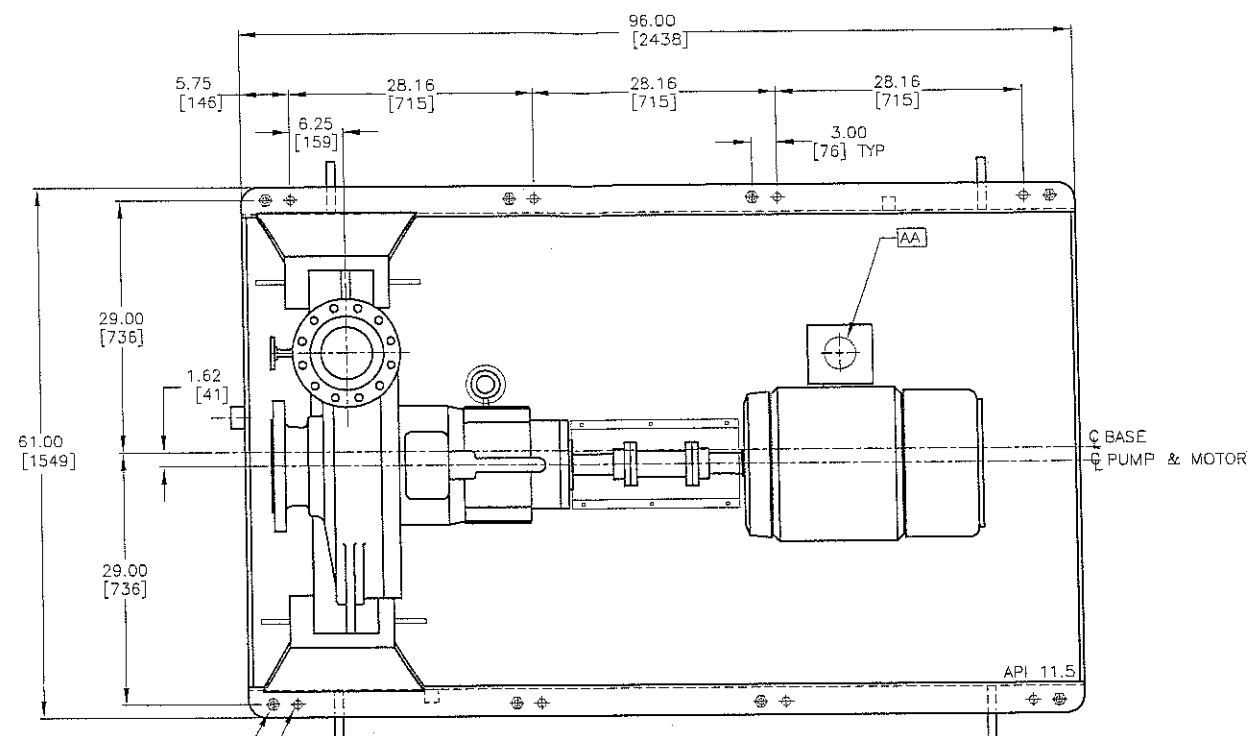
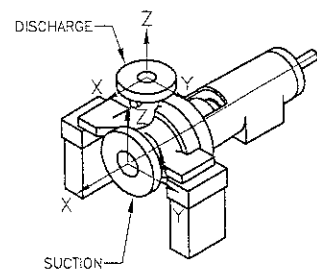
This information has been specially prepared for the following unit(s):

CUSTOMER:	SPECTRUM PROCESS SYSTEMS INC.
CUSTOMER ORDER NO:	002020
PUMP SIZE & TYPE:	6x8x26 CUP-OH2
PUMP SERIAL NUMBER:	CC130189A-1
PUMP ITEM NUMBER:	P-436

The purpose of this data package is to assist in the installation of the pumping unit and to provide a permanent record of contract documents. It is not intended to cover all the details or variations which may arise in connection with the installation of the pump.

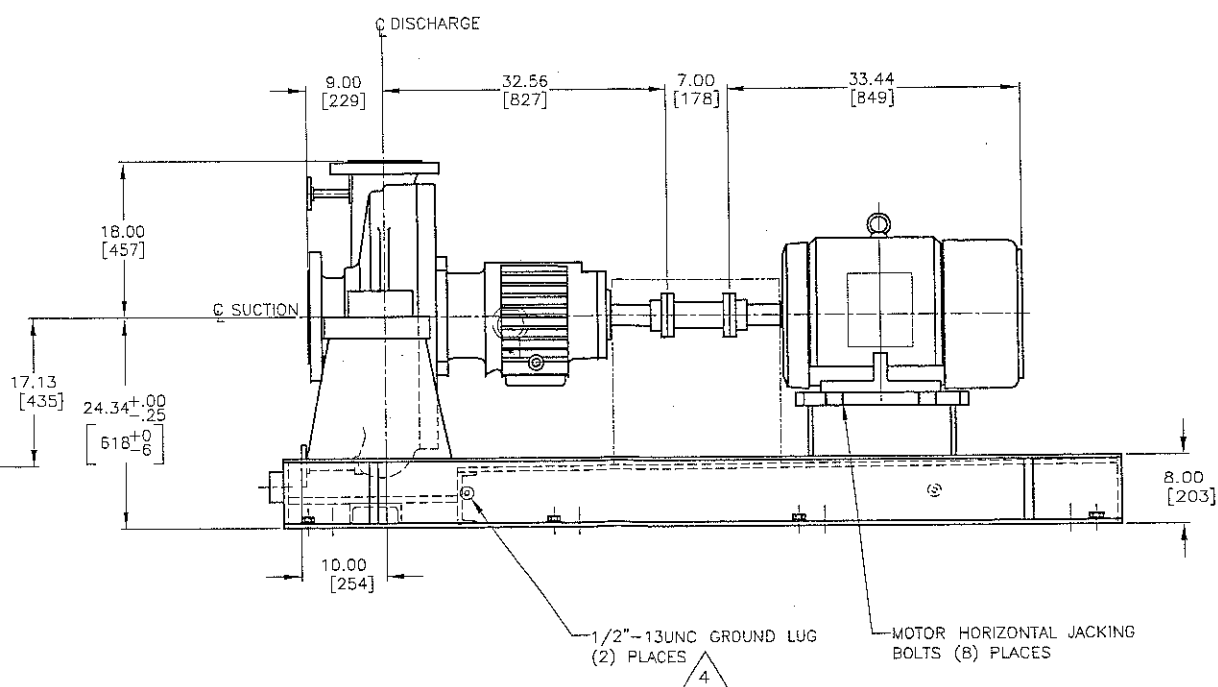
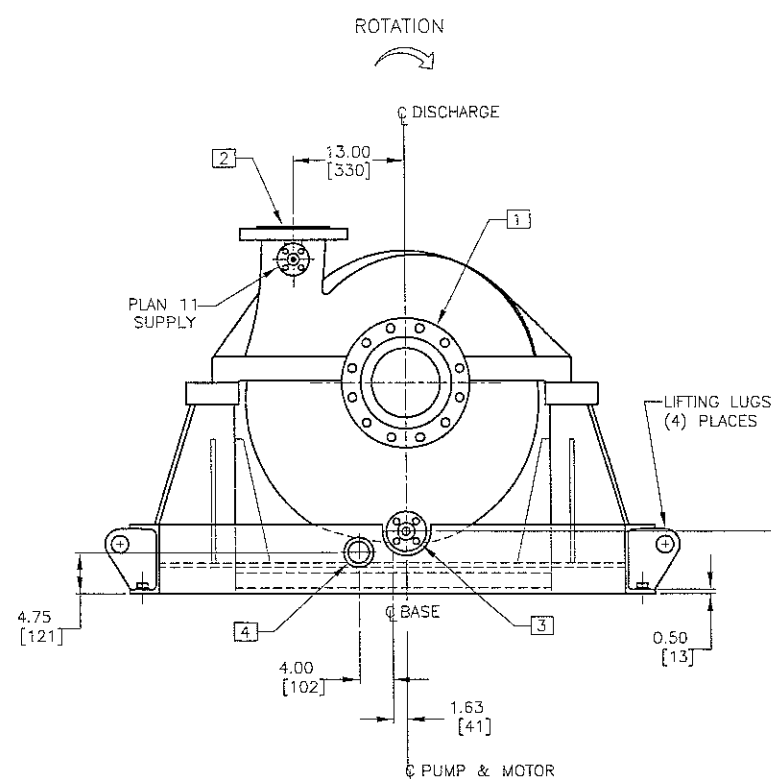
If additional information is required, contact ClydeUnion Pumps

SECTION	DOCUMENT NUMBER	DESCRIPTION
B Dimensional & Assembly Drawings	A-B01	General Arrangement Drawing
D Detail Drawings & Parts lists	A-D01	Cross-sectional Drawing
	A-D02	Pump Bill of Material
	A-D03	Mechanical Seal Drawing
E Electrical Data	A-E01	Motor Outline Drawing
	A-E03	Motor Performance Data & Curves
	A-E04	Motor Wiring Diagrams
H Q.A Documents	A-H02	Inspection & Test Plan
J Installation, Operation & Maintenance Manuals	A-J01	IOM Manual: Pump
	A-J02	IOM Manual: Motor
K Test Certificates	A-K01	Performance Test Data & Curves
	A-K02	Hydrotest Certificate
L Material & NDE Certificates	A-L01	Material Test Certificates
	A-L02	Magnetic Particle Inspection (MPI) Certificate
M Miscellaneous Drawings & Data	A-S01	Recommended Spares (2 Years & Commissioning)



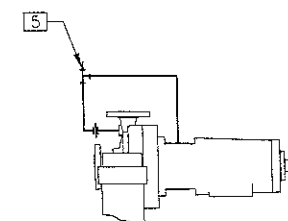
(B) 3/4"-10 UNC TAPPED HOLES
FOR LEVELING SCREWS SUPPLIED BY CUP

(B) 1" [25] FOUND. BOLT HOLES
FOR MAX 3/4" [20] DIA BOLTS
(SUPPLIED BY CUSTOMER)



ISS.	BY	CHK.	DESCRIPTION	DATE
01	UG	JD	ORIGINAL ISSUE	8/29/13
02/03	UG	JD	INTERNAL REVISION	9/3/13
04	JD	AP	AS BUILT -- ADDED GROUND LUG	3/11/14

API PLAN 11
1/2" OD X .065" WALL SS TUBING WITH
316SS TUBE FITTINGS



ALLOWABLE FORCES & MOMENTS F (N.) M (N.-m.)							
FLANGE	FX	FY	FZ	FR	MX	MY	MR
SUCTION	4890	3780	3110	6920	3530	1760	2580
DISCHARGE	2490	2050	3110	4480	2300	1180	1760

FORCES & MOMENTS ARE API 1X

MECHANICAL SEAL

MFGR.: JOHN CRANE INC. TYPE: 48LP / ECS
CODE: BTPFN SHAFT SIZE: 3.150"(80MM)

COUPLING

MFGR.: THOMAS TYPE: 71-300
COUPLING GUARD BY: CLYDE UNION MATERIAL: ALUMINUM

DRIVER

MFGR.: BALDOR FRAME: 364T HP: 30 RPM: 900
ENCL.: TEFC PHASE: 3 CYCLES: 60 VOLTS: 575

CUSTOMER CONNECTIONS

NO.	SIZE	TYPE	CONNECTION
1	8"	FLG	PUMP SUCTION - 300# R.F. ANSI FLANGE
2	6"	FLG	PUMP DISCHARGE - 300# R.F. ANSI FLANGE
3	3/4"	FLG	PUMP DRAIN - 300# R.F. ANSI SW FLANGE
4	2"	NPT	BASEPLATE DRAIN
5	1/2"	NPT	PLAN 11 VENT PLUGGED

AA 2-1/2" NPT MOTOR CONDUIT ENTRY

NOTES:
1. Dimensions are in inches [mm].
2. Dimensions $\pm .12"$ [3] unless noted.
3. Dimensions of piping $\pm 1"$ [25] unless noted.
4. Location of piping components may vary.
5. ** Dimensions to be confirmed.

	WEIGHTS	LBS.	KG
PUMP	2500	1134	
DRIVER	792	359	
BASEPLATE	2000	907	
OTHER	-	-	
TOTAL	5292	2400	

CERTIFIED CORRECT FOR THE FOLLOWING:

CUSTOMER: SPECTRUM PROCESS SYSTEMS INC. / ENCANAL CORP.

LOCATION: FARMINGTON BC

SERVICE: CONDENSATE BOOSTER PUMP

CUST. P.O.: 002020

TAG NO.: P-436

PUMP S/N: CC130189A-1

CERTIFIED BY: UG

SPX ClydeUnion Pumps	DRN.	UG 8/29/13	GENERAL ARRANGEMENT	
	CHK.	JD 9/3/13	6X8X26A CUP-OH2	
	APP.	AP 9/13	DWG. NO.	CC130189A-B01
			ISSUE	04



Document Front Sheet

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ClydeUnion Pumps
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Burlington
Ontario L7L 4X6
Canada

Page 1 of 6

Document Title: Pump Bill of Material
ClydeUnion Ref: A-D02
Client Reference: D02 (CC130189A-1 - 6x8x26 CUP-OH2 (Item No. P-436))
Contract: CC130189 (Spectrum Process Systems Inc)
Client PO No: 002020
Revision: 1 Reason: For Information
Comment :

Document History

Revision	Sent Date	Reason	From	Comment

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To: SPX Clyde Union Pumps
Document Control Group
(address as above)



Bill of Material

ClydeUnion Pumps

Description:	6 X 8 X 26A CUP-OH2	Pump Serial No:	CC130189A-1
Service:	CONDENSATE BOOSTER PUMP	Customer Item No:	P-436

SECT REF	QTY	DESCRIPTION OF PART	PART NUMBER	MATERIAL
CAS, HHS-8, 6X8X26, S-5 (IIIB)			(NM)	
800	1	Casing	800 D 90184 20 B44400	A216 WCB
802	1	Cover	802 E 03322 00 B21100	A516 Grade 70
805	1	Impeller	805 D 90198 01 B44500	A216 WCB
806	2	Wear ring - impeller	806 A 01746 02 E11500	CA-15
808	2	Wear ring - casing	808 A 01719 00 E11501	CA-15, 37-42 Rc
815-1	1	Gasket - casing	815 B 90342 04 R20500	316/Graphoil
847-1	1	Throat bushing	847 C 13071 00 E21100	A276 410
	20	Stud - casing	824 A 01563 19 C42522	A193 B7 / Zinc
	20	Nut - casing	9108X000267	A194 2H / Zinc
HHS, DRAIN - SOCKET WELD FLANGE			(NM)	
6"		Pipe, 3/4 sch 160	9PC06B32657	A106 Grade B
1		Flange - 3/4"-300# RF SW	9217X000298	A105
HHS, - SW FLG AT DISCHARGE CONNECTION			(NM)	
6"		Pipe - 1/2" sch 160	9PC04B32657	A106 Grade B
1		Flange - 1/2"-300# RF SW	9217X000361	A105



Bill of Material

ClydeUnion Pumps

Description:	6 X 8 X 26A CUP-OH2	Pump Serial No:	CC130189A-1
Service:	CONDENSATE BOOSTER PUMP	Customer Item No:	P-436

SECT REF	QTY	DESCRIPTION OF PART	PART NUMBER	MATERIAL
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**SEAL, HHS-8, GR III, 80 MM SHAFT
LAYOUT: LAY-D-97693-00 (NM)**

823	1	Mechanical seal Manufacturer: JOHN CRANE Type: 48LP/ECS Code: BTPFN	9421X002260	
	4	Stud - gland 5/8-11UNC X 4.75"	824 A 01549 19 C42522	A193 B7 / Zinc
	4	Nut - gland	9108A101DA5	A194 2H / Zinc

SHAFT, HHS, GR IIIB, STEEL (NM)

820	1	Shaft	820 E 03270 01 C43801	A434 4140
821-1	1	Impeller nut	821 A 90086 00 F11513	A747 CB-7Cu
	1	Socket head setscrew, 1/4-20 X 3/4	9103B0412D4	304 SS
811-1	1	Key - impeller	811 B 03232 14 D21400	316 SS
811-2	1	Key - coupling	811 B 03232 20 D21400	316 SS

1 BEARING BRKT, HHS-8, GR III (M)093300

849	1	Bearing bracket	849 E 03265 05 B44500	A216 WCB
	4	Socket head capscrew, 3/4-10 x 2-1/2 lg.	9102B1224A1	Steel
813-1	1	End cap - inboard	813 B 90971 00 B25500	Steel
	2	Hex head capscrew, 5/16-18 X1/2 lg.	9101A0504A1	Steel
	1	O-ring - inboard end cap	9410A26500G	Viton
829-1	1	Bearing isolator - inboard, Inpro VBX	9411X000108	Bronze
829-3	1	Bearing isolator - outboard, Inpro VBX	9411X000109	Bronze
813-2	1	End cap - outboard	813 C 13012 07 B25500	Steel
	4	Hex head capscrew, 5/8-11 x 1-3/4 lg.	9101A1016A1	Steel
815-5	1	Shim assembly - outboard end cap (3) .003 thick 815 B 12247 02 T31100 (4) .010 thick 815 B 12247 03 T31100	016494	Plastic



Bill of Material

ClydeUnion Pumps

Description: 6 X 8 X 26A CUP-OH2

Pump Serial No: CC130189A-1

Service: CONDENSATE BOOSTER PUMP

Customer Item No: P-436

SECT REF	QTY	DESCRIPTION OF PART	PART NUMBER	MATERIAL
881-1	1	Bearing - radial, 6218	9608X021801	
881-2	2	Bearing - thrust, 7317WN SUL	9608X731716	
831	1	Lockwasher - bearing, W-17	9601AW1700A	Steel
821-4	1	Locknut - bearing, N-17	9601BN1700A	Steel
	1	Oil level gauge, 3/4 NPT	9513X000104	
	1	Constant level oiler, Trico #5	9517AADE000	
	1	Cage - #5 oiler	9517AADY200	
	1	Pipe nipple, 1/4 x 3 lg.	920202A06C3	316 SS
	2	Hex head pipe plug, 3/4 NPT	9214CA06KA1	Steel
	1	Countersunk hex head pipe plug -1-1/4" NPT	9214FA12JD5	Steel
	1	Breather, Tedeco M812	9514B1F0000	
	2	Square head pipe plug, 1/4 NPT	9214CA02KA1	Steel
	2	Oil ring	817 B 02227 15 J11600	Bronze
	2	Retaining screw - oil ring	999 B 91192 02 B29100	Steel
	1	Nameplate	179 B 91445 00 D40401	316 SS



Bill of Material

> ClydeUnion Pumps

Description:	6 X 8 X 26A CUP-OH2	Pump Serial No:	CC130189A-1
Service:	CONDENSATE BOOSTER PUMP	Customer Item No:	P-436

SECT REF	QTY	DESCRIPTION OF PART	PART NUMBER	MATERIAL
		HHS, PLAN 11B - SW FLG AT CASING	(NM)	
	1	Flange - 1/2"-300# RF NPT	9218X000133	A105
	1	Paddle orifice - 1/2"-300#, 1/8" dia. Hole	9224X000135	316 SS
	2	Gasket - 1/2"-300#	9412ABB0015	316/graphoil
	4	Stud - 1/2"-13 x 3-1/4" lg.	824 N 01548 13 C42400	A193 B7
	8	Nut, heavy hex - 1/2"-13	9108A081DF1	A194 2H
	1	Male connector - 1/2T x 1/2P	9250A0808DS	316 SS
	1	Male 90 elbow - 1/2T x 1/2P	9250C0808DS	316 SS
	1	Pipe nipple - 1/2" sch 80 x 6" lg.	9202X000119	A106 Grade B
	1	Pipe tee - 1/2"-3000#	9205X000288	A105
	1	Plug - 1/2" NPT	9214X000127	A105
	36"	Mech. tubing - 1/2 OD x .065" wall	9MADND32900	A269 TP316



Bill of Material



ClydeUnion Pumps

Description: 6 X 8 X 26A CUP-OH2

Pump Serial No: CC130189A-1

Service: CONDENSATE BOOSTER PUMP

Customer Item No: P-436

SECT REF	QTY	DESCRIPTION OF PART	PART NUMBER	MATERIAL
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HHS, ACCESSORIES

(NM)

1	Baseplate	838 D 90740 08 B25500	
12	Motor shim packs	870 A 01872 02 D40400	304 SS
8	Leveling screws	9114A1264A1	Steel
8	Motor horizontal jacking screw block	850 A 02745 10 B25500	Steel
1	Coupling - Thomas 71-300	9625X000419	
1	Guard - coupling	812 B 90795 AL K25500	Aluminum
1	Driver - 30 HP, 900 RPM, 3/60/575, 364T	96604161648	

Processes

(NM)

1	Painting - pump	PNT130189A1	
1	Painting - Baseplate Top	PNT130189A2	
1	NDE - MPI Casing Machined Surfaces	NDE130189A1	
1	Skidding	SKD130189A1	
1	Flange cover - 8"-300#	700 B 90570 05 B29100	Steel
1	Flange cover - 6"-300#	700 B 90570 04 B29100	Steel
1	Flange cover - 8"-300#	700 B 90570 30 B29100	Steel



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Page 1 of 2

Document Title: Mechanical Seal Drawing
ClydeUnion Ref: A-D03
Client Reference: D03 (CC130189A-1 - 6x8x26 CUP-OH2 (Item No. P-436))
Contract: CC130189 (Spectrum Process Systems Inc)
Client PO No: 002020
Revision: 1 Reason: For Information
Comment :

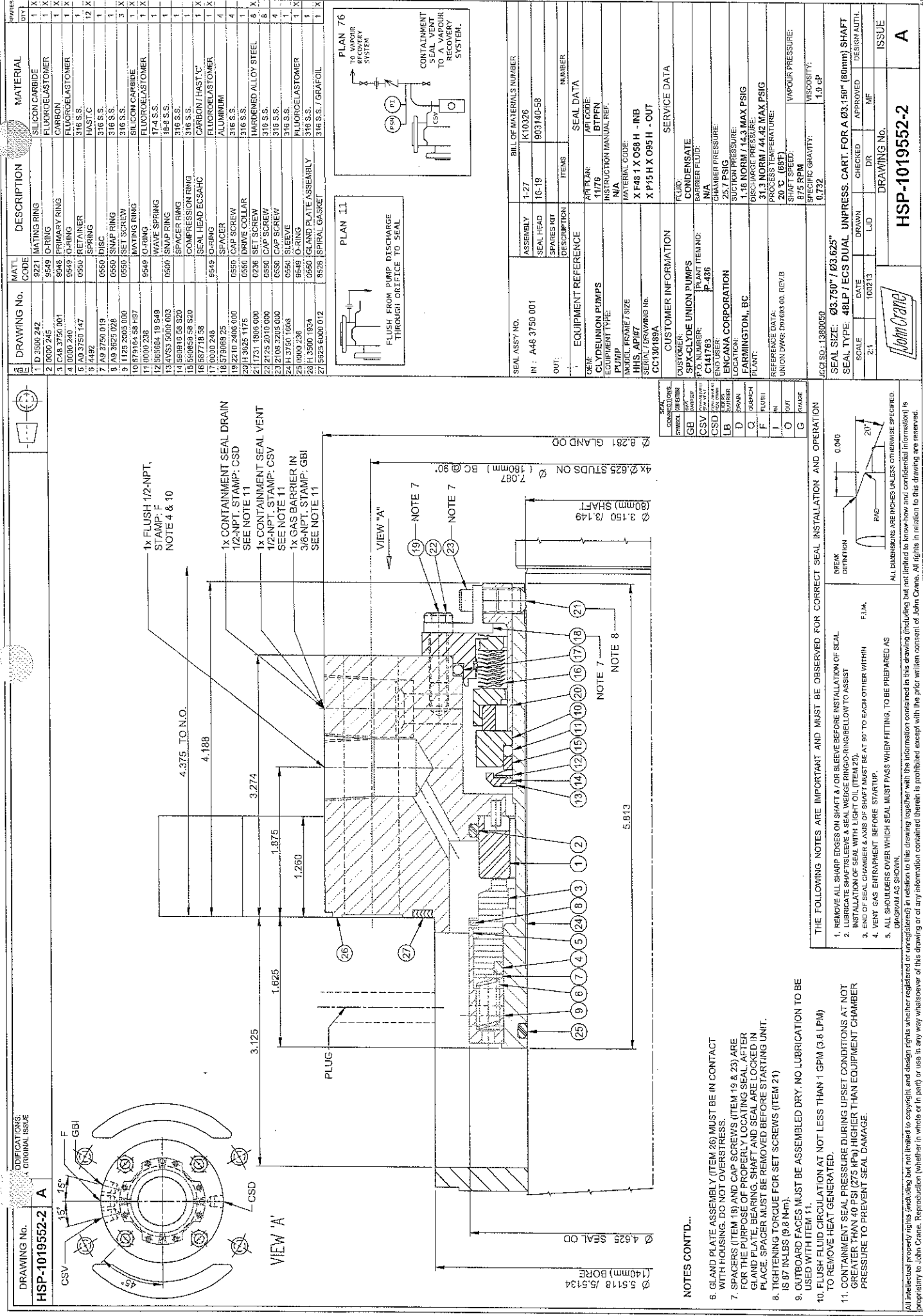
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DRAWING No.	DRAWING No.	MAT'L CODE	DESCRIPTION	MATERIAL
HSP-1019552-2	1 D 3500 242	9221	MATING RING	SILICON CARBIDE
	2 0000 245	9549	O-RING	FLUOROELASTOMER
	3 C18 3750 001	9048	PRIMARY RING	CARBON
	4 0000 240	9549	O-RING	FLUOROELASTOMER
	5 A3 3750 147	0550	RETAINER	316 S.S.
	6 1482		SPRING	HAST C
	7 A9 3750 019	0650	DISC	316 S.S.
	8 A9 3625 028	0550	SNAP RING	316 S.S.
	9 1125 2003 000	0550	SET SCREW	316 S.S.
	10 578164 58 197		MATING RING	SILICON CARBIDE
	11 0000 238	9549	O-RING	FLUOROELASTOMER
	12 565884 19 940		WAVE SPRING	174 S.S.
	13 A53 5000 003	0550	SNAP RING	183 S.S.
	14 580816 58 920		SPACER RING	316 S.S.
	15 580816 58 920		SPACER RING	316 S.S.
	16 587718 58		COMPRESSION RING	CARBON/HAST C
	17 0000 248	9549	O-RING	FLUOROELASTOMER
	18 578088 25		SPACER	ALUMINUM
	19 2210 2406 000	0550	CAP SCREW	316 S.S.
	20 H 3625 1176	0550	DRIVE COLLAR	316 S.S.
	21 1731 1806 000	0236	SET SCREW	HARDENED ALLOY STEEL
	22 2125 2010 000	0550	CAP SCREW	316 S.S.
	23 2108 3208 000	0550	CAP SCREW	316 S.S.
	24 H 3750 1608	0550	SLEEVE	316 S.S.
	25 0000 236	9549	O-RING	FLUOROELASTOMER
	26 H 3500 1834	0550	GLAND PLATE/ASSEMBLY	316 S.S.
	27 5825 6000 012	9525	SPIRAL GASKET	316 S.S./GRAFOIL

SEAL	CONNECTIONS	SYMBOL	DESCRIPTION	PLANT ITEM NO.	ITEMS	NUMBER
GB	GB		SEAL HEAD	16-19	903140-58	
CSV	CSV		SPACERS KIT			
CSD	CSD		DESCRIPTION			
LB	LB		EQUIPMENT REFERENCE			
D	D		APPLAN	11/76	ART CODE	
Q	Q		EQUIPMENT TYPE		BT/PTN	
F	F		MODEL FRAME / SIZE		INSTRUCTION MANUAL REF.	
I	I		PUMP			
O	O		MATERIAL CODE			
G	G		HHS, API#7			
			SERIAL / DRAWING No.			
			CC130189A			

CUSTOMER INFORMATION	FLUID	CONDENSATE	SEAL DATA
SPX-CLYDE UNION PUMPS	CLYDE		
P.O. NUMBER: C141763	BARRELL FLUID:		
END USER: ENCANIA CORPORATION	CHAMBER PRESSURE:		
LOCATION: FARMINGTON, BC	25.7 PSIG		
PLANT: 110 NORM / 14.3 MAX PSIG	DISCHARGE PRESSURE:		
REFERENCE DATA: 31.3 NORM / 44.42 MAX PSIG	PROCESS TEMPERATURE:		
UNION DWG: D0483 00 REV/B	SHAFT SPEED:		
	875 RPM		
	VAPOR PRESSURE:		
	20 °C (68°F)		
	SPECIFIC GRAVITY:		
	1.0 GP		

SEAL SIZE: 03.750" / 03.625"	SEAL TYPE: 48P / ECS DUAL UNPRESS. CART. FOR A Ø3.150" (80mm) SHAFT
SCALE: 2:1	DATE: 10/21/13
CHECKED: DR	APPROVED: MF
DRAWING No. HSP-1019552-2	ISSUE: A

THE FOLLOWING NOTES ARE IMPORTANT AND MUST BE OBSERVED FOR CORRECT SEAL INSTALLATION AND OPERATION

- REMOVE ALL SHARP EDGES ON SHAFT & (OR) SLEEVE BEFORE INSTALLATION OF SEAL
- LUBRICATE SHAFT/SLEEVE & SEAL WEDGE RING-O-RINGS/BELLOW TO ASSIST INSTALLATION OF SEAL WITH LIGHT OIL (ITEM 25)
- END OF SEAL CHAMBER & AXIS OF SHAFT MUST BE AT 90° TO EACH OTHER WITHIN 0.040"
- VENT GAS ENTRAPMENT BEFORE STARTUP
- ALL SHOULDERS OVER WHICH SEAL MUST PASS WHEN FITTING, TO BE PREPARED AS SHOWN

NOTES CONT'D..

- GLAND PLATE ASSEMBLY (ITEM 26) MUST BE IN CONTACT WITH HOUSING. DO NOT OVERSTRESS
- SPACERS (ITEM 19) AND CAP SCREWS (ITEM 19 & 23) ARE FOR THE PURPOSE OF PROPERLY LOCATING SEAL AFTER GLAND PLATE BEARING, SHAFT AND SEAL ARE LOCKED IN PLACE. SPACER MUST BE REMOVED BEFORE STARTING UNIT.
- TIGHTENING TORQUE FOR SET SCREWS (ITEM 21) IS 87 IN-LBS (9.6 Nm).
- OUTBOARD FACES MUST BE ASSEMBLED DRY. NO LUBRICATION TO BE USED WITH ITEM 11.
- FLUSH FLUID CIRCULATION AT NOT LESS THAN 1 GPM (3.8 LPM) TO REMOVE HEAT GENERATED.
- CONTAINMENT SEAL PRESSURE DURING UPSET CONDITIONS AT NOT GREATER THAN 40 PSI (275 kPa) HIGHER THAN EQUIPMENT CHAMBER PRESSURE TO PREVENT SEAL DAMAGE.

ALL DIMENSIONS ARE INCHES UNLESS OTHERWISE SPECIFIED

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Document Title: Motor Outline Drawing
ClydeUnion Ref: A-E01
Client Reference: E01 (CC130189A-1 - 6x8x26 CUP-OH2 (Item No. P-436))
Contract: CC130189 (Spectrum Process Systems Inc)
Client PO No: 002020
Revision: 1 Reason: For Information
Comment :

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611760-570-SH1

DUTY MASTER ALTERNATING CURRENT MOTORS

SQUIRREL-CAGE INDUCTION
CAST IRON CONSTRUCTION

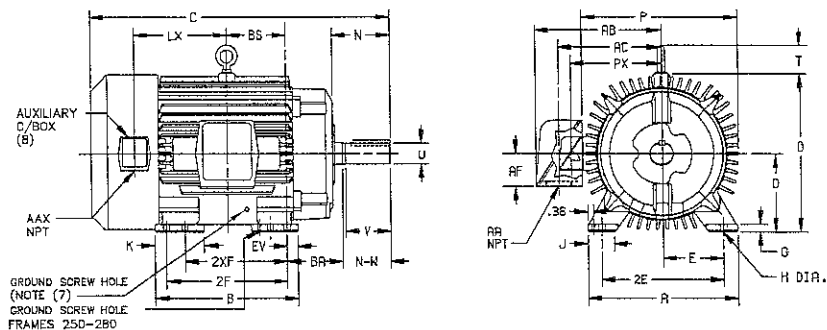
ENCLOSURE: TOTALLY ENCLOSED

COOLING: FAN COOLED

MOUNTING: FOOT

FRAMES 250T THRU 440TS

841-XL WITH STANDARD OVERSIZED CONDUIT BOX



FRAME	CAST IRON TERMINAL BOX											AUX C/BOX (B)							
	A	D(2)	E	G	H	J	K	O	P	T	AA	AB	AC	AP	BA	EV	AAX	LX	PX
254T-256T	12.50	6.25	5.00	.75	.56	2.50	--	13.25	13.25	2.44	1-1/4	10.81	8.81	2.50	4.25	1.00	3/4	7.06	9.31
284T-286TS	13.75	7.00	5.50	.75	.56	2.50	--	14.75	14.88	2.44	1-1/2	12.62	10.19	3.00	4.75	1.00	3/4	7.63	10.50
324T-326TS	15.50	8.00	6.25	.88	.89	2.75	4.50	15.69	17.00	2.44	2	15.44	11.69	3.62	5.25	1.38	3/4	8.75	10.50
364T-365TS	17.00	9.00	7.00	.88	.69	2.75	3.88	18.50	19.50	2.94	3	18.00	13.81	4.12	5.88	1.38	3/4	9.12	11.62
404T-405TS	19.00	10.00	8.00	1.12	.81	3.25	4.62	21.31	22.50	2.94	3	19.25	15.06	4.12	6.62	1.13	3/4	9.62	14.44
444T-445TS	21.00	11.00	9.00	1.12	.81	3.25	5.25	23.38	25.25	3.25	3	22.19	17.44	6.00	7.50	1.25	3/4	11.12	15.25

FRAME SIZE	C	BS	B	2F	SHAFT AND KEY										WEIGHT LBS. (5)
					(4)	2XF	N	N-W(6)	U(3)	V	SQ.	LGTH.			
254T	24.58	5.00	12.00	---	8.25	4.12	4.00	1.825	3.75	.375	2.88	335			335
256T	24.58	5.00	12.00	10.00	---	4.12	4.00	1.825	3.75	.375	2.88	345			345
284T	27.44	5.50	13.00	---	8.50	5.00	4.62	1.875	4.38	.500	3.25	475			475
284TS	26.06	5.50	13.00	---	8.50	3.62	3.25	1.625	3.00	.375	1.88	475			475
286T	27.44	5.50	13.00	11.00	---	5.00	4.62	1.875	4.38	.500	3.25	490			490
286TS	26.06	5.50	13.00	11.00	---	3.62	3.25	1.625	3.00	.375	1.88	490			490
324T	30.44	6.00	14.75	---	10.50	5.82	5.25	2.125	5.00	.500	3.88	690			690
324TS	28.94	6.00	14.75	---	10.50	4.12	3.75	1.875	3.50	.500	2.00	690			690
326T	30.44	6.00	14.75	12.00	---	5.82	5.25	2.125	5.00	.500	3.88	630			630
326TS	28.94	6.00	14.75	12.00	---	4.12	3.75	1.875	3.50	.500	2.00	630			630
364T	33.44	6.12	15.00	---	11.25	6.25	5.88	2.375	5.62	.625	4.25	865			865
364TS	31.31	6.12	15.00	---	11.25	4.12	3.75	1.875	3.50	.500	2.00	859			859
365T	33.44	6.12	15.00	12.25	---	6.25	5.88	2.375	5.62	.625	4.25	890			890
365TS	31.31	6.12	15.00	12.25	---	4.12	3.75	1.875	3.50	.500	2.00	884			884
404T	38.31	6.88	16.00	---	12.25	7.50	7.25	2.875	7.00	.750	5.62	1220			1220
404TS	35.31	6.88	16.00	---	12.25	4.50	4.25	2.125	4.00	.500	2.75	1211			1211
405T	38.31	6.88	16.00	13.75	---	7.50	7.25	2.875	7.00	.750	5.62	1260			1260
405TS	35.31	6.88	16.00	13.75	---	4.50	4.25	2.125	4.00	.500	2.75	1251			1251
444T	44.62	8.25	19.00	---	14.50	8.94	8.50	3.375	8.25	.875	6.88	1670			1670
444TS	42.88	8.25	19.00	---	14.50	5.19	4.75	2.375	4.50	.625	3.00	1654			1654
445T	44.62	8.25	19.00	16.50	---	8.94	8.50	3.375	8.25	.875	6.88	1860			1860
445TS	42.88	8.25	19.00	16.50	---	5.19	4.75	2.375	4.50	.625	3.00	1844			1844

(1) SPECIAL DIMENSIONS APPLYING TO THIS ORDER ON THIS LINE.

(2) "D" VARIES
250T - 320T +.00, -.03.
360T - 440T +.00, -.06.(3) "U" VARIES
HP TO 1.625 DIA. +.0000, -.0005
1.625 AND LARGER +.000, -.001.

(4) ALL FRAMES HAVE EIGHT MOUNTING HOLES FOR DUAL MOUNTING.

(5) MOTOR WEIGHTS MAY VARY BY 15% DEPENDING UPON RATING.

(6) "N-W" VARIES +.00, -.25.

(7) GROUND SCREW HOLE 3/8-16 TAP 1 TO 200 HP
ABOVE 200 HP 1/2-13

(8) AUXILIARY CONDUIT BOX SUPPLIED ONLY WHEN REQUESTED

CONDUIT BOX LOCATED ON OPPOSITE SIDE WHEN F-2,W-1,
W-4,W-5,W-7, OR C-1 MOUNTING IS SPECIFIED.IF MOUNTING CLEARANCE DETAILS ARE REQUIRED, CONSULT
FACTORY.MAXIMUM PERMISSIBLE SHAFT RUNOUT WHEN MEASURED
AT END OF STD. SHAFT EXTENSION IS .001 T.I.R. UP TO
AND INCLUDING 1.625 DIA. AND .0015 T.I.R. BALL BEARINGS
.002 T.I.R. ROLLER BEARINGS FOR LARGER DIAMETERS.

FRAME _____ TYPE _____ CERTIFIED FOR _____
ORDER _____ ITEM _____ HP _____ RPM _____ PH _____ HZ _____ VOLTS _____
SALES ORDER _____ APPROVED BY _____ DATE _____

IHS-070-096119

CUSTOMER IS RESPONSIBLE FOR DETERMINING THAT BALDOR'S PRODUCT WILL PERFORM SUITABLY IN THE INTENDED APPLICATION.

Baldor • Dodge • Reliance
DIM SHIT TEFC 250T-440TS STD BRKT 841-XL STD OS CRBK
SH 1 of 1

REV. DESC: FIX TITLE BLOCK DESCRIPTION
REV. LTR: C
FILE: VRA000000357
MFL: -

TRD: 000000050807
BY: PAGEC
REVISED: 01-16-34 07/19/2009



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Page 1 of 4

Document Title: Motor Performance Data & Curves
ClydeUnion Ref: A-E03
Client Reference: E03 (CC130189A-1 - 6x8x26 CUP-OH2 (Item No. P-436))
Contract: CC130189 (Spectrum Process Systems Inc)
Client PO No: 002020
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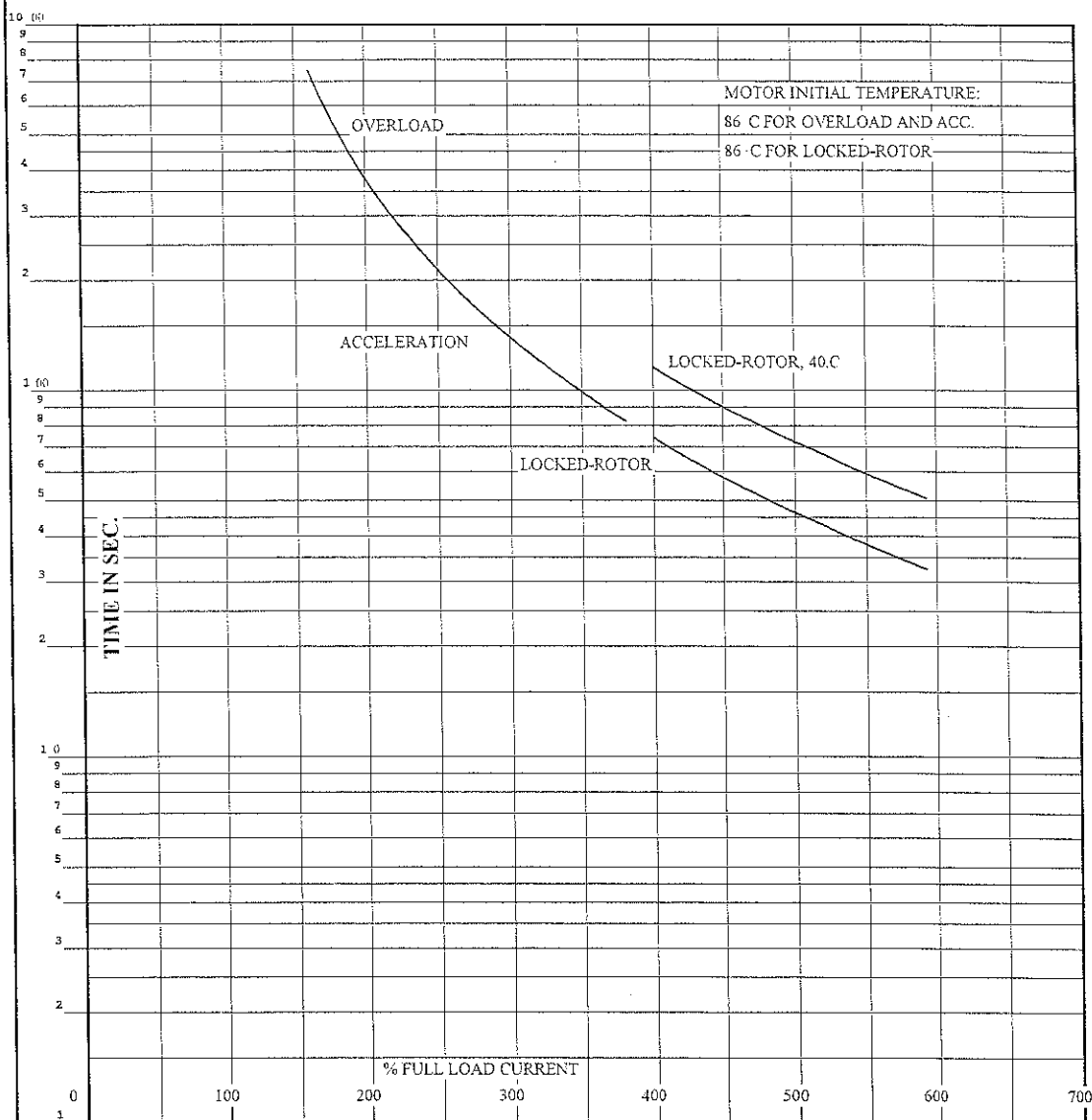
REL. S.O.	FRAME	HP	TYPE	PHASE/ HERTZ	RPM	VOLTS					
	364T	30	P	3/60	890	575					
AMPS	DUTY	AMB °C/ INSUL.	S.F.	NEMA DESIGN	CODE LETTER	ENCL.					
31.4	CONT	40/F	1.15	B	G	TEFC					
E/S	ROTOR	TEST S.O.	TEST DATE	STATOR RES. @25 °C OHMS (BETWEEN LINES)							
591831	418141-73-AE	---	---	.424							
PERFORMANCE											
LOAD	HP	AMPERES	RPM	% POWER FACTOR	% EFFICIENCY						
NO LOAD	0	15.7	900	4.21	0						
1/4	7.52	17.2	897	37.0	88.6						
2/4	15.0	20.6	895	59.1	92.4						
3/4	22.5	25.6	892	70.7	93.0						
4/4	30.0	31.4	889	77.0	92.7						
5/4	37.5	38.2	885	80.0	92.0						
SPEED TORQUE											
	RPM	TORQUE % FULL LOAD	TORQUE LB.-FT.	AMPERES							
LOCKED ROTOR	0	137	242	170							
PULL UP	213	128	227	160							
BREAKDOWN	844	229	405	94.7							
FULL LOAD	889	100	177	31.4							
AMPERES SHOWN FOR 575. VOLT CONNECTION. IF OTHER VOLTAGE CONNECTIONS ARE AVAILABLE, THE AMPERES WILL VARY INVERSELY WITH THE RATED VOLTAGE											
REMARKS: TYPICAL DATA NEMA NOM. EFF. 92.4 %, GUAR. EFF. 91%											
BALDOR A MEMBER OF THE ABB GROUP		DR. BY R.K. BRIDGES		A-C MOTOR PERFORMANCE DATA A36WG1000-R001 ISSUE DATE 09/03/13							
		CK. BY G.R. WEBB									
		APP. BY W.L. SMITH									
		DATE 09/03/13									

REL. S.O.
FRAME 364T
HP 30
TYPE P
PHASE/HERTZ 3/60

RPM 890
VOLTS 575
AMPS 31.4
DUTY CONT
AMB °C/INSUL 40/F

S.F. 1.15
NEMA DESIGN B
CODE LETTER G
ENCLOSURE TEFC
E/S 591831

ROTOR 418141-73-AE
TEST S.O. TYPICAL DATA
TEST DATE ---
STATOR RES. @ 25 °C. 424
OHMS (BETWEEN LINES)



THERMAL LIMIT CURVE

REMARKS: NEMA NOM. EFF. 92.4 %, GUAR. EFF. 91%

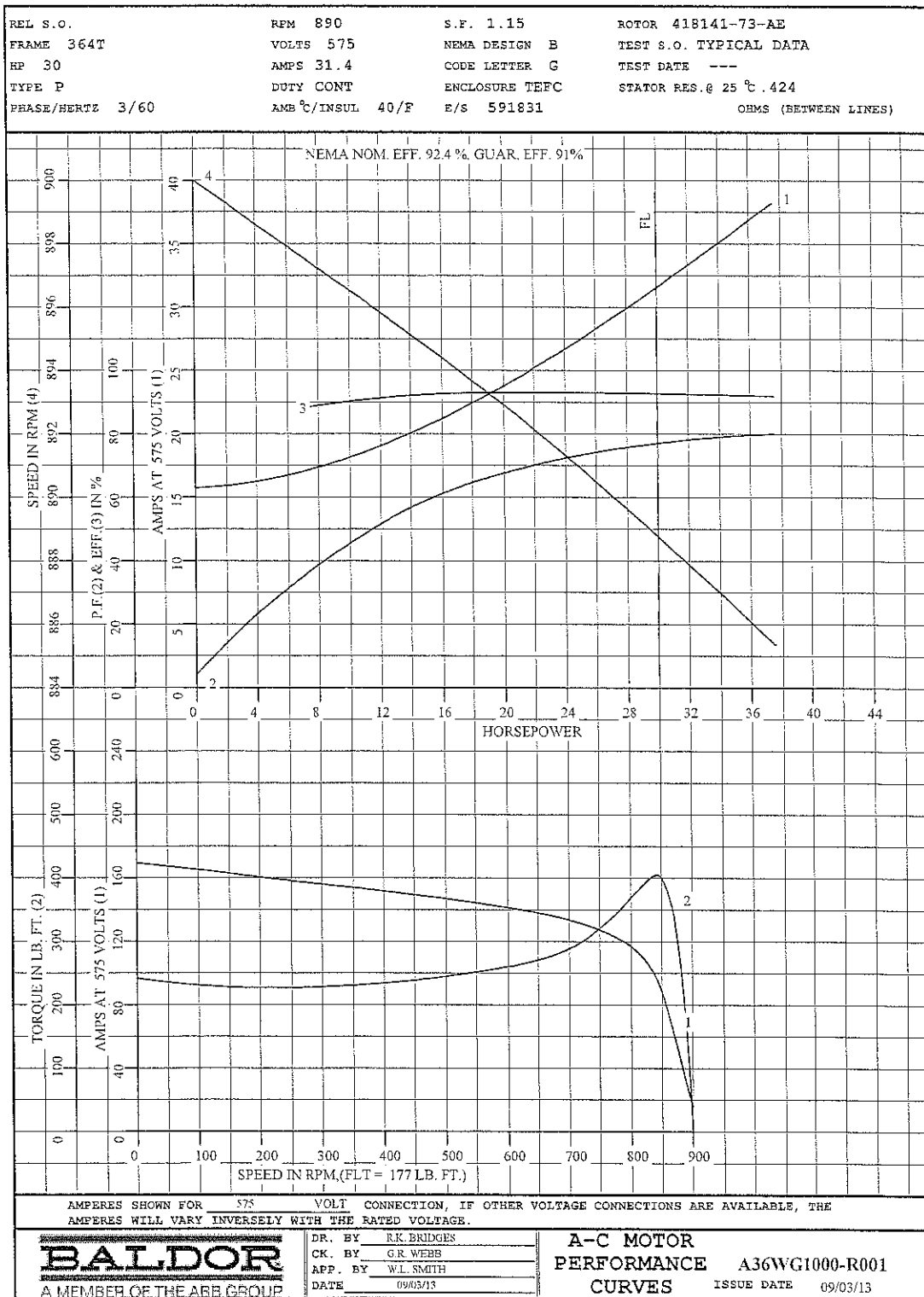
AMPERES SHOWN FOR 575 VOLT CONNECTION, IF OTHER VOLTAGE CONNECTIONS ARE AVAILABLE, THE AMPERES WILL VARY INVERSELY WITH THE RATED VOLTAGE.

BALDOR
A MEMBER OF THE ABB GROUP

DR. BY R.K. BRIDGES
CK. BY G.R. WEBB
APP. BY W.L. SMITH
DATE 09/03/13

A-C MOTOR
PERFORMANCE A36WG1000-R001
CURVES ISSUE DATE 09/03/13

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Page 1 of 2

Document Title: Motor Wiring Diagrams
ClydeUnion Ref: A-E04
Client Reference: E04 (CC130189A-1 - 6x8x26 CUP-OH2 (Item No. P-436))
Contract: CC130189 (Spectrum Process Systems Inc)
Client PO No: 002020
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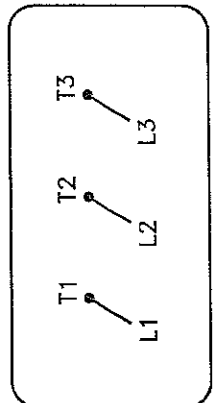
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416820-036

A-C MOTOR
 CONNECTION DIAGRAM
 STANDARD 3 LEAD CONNECTED



(N.P. 1575-BA)

416820-036

BALDOR

REV. DESC: LOADED TO BUS, C/R 335225

REV. LTR: - VERSION: 00

FILE: \MGA\00000\682

MTL: --

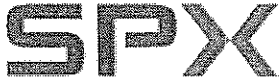
TDR: 000000538207

REVISED: 11:54:06 04/30/2010

BY: RAGRA

CONN DIAG - STANDARD 3 LEAD

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Page 1 of 2

Document Title: Inspection & Test Plan
ClydeUnion Ref: A-H02
Client Reference: H02 (CC130189A-1 - 6x8x26 CUP-OH2 (Item No. P-436))
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Client PO No: 002020
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Comment: Original

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Inspection & Test Plan

>ClydeUnion Pumps

Centrifugal

Description: 6x8x26 OH2

Item No: P-436

Pump Serial No: CC130189A-1

TASK DESCRIPTION	PROCEDURE	ACCEPTANCE CRITERIA	VERIFYING DOCUMENT	APPLICABLE TO	INSP CODE	CU INITIAL	CUSTOMER INITIAL	CERT AUTH INITIAL
Material Certification								
Material Test Report	Pro. 7.5	ASTM Standard	Certificate	Shaft	C			
Non-Destructive Examination								
Magnetic Particle Inspection (MPI)	Foundry	ASME	Report	Foundry, Case	•			
Magnetic Particle Inspection (MPI)	CES 3007.00	ASME	Report	Case Machined Surfaces	C			
Component Testing								
Hydrostatic Testing	CES 3001.00	API 610	Certificate	Casing, cover	C, U			
Static Balancing	CES 3011.02	ANSI	Report	Impeller	•			
Testing								
Performance Testing	CES 3002.00	ANSI	Certificate	Pump	C, U			
NPSH Test	CES 3002.00	ANSI	Certificate	Pump	C, U			
Final Preparation & Shipping								
Preservation	CES 3004.00	CES 3004.00	None	Assembled unit	•			
Final Inspection	Pro. 7.5	B/M, Dwgs	Report	Assembled unit	•			

LEGEND:

H - Hold

"By UP" - Internal QS requirements only.

"By customer" - Manufacturing will not proceed without customer approval or waiver.

W - Witnessed

Manufacturing will not proceed until customer has witnessed the required task.

C - Certified

Certificate or Report will be provided as part of final data package.

U - Unwitnessed

No customer witness requirements identified. Certificate or Report will be provided as part of final data package.

Activity carried out to satisfy UP internal quality system requirements.



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MANUAL

Document Title: IOM Manual: Pump
ClydeUnion Ref: A-J01
Client Reference: J01 (CC130189A-1 - 6x8x26 CUP-OH2 (Item No. P-436))
Contract: CC130189 (Spectrum Process Systems Inc)
Client PO No: 002020
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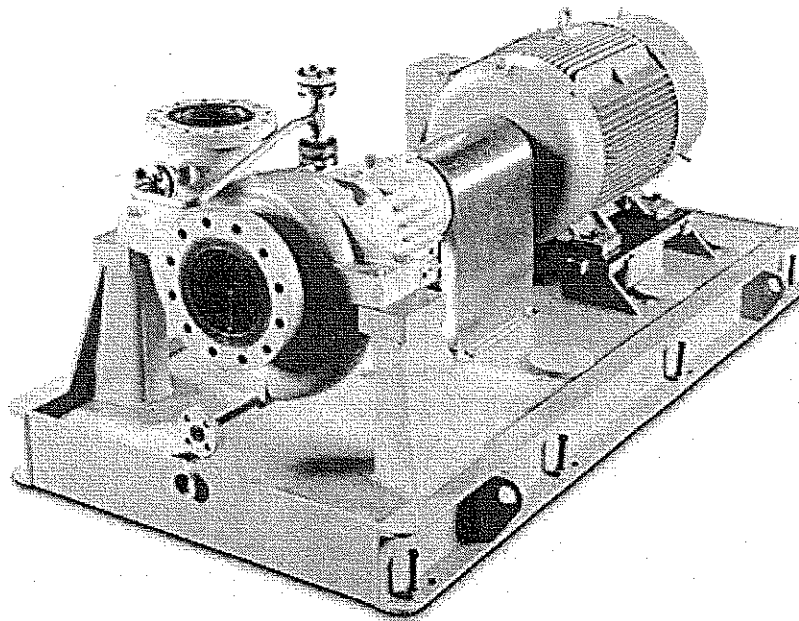
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CUP-OH2 Pumps

Installation, Operation and Maintenance Manual



› ClydeUnion Pumps



IMPORTANT SAFETY NOTIFICATION

To: Our valued customer / end user,

ClydeUnion Pumps, an SPX Brand, will provide safe, trouble-free service when properly installed, operated, and maintained. We have an extensive network of sales and service professionals to assist in maximizing your satisfaction with our products.

Safe installation, operation, and maintenance of ClydeUnion Pumps' equipment are an essential end user responsibility. This Installation, Operation, and Maintenance (IOM) manual identifies specific safety risks that must be considered at all times during product life. Understanding and adhering to these safety warnings is mandatory to ensure personnel, property, and/or the environment will not be harmed. It is expected that the end user will also comply with industry and corporate safety standards.

The following two significant risks bear reinforcement above and beyond normal safety precautions:



1. Operation of any pumping system with a blocked suction and discharge must be avoided in all cases. Even a brief period operation under these conditions can cause overheating of enclosed pumpage and result in a violent explosion. All necessary measures must be taken by the end user to ensure this condition is avoided.



2. IOM for the pumping equipment clearly identifies accepted method for disassembling the unit. This method must be followed completely. Specifically, applying heat to impeller and/or impeller retaining device to aid in their removal is strictly forbidden. Trapped lubricant or vapor could cause an explosion.

Please go through and understand the safe installation, operation, and maintenance guidelines outlined in this manual. In case of doubt and/or need clarification, please contact ClydeUnion Pumps before proceeding.



FOREWORD



These instructions must always be kept close to the product's operating location or directly with the product. Read all instructions including notes, cautions, and warnings carefully before installation, operation, and maintenance of this equipment.

ClydeUnion Pumps, an SPX Brand has provided the information contained in this manual to enable you to install, operate, and maintain your pump properly and safely. Operating the pump in compliance with these instructions is important to help ensure reliability in service and avoid risks. Study this manual as well as any supplements provided in the final data package to ensure satisfactory and safe operation of the pump. The instructions may not take into account local regulations; ensure such regulations are observed by all, including those installing the product; follow all plant safety requirements and applicable safety and health laws and regulations.

Deviation from the recommendations and instructions in this manual and other data supplied by or referred to by ClydeUnion Pumps may result in a hazardous situation. Any modification or removal of original components may impair the product's safety.

The failure to properly select, install, or use authorized ClydeUnion Pumps' parts and accessories is considered a deviation. ClydeUnion Pumps shall not be liable for physical injury, damage or delays caused by any deviation.

The pump's selection and performance is based on the duty conditions stated in the pump data sheet included in the Final Data supplied with this pump. If the conditions of service are going to be changed, it is requested that the end user obtain a written confirmation from ClydeUnion Pumps before start-up.



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SECTION I - SAFETY

DEFINITIONS:

The following definitions apply to these terms as used in this manual:

NOTE: *A Note provides specific information and must be read before continuing.*



Caution sign provides information necessary to prevent damage to equipment or personal injury.



Warning sign provides information necessary to prevent serious personal injury or death.



When pumping unit is installed in a potentially explosive atmosphere, the instructions following the Ex symbol of ATEX must be followed. Personal injury and/or equipment damage may occur if these instructions are not followed.

NOTE: *Contact ClydeUnion Pumps if you have questions regarding the installation, operation, maintenance, or storage of this pump.*

RECOMMENDATIONS:

Safe installation, operation and maintenance of ClydeUnion Pumps' equipment are an essential end user responsibility. The following general safety recommendations are to prevent any damage/harm to personnel, equipment and/or property.

Safety Apparel:

- Insulated work gloves when handling hot parts, especially hot bearings
- Heavy work gloves when handling parts with sharp edges, especially impeller
- Safety glasses for eye protection
- Steel-toed shoes for foot protection when handling parts, heavy tools, etc.
- Other personal protective equipment to protect against hazardous/toxic fluids

Flanged Connections:

- Never force piping to align for making a connection to the pump flange
- Use only fasteners of the proper size and material
- Replace corroded or missing fasteners
- Tighten loose fasteners

Coupling Guards:

- Never operate pump without coupling guard properly installed



Start-up / Operation:

- Follow the start-up check list, included in this manual, for all the items listed
- Do not operate below minimum rated flow, or with suction/discharge valves closed
- Do not open vent or drain valves, or remove plugs while system is pressurized
- Take proper precautions for handling toxic, flammable or corrosive pumpage before draining the pump

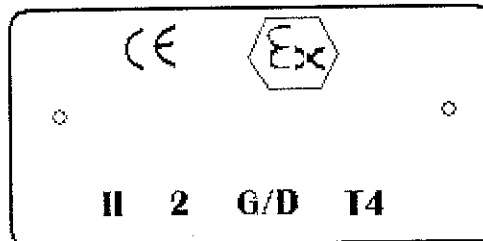
Maintenance safety:

- Always turn off and lock out power
- Ensure pump is isolated from system and pressure is relieved before disassembling pump, removing plugs, or disconnecting piping
- Use proper lifting and supporting equipment, applying proper lifting techniques to prevent serious injury
- Observe proper decontamination procedures
- Know and follow all safety regulations in place; company as well as local regulations

ATEX CONSIDERATIONS:

ATEX certification is a directive enforced in Europe for non-electrical and electrical equipment installed in Europe. ATEX requirements must be closely followed if the equipment is installed in environment containing explosive gases, and/or dust.

Proper ATEX identification tag will be secured to the pump or the baseplate on which it is mounted to identify that the unit is certified for use in an ATEX classified environment. A typical tag will look like as follows:



Symbols at the top of the tag, CE and Ex, designate ATEX compliance. Codes at the bottom of the tag (from left to right) tell about the following aspects of ATEX specifications:

- | | | |
|-----|---|--|
| II | = | Area classification group 2 |
| 2 | = | Category 2 of above area classification indicating the level of protection (Category 1 being very high and 2 being high) |
| G/D | = | Explosive Gas and Dust present |
| T4 | = | Temperature class which can be T1 thru T6 |



The surface temperature on the pump is influenced by the temperature of the liquid handled. The maximum permissible liquid temperature depends on the temperature class and must not exceed values given in the following table:

Temperature Class Code	Max. Permissible Surface Temperature °C (°F)	Max. Permissible Liquid Temperature °C (°F)
T1	450 (842)	400 (752)
T2	300 (572)	275 (527)
T3	200 (392)	180 (356)
T4	135 (275)	115 (239)
T5	100 (212)	Contact ClydeUnion Pumps
T6	85 (185)	Contact ClydeUnion Pumps

The temperature rise at the seals and bearings and due to minimum operating flow permitted is taken into account in the temperatures stated in the table.

NOTE:

- 1. The responsibility for compliance with the specified maximum liquid temperature lies with the customer / end user.*
- 2. The end user is responsible for ensuring that the pump surface temperature does not exceed the permitted value in its actual installed location.*

Conformance to ATEX is only applicable when the pump unit is operated within its intended use. The code classification marked on the tag should be in accordance with the specified area where the equipment will be installed. If it is not, please contact ClydeUnion Pumps before proceeding.

NOTE:

Where ClydeUnion Pumps has supplied only the bare shaft pump, the ATEX compliance applies only to the pump. The party responsible for assembling the complete unit shall select coupling, coupling-guard, driver and any additional equipment with the necessary CE and Ex certification to establish its suitability for the area in which it is to be installed.

For additional safety precautions, the equipment installed in potentially explosive environment should be provided with the following condition monitoring devices as a minimum:

- Pressure, Flow, and Temperature
- Motor Load readings
- Level indicators
- Leak detection
- Vibration level



SECTION II – PUMP DESCRIPTION

The CUP-OH2 is an advanced design Single Stage Horizontal Centrifugal Pump, centerline mounted, with exceptional flexibility and versatility to meet the requirements of a wide variety of pumping applications. The unit is ruggedly designed for minimum maintenance and to meet the heavy-duty requirements of continuous duty operation of general industry, as well as API 610 applications.

The CUP-OH2 pump features short impeller overhang, and can be combined with single and double volute casings in various sizes. The back pull-out design, in most cases, allows the complete rotating assembly of the pump to be removed without removing or disrupting the driver as well as the suction and discharge piping.

The seal chamber cover meets API 682 2nd edition dimensions for improved performance of mechanical seals. Ring oil lubricated bearings are standard, pure and purge oil mist lubrication are options. The standard shaft is machined and ground to comply with API-610 10th edition criteria. The inboard bearing is a single row deep groove ball bearing. The outboard bearing is a duplex angular contact bearing comprising of a pair of single row angular contact ball bearings mounted back to back. Direction of rotation is counter clockwise as viewed from the coupling end, looking at the pump shaft.

High rigidity baseplate has a reputation of being stiffest in the industry. It meets or exceeds the API-610 10th edition requirements.

SECTION III - INSTALLATION & HANDLING

INSPECTION

Upon receipt, carefully inspect the pump for damage and check against the bill of lading. Report any damage or shortage to the carrier's local representative immediately and send a copy to ClydeUnion Pumps, which must be received in writing within one month of receipt of the equipment. Inspect the preservative coating on various parts and, if necessary, apply fresh preservative in areas where it has been rubbed or scraped. Inspect all painted surfaces. If necessary, touch up the areas where paint has been chipped or scraped. Inspect all covers over suction and discharge flanges, and piping connections for damage or loosening. If that is the case, remove the covers and make a visual inspection of the accessible interior areas for accumulation of foreign materials or water. If necessary, clean and preserve the interior parts, as noted above, and replace covers and fasten securely.

NOTE: *When uncrating, be careful not to discard any boxes or wrappings for any accessories or spare parts that may be attached to the crate.*

SPX[®]

HANDLING

Lift the complete unit using proper lifting techniques (Figure B). Fully trained personnel must carry out lifting in accordance with the local regulations. The driver and pump weights are given on the outline drawing included in the Final Data.



1. *Lifting eyebolts may be provided on the casing cover. These are designed for lifting the casing cover only. Never lift the pump assembly using these lifting eyebolts.*
2. *The pump assembly may not be balanced when lifting. Always provide proper support so that the pump cannot tip.*
3. *Ensure that the equipment used for lifting is capable of handling the weights encountered and that the parts are properly rigged before lifting.*
4. *Remove coupling and spacer piece before lifting complete unit. Always sling from all 4 lifting lugs provided on the baseplate for lifting the unit.*
5. *Do not lift pump, motor, baseplate unit by slinging from pump casing and/or eye bolt on motor.*

To lift driver: Refer to manufacturer's instructions.

To lift baseplate mounted units with or without drivers: Rig lifting slings through the lifting lugs provided on the baseplate (Figures A & B) with a proper lifting device to lift the unit evenly without tipping one side or the other.

To lift complete pump only: Rig lifting slings at suction nozzle and at coupling end of bearing housing to lift the pump evenly (without tipping) with a proper lifting device (Figure C).

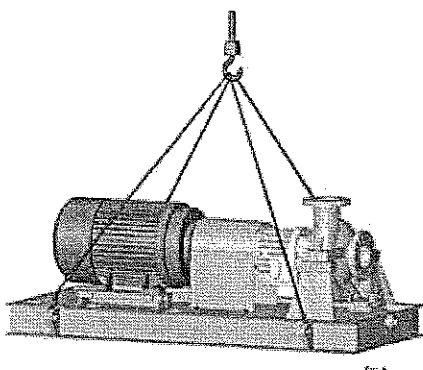


Figure A

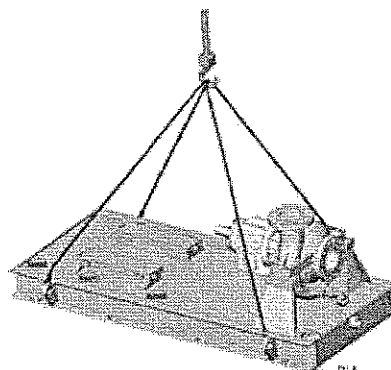


Figure B

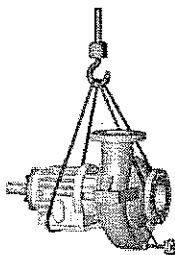


Fig. C

Figure C



STORAGE – SHORT TERM

When it is necessary to store the pump for a short time (less than 6 months) before it can be installed, place it on a skid in a dry location away from vibration. Protect it thoroughly from moisture, sand, grit and other contaminants. Do not remove the protective covers provided on the suction and discharge flanges, and piping connections.



Turn pump by rotating the shaft, in the direction of rotation, a 2 ¼ turns each week to prevent brinelling of the bearings and the seal faces from sticking. For motor storage, refer to the motor manufacturer's instructions.

STORAGE – LONG TERM

More thorough precautions are required if the pump is to be stored for greater than 6 months. The pump must be covered or stored indoors. Prior to storage, remove the oil vent plug and fill the bearing housing with one quart of vapor emitting oil. Reinstall vent plug.

Perform the following at 3-month intervals:

1. Coat all unpainted exterior machined surfaces liberally with a light petroleum grease or equivalent rust preventative.
2. Remove bearing housing vent, drain plugs, and drain oil. Reinstall drain plug and refill bearing housing with one quart of new vapor emitting oil. Reinstall vent plug.
3. Rotate pump shaft 3 ½ turns (to rest at 180° from original position).
4. Remove the protective covers on the suction and discharge flanges. Remove any visible rust on internal surfaces and coat with rust preventative. Replace protective covers on the flanges.

NOTE: *Accumulation of condensation in the pump must be avoided. Store the equipment away from climatic extremes. Do not store the pump in areas of high ambient temperature variation, as damage to bearings may occur.*

When auxiliary equipment such as drivers, mechanical seals, and instrumentation is provided, it may require additional preparation for long-term storage. Refer to the manufacturer's literature for specific instructions.

LOCATION

The pump should be positioned as close to the suction source as practical, in an effort to optimize suction conditions. Ensure sufficient clearance around the pump to allow for cooling and maintenance accessibility.

SECTION IV - FOUNDATION

GENERAL

A proper foundation and grouting can mean the difference between a unit that gives many years of trouble-free service and one that requires constant realignment. It should therefore be everyone's concern that only the best of materials, together with proper design, be used when performing this important function.

NOTE: *The foundation (4" to 6" longer and wider than baseplate) shall be sufficiently rigid and substantial to absorb any vibration and to form a permanent support for the baseplate; this is important in maintaining the alignment of the units. A concrete foundation on a solid base should be satisfactory. The foundation bolts should be installed as shown in (Figure 1), and must be located according to the certified outline drawing.*

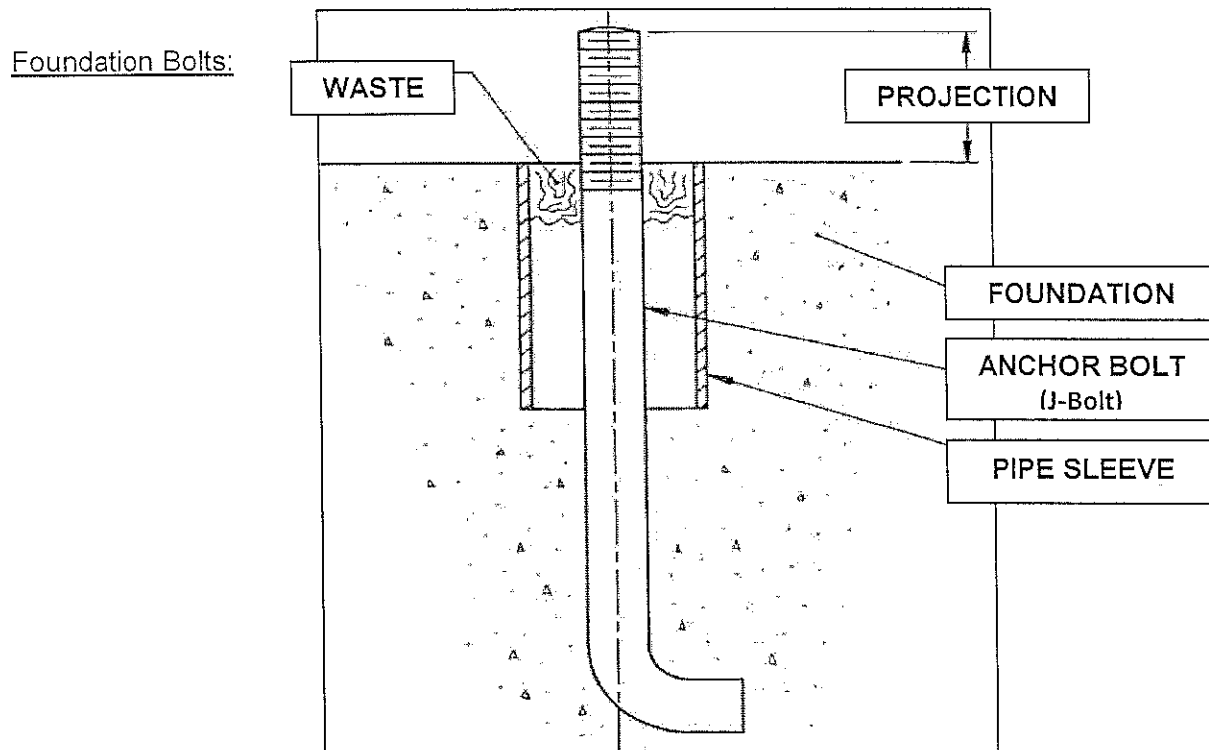


Figure 1



LEVELING OF THE UNIT

1. Before the machine is set on the foundation, chip away defective concrete, leveling the entire surface of the foundation leaving it rough but level. The surface must be free of oil, grease, loose particles and the waste material stuffed around the foundation bolts must be removed.
2. Clean the bolts and underside of the baseplate of oil, grease, dirt and other coatings that may interfere with complete bearing or react with cement. Check baseplate and proposed method of placing the grout to avoid trapping air beneath the baseplate. Air vent holes are provided in the baseplate deck to help fill all pockets.
3. Place the unit on the foundation with the coupling halves disconnected. The coupling should not be reconnected until the alignment operations have been completed. Follow the proper alignment procedure for your equipment after leveling. The baseplate should be supported on rectangular metal blocks and shims or on metal wedges having a small taper. These support pieces should be placed close to the foundation bolts (Figure 2). Adjust the metal supports or wedges until pump and driver shafts are level. Check the coupling faces and the suction and discharge flanges of the pump for vertical / horizontal position with a level. Correct the positions if necessary by adjusting the supports under the baseplate as required (see section on Field Installation of Motor and Coupling Alignment).

Foundation Supports:

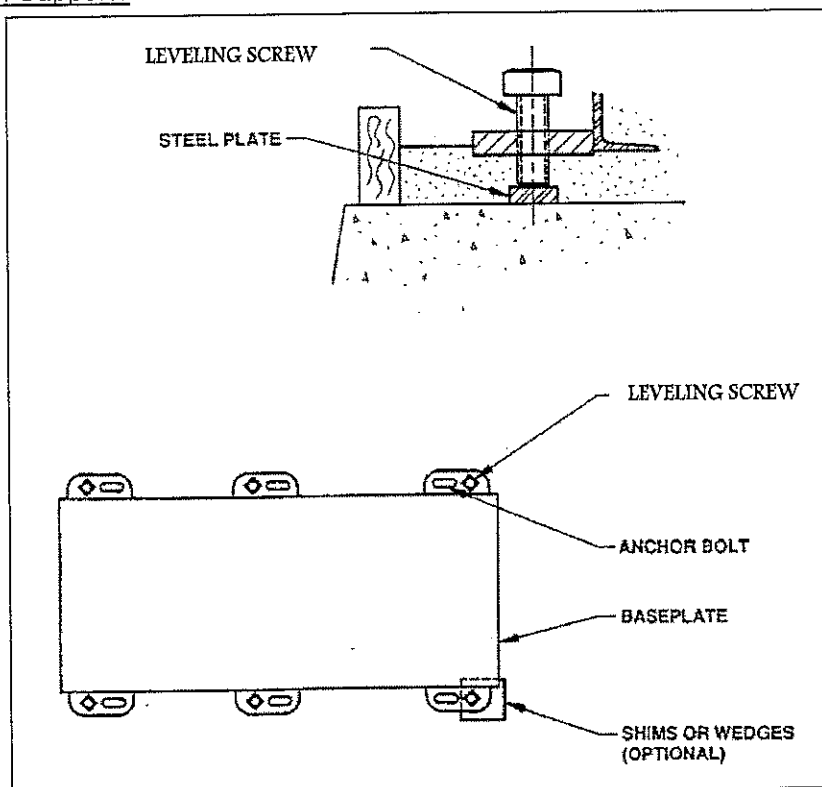


Figure 2



GROUTING



Before grouting, make sure that leveling of the baseplate and rough shaft / coupling alignment has been completed.

When the alignment is correct, the foundation bolts should be tightened evenly, but not too firmly. The unit then is grouted to the foundation. The baseplate must be completely filled with oil and water-resisting non-shrink grout.* Grout must not have an exothermic temperature greater than ASTM D2471 or 45 °C.

The following suggestions, highlighting generally accepted successful field procedures, are not mandatory but should be followed, modified, or rejected by the engineer, owner, or contractor since they, and not ClydeUnion Pumps, are responsible for planning and executing procedures for the job.

1. Build wooden forms around foundation and saturate the top surface of the foundation with water for at least six (6) hours prior to grouting. Remove free water with hose or rags just before placing grout. Remove water from anchor bolts with rags or a siphon.
2. The method of forming is dependent on the contractor's selection of a grout placing procedure that affords rapid and complete filling of the spaces to be grouted, and that keeps the grout in full contact with the underside of the baseplate until the grout has hardened (Figure 3).
3. Vibration from machines operating nearby is often transmitted into the foundation of the machine being grouted. Such machines should be shut down until the grout takes its initial set, otherwise the bond of the grout may be affected. Observing the surface of water in a shallow pan sitting on the baseplate indicates whether vibrations are present.
4. Vibrate/stir grout continuously as it is poured to expel all air and completely fill all cavities under the baseplate to the level of the grout holes. Check to see that the grout flows under the edges of the baseplate evenly.
5. After 48 hours, shims, wedges, and jack bolts, used to level baseplate shall be removed, and the resulting void filled with grout.
6. The exposed edge of the grout can now be finished as shown in (Figure 4).
7. Only after grout is hard (72 hours or more) should the foundation bolts be tightened and the pump and driver aligned.

* Available from: AD Mixtures, Inc., Concrete Service Co., Master Builders Co., and Toch Brothers, Inc.

Grout Placement:

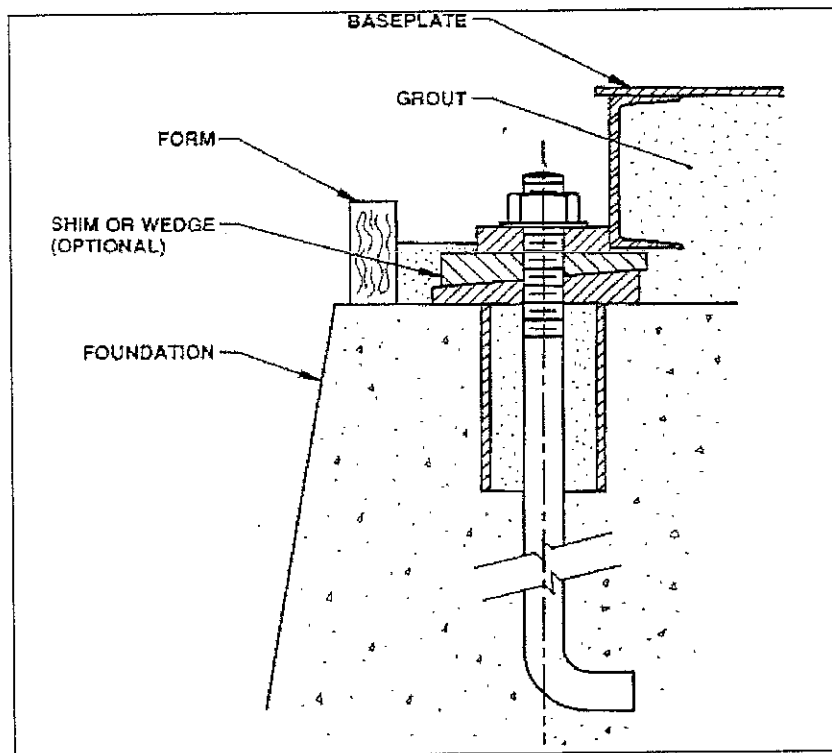


Figure 3

Grout Finishing:

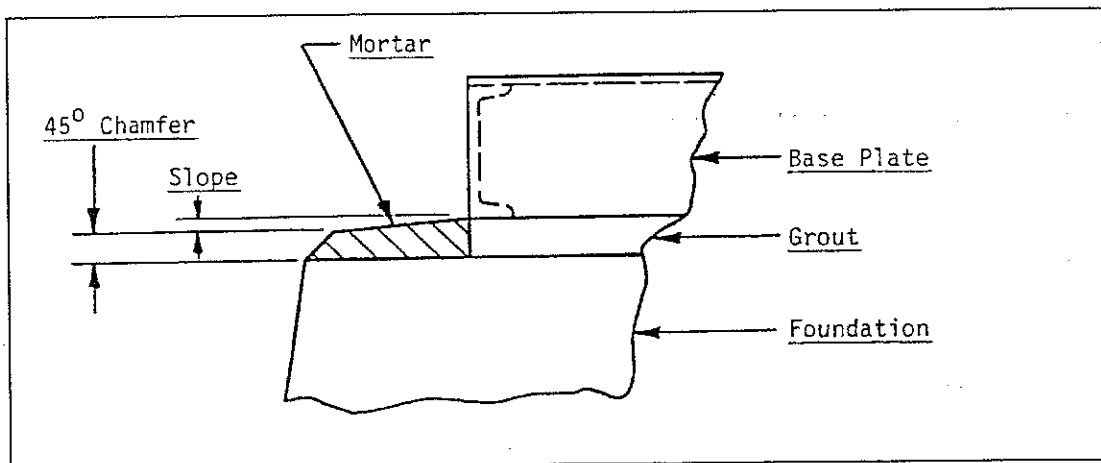


Figure 4

SECTION V – PIPING

GENERAL



*Never use the pump as a support for the piping.
Never force piping into place at suction or discharge flanges.
Ensure piping for hazardous liquids has a provision of flushing the pump before its removal.*

Support and anchor suction and discharge piping independently near the pump so that when flange bolts are tightened strain will not be transmitted to the pump casing. Piping must align with the pump flanges to prevent excessive nozzle loads and avoid pipe induced vibrations.

If an expansion joint or non-rigid pipe coupling is used, install a pipe anchor between the fitting and the pump. Proper installation of the pipe anchor will prevent excessive nozzle loads on the pump.

It is good practice to increase the size of suction and discharge piping leading to the pump nozzles. Arrange piping with as few bends and fittings as possible. Use large radius elbows wherever possible, see (Figure 8) Piping Diagram. All of this results in reduction of the head loss due to friction.

Flush all piping thoroughly to remove any foreign matter before connecting to the pump.

SUCTION PIPING

1. The nominal suction pipe diameter must be as large as, or larger than the nominal pump suction size. Suction piping should be as short and direct as possible. At least five (5) pipe diameters of straight pipe must be connected to the pump suction flange to have uniform flow at the entry.
2. Ensure that suction lines are sealed and vented to avoid leakage and air pockets.
3. Reducers, if used, must be eccentric and installed with the sloping side down to prevent air locks. The reducers should have a maximum angle of divergence of 15°.
4. A suction pipe reducer or elbow must be located at least five (5) pipe diameters from the pump suction flange.
5. For start-up, cone type suction strainers should be used and must have a net free flow area of at least three (3) times the suction pipe area of cross-section.
 - The suction strainer should be installed between 5 to 20 pipe diameters upstream from the pump suction flange. A spool piece should be installed in the suction line to facilitate installation and removal of the suction strainer.
 - Pressure gauges should be installed on both sides of the strainer to measure the pressure drop. An increase in the differential pressure indicates that the screen of the strainer is getting clogged. At this point, the pump should be shut down and the screen cleaned and/or replaced.



6. When working under suction head or flooded suction, install a gate valve in the suction line to permit closing the line for pump inspection and maintenance.



Never throttle the pump with the suction valve and never place a valve directly on the pump inlet nozzle.

DISCHARGE PIPING

1. A check valve and gate valve should be installed in the discharge line. The check valve, placed between the pump and gate valve, prevents pumpage from running back through the pump in the event of driver failure. The gate valve is used in priming, starting, and shutdown of the pump.
2. If increasers are used on the discharge, they should be located between the check valve and the pump; should have a maximum angle of divergence of 15° and (if located horizontally) installed sloping downwards to prevent airlocks.

BY PASS PIPING

Systems requiring operation at reduced flows for prolonged periods should be provided with a bypass line connected from discharge side (before any valves) to the source of suction; using a pre-sized minimum flow orifice in the bypass line to prevent excessive bypassing.

SECTION VI - PREPARING FOR OPERATION

DRIVER LUBRICATION

Motor bearings should be serviced and lubricated as outlined in the motor manufacturer's instructions.

PUMP LUBRICATION

Oil mist lubricated pumps - Pump bearings have been designed for dry sump oil mist lubrication. Follow your company's procedures for proper installation of the oil mist system. See Figure 9, 10 or 11 for proper oil mist connections. Figure 11 is for pure oil mist system.

Oil sump lubricated pumps - Bearing housing incorporates oil rings to circulate oil to the bearings. Fill the bearing housing to the proper level (Centerline of the bull's eye) with ISO/ASTM VG 32 oil.

NOTE: *For lube changing intervals and recommended lubricants refer to Section VIII.*

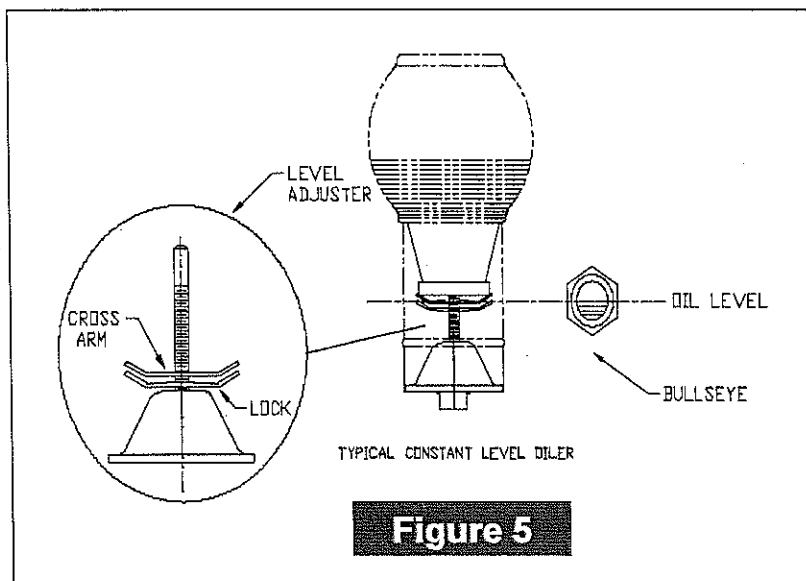
The constant level oiler bottle will be found in the box of fittings shipped with the pump. Adjustment should be made as detailed below.

Fill the bearing housing with proper grade of oil through the constant level oiler cup to 1/4" (6.35 millimeters) below the level mark. Then fill the oiler bottle with oil and place it in the oiler cup. The housing is filled when oil remains in the oiler bottle.



Constant Level Oiler:

IF THE OIL LEVEL IS NOT AT THE PROPER LEVEL, REMOVE BOTTLE AND RESET LEVEL ADJUSTER (per Figure 5). REPLACE BOTTLE, REPEAT OPERATION UNTIL PROPER LEVEL IS OBTAINED. THEREAFTER, IT IS ONLY NECESSARY TO KEEP THE BOTTLE FILLED WITH OIL.



MECHANICAL SEALS

As a standard, the CUP-OH2 pump is fitted with a cartridge type mechanical seal, which complies with the service requirements outlined on the pump data sheet. The seals are factory installed and no adjustment is required. Seal installation details are provided in the final data package.

NOTE: Seal locating devices must be disengaged before start-up.

SEAL FLUSH PIPING

Seal flush piping should be installed in accordance with the service requirements outlined in the pump data sheet and the seal manufacturer's recommendations. Vent seal cavity and flush piping prior to start-up. Refer to the Outline Drawing provided in the final data package for specific seal flush piping details.



1. The mechanical seal used in an ATEX classified environment must be properly certified.
2. The mechanical seal must have an appropriate seal flush system. Failure to do so will result in an excess heat generation and seal failure.
3. Cooling systems such as those for bearing lubrication, mechanical seal systems, etc., where provided, must be operating properly to prevent excess heat generation and premature failure.



Never operate the pump without liquid supplied to the mechanical seal. Running it dry, even for a few seconds, can damage the seal and could cause physical injury.



If the pump is fitted with an auxiliary seal flush reservoir, such as in Plan 52, perform the following before operating the pump:

1. Connect a vent line to the flange or union vent connection at the top of the reservoir.
2. Fill the reservoir and piping through the filler connection.
3. Pipe the gauge connection to a pressure gauge and or pressure switch.

NOTE: *Ensure that the liquid level in the reservoir is located in the approximate center of the level gauge.*

SHAFT / COUPLING ALIGNMENT

GENERAL

When pumps and drivers are received from the factory with both machines mounted on a common baseplate, they have been accurately aligned before shipment. All baseplates are flexible to some extent, and therefore must not be relied upon to maintain the factory alignment.

Realignment is necessary after the complete unit has been leveled on the foundation, again after the grout has set, any final pressure grouting done, and foundation bolts have been tightened. The final pump to motor alignment must be checked after the unit is piped and rechecked periodically as outlined. To facilitate accurate field alignment, ClydeUnion Pumps does not dowel the pumps and drivers on the baseplates before shipment.



The shafts must be aligned in all directions for successful operation. Misalignment beyond the limits specified in this section may cause noise, vibration, excessive wear and damage to the equipment.



Be sure that power to the motor is off and locked out before removing or installing the coupling or coupling guard.

Remove the coupling guard and coupling spacer (if required for your tooling). Verify that coupling hub run-out measured between the flange rims is within .005 inches (.127 mm) TIR. Verify that coupling hub flange faces are parallel within .003 inches (.076 mm).

NOTE: *If the pump is to operate above 300 °F (150 °C), it is important to perform the alignment with the pump at operating temperature. Consult ClydeUnion Pumps' local Service Center for assistance.*



FIELD MOUNTING OF DRIVER

When the driver is to be mounted on the baseplate in the field, it is necessary to place the baseplate with pump on the foundation, to level the pump shaft, to check the coupling faces including parallelism and angular misalignment, the suction and discharge flanges for horizontal or vertical position, and to make any necessary corrective adjustments.

The driver pads on the baseplate can now be coated with chalk to facilitate marking the hold-down bolt holes. Place the driver on the baseplate so that the distance between the coupling halves is as indicated on the outline drawing. Adjust the height of the driver by placing shims under the driver feet. After the alignment of the coupling halves is correct including parallelism and angular misalignment, center punch with transfer tooling or scribe on the baseplate pads the circumference of the bolt holes in the driver feet. Remove the driver, determine size of hold-down bolts, and drill and tap baseplate. Replace driver on the baseplate, insert the bolts, and align the driver before tightening. The subsequent procedures are the same as for factory-aligned units.

RECOMMENDED HOLD-DOWN BOLTS FOR DRIVERS			
Hole Size	Bolt Size	Hole Size	Bolt Size
11/32	1/4"	21/32	1/2"
13/32	5/16"	13/16	5/8"
17/32	3/8"	15/16	3/4"

FLEXIBLE COUPLINGS

The primary functions of all flexible couplings are:

1. To transmit power from one shaft to another, efficiently and effectively.
2. To accommodate the slight shaft misalignments which develop in service.

The secondary functions of flexible couplings are:

1. To absorb shock loads and pulsations.
2. To dampen vibration.
3. To accommodate load reversals.
4. To minimize initial backlash.
5. To provide ease of installation and maintenance.
6. To decrease wear on shaft bearings and driven equipment.

Shafts become misaligned during operation because of settling foundations, the effects of heat, vibration, worn bearings, etc. These misalignments take place in the form of angular misalignment, parallel misalignment, or axial movement of the shafts (end float). Therefore, to get full service life from any flexible coupling, it is necessary to (a) assure proper shaft alignment during initial installation, and (b) to occasionally check for and correct shaft misalignments in all directions during service.



Coupling Misalignment:

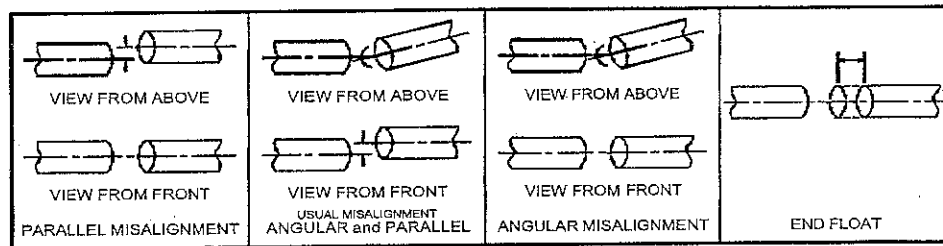


Figure 6



Misaligned shafts not properly coupled are subject to severe stresses which can damage bearings and seals.

Any or all of the misalignments shown in the above diagrams are present in all connected drives. There are so many factors entering into the probable life of a coupling that it is impossible to tabulate the misalignment capacities for every application.

NOTE: Any coupling, which is stressed heavily with torque, will have little reserve left for misalignment stresses. Conversely, if a coupling is lightly torqued, it will have a larger reserve for misalignment conditions.

NOTE: It should also be pointed out that a coupling rotating at a slow speed such as used in conjunction with the slow speed side of a gear reducer can take relatively large misalignments over a long period. On the other hand, a coupling rotating at high speeds must be aligned with great care to make sure that it will give continuous trouble-free service.

ALIGNMENT OF SPACER TYPE COUPLINGS

Prior to alignment, check driver for soft foot to ensure that there is no undue stress on the driver hold-down bolts; owing to non-level or twisted baseplate. To check, remove all shims and tighten down driver to the baseplate. Start loosening one bolt and measure the deflection of that foot by a dial indicator or using feeler gauges. If the deflection is more than 0.002", shim the foot with amount of deflection. For example, if the deflection observed is 0.010", then that is the size of the shim to be placed under the foot. Tighten down and repeat the procedure on all other feet.

A spacer type coupling is used between the pump and driver. To align the spacer coupling, remove the spacer between the pump and driver. Make a bracket, as shown in (Figure 7), which can be fastened to one of the coupling halves and which is long enough to reach the other coupling half. Fasten this bracket to one coupling half and a dial-type indicator to the bracket arm so that the indicator is in contact with the rim of the other coupling half as shown at "A", (Figure 7). Revolve one coupling half by hand, so that the indicator moves around the other coupling half.



After alignment on the coupling rim has been obtained, change the indicator so it bears against the face of the same coupling half, and make any necessary adjustments. If the shafts have endplay, it is preferable to make this check of face alignment by using inside micrometers as shown at "B", (Figure 7).

Coupling Alignment:

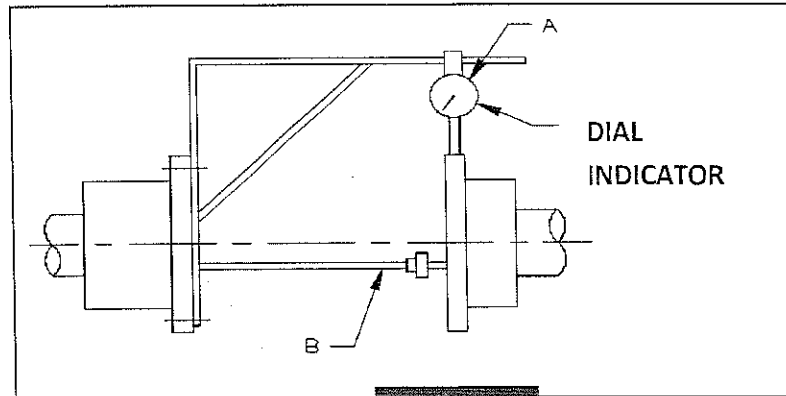


Figure 7

Maximum total run-out at "A" shall be per coupling manufacturer recommendation and not exceed .005-inch TIR.

Maximum variation in parallelism at "B" shall be per coupling manufacturer recommendation and not exceed .003-inch. Recommended hub spacing must be maintained.

NOTE: *Gear type couplings are aligned in the same manner as outlined (Figure 7). However, the coupling covers must be moved back out of the way and measurements made on the coupling hubs.*

It is impossible to align any equipment perfectly. We therefore recommend that on the vertical misalignment you set the equipment with the largest dimension between the bottom of its mounting feet and its shaft centerline low before shimming for alignment.

Example: *The shaft of a foot-mounted motor or gear would sit lower than the shaft on the centerline-mounted pump.*

When a turbine driver is used to drive the pump, the variation in the shaft elevation must be rechecked after the driver has been allowed to come up to the operating temperature. An approximate cold setting can be obtained from the driver manufacturer.

FINAL CHECK OF ALIGNMENT

After the grout has set, pressure grouting to fill voids has also set, and the foundation bolts have been properly tightened, the unit should be checked for parallel and angular alignment and if necessary, corrective measures taken.



Machinery must be free of strain or distortion. Loosen and then tighten the hold-down bolts of the pump and motor sequentially, using the dial indicator on the coupling as a monitor to assure that units are uniformly supported. After the piping of the unit has been connected, the alignment should again be checked while tightening the connection bolts.

NOTE: *The direction of rotation of the driver should be checked to make certain that it matches that of the pump.*

The coupling halves can then be reconnected. With the pump properly primed, the unit then should be operated under normal operating conditions until temperatures have stabilized. The unit should then be shut down and immediately checked again for alignment of the coupling.

It should be emphasized that attempts to correct alignment in one direction may alter the alignment in the other direction; therefore, it is necessary to check in all directions after making any adjustment. Pumps should be level to .005 inches per foot at operating temperature when measured at the shaft extension.

SHIMS

The shims should be clean and dry. Water, dirt, and rust can affect the shim height over a period of time. Shims should be large enough to support the weight of the equipment on its mounting foot. Use a combination of thick and thin shims (up to a total pack of 5 maximum) under a foot to make up for the misalignment rather than using many thin shims which can result in a spongy mounting. The equipment should be moved vertically to add or remove shims. Torque hold down bolts to required values given on page 40.

NOTE: *Factory added shims stack up to 1/8" (3 mm) minimum and 1/4" maximum.*

DOWELING

After the unit has been running for about one week, the coupling halves should be given a final check for misalignment caused by pipe strains or temperature strains. If the alignment is correct, both pump, and driver should be doweled to the baseplate. For locations of the dowels, see certified Outline Drawing.

FACTORS THAT MAY AFFECT ALIGNMENT

The unit should be hot checked periodically for alignment. If the unit does not stay in line after being properly installed, the following are possible causes:

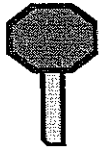
1. Settling, seasoning, or springing of the foundation.
2. Pipe strains distorting or shifting the machine.
3. Wear of the bearings.
4. Springing of the baseplate by heat from adjacent steam pipe, etc.
5. Shifting of the building structure due to variable loading or other causes.

For a new unit and foundation, it may be necessary to slightly readjust the alignment from time to time.



ROTATION

The driver rotation for all CUP-OH2 pumps must be verified prior to coupling the pump. To check rotation, remove the coupling guard and coupling spacer. Make momentary contact with the motor starter to verify correct rotation.



Keep clear of rotating components when checking motor rotation. Ensure that tools and loose hardware are clear before starting motor.

HIGH TEMPERATURE OPERATION

Pumps handling liquids at temperatures above 300°F (150°C) should be brought up to operating temperature before start-up. This can be accomplished by circulating hot pumpage through the pump. Control the circulation so that the pump casing temperature rise does not exceed 100°F (37.8 °C) per hour. The pump casing temperature must be within 75°F (24°C) of the pumpage before start-up and operation.



Bring pump up to operating temperature slowly before start-up. Severe thermal shock can damage the pump and cause injury.

SECTION VII - STARTING THE PUMP

START-UP CHECKLIST

The following items should be checked at initial start-up and after the equipment has been overhauled:

- | | |
|---|---|
| 1. Pump rotation is correct | 9. Coupling Guard installed |
| 2. Seal locking plates removed | 10. Suction Valve open |
| 3. Seal flush connected | 11. Discharge side in start-up position |
| 4. Vent and drain lines installed | 12. Instrumentation connections made |
| 5. Motor and pump bearings lubricated | 13. Everyone standing clear |
| 6. Pipe connections and plugs tight | |
| 7. Coupling spacer installed; pump and driver aligned | |
| 8. Pump shaft rotates freely | |



If the pump is installed in a potentially explosive area / ATEX classified environment or is handling a hazardous liquid, the system must have protection devices to ensure the following:

- *Temperature of the liquid does not rise to an unsafe level*
- *System does not allow the pump to run dry or start-up empty*
- *There is no leakage of product from the pump or its associated sealing system*
- *Surface temperature at bearings are not excessive*



PRIMING

NOTE: When the pump is located above the pumpage source, it must be primed to evacuate all air from the pump case.



The pump casing, suction line, and seal flush must be filled with liquid BEFORE the pump is started.

STARTING

A centrifugal pump usually requires less power to operate with the discharge valve closed than with the discharge valve open. For this reason, it is often an advantage to have this valve partially closed when starting. Open the valve to achieve approximately minimum stable flow on start-up.

NOTE: Do not start the unit with fully closed discharge valve.
Never throttle pump on suction side.



Do not operate the unit unless coupling guard is securely and properly bolted in place.

Start the pump and bring it immediately to operating speed. Slowly open the discharge valve further as soon as there is a discharge pressure indication. Continue opening the discharge valve until rated capacity and discharge pressure are obtained. If the rated conditions cannot be obtained, refer to Section IX - Trouble Shooting.

SECTION VIII - OPERATION

OPERATING CAPACITY

Centrifugal pumps should not be operated at greatly reduced capacity or with a closed discharge valve because the energy required to drive the pump is converted to heat and the temperature of the liquid may reach its boiling point. If this occurs, the rotating parts are exposed to vapor with no lubrication and damage to internal parts will occur.

There are several means to protect the pump from such possible damage:

1. Liquid temperature sensor to shut the pump down if the pumpage temperature exceeds a pre-determined level.
2. Constant open by-pass between the pump discharge and the suction source.
3. Suction pressure sensor to shut the pump down if the suction pressure drops below a pre-determined level.
4. Vibration sensor to shut the pump down if the vibration level exceeds a pre-determined value.



CHANGING OPERATING CONDITIONS

NOTE: Before making any changes in the operating conditions of the pump, contact ClydeUnion Pumps, and provide complete data on the new operating conditions.

FREEZING

During cold weather when the pump is not in operation, the pump should be drained to prevent the liquid inside from freezing.



If the pumpage is toxic, flammable, or corrosive, take proper precautions for handling pumpage before draining the pump.

Pumps used for stand-by service must be kept ready for operation. Circulate pumpage through pump and keep bearings lubricated. Consult ClydeUnion Pumps concerning pumps used in stand-by service.

SHUT DOWN

To avoid water hammer, it is recommended that the discharge valve be partially closed to the minimum flow point just prior to shutdown of the pump.

SECTION IX - OPERATIONAL CHECKS

FIRST 60 MINUTES

It is recommended that the following parameters be recorded at 10-minute intervals during the first 60 minutes of operation and periodically thereafter:

1. Suction and discharge pressures
2. Bearing housing temperature
3. Pumpage temperature
4. Vibration levels
5. Leakage

Satisfactory operation is indicated by correct capacity and discharge pressure and stable bearing housing temperature. Keep records for future troubleshooting reference and performance trend analysis.

Periodic check of the items listed below will ensure the pump is maintained in its best operating condition.



MECHANICAL SEAL

Check mechanical seals for leakage during the first hours of operation. Minor leakage through the seal usually stops after a short run-in period but if it continues shut down the pump and investigate the cause. Excessive leakage past the seal generally indicates worn or broken parts requiring replacement. A chronic leakage condition should be reported to ClydeUnion Pumps for further investigation.

LUBRICATION:

Driver Lubrication

Driver bearings should be serviced and lubricated according to the motor manufacturer's instructions. Consult lubrication directions on nameplate and literature provided in the final data package.

Pump Lubrication

NOTE: *Great care should be exercised to keep the housing clean and only clean lubricants should be used. Foreign solids or liquids within the bearing housing can completely ruin the bearings in a short time.*

Keep the oiler bottle filled with the correct grade of oil. Under normal conditions, the oiler will maintain proper oil level. A routine check of the oil level will verify proper working order of the oiler.

At initial start-up, change oil after 24 hours of running time. Thereafter, change oil at the following intervals:

Service	Change	Check Level
Continuous	Every 3 Months	Weekly
Intermittent	Every 6 Months	Monthly
High Temp.	Monthly	Daily

When changing the oil, flush the inside of the housing with clean oil to remove any accumulated contaminants. Due to rolling friction and drag of the race, heat is generated within bearings and unless cooled, they will operate at temperatures above that of the surrounding atmosphere. Oil lubricated ball bearings can safely be operated up to 180°F (82.2°C) and bearing temperatures of 160°F (71.1°C) are normal. Do not use the human hand as a thermometer. Determine the temperatures accurately by placing a contact type thermometer against the bearing housing. Record this temperature on a regular basis and maintain a log of the reading. A stable temperature indicates normal operation.

NOTE: *Sudden increases in bearing housing/oil temperature or an excessively high temperature are indications of operational problems or a pending bearing failure.*

Check to see that oil is of proper viscosity and the oil level is neither too high nor too low. The unit should also be checked for unstable hydraulic operation and shaft misalignment.



BEARING BRACKET

Periodically check bearing housing surface temperature. Normal bearing housing operating temperature is 125 to 180 °F (50 to 80 °C).

- NOTES:**
1. Stop the pump immediately if bearing housing temperature exceeds 190 °F (88 °C). Inspect for possible problems such as those stated above before restarting the pump.
 2. Bearing housings equipped with water cooling coils are to be adjusted to operate to maintain an oil temperature no less than 25 °F above the surrounding ambient temperature to prevent condensation.



Bearing housings are not supplied to accommodate synthetic grade lubrications. Lube oils should be acid free, contain rust and oxidation inhibitor and be "anti-foaming".

LUBRICATION REQUIREMENTS

LUBE OIL VISCOSITY AT 100°F (38°C)	SHUT DOWN AT BEARINGS TEMPERATURE	MAXIMUM LUBE OIL TEMPERATURE
155 SSU	190° F (88° C)	180° F (82° C)
LUBRICATION RECOMMENDATIONS (ISO VG32)		
AMOCO AW 32		
ARCO DURO S-150		
BP ENERGOL HL-C32		
CHEVRON GST OIL 32		
EXXON TERESSTIC 32		
GULF HARMONY 44		
MOBIL DTE LIGHT		
SHELL TURBO 32		
SUN R & O 150		
TEXACO RANDO 32(A)		
UNOCAL TURBINE OIL 32		
Continued on next page		



PHYSICAL AND CHEMICAL PROPERTIES - LUBRICANTS	
Color	Yellow
Odor	Petroleum Odor
Physical State	Liquid
pH	Not Applicable
Vapor Pressure	<0.01 mmHg @ 37.8 deg C (100 deg F)
Vapor Density	>1 (Air = 1)
Boiling Point	>315 deg C (599 deg F)
Freezing Point	Not Applicable
Solubility	Soluble in hydrocarbon solvents; insoluble in water
Specific Gravity	0.86 - 0.9 @ 15.6 deg C (60.1 deg F) / 15.6 deg C (60.1 deg F)
Density	0.86 kg/l - 0.9 kg/l @ 15 deg C (59 deg F)
VOC Content	<2.1% Weight
Viscosity	28.8 cSt @ 40 deg C (104 deg F)
Comment	The data above are typical values and do not constitute a specification

SECTION X - TROUBLE SHOOTING

<u>SYMPTOM</u>	<u>PROBABLE CAUSES</u>	<u>POSSIBLE REMEDIES</u>
No liquid discharge from the pump	1. Pump not primed. 2. Wrong direction of rotation. 3. Speed too low. 4. Suction-lift too high or insufficient NPSHA. 5. Impeller or piping plugged. 6. Air leaks or air pockets in suction line.	1. Re-prime the pump. 2. Reverse 2 phases at motor terminal box. 3. Check to see if motor receiving full voltage. 4. Check and improvise on the suction lift or the NPSHA. 5. Check and remove any clogs in impeller or piping. 6. Check and purge suction line and ensure suction line is air-tight. Continued on next page

SYMPTOM	PROBABLE CAUSES	POSSIBLE REMEDIES
Insufficient liquid discharge	1. Wrong direction of rotation. 2. Speed too low. 3. Total head of system higher than differential head of pump. 4. Suction-lift too high or insufficient NPSHA. 5. Impeller or piping partially plugged. 6. Air leaks or air pockets in suction line. 7. Mechanical defects (worn wear rings or impeller damage).	1. Reverse 2 phases at motor terminal box. 2. Check to see if motor is receiving full voltage. 3. Check and remedy system losses. 4. Check and improvise on the suction lift or the NPSHA. 5. Check and remove any clogs in impeller or piping. 6. Check and purge suction line and ensure that the line is air-tight. 7. Check and replace worn wear rings and the damaged impeller.
Insufficient Pressure	1. Speed too low. 2. Air or gases in liquid. 3. Total head of system higher than differential head of pump. 4. Capacity too great. 5. Mechanical defects (worn wear rings or damaged impeller). 6. Wrong direction of rotation. 7. Viscosity of liquid differs from that for which designed.	1. Check to see if motor receiving full voltage. 2. Check vents and purge pipes and system. 3. Check and remedy system losses. 4. Check and adjust the flow rate. 5. Check and replace worn wear rings and the damaged impeller. 6. Reverse 2 phases at motor terminal box. 7. Check and consult ClydeUnion Pumps.
Surges in Performance	1. Air leaks or air-pockets in suction line. 2. Not enough NPSHA. 3. Air or gases in liquid. 4. Impeller plugged.	1. Check and purge suction line and ensure that it is air-tight. 2. Check and improvise NPSHA. 3. Check vents, and purge pipes and system. 4. Check and remove any clogs in impeller.

Continued on next page



SYMPTOM	PROBABLE CAUSES	POSSIBLE REMEDIES
Excessive Power Consumption	1. Speed too high. 2. Head too low (causing excessive capacity). 3. Specific gravity or viscosity of liquid pumped is higher than what designed for. 4. Mechanical defects (bent shaft, worn wear rings, misalignment due to pipe strain, rotating parts rubbing against stationary).	1. Check and correct the speed. 2. Check system losses, remedy, or consult ClydeUnion Pumps. 3. Check and consult ClydeUnion Pumps. 4. Check and remedy mechanical defect(s) Consult ClydeUnion Pumps, if necessary.
Mechanical seal leaks excessively	1. Misalignment due to pipe strain. 2. Shaft bent. 3. Bearings worn. 4. Shaft running off-center because of worn bearings or misalignment.	1. Check and remedy misalignment at the flange connections. 2. Check shaft run-outs are within allowable values. Consult ClydeUnion Pumps. 3. Check and replace bearings. 4. Check misalignment at the coupling and correct, if necessary. Otherwise, check bearing for excessive wear.

SECTION XI - MAINTENANCE

GENERAL

The procedures given below are general and apply to all CUP-OH2 pumps. For procedures specific to your particular pump, refer to the drawings and instructions supplied in the final data package with your pump.

PUMP DISASSEMBLY

The disassembly procedure is not specific to any pump but is general to the CUP-OH2 series supplied with a cartridge type seal. Refer to the specific drawings supplied with your pump to augment this procedure. The numbers in parentheses after certain steps refer to component parts as identified on the typical pump sectional drawing (Figures 9, 10 and 11), as applicable.

NOTE: *Typical sectional drawings are for disassembly and assembly purposes only and should not be used for specific detailed dimensions.*



1. Turn power off and lock in off position.



Be sure the power to the motor is turned off and locked in the off position before beginning disassembly.

2. Close suction and discharge gate valves and any auxiliary valves.
3. Drain the pump by opening the case drain.



If the pumpage is toxic, flammable or corrosive take proper precautions for handling pumpage before draining the pump.

4. Disconnect and remove all seal flush piping after the pump is completely drained.
5. If the pump is equipped with an auxiliary seal flush reservoir, drain the reservoir and disconnect the seal flush piping.

NOTE: Always cap off open ports and lines to prevent dirt from entering.

6. Remove coupling guard. Disassemble and remove drive-coupling spacer.



The back pull-out unit is heavy. It should be adequately rigged to prevent tipping over and proper lifting equipment / devices must be used to avoid injury.

7. Unbolt casing cover (802) from pump casing (800). Screw jack bolts into tapped holes in casing cover (802) and evenly tighten bolts to facilitate removal of the rotating assembly. [Impeller (805), casing cover (802), bearing bracket (849), and shaft (820)]. Remove casing gasket (815-1).

NOTE: *The back pull-out design of this pump allows the complete back pull-out unit to be removed without disturbing the suction and discharge piping or the driver.*

NOTE: *The pump back pull-out unit should now be moved to a repair shop where proper equipment and facilities are available.*

Disassembly of Back Pull-Out Unit

After the complete back pull-out unit has been taken to a clean work area, the unit can be fully dismantled by following the instructions given below and referring frequently to the applicable pump sectional drawing (Figures 9, 10 and 11).

1. Remove impeller locknut setscrew and impeller locknut (821-1).

NOTE: *The impeller locknut loosens in a clockwise direction. It has a left hand thread.*



2. Remove impeller and impeller key. The impeller is a slip fit but may require the use of a puller for removal (805, 811-1).



*Do not bend or damage the impeller when removing with a puller.
Never apply heat to remove impeller; trapped liquid or vapor could cause an explosion.*

3. Remove inboard heat sink.
4. Engage seal locating devices. Loosen cartridge seal drive collar set screws. Refer to seal drawing in final data package.
5. Unscrew cap-screws holding bearing bracket (849) to casing cover (802), and pull casing cover and seal from remaining rotating assembly.



When separating the casing cover from the bearing bracket, be careful not to damage the mechanical seal.

6. Unbolt and remove cartridge seal assembly and seal chamber gasket from casing cover. Refer to the manufacturer's instructions for seal maintenance.
7. To disassemble casing / cover wear rings (808-1, 2), remove setscrews holding the wear ring. Remove the wear ring.
8. Grind off welds between cover and throat bushing (847) and remove the bushing.
9. For disassembly of bearing bracket, see following instructions.

Bearing Bracket Disassembly

After dismantling the casing cover, the bearing bracket can be disassembled as follows:

1. Remove pump-coupling hub and drive key.
2. Remove the fan guard (812), inboard heat sink (829-2), and fan (853) as applicable.
3. Remove the two oil ring retainers.
4. Loosen cap-screws and remove inboard & outboard end caps (813-1 & 2), bearing isolators (829-1 & 3), and plastic shims (815-5).
5. Slide shaft assembly out of bearing bracket.
6. Remove ball bearing locknut and lock washer (821-4 and 831) from fan shaft.
7. Using an arbor press with appropriate fixturing, remove thrust bearings (881-2) and radial bearing (881-1) from the pump shaft.
8. Remove oil rings (817) from shaft.



INSPECTION OF PUMP PARTS

Clean all parts in appropriate cleaning solution and inspect for wear or damage. Closely inspect bushings, sleeves, wear rings, and shaft keyways and keys. Replace any part that shows signs of wear or damage.

Impeller

Inspect impeller passages and vane surfaces for evidence of erosion. Replace if excessively worn or corroded. The impeller is dynamically balanced at the factory, and balance must be maintained for proper operation of the pump.

Case & Impeller Wear Rings

Case and impeller wear rings are normally provided for both sides of the impeller. These rings allow a small clearance to be maintained between the rotating impeller and the stationary casing rings. For proper hydraulic performance, these clearances should be as listed below. Rings should be replaced when clearances have increased to a point where hydraulic performance cannot be met.

Standard Material Minimum Running Clearances (API 610)

Wear Ring Diameter Inches	Min. Diametral Clearance	
	Inches	Micrometers
3.500 - 3.999	0.016	406
4.000 - 4.499	0.016	406
4.500 - 4.999	0.016	406
5.000 - 5.999	0.017	432
6.000 - 6.999	0.018	457
7.000 - 7.999	0.019	483
8.000 - 8.999	0.020	508
9.000 - 9.999	0.021	533
10.000 - 10.999	0.022	559
11.000 - 11.999	0.023	584
12.000 - 12.999	0.024	610
13.000 - 13.999	0.025	635

NOTE: For materials with known galling tendencies and for all materials operating at temperatures above 500 °F, add 0.005-inch (127 micrometers) to the above diametral clearances. Pumps utilizing special non-galling wear materials may run tighter clearances.



Ball Bearings

Replace if worn, loose, or rough and noisy when rotated.



New bearings should not be unwrapped until ready for use. Whenever in doubt about the condition of a bearing, replace it.

Seals

Inspect all seals for irregularities or damage. Consult the seal manufacturer's data for seal reconditioning and service. Seal faces, O-Rings, and seal sleeves must be in perfect condition. Replace all worn parts.

Shaft

Inspect the shaft for damage and straightness. Dress minor damage and polish areas where the shaft contacts a seal. Support the shaft in rollers or V-blocks at the bearing locations and check run-out. Run-out must not exceed .001 inch TIR on all diameters.

PUMP ASSEMBLY

General

When assembling this pump, it is recommended that only genuine ClydeUnion Pumps' parts be used. Always use new O-Rings, gaskets, and lock washers.

All parts should be cleaned before assembly. This is especially important at O-Ring grooves, threads, cylindrical fits, and gasket surfaces. Any burred edge must be removed before part is installed into the pump. Coat all parts with light oil and cover with protective cloth if the pump is not immediately reassembled.

NOTE: *Use appropriate Torque Values from the table given on page 40 and apply correct torquing procedure given on page 41 for proper assembly/reassembly of the parts disassembled.*

Bearing Bracket Assembly

The bearing bracket can be reassembled by following the instructions given below¹ and by referring to the pump drawing.

NOTE: *The bearing bracket is common for both the mechanical seal and seal reservoir arrangements.*

NOTE: *Bearing seal oil return slot must be located such that it faces down with the bearing bracket in its normally mounted position.*



1. Press inboard bearing isolator (829-1) and firmly seat into bearing bracket (849), if removed during disassembly.
2. Assemble oil rings (817) if applicable, on shaft (820), installing each in the groove in the shaft.
3. Lubricate bearing seat on shaft. Slide thrust bearing (881-2) on shaft (820) as far as possible by hand. Place sleeve over shaft, being sure it rests against inner race only. Press sleeve evenly until bearing is seated firmly against shaft shoulder.

NOTE: *Install thrust bearings back to back. Generally, this means that the markings on the outer race are installed together. Bearings must always be replaced in pairs. New bearings are normally packaged in the correct back-to-back orientation for installation.*

4. Assemble thrust bearing lock washer (831) and locknut (821-4). Crimp tab of lock washer into bearing locknut slot.
5. Lubricate bearing seat on shaft. Slide radial bearing (881-1) on shaft (820) as far as possible by hand. Place sleeve over shaft, being sure it rests against inner race only. Press sleeve evenly until bearing is firmly seated against shaft shoulder.

NOTE: *Heating the bearings using an induction bearing heater or hot oil bath can be used to obtain a slip fit assembly. Ensure the bearing is not magnetized if induction heating is used. Do not heat bearings above 250 °F.*

6. Install shaft and bearing sub-assembly into bearing bracket.
7. Install outboard bearing end cap / bearing isolator assembly (813-2, 829-3), and plastic shims (815-5) on to bearing bracket.
8. Check axial end play of shaft. End play should be adjusted to .003 to .005-inch by adding or removing shims.
9. Install inboard bearing end cap / bearing isolator assembly (813-1, 829-1). Rotate shaft to check for possible rubs on Inpro seals and adjust if necessary.
10. Install oil ring retainers.
11. Install inboard heat sink (829-2), outboard fan (853), and fan shroud (812), if applicable.
12. Install pump coupling hub and drive key (811-2).

Assembly of Back Pull-Out Unit

The back pull-out unit can be reassembled by following the instructions given below and referring to the appropriate pump sectional drawing (Figures 9, 10 or 11).

1. For assembly of bearing bracket see preceding instructions.
2. If removed during disassembly press throat bushing (847) into casing cover (802), and tack welds in two places equally spaced.
3. If removed during disassembly, press casing or cover wear rings (808-1, 2) into casing or cover and set screw in three places. Check wear rings for proper clearance to the impeller rings per Table on page 35.
4. Lubricate pump shaft and slide cartridge seal assembly onto shaft.



Care must be taken not to damage seal sleeve gasket or seal face.

5. Place gland gasket (815-2 not shown in sectional drawing) on pilot or in groove of gland plate.
6. Slide casing cover (802) over pump shaft (820) and seal. Insert and tighten cap screws between bearing bracket (849) and cover.
7. Draw gland nuts up evenly until metal-to-metal contact is realized between gland and cover.
8. Install impeller key (811-1) and impeller (805). The impeller is a very snug slip fit; therefore, the use of gentle force may be required to fully seat it to the shaft shoulder.
9. Tighten the seal drive collar setscrews. Disengage seal locating devices and check rotation.
10. Check shaft and make sure it is free to rotate. Re-engage seal locating device prior to storing or installing back pull-out unit in casing.

Assembly of Back Pull-Out Unit to Pump Casing

The pump back pull-out unit that includes the impeller (805), the casing cover (802), the bearing bracket (849), and the shaft (820), is now ready for reassembly to the pump in the field. Follow the instructions given below and refer to the applicable sectional drawing.

1. Return complete back pull-out unit to pump.
2. Slide casing gasket (815-1) over cover.
3. Slide back pull-out unit into casing (800) and tighten casing stud nuts evenly. Refer to pages 40 & 41 for appropriate Torque Values and Torquing Procedure. Case and cover must have metal to metal contact.



Check shaft that it is free to rotate and does not bind.

4. Check coupling alignment. Refer to Section VII – Preparation for Operation.
5. Install coupling spacer and lubricate if required.
6. Install coupling guard.
7. Replace all previously removed piping.
8. Refer to Section VII – Starting the Pump.



SECTION XII - SPARE PARTS

Save time and money by maintaining one complete set of the essential wearing parts for each pump. Do not wait until breakdown occurs.

Recommended spare parts for the CUP-OH2 pump are tabulated below.

PART NO.	DESCRIPTION	START-UP	PUMP RECONDITION	CRITICAL SERVICE
815-1	Casing Gasket	1	1	2
823	Cartridge Seal	1	1	1
805	Impeller	-	1	1
821-1	Impeller Nut	-	1	1
820	Shaft	-	1	1
806-1, -2	Impeller Wear Rings	-	2	2
808-1, -2	Casing Wear Rings	-	2	2
815-3	Shim Assembly	-	1	-
829-1	Bearing Seal	-	1	1
829-2	Bearing Seal	-	1	1
881-1	Radial Bearing	-	1	-
881-2	Thrust Bearing	-	1	-



TORQUE VALUES TABLE

TORQUE VALUES FOR LUBRICATED STUDS & NON-LUBRICATED CAP SCREWS / BOLTS - OH2 PUMPS [Refer Notes (1) & (2)]												
Torque Values are for our standard material A193 Grade B7 (SAE Grade 5) only and are within ± 5%												
PUMP SIZE OH2	Case / Cover Nut (1)		Seal Gland Nut (1) [Table 1]		Seal Gland Nut (1) [Table 2]		Impeller Nut (1)		Brg. Hsg. / Cover (2)		End cap / Brg. Hsg. (2)	
	Stud size (No. of studs)	Torque Lube ft.lbs.	Stud size	Torque Lube ft.lbs.	Stud size	Torque Lube ft.lbs.	Thread size	Torque Lube ft.lbs.	Cap Screw size	Torque Dry ft.lbs.	Cap Screw size	Torque Dry ft.lbs.
1.5x3x7	3/4-10 (8)	175	5/8-11 (4)	100	5/8-11 (4)	100	5/8-18 UNF	75	1/2-13 (4)	65	1/2-13 (4)	65
2x3x7.5	7/8 - 9 (6)	280	5/8-11 (4)	100	5/8-11 (4)	100	5/8-18 UNF	75	1/2-13 (4)	65	1/2-13 (4)	65
1.5x2x8	3/4-10 (8)	175	5/8-11 (4)	100	5/8-11 (4)	100	5/8-18 UNF	75	1/2-13 (4)	65	1/2-13 (4)	65
2x3x8	3/4-10 (8)	175	5/8-11 (4)	100	5/8-11 (4)	100	5/8-18 UNF	75	1/2-13 (4)	65	1/2-13 (4)	65
3x4x8	3/4-10 (8)	175	5/8-11 (4)	100	5/8-11 (4)	100	5/8-18 UNF	75	1/2-13 (4)	65	1/2-13 (4)	65
4x6x8	3/4-10 (8)	175	5/8-11 (4)	100	5/8-11 (4)	100	5/8-18 UNF	75	1/2-13 (4)	65	1/2-13 (4)	65
6x6x8	3/4-10 (8)	175	5/8-11 (4)	100	5/8-11 (4)	100	5/8-18 UNF	75	1/2-13 (4)	65	1/2-13 (4)	65
1.5x3x9	7/8 - 9 (8)	280	5/8-11 (4)	100	5/8-11 (4)	100	5/8-18 UNF	75	1/2-13 (4)	65	1/2-13 (4)	65
2x3x9	7/8 - 9 (8)	280	5/8-11 (4)	100	5/8-11 (4)	100	5/8-18 UNF	75	1/2-13 (4)	65	1/2-13 (4)	65
4x6x9	7/8 - 9 (8)	280	5/8-11 (4)	100	5/8-11 (4)	100	5/8-18 UNF	75	1/2-13 (4)	65	1/2-13 (4)	65
1.5x2x10	3/4-10 (12)	175	5/8-11 (4)	100	5/8-11 (4)	100	5/8-18 UNF	75	1/2-13 (4)	65	1/2-13 (4)	65
1.5x3x10	3/4-10 (12)	175	5/8-11 (4)	100	5/8-11 (4)	100	5/8-18 UNF	75	1/2-13 (4)	65	1/2-13 (4)	65
2x3x10	3/4-10 (12)	175	5/8-11 (4)	100	5/8-11 (4)	100	5/8-18 UNF	75	1/2-13 (4)	65	1/2-13 (4)	65
3x4x10	3/4-10 (12)	175	5/8-11 (4)	100	5/8-11 (4)	100	5/8-18 UNF	75	1/2-13 (4)	65	1/2-13 (4)	65
4x6x10	3/4-10 (12)	175	5/8-11 (4)	100	5/8-11 (4)	100	5/8-18 UNF	75	1/2-13 (4)	65	1/2-13 (4)	65
6x6x10	3/4-10 (12)	175	5/8-11 (4)	100	5/8-11 (4)	100	5/8-18 UNF	75	1/2-13 (4)	65	1/2-13 (4)	65
1.5x3x11.5	7/8 - 9 (12)	280	5/8-11 (4)	100	5/8-11 (4)	100	5/8-18 UNF	75	1/2-13 (4)	65	1/2-13 (4)	65
3x4x11.5	7/8 - 9 (12)	280	5/8-11 (4)	100	5/8-11 (4)	100	5/8-18 UNF	75	1/2-13 (4)	65	1/2-13 (4)	65
4x6x11.5	7/8 - 9 (12)	280	5/8-11 (4)	100	5/8-11 (4)	100	5/8-18 UNF	75	1/2-13 (4)	65	1/2-13 (4)	65
6x8x11.5	7/8 - 9 (12)	280	5/8-11 (4)	100	5/8-11 (4)	100	5/8-18 UNF	75	1/2-13 (4)	65	1/2-13 (4)	65
2x3x13	7/8 - 9 (16)	280	5/8-11 (4)	100	3/4-10 (4)	175	3/4-16 UNF	130	5/8-11 (4)	130	5/8-11 (4)	130
3x4x13	7/8 - 9 (16)	280	5/8-11 (4)	100	3/4-10 (4)	175	3/4-16 UNF	130	5/8-11 (4)	130	5/8-11 (4)	130
6x8x13	7/8 - 9 (16)	280	5/8-11 (4)	100	3/4-10 (4)	175	3/4-16 UNF	130	5/8-11 (4)	130	5/8-11 (4)	130
3x4x14	7/8 - 9 (16)	280	5/8-11 (4)	100	3/4-10 (4)	175	3/4-16 UNF	130	5/8-11 (4)	130	5/8-11 (4)	130
4x6x14	7/8 - 9 (16)	280	5/8-11 (4)	100	3/4-10 (4)	175	3/4-16 UNF	130	5/8-11 (4)	130	5/8-11 (4)	130
6x8x14	7/8 - 9 (16)	280	5/8-11 (4)	100	3/4-10 (4)	175	3/4-16 UNF	130	5/8-11 (4)	130	5/8-11 (4)	130
6x8x14	1 - 8 (12)	420	5/8-11 (4)	100	3/4-10 (4)	175	1 - 12 UNF	300	5/8-11 (4)	130	5/8-11 (4)	130
8x10x14	1 - 8 (12)	420	5/8-11 (4)	100	3/4-10 (4)	175	1 - 12 UNF	300	5/8-11 (4)	130	5/8-11 (4)	130
10x12x14	1 - 8 (12)	420	5/8-11 (4)	100	3/4-10 (4)	175	1 - 12 UNF	300	5/8-11 (4)	130	5/8-11 (4)	130
1.5x3x15	7/8 - 9 (16)	280	5/8-11 (4)	100	5/8-11 (4)	100	5/8-18 UNF	75	1/2-13 (4)	65	1/2-13 (4)	65
6x8x15	7/8 - 9 (16)	280	5/8-11 (4)	100	3/4-10 (4)	175	3/4-16 UNF	130	5/8-11 (4)	130	5/8-11 (4)	130
8x10x15	7/8 - 9 (16)	280	5/8-11 (4)	100	3/4-10 (4)	175	3/4-16 UNF	130	5/8-11 (4)	130	5/8-11 (4)	130
10x10x15	7/8 - 9 (16)	280	5/8-11 (4)	100	3/4-10 (4)	175	3/4-16 UNF	130	5/8-11 (4)	130	5/8-11 (4)	130
4x6x16	1 - 8 (16)	420	5/8-11 (4)	100	3/4-10 (4)	175	3/4-16 UNF	130	5/8-11 (4)	130	5/8-11 (4)	130
4x6x17	1 - 8 (16)	420	5/8-11 (4)	100	3/4-10 (4)	175	1 - 12 UNF	300	5/8-11 (4)	130	5/8-11 (4)	130
12x12x17	1 - 8 (16)	420	5/8-11 (4)	100	7/8 - 9 (4)	280	1 - 12 UNF	300	3/4-10 (4)	230	5/8-11 (4)	130
4x6x18	7/8 - 9 (20)	280	5/8-11 (4)	100	3/4-10 (4)	175	3/4-16 UNF	130	5/8-11 (4)	130	5/8-11 (4)	130
6x8x18	7/8 - 9 (20)	280	5/8-11 (4)	100	3/4-10 (4)	175	3/4-16 UNF	130	5/8-11 (4)	130	5/8-11 (4)	130
8x10x18	7/8 - 9 (20)	280	5/8-11 (4)	100	7/8 - 9 (4)	280	1 - 12 UNF	300	3/4-10 (4)	230	5/8-11 (4)	130
10x12x18	7/8 - 9 (20)	280	5/8-11 (4)	100	7/8 - 9 (4)	280	1 - 12 UNF	300	3/4-10 (4)	230	5/8-11 (4)	130
12x12x18	7/8 - 9 (20)	280	5/8-11 (4)	100	7/8 - 9 (4)	280	1 - 12 UNF	300	3/4-10 (4)	230	5/8-11 (4)	130
10x12x21	1.25 - 7 (16)	840	5/8-11 (4)	100	7/8 - 9 (4)	280	1 - 12 UNF	300	3/4-10 (4)	230	5/8-11 (4)	130
8x10x22	1 - 8 (20)	420	5/8-11 (4)	100	7/8 - 9 (4)	280	1 - 12 UNF	300	3/4-10 (4)	230	5/8-11 (4)	130
10x12x22	1 - 8 (20)	420	5/8-11 (4)	100	7/8 - 9 (4)	280	1 - 12 UNF	300	3/4-10 (4)	230	5/8-11 (4)	130
6x10x25	1.375 - 8 (16)	1175	5/8-11 (4)	100	7/8 - 9 (4)	280	1 - 12 UNF	300	3/4-10 (4)	230	5/8-11 (4)	130
6x8x26	1.125 - 7 (20)	595	5/8-11 (4)	100	7/8 - 9 (4)	280	1 - 12 UNF	300	3/4-10 (4)	230	5/8-11 (4)	130

NOTES: (1) Lubricate threaded holes and the studs with light oil SAE 10W, the nuts are not to be lubricated.
(2) Do not lubricate Cap Screws / Bolts, for example, Brg. Hsg. / Cover, End cap / Brg. Hsg.

TORQUING PROCEDURE & TORQUING SEQUENCE SHEET

Torquing Procedure:

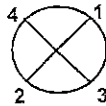
Stud Nuts:

1. After lubricating, install fasteners finger tight.
2. Tighten opposing fasteners in an alternating sequence as shown.
3. Develop the required fastener torque in a minimum of 3 steps with a maximum of 30% torque value on the initial pass.
4. A final 'check pass' tightening to required value should be performed in a clockwise bolt to bolt sequence.

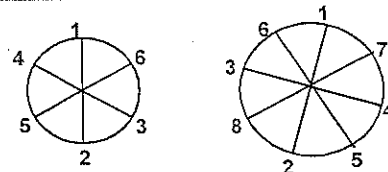
Tightening Procedure:

Cap Screws / Bolts:

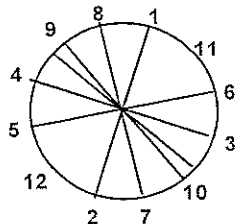
1. Hand tighten until Heads contact. [Do not lubricate]
2. Tighten opposing fasteners in an alternating sequence as shown. Develop the required fastener torque in a minimum of 3 steps with a maximum of 30% torque value on the initial pass.
3. A final 'check pass' tightening to required value should be performed in a clockwise bolt to bolt sequence.



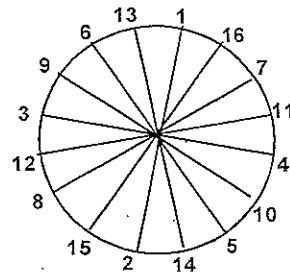
Torquing Sequence: 4 studs/bolts pattern; Seal gland, Brg. Hsg./Cover, End Cap to Brg. Hsg.



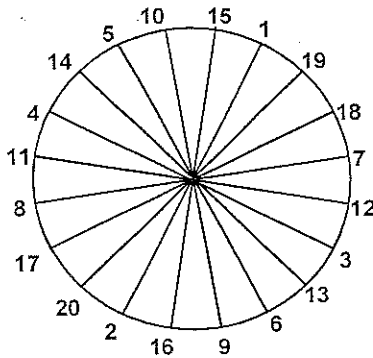
Torquing Sequence: 6 studs and 8 studs pattern.



Torquing Sequence: 12 studs pattern



Torquing Sequence: 16 studs pattern



Torquing Sequence: 20 studs pattern

TYPICAL HORIZONTAL PIPING DIAGRAM

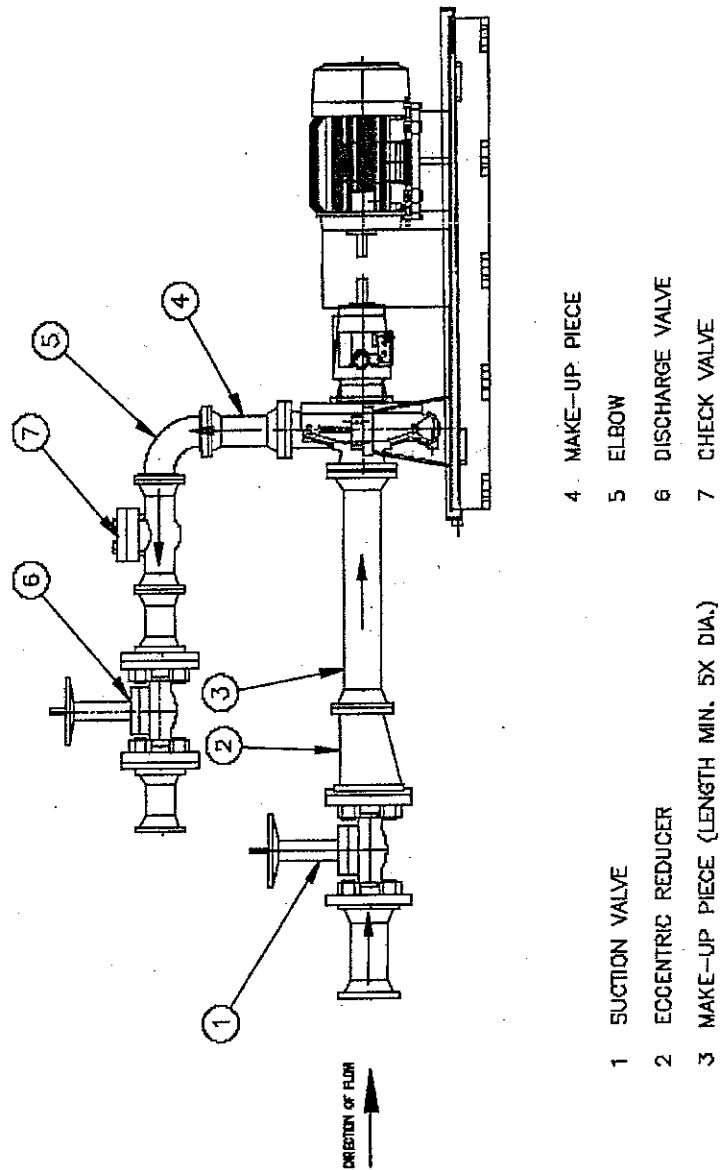


Figure 8
Piping Diagram



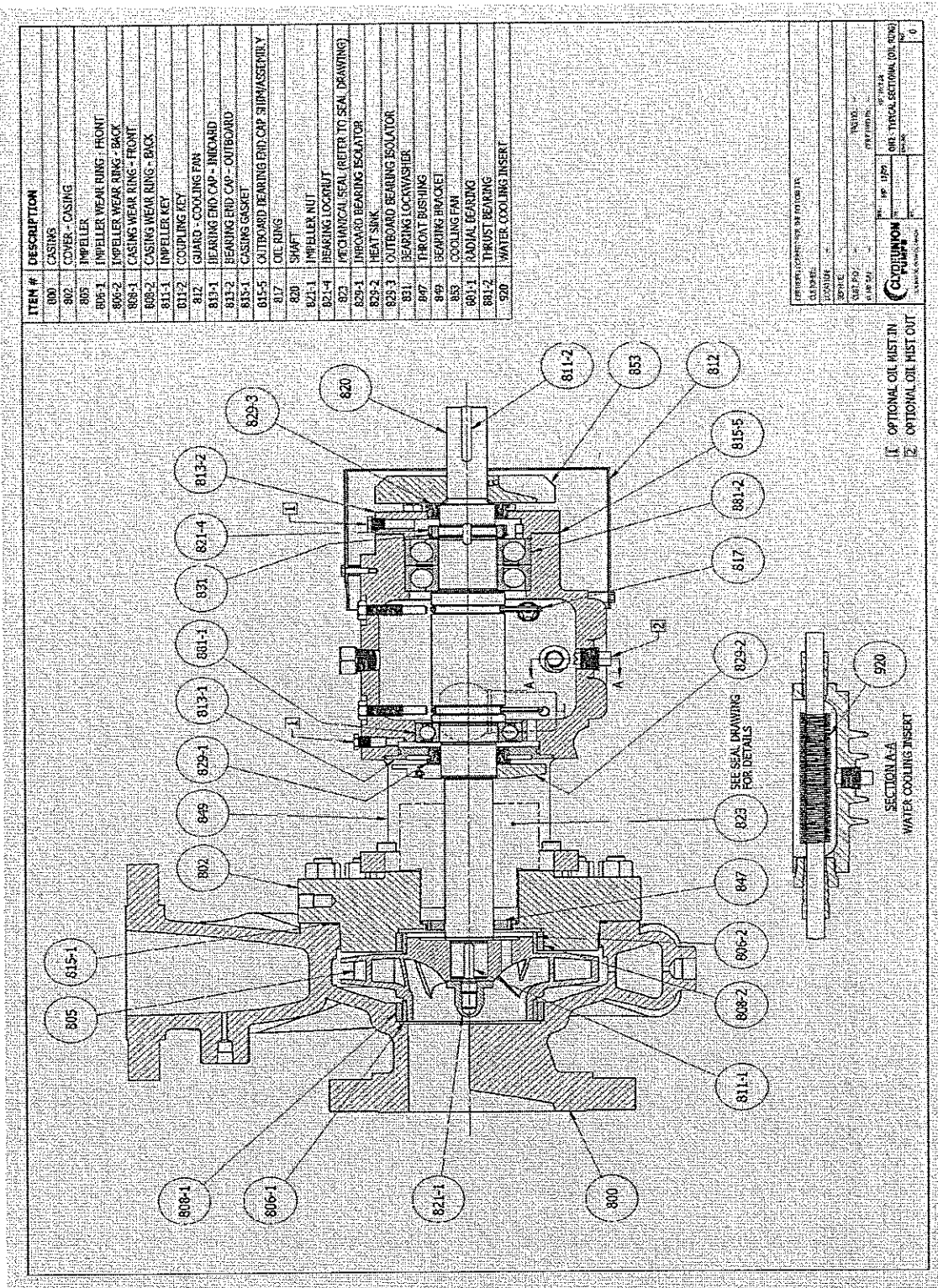


Figure 10: Sectional Drawing, Oil Ring Lube Configuration (with Cooling)

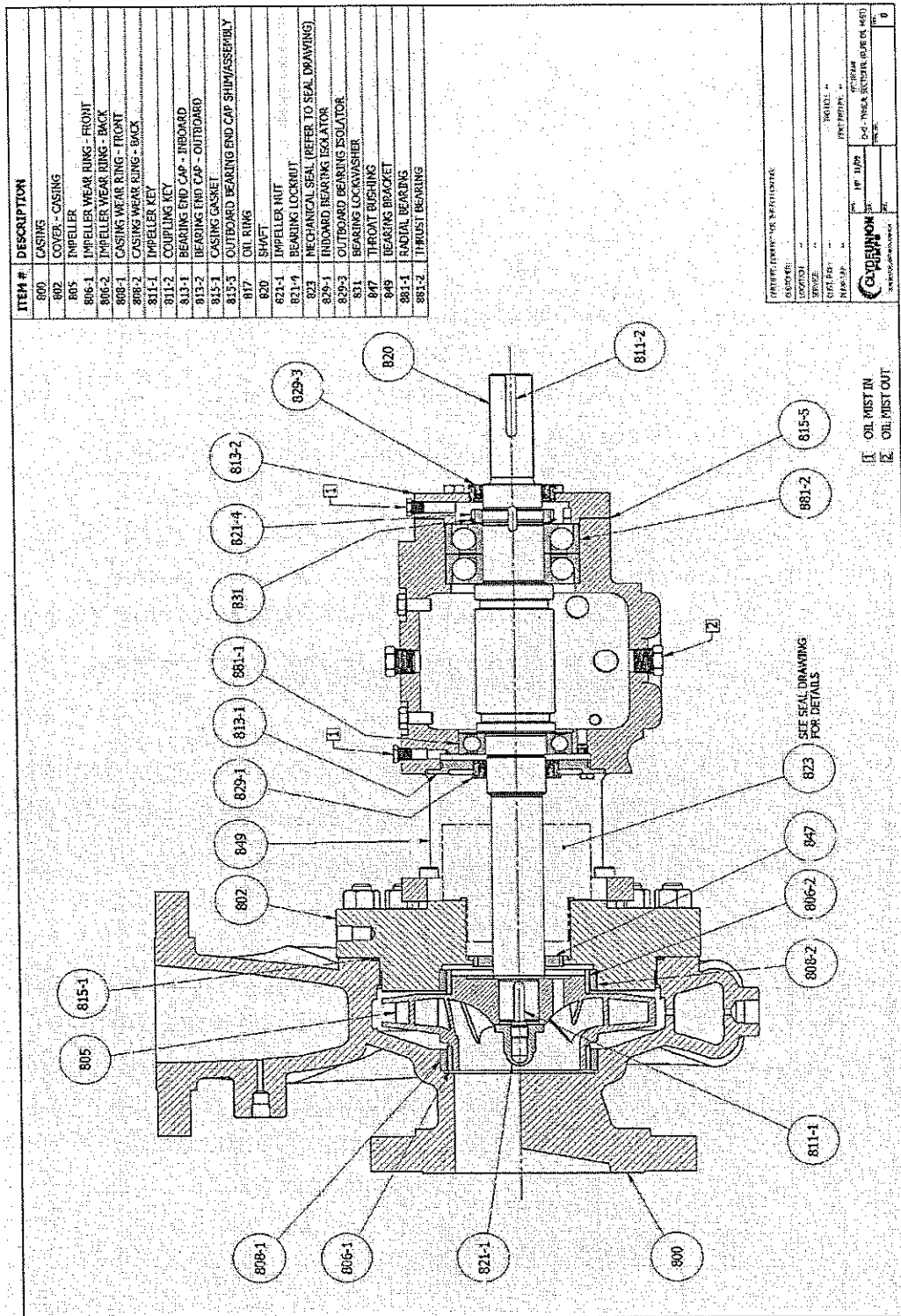


Figure 11: Sectional Drawing, Oil Mist Lube Configuration



SECTIONAL DRAWINGS ITEM & DESCRIPTION TABLE

ITEM #	DESCRIPTION
800	Casing
802	Cover - Casing
805	Impeller
806-1	Impeller Wear Ring - Front
806-2	Impeller Wear Ring - Back
808-1	Casing Wear Ring - Front
808-2	Casing Wear Ring - Back
811-1	Impeller Key
811-2	Coupling Key
812	Guard – Cooling Fan
813-1	Bearing End Cap - Inboard
813-2	Bearing End Cap - Outboard
815-1	Casing Gasket
815-5	Outboard Bearing End Cap Shim/Assembly
817	Oil Ring
820	Shaft
821-1	Impeller Nut
821-4	Bearing Locknut
823	Mechanical Seal (Refer to Seal Drawing)
829-1	Inboard Bearing Isolator
829-2	Heat Sink
829-3	Outboard Bearing Isolator
831	Bearing Lockwasher
847	Throat Bushing
849	Bearing Bracket
881-1	Radial Bearing
881-2	Thrust Bearing
920	Water Cooling Insert



SPX[®]

Index of Order Specific Drawings (If applicable)



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Warranty _____

ClydeUnion Pumps warrants that on the date of shipment from Company's facility the Goods are of the kind and qualities described herein and are free of non-conformities in design, workmanship and material and meet the specifications set forth on the Purchase Order accepted by Company. Buyer's exclusive remedy for nonconformity in any item of the Goods shall be the repair or the replacement (at Company's option) of the item and any affected part of the Goods. Company's obligation to repair or replace shall be in effect for a period of one (1) year from initial operation of the Goods but not more than eighteen (18) months from Company's delivery of the Goods, provided Buyer has sent written notice within that period of time, or within thirty (30) days after the end of the applicable warranty period to Company that the Goods do not conform to the above warranty. Repaired and replacement parts shall be warranted for the remainder of the original period of notification set forth above, but in no event less than 12 months from repair or replacement. At its expense, Buyer shall remove and ship to Company any such nonconforming items and shall reinstall the repaired or replaced parts. Buyer shall grant Company access to the Goods at all reasonable times in order for Company to determine any nonconformity in the Goods. Company shall have the right of disposal of items replaced by it. If Company is unable or unwilling to repair or replace, or if repair or replacement does not remedy the nonconformity, Company and Buyer shall negotiate an equitable adjustment in the Purchase Order price. This warranty shall not apply in the event of defects caused by: (i) physical abuse of the Goods or any component, or acts of vandalism by any persons other than Company, its employees, agents, or subcontractors; (ii) alterations, modifications, additions, or repairs made during the applicable warranty period by anyone other than Company, its employees, agents or subcontractors; (iii) accidents or damage resulting from fire, water, wind, hail, lightning, electrical surge or failure, earthquake, theft or similar causes not caused or contributed to by the sole negligence of Company or its employees, agents, or subcontractors; or (iv) damage as a result of corrosion or other damage caused by Buyer's failure to protect the Goods in accordance with Company's written instructions and warnings.

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Installation & Operating Manual

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Section 1 General Information

Overview This manual contains general procedures that apply to Baldor Motor products. Be sure to read and understand the Safety Notice statements in this manual. For your protection, do not install, operate or attempt to perform maintenance procedures until you understand the Warning and Caution statements. A Warning statement indicates a possible unsafe condition that can cause harm to personnel. A Caution statement indicates a condition that can cause damage to equipment.

Important: This instruction manual is not intended to include a comprehensive listing of all details for all procedures required for installation, operation and maintenance. This manual describes general guidelines that apply to most of the motor products shipped by Baldor. If you have a question about a procedure or are uncertain about any detail, Do Not Proceed. Please contact your Baldor distributor for more information or clarification.

Before you install, operate or perform maintenance, become familiar with the following:

- NEMA Publication MG-2, Safety Standard for Construction and guide for Selection, Installation and Use of Electric Motors and Generators.
- IEC 34-1 Electrical and IEC72-1 Mechanical specifications
- ANSI C51.5, the National Electrical Code (NEC) and local codes and practices.

Limited Warranty

www.baldor.com/support/warranty_standard.asp

Safety Notice: This equipment contains high voltage! Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt installation, operation and maintenance of electrical equipment.

Be sure that you are completely familiar with NEMA publication MG-2, safety standards for construction and guide for selection, installation and use of electric motors and generators, the National Electrical Code and local codes and practices. Unsafe installation or use can cause conditions that lead to serious or fatal injury. Only qualified personnel should attempt the installation, operation and maintenance of this equipment.

WARNING: Do not touch electrical connections before you first ensure that power has been disconnected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the installation, operation and maintenance of this equipment.

WARNING: Disconnect all electrical power from the motor windings and accessory devices before disassembly of the motor. Electrical shock can cause serious or fatal injury.

WARNING: Be sure the system is properly grounded before applying power. Do not apply AC power before you ensure that all grounding instructions have been followed. Electrical shock can cause serious or fatal injury. National Electrical Code and Local codes must be carefully followed.

WARNING: Avoid extended exposure to machinery with high noise levels. Be sure to wear ear protective devices to reduce harmful effects to your hearing.

WARNING: Surface temperatures of motor enclosures may reach temperatures which can cause discomfort or injury to personnel accidentally coming into contact with hot surfaces. When installing, protection should be provided by the user to protect against accidental contact with hot surfaces. Failure to observe this precaution could result in bodily injury.

WARNING: This equipment may be connected to other machinery that has rotating parts or parts that are driven by this equipment. Improper use can cause serious or fatal injury. Only qualified personnel should attempt to install, operate or maintain this equipment.

WARNING: Do not by-pass or disable protective devices or safety guards. Safety features are designed to prevent damage to personnel or equipment. These devices can only provide protection if they remain operative.

WARNING: Avoid the use of automatic reset devices if the automatic restarting of equipment can be hazardous to personnel or equipment.

WARNING: Be sure the load is properly coupled to the motor shaft before applying power. The shaft key must be fully captive by the load device. Improper coupling can cause harm to personnel or equipment if the load decouples from the shaft during operation.

WARNING: UL Listed motors must only be serviced by UL Approved Authorized Baldor Service Centers if these motors are to be returned to a hazardous and/or explosive atmosphere.

WARNING: Thermostat contacts automatically reset when the motor has slightly cooled down. To prevent injury or damage, the control circuit should be designed so that automatic starting of the motor is not possible when the thermostat resets.

Safety Notice Continued

- WARNING:** Use proper care and procedures that are safe during handling, lifting, installing, operating and maintaining operations. Improper methods may cause muscle strain or other harm.
- WARNING:** Pacemaker danger – Magnetic and electromagnetic fields in the vicinity of current carrying conductors and permanent magnet motors can result in a serious health hazard to persons with cardiac pacemakers, metal implants, and hearing aids. To avoid risk, stay away from the area surrounding a permanent magnet motor.
- WARNING:** Before performing any motor maintenance procedure, be sure that the equipment connected to the motor shaft cannot cause shaft rotation. If the load can cause shaft rotation, disconnect the load from the motor shaft before maintenance is performed. Unexpected mechanical rotation of the motor parts can cause injury or motor damage.
- WARNING:** Do not use non UL/CSA listed explosion proof motors in the presence of flammable or combustible vapors or dust. These motors are not designed for atmospheric conditions that require explosion proof operation.
- WARNING:** Motors that are to be used in flammable and/or explosive atmospheres must display the UL label on the nameplate along with CSA listed logo. Specific service conditions for these motors are defined in NFPA 70 (NEC) Article 500.
- WARNING:** Guards must be installed for rotating parts such as couplings, pulleys, external fans, and unused shaft extensions, should be permanently guarded to prevent accidental contact by personnel. Accidental contact with body parts or clothing can cause serious or fatal injury.
- Caution:** To prevent premature equipment failure or damage, only qualified maintenance personnel should perform maintenance.
- Caution:** Do not over tension belts. Excess tension may damage the motor or driven equipment.
- Caution:** Do not over-lubricate motor as this may cause premature bearing failure.
- Caution:** Do not lift the motor and its driven load by the motor lifting hardware. The motor lifting hardware is adequate for lifting only the motor. Disconnect the load (gears, pumps, compressors, or other driven equipment) from the motor shaft before lifting the motor.
- Caution:** If eye bolts are used for lifting a motor, be sure they are securely tightened. The lifting direction should not exceed a 20° angle from the shank of the eye bolt or lifting lug. Excessive lifting angles can cause damage.
- Caution:** To prevent equipment damage, be sure that the electrical service is not capable of delivering more than the maximum motor rated amps listed on the rating plate.
- Caution:** If a HI POT test (High Potential Insulation test) must be performed, follow the precautions and procedure in NEMA MG1 and MG2 standards to avoid equipment damage.
- If you have any questions or are uncertain about any statement or procedure, or if you require additional information please contact your Baldor distributor or an Authorized Baldor Service Center.
- Receiving** Each Baldor Electric Motor is thoroughly tested at the factory and carefully packaged for shipment. When you receive your motor, there are several things you should do immediately.
1. Observe the condition of the shipping container and report any damage immediately to the commercial carrier that delivered your motor.
 2. Verify that the part number of the motor you received is the same as the part number listed on your purchase order.
- Handling** The motor should be lifted using the lifting lugs or eye bolts provided.
- Caution:** Do not lift the motor and its driven load by the motor lifting hardware. The motor lifting hardware is adequate for lifting only the motor. Disconnect the load (gears, pumps, compressors, or other driven equipment) from the motor shaft before lifting the motor.
1. Use the lugs or eye bolts provided to lift the motor. Never attempt to lift the motor and additional equipment connected to the motor by this method. The lugs or eye bolts provided are designed to lift only the motor. Never lift the motor by the motor shaft or the hood of a WP11 motor.
 2. To avoid condensation inside the motor, do not unpack until the motor has reached room temperature. (Room temperature is the temperature of the room in which it will be installed). The packing provides insulation from temperature changes during transportation.
 3. When lifting a WP11 (Weather Proof Type 2) motor, do not lift the motor by inserting lifting lugs into holes on top of the cooling hood. These lugs are to be used for hood removal only. A spreader bar should be used to lift the motor by the cast lifting lugs located on the motor frame.

4. If the motor must be mounted to a plate with the driven equipment such as pump, compressor etc., it may not be possible to lift the motor alone. For this case, the assembly should be lifted by a sling around the mounting base. The entire assembly can be lifted as an assembly for installation.
Do not lift the assembly using the motor lugs or eye bolts provided. Lugs or eye bolts are designed to lift motor only. If the load is unbalanced (as with couplings or additional attachments) additional slings or other means must be used to prevent tipping. In any event, the load must be secure before lifting. If the load is unbalanced (as with couplings or additional attachments) additional slings or other means must be used to prevent tipping. In any event, the load must be secure before lifting.

Storage

Storage requirements for motors and generators that will not be placed in service for at least six months from date of shipment.

Improper motor storage will result in seriously reduced reliability and failure. An electric motor that does not experience regular usage while being exposed to normally humid atmospheric conditions is likely to develop rust in the bearings or rust particles from surrounding surfaces may contaminate the bearings. The electrical insulation may absorb an excessive amount of moisture leading to the motor winding failure.

A wooden crate "shell" should be constructed to secure the motor during storage. This is similar to an export box but the sides & top must be secured to the wooden base with lag bolts (not nailed as export boxes are) to allow opening and reclosing many times without damage to the "shell".

Minimum resistance of motor winding insulation is 5 Meg ohms or the calculated minimum, which ever is greater. Minimum resistance is calculated as follows: $R_m = kV + 1$

where: (R_m is minimum resistance to ground in Meg-Ohms and

kV is rated nameplate voltage defined as Kilo-Volts.)

Example: For a 480VAC rated motor $R_m = 1.48$ meg-ohms (use 5 M Ω).

For a 4160VAC rated motor $R_m = 5.16$ meg-ohms.

Preparation for Storage

1. Some motors have a shipping brace attached to the shaft to prevent damage during transportation. The shipping brace, if provided, must be removed and stored for future use. The brace must be reinstalled to hold the shaft firmly in place against the bearing before the motor is moved.
2. Store in a clean, dry, protected warehouse where control is maintained as follows:
 - a. Shock or vibration must not exceed 2 mills maximum at 60 hertz, to prevent the bearings from brinelling. If shock or vibration exceeds this limit vibration isolation pads must be used.
 - b. Storage temperatures of 10°C (50°F) to 49°C (120°F) must be maintained.
 - c. Relative humidity must not exceed 60%.
 - d. Motor space heaters (when present) are to be connected and energized whenever there is a possibility that the storage ambient conditions will reach the dew point. Space heaters are optional.
Note: Remove motor from containers when heaters are energized, reprotect if necessary.
3. Measure and record the resistance of the winding insulation (dielectric withstand) every 30 days of storage.
 - a. If motor insulation resistance decreases below the minimum resistance, contact your Baldor District office.
 - b. Place new desiccant inside the vapor bag and re-seal by taping it closed.
 - c. If a zipper-closing type bag is used instead of the heat-sealed type bag, zip the bag closed instead of taping it. Be sure to place new desiccant inside bag after each monthly inspection.
 - d. Place the shell over the motor and secure with lag bolts.
4. Where motors are mounted to machinery, the mounting must be such that the drains and breathers are fully operable and are at the lowest point of the motor. Vertical motors must be stored in the vertical position. Storage environment must be maintained as stated in step 2.

5. Motors with anti-friction bearings are to be greased at the time of going into extended storage with periodic service as follows:
 - a. Motors marked "Do Not Lubricate" on the nameplate do not need to be greased before or during storage.
 - b. Ball and roller bearing (anti-friction) motor shafts are to be rotated manually every 3 months and greased every 6 months in accordance with the Maintenance section of this manual.
 - c. Sleeve bearing (oil lube) motors are drained of oil prior to shipment. The oil reservoirs must be refilled to the indicated level with the specified lubricant. (see Maintenance). The shaft should be rotated monthly by hand at least 10 to 15 revolutions to distribute oil to bearing surfaces.
 - d. "Provisions for oil mist lubrication" — These motors are packed with grease. Storage procedures are the same as paragraph 5b.
 - e. "Oil Mist Lubricated" — These bearings are protected for temporary storage by a corrosion inhibitor. If stored for greater than 3 months or outdoor storage is anticipated, connected to the oil mist system while in storage. If this is not possible, add the amount of grease indicated under "Standard Condition" in Section 3, then rotate the shaft 15 times by hand.
6. All breather drains are to be fully operable while in storage (drain plugs removed). The motors must be stored so that the drain is at the lowest point. All breathers and automatic "T" drains must be operable to allow breathing and draining at points other than through the bearings around the shaft. Vertical motors should be stored in a safe stable vertical position.
7. Coat all external machined surfaces with a rust preventing material. An acceptable product for this purpose is Exxon Rust Ban # 392.
8. Carbon brushes should be lifted and held in place in the holders, above the commutator, by the brush holder fingers. The commutator should be wrapped with a suitable material such as cardboard paper as a mechanical protection against damage.

Non-Regreaseable Motors

Non-regreaseable motors with "Do Not Lubricate" on the nameplate should have the motor shaft rotated 15 times to redistribute the grease within the bearing every 3 months or more often.

All Other Motor Types

Before storage, the following procedure must be performed.

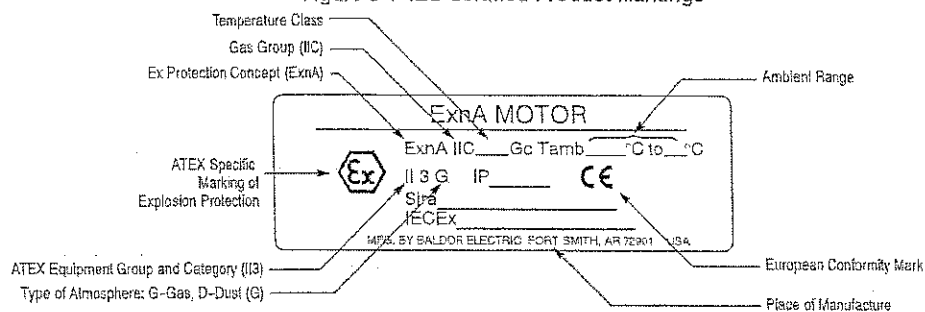
1. Remove the grease drain plug, if supplied, (opposite the grease fitting) on the bottom of each bracket prior to lubricating the motor.
2. The motor with regreaseable bearing must be greased as instructed in Section 3 of this manual.
3. Replace the grease drain plug after greasing.
4. The motor shaft must be rotated a minimum of 15 times after greasing.
5. Motor Shafts are to be rotated at least 15 revolutions manually every 3 months and additional grease added every nine months (see Section 3) to each bearing.
6. Bearings are to be greased at the time of removal from storage.

Removal From Storage

1. Remove all packing material.
2. Measure and record the electrical resistance of the winding insulation resistance meter at the time of removal from storage. The insulation resistance must not be less than 50% from the initial reading recorded when the motor was placed into storage. A decrease in resistance indicates moisture in the windings and necessitates electrical or mechanical drying before the motor can be placed into service. If resistance is low, contact your Baldor District office.
3. Regrease the bearings as instructed in Section 3 of this manual.
4. Reinstall the original shipping brace if motor is to be moved. This will hold the shaft firmly against the bearing and prevent damage during movement.

Equipment Marking for IEC Certified Product

IEC certified products have special markings that identify the protection concept and environment requirements. An example is shown in Figure 3-1.

Figure 3-1 IEC Certified Product Markings**Specific Conditions of Use:**

If the motor certificate number is followed by the symbol "X", this indicates that the motor has specific conditions of use which are indicated on the certificate. It is necessary to review the product certification certificate in conjunction with this instruction manual.

Operation On Frequency Converters:

If the motor is evaluated for operation with an adjustable speed drive, the type of converter (for example PWM for Pulse Width Modulated) and safe speed ranges (for example 0-120Hz) will be specified in the certification documents or on motor nameplates. It is necessary to consult the adjustable speed drive manual for proper set up.

Section 2 Installation & Operation

- Overview** Installation should conform to the National Electrical Code as well as local codes and practices. When other devices are coupled to the motor shaft, be sure to install protective devices to prevent future accidents. Some protective devices include, coupling, belt guard, chain guard, shaft covers etc. These protect against accidental contact with moving parts. Machinery that is accessible to personnel should provide further protection in the form of guard rails, screening, warning signs etc.
- Location** It is important that motors be installed in locations that are compatible with motor enclosure and ambient conditions. Improper selection of the motor enclosure and ambient conditions can lead to reduced operating life of the motor.
- Proper ventilation for the motor must be provided. Obstructed airflow can lead to reduction of motor life.
1. **Open Drip-Proof/WPI** motors are intended for use indoors where atmosphere is relatively clean, dry, well ventilated and non-corrosive.
 2. **Totally Enclosed and WPII** motors may be installed where dirt, moisture or dust are present and in outdoor locations.
- Severe Duty**, IEEE 841 and Washdown Duty enclosed motors are designed for installations with high corrosion or excessive moisture conditions. These motors should not be placed into an environment where there is the presence of flammable or combustible vapors, dust or any combustible material, unless specifically designed for this type of service.
- Hazardous Locations** are those where there is a risk of ignition or explosion due to the presence of combustible gases, vapors, dust, fibers, or flyings. Facilities requiring special equipment for hazardous locations are typically classified in accordance with local requirements. In the US market, guidance is provided by the National Electric Code.
- Mounting Location**
- The motor should be installed in a location compatible with the motor enclosure and specific ambient. To allow adequate air flow, the following clearances must be maintained between the motor and any obstruction:

Table 2-1 Enclosure Clearance

TEFC / TENV (IC0141) Enclosures	
Fan Cover Air Intake	180 – 210T Frame 1" (25mm)
Fan Cover Air Intake	250 – 449T Frame 4" (100mm)
	IEC 112 – 132 1" (25mm)
	IEC 160 – 280 4" (100mm)
Exhaust	Envelope equal to the P Dimension on the motor dimension sheet
OPEN/Protected Enclosures	
Bracket Intake	Same as TEFC
Frame Exhaust	Exhaust out the sides envelope A minimum of the P dimension plus 2" (50mm) Exhaust out the end same as intake.

The motor must be securely installed to a rigid foundation or mounting surface to minimize vibration and maintain alignment between the motor and shaft load. Failure to provide a proper mounting surface may cause vibration, misalignment and bearing damage.

Foundation caps and sole plates are designed to act as spacers for the equipment they support. If these devices are used, be sure that they are evenly supported by the foundation or mounting surface.

When installation is complete and accurate alignment of the motor and load is accomplished, the base should be grouted to the foundation to maintain this alignment.

The standard motor base is designed for horizontal or vertical mounting. Adjustable or sliding rails are designed for horizontal mounting only. Consult your Baldor distributor or authorized Baldor Service Center for further information.

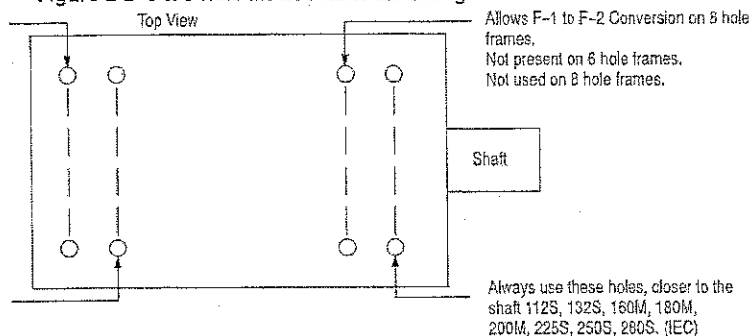
Frame Mounting Holes

Some motors have standardized frames containing 6 or 8 mounting holes. 6 hole frames are not suitable for field reversal of mounting from F-1 to F-2, etc. Figure 2-2 indicates the proper mounting holes to use.

Figure 2-2 6 & 8 Hole Motor Frame Mounting

For short frame designations 182, 213, 254, 284, 324, 364, 404, 444 (NEMA)

For long frame designations 184, 215, 256, 286, 326, 365, 405, 445 (NEMA)
(IEC) 112M, 132M, 160L, 200L, 225M, 250M, 280M

**Caution:**

Do not lift the motor and its driven load by the motor lifting hardware. The motor lifting hardware is adequate for lifting only the motor. Disconnect the load (gears, pumps, compressors, or other driven equipment) from the motor shaft before lifting the motor.

In the case of assemblies on a common base, any lifting means provided on the motor should not be used to lift the assembly and base but, rather, the assembly should be lifted by a sling around the base or by other lifting means provided on the base. Assure lifting in the direction intended in the design of the lifting means. Likewise, precautions should be taken to prevent hazardous overloads due to deceleration, acceleration or shock forces.

Alignment

Accurate alignment of the motor with the driven equipment is extremely important. The pulley, sprocket, or gear used in the drive should be located on the shaft as close to the shaft shoulder as possible. It is recommended to heat the pulley, sprocket, or gear before installing on the motor shaft. Forcibly driving a unit on the motor shaft will damage the bearings.

1. Direct Coupling

For direct drive, use flexible couplings if possible. Consult the drive or equipment manufacturer for more information. Mechanical vibration and roughness during operation may indicate poor alignment. Use dial indicators to check alignment. The space between coupling hubs should be maintained as recommended by the coupling manufacturer.

2. End-Play Adjustment

The axial position of the motor frame with respect to its load is also extremely important. The standard motor bearings are not designed for excessive external axial thrust loads. Improper adjustment will cause failure.

3. Pulley Ratio

The best practice is to not exceed an 8:1 pulley ratio.

Caution:

Do not over tension belts. Excess tension may damage the motor or driven equipment.

4. Belt Drive

Align sheaves carefully to minimize belt wear and axial bearing loads (see End-Play Adjustment). Belt tension should be sufficient to prevent belt slippage at rated speed and load. However, belt slippage may occur during starting.

Doweling & Bolting After proper alignment is verified, dowel pins should be inserted through the motor feet into the foundation. This will maintain the correct motor position should motor removal be required.
(Baldor-Reliance motors are designed for doweling.)

1. Drill dowel holes in diagonally opposite motor feet in the locations provided.
2. Drill corresponding holes in the foundation.
3. Ream all holes.
4. Install proper fitting dowels.
5. Mounting bolts must be carefully tightened to prevent changes in alignment.
Use a flat washer and lock washer under each nut or bolt head to hold the motor feet secure.
Flanged nuts or bolts may be used as an alternative to washers.

WARNING: Guards must be installed for rotating parts such as couplings, pulleys, external fans, and unused shaft extensions, should be permanently guarded to prevent accidental contact by personnel. Accidental contact with body parts or clothing can cause serious or fatal injury.

- Guarding** Guards must be installed for rotating parts such as couplings, pulleys, external fans, and unused shaft extensions. This is particularly important where the parts have surface irregularities such as keys, key ways or set screws. Some satisfactory methods of guarding are:
1. Covering the machine and associated rotating parts with structural or decorative parts of the driven equipment.
 2. Providing covers for the rotating parts. Covers should be sufficiently rigid to maintain adequate guarding during normal service.

Power Connection Motor and control wiring, overload protection, disconnects, accessories and grounding should conform to the National Electrical Code and local codes and practices.

For ExnA hazardous location motors, it is a specific condition of use that all terminations in a conduit box be fully insulated. Flying leads must be insulated with two full wraps of electrical grade insulating tape or heat shrink tubing.

Grounding In the USA consult the National Electrical Code, Article 430 for information on grounding of motors and generators, and Article 250 for general information on grounding. In making the ground connection, the installer should make certain that there is a solid and permanent metallic connection between the ground point, the motor or generator terminal housing, and the motor or generator frame. In non-USA locations consult the appropriate national or local code applicable.

Motors with resilient cushion rings usually must be provided with a bonding conductor across the resilient member. Some motors are supplied with the bonding conductor on the concealed side of the cushion ring to protect the bond from damage. Motors with bonded cushion rings should usually be grounded at the time of installation in accordance with the above recommendations for making ground connections. When motors with bonded cushion rings are used in multimotor installations employing group fusing or group protection, the bonding of the cushion ring should be checked to determine that it is adequate for the rating of the branch circuit over current protective device being used.

There are applications where grounding the exterior parts of a motor or generator may result in greater hazard by increasing the possibility of a person in the area simultaneously contacting ground and some other nearby live electrical parts of other ungrounded electrical equipment. In portable equipment it is difficult to be sure that a positive ground connection is maintained as the equipment is moved, and providing a grounding conductor may lead to a false sense of security.

Select a motor starter and over current protection suitable for this motor and its application. Consult motor starter application data as well as the National Electric Code and/or other applicable local codes.

For motors installed in compliance with IEC requirements, the following minimum cross sectional area of the protective conductors should be used:

Cross-sectional area of phase conductors, S	Minimum cross-sectional area of the corresponding protective conductor, S_p
mm^2	mm^2
$S < 16$	S
$16 < S \leq 35$	16
$S > 35$	$0.5 S$

Equipotential bonding connection shall made using a conductor with a cross-sectional area of at least 4 mm^2 .

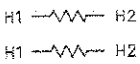
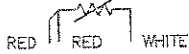
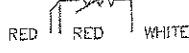
Conduit Box For ease of making connections, an oversize conduit box is provided. Most conduit boxes can be rotated 360° in 90° increments. Auxiliary conduit boxes are provided on some motors for accessories such as space heaters, RTD's etc.

AC Power Motors with flying lead construction must be properly terminated and insulated. Connect the motor leads as shown on the connection diagram located on the name plate or inside the cover on the conduit box. Be sure the following guidelines are met:

1. AC power is within $\pm 10\%$ of rated voltage with rated frequency. (See motor name plate for ratings).
OR
2. AC power is within $\pm 5\%$ of rated frequency with rated voltage.
OR
3. A combined variation in voltage and frequency of $\pm 10\%$ (sum of absolute values) of rated values, provided the frequency variation does not exceed $\pm 5\%$ of rated frequency.

Performance within these voltage and frequency variations are shown in Figure 2-4.

Figure 2-3 Accessory Connections

HEATERS 	One heater is installed in each end of motor. Leads for each heater are labeled H1 & H2. (Like numbers should be tied together).
THERMISTORS 	Three thermistors are installed in windings and tied in series. Leads are labeled TD1 & TD2.
WINDING RTDS 	Winding RTDs are installed in windings (2) per phase. Each set of leads is labeled 1TD1, 1TD2, 1TD3, 2TD1, 2TD2, 2TD3 etc.
BEARING RTD 	* One bearing RTD is installed in Drive endplate (PUEP), leads are labeled RTDDE. * One bearing RTD is installed in Opposite Drive endplate (FREP), leads are labeled RTDODE. * Note RTD may have 2-Red/1-White leads; or 2-White/1-Red Lead.

Rotation All three phase motors are reversible. To reverse the direction of rotation, disconnect and lock out power and interchange any two of the three line leads for three phase motors. For single phase motors, check the connection diagram to determine if the motor is reversible and follow the connection instructions for lead numbers to be interchanged. Not all single phase motors are reversible.

Adjustable Frequency Power Inverters used to supply adjustable frequency power to induction motors produce wave forms with lower order harmonics with voltage spikes superimposed. Turn-to-turn, phase-to-phase, and ground insulation of stator windings are subject to the resulting dielectric stresses. Suitable precautions should be taken in the design of these drive systems to minimize the magnitude of these voltage spikes. Consult the drive instructions for maximum acceptable motor lead lengths, and proper grounding.

Note: Main power leads for CE Marked Motors may be marked U,V,W – for standard configurations, please consult connection diagrams.

Connection Diagrams

AC Motor Connection Diagram

IEC VERSUS NEMA LEAD MARKING

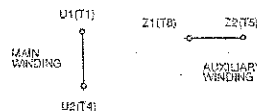
EXAMPLE COMPARISONS OF IEC AND NEMA LEADING MARKINGS FOR COMMON CONNECTION TYPES ARE SHOWN BELOW.

SINGLE PHASE MOTORS

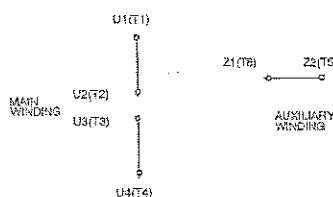
SINGLE VOLTAGE NON REVERSIBLE



SINGLE VOLTAGE REVERSIBLE



DUAL VOLTAGE REVERSIBLE



AC Motor Connection Diagram

THREE PHASE

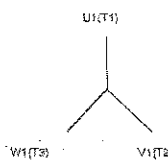
FOR SINGLE WINDING 3 PHASE MOTORS, LEAD MARKINGS CAN BE DIRECTLY TRANSLATED BETWEEN IEC AND NEMA DESIGNATIONS. FOR THESE MOTORS, THE LEAD MARKINGS ARE EQUIVALENT AS FOLLOWS:

U1=T1 U2=T4 U5=T7 U6=T10
V1=T2 V2=T5 V8=T9 V9=T11
W1=T3 V3=T6 V6=T8 W6=T12

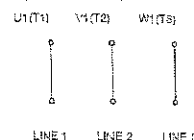
EXAMPLES OF COMMON CONNECTIONS ARE GIVEN BELOW.

THREE LEADS

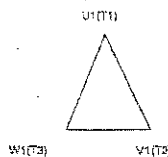
WYE CONNECT



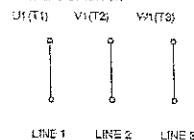
WIRING DIAGRAM



DELTA CONNECT



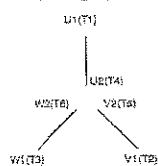
WIRING DIAGRAM



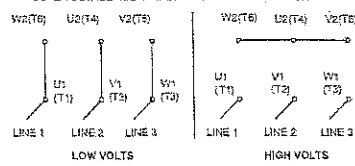
AC Motor Connection Diagram

SIX LEADS

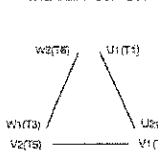
DELTA-WYE CONNECT



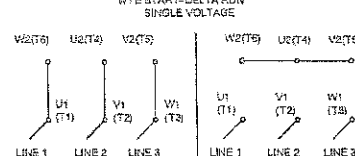
DUAL VOLTAGE-HIGH TO LOW VOLTAGE RATIO 1.73:1



WYE-DELTA CONNECT



WYE START-DELTA RUN SINGLE VOLTAGE

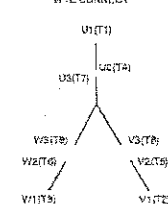


AC Motor Connection Diagram

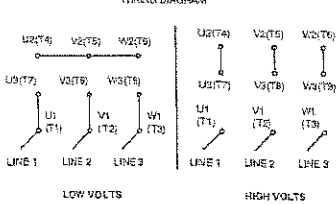
NINE LEADS

DUAL VOLTAGE-HIGH TO LOW VOLTAGE RATIO 2:1

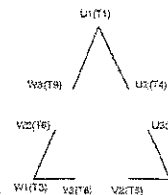
WYE CONNECT



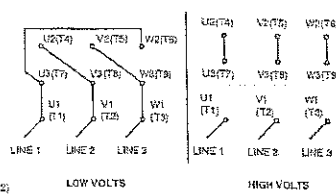
WIRING DIAGRAM



DELTA CONNECT



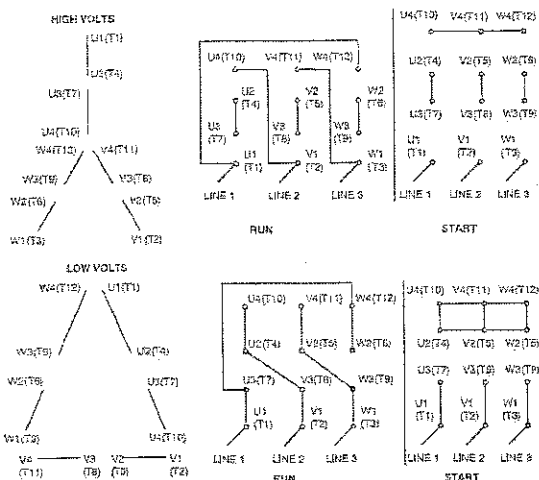
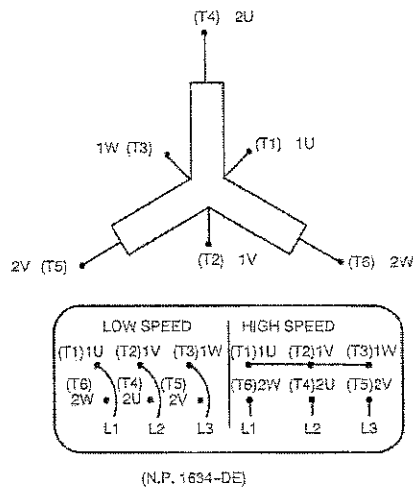
WIRING DIAGRAM



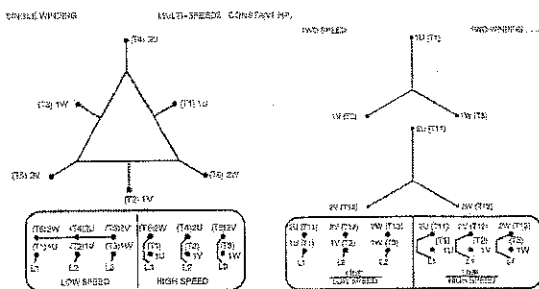
Connection Diagrams Continued
AC Motor Connection Diagram

TWELVE LEADS

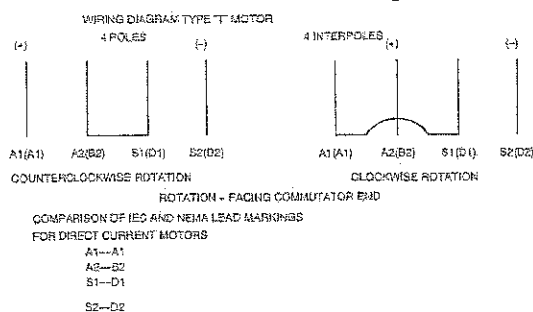
DUAL VOLTAGE WYE START - DELTA - RUN

AC Motor Connection Diagram
SINGLE WINDING MULTI-SPEEDS CONSTANT TORQUE

AC Motor Connection Diagram



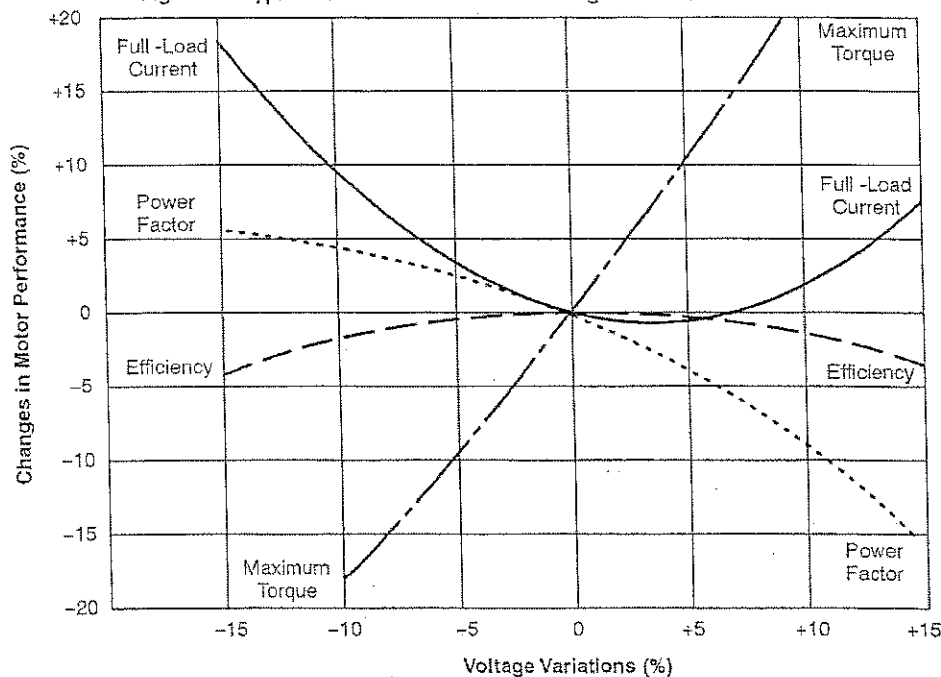
DC Motor Connection Diagram



MOTOR WINDING THERMOSTATS		
CONTACTS	°C	
FIGURE NUMBER		
CONTACT RATING		
VOLTS	CONTINUOUS AMPERES	INRUSH AMPERES
110 - 120	3.0	30
220 - 240	1.5	15
440 - 480	0.75	7.5
550 - 600	0.60	6.0

THERMOSTATS	
NORMALLY CLOSED	NORMALLY OPEN
FIGURE 1 	FIGURE 4
FIGURE 2 	FIGURE 5
FIGURE 3 	FIGURE 6

Figure 2-4 Typical Motor Performance VS Voltage Variations



Initial Lubrication Baldor-Reliance motors are shipped from the factory with the bearings properly packed with grease and ready to operate. Where the unit has been subjected to extended storage (6 months or more) the bearings should be relubricated (regreasable type) prior to starting. When motors are equipped for oil mist lubrication refer to the instruction manual for installation, operation, and maintenance of oil mist lubrication systems.

First Time Start Up Be sure that all power to motor and accessories is off. Be sure the motor shaft is disconnected from the load and will not cause mechanical rotation of the motor shaft.

1. Make sure that the mechanical installation is secure. All bolts and nuts are tightened etc.
2. If motor has been in storage or idle for some time, check winding insulation integrity.
3. Inspect all electrical connections for proper termination, clearance, mechanical strength and electrical continuity.
4. Be sure all shipping materials and braces (if used) are removed from motor shaft.
5. Manually rotate the motor shaft to ensure that it rotates freely.
6. Replace all panels and covers that were removed during installation.
7. Momentarily apply power and check the direction of rotation of the motor shaft.
8. If motor rotation is wrong, be sure power is off and change the motor lead connections. Verify rotation direction before you continue.
9. Start the motor and ensure operation is smooth without excessive vibration or noise. If so, run the motor for 1 hour with no load connected.
10. After 1 hour of operation, disconnect power and connect the load to the motor shaft. Verify all coupling guards and protective devices are installed. Ensure motor is properly ventilated.
11. If motor is totally enclosed fan-cooled or non-ventilated it is recommended that condensation drain plugs, if present, be removed. These are located in the lower portion of the end-shields. Totally enclosed fan-cooled "XT" motors are normally equipped with automatic drains which may be left in place as received.

Coupled Start Up This procedure assumes a coupled start up. Also, that the first time start up procedure was successful.

1. Check the coupling and ensure that all guards and protective devices are installed.
 2. Check that the coupling is properly aligned and not binding.
 3. The first coupled start up should be with no load. Apply power and verify that the load is not transmitting excessive vibration back to the motor through the coupling or the foundation. Vibration should be at an acceptable level.
 4. Run for approximately 1 hour with the driven equipment in an unloaded condition.
- The equipment can now be loaded and operated within specified limits. Do not exceed the name plate ratings for amperes for steady continuous loads.

Jogging and Repeated Starts Repeated starts and/or jogs of induction motors generally reduce the life of the motor winding insulation. A much greater amount of heat is produced by each acceleration or jog than by the same motor under full load. If it is necessary to repeatedly start or jog the motor, it is advisable to check the application with your local Baldor distributor or Baldor Service Center.

Heating - Duty rating and maximum ambient temperature are stated on the motor name plate. Do not exceed these values. If there is any question regarding safe operation, contact your local Baldor distributor or Baldor Service Center.

Hazardous Locations

Hazardous locations are those where there is a risk of ignition or explosion due to the presence of combustible gases, vapors, dust, fibers or flyings.

Selection Facilities requiring special equipment for hazardous locations are typically classified in accordance with local requirements. In the US market, guidance is provided by the National Electric Code. In international hazardous location areas, guidance for gas / vapor / mist classification is given in IEC60079-14, or for dust in IEC61241-14. This classification process lets the installer know what equipment is suitable for installation in that environment, and identifies what the maximum safe temperature or temperature class is required. It is the customer or users responsibility to determine the area classification and select proper equipment.

Areas are classified with respect to risk and exposure to the hazard. In the US market, areas are typically classified as follows Class, Division, Group and Temperature Class. In some newer installations in the US and in most international markets, areas are classified in Zones.

Protection Concepts

Class I Division 1 / Zone 1 [Equipment Group I (mining) or II (surface), Equipment Protection Level (EPL) Gb, Mb]

Baldor offers a range of motors suitable for installation in a Division 1 or Zone 1 environment. These motors are known as explosion proof or flameproof. (Insert flameproof motor cut away drawing)

Motors that are explosion proof or flameproof use specially machined flameproof joints between the end bell or bracket and the frame, as well as along the rotating shaft and at connection box covers and entries. The fit of these flameproof joints are designed to contain the combustion or quench the flame of an explosive gas atmosphere prior to it exiting the motor. These flameproof joints have lengths and widths selected and tested based on the gas group present in the atmosphere. Baldor-Reliance motors are typically designed to meet Class I (Division 1) Group C and D (explosion proof) or Ex d IIB (flameproof).

An application note regarding equipment applied in accordance with the US National Electric Code (NFPA 70-2008) - according to Article 500.8(C) Marking, sub clause (2) in the fine print note, it is noted that Equipment not marked to indicate a division is suitable for both Division 1 and Division 2 locations. These motors are not gas tight. To the contrary, this protection concept assumes that due to the normal heating and cooling cycle of motor operation that any gas present will be drawn into the motor. Since flameproof or explosion proof motors are designed to contain the combustion and extinguish any flame transmission, for this protection concept, only external surface temperatures are of concern. Thermal limiting devices such as thermostats, thermistors or RTDs may be provided on these motors to limit the external surface temperature during overload conditions.

If thermostats are provided as a condition of certification, it is the installer's responsibility to make sure that these devices are properly connected to a suitable switching device. The ATEX directive requires that motor shutdown on thermal trip be accomplished without an intermediate software command.

Flameproof motors, internationally referred to as Ex d use a protection concept similar to that used in Class I Division 1 motors, with minor differences in the flameproof joints and cable entry designs. Flameproof and explosion proof motors are both type tested. Representative motors are connected to a reference gas and ignited in laboratory conditions to verify that the flame is not transmitted outside the motor enclosure and to determine the maximum internal pressure encountered.

Explosion proof and Flame proof motors shipped without a conduit box require use of a certified box of suitable dimensions and that is appropriate for the classification.

Class I Division 2 / Zone 2 Ex nA, [Equipment Protection Level (EPL) Gc]

This protection concept relies on having no sources of ignition present such as arcing parts or hot surfaces. For this protection concept, internal temperatures as well as external temperatures are considered. In many cases, the internal temperatures are higher than the external temperatures and therefore become the limiting factor in determination of temperature code designation. In these applications, it is very important to use a motor that has been evaluated thermally for use with an inverter or converter, if variable speed operation is desired. Thermostats used for Class I Division 2 and Ex nA motors are used to protect the motor only. For motors using flying lead construction, it is important to use connection lugs and insulate with heat shrink tubing or a double wrap of insulation grade electrical tape to avoid the risk of spark or ignition.

Class II Division 1 / Zone 21 [Equipment Group III, Equipment Protection Level (EPL) Db]

This area classification is one where the risk of ignitable concentrations of dust is present at all or some of the time. The protection concepts used for Class II Division 1 is similar to flameproof, except with additional dust exclusion paths designed for the rotating shaft. In the international designations, this concept is referred to as dust ignition proof or Ex tD. External surface temperature remains the limiting factor. Thermal limiting devices such as thermostats, thermistors or RTDs may be provided on these motors to limit the external surface temperature during overload conditions. If thermostats are provided as a condition of certification, it is the installer's responsibility to make sure that these devices are properly connected to a suitable switching device.

Note: In the North American area classification system, Class III exists for fibers and flyings.

In the IEC designation, both dusts and flyings are absorbed into Group III.

Class II Division 2 / Zone 22 [Equipment Group III, Equipment Protection Level (EPL) Dc]

This area classification is one where the risk of exposure to ignitable concentrations of dust are not likely to occur under normal operating conditions and relies heavily on the housekeeping practices within the installation.

Sine Wave Power Operation for Division 1 or 2 and Zone 1 or 2 and Zone 21 or 22 Hazardous Location.

These motors are designed to operate at or below the maximum surface temperature (or T-Code) stated on the nameplate. Failure to operate the motor properly can cause this maximum surface temperature to be exceeded. If applied in a Division 1 or 2 / Zone 1 or 2 and Zone 21 or 22 environment, this excessive temperature may cause ignition of hazardous materials. Operating the motor at any of the following conditions can cause the marked surface temperature to be exceeded.

1. Motor load exceeding service factor nameplate value
2. Ambient temperatures above nameplate value
3. Voltages above or below nameplate value
4. Unbalanced voltages
5. Loss of proper ventilation
6. Altitude above 3300 feet / 1000 meters
7. Severe duty cycles of repeated starts
8. Motor stall
9. Motor reversing
10. Single phase operation of polyphase equipment
11. Variable frequency operation

Variable Frequency Power Operation for Division 1 or 2 and Zone 1 or 2 and Zone 21 or 22

Hazardous Location (motors with maximum surface temperature listed on the nameplate).

Only motors with nameplates marked for use on inverter (variable frequency) power, and labeled for specific hazardous areas may be used in those hazardous areas on inverter power. The motor is designed to operate at or below the maximum surface temperature (or T-Code) stated on the nameplate. Failure to operate the motor properly can cause this maximum surface temperature to be exceeded.

If applied in a Division 1 or 2 / Zone 1 or 2 and Zone 21 or 22 environment, this excessive temperature may cause ignition of hazardous materials. Operating the motor at any of the following conditions can cause the marked surface temperature to be exceeded.

1. Motor load exceeding service factor nameplate value
2. Ambient temperature above nameplate value
3. Voltage (at each operating frequency) above or below rated nameplate value
4. Unbalanced voltages
5. Loss of proper ventilation
6. Operation outside of the nameplate speed / frequency range
7. Altitudes above 3300 feet / 1000 meters
8. Single phase operation of polyphase equipment
9. Unstable current wave forms
10. Lower than name plate minimum carrier frequency

Thermal Limiting

Thermal limiting devices are temperature sensing control components installed inside the motor to limit the internal temperature of the motor frame by interrupting the circuit of the holding coil of the magnetic switch or contactor. They are required for most Division 1 and Zone 1 applications. For Division 2 or Zone 2 applications, motors should be selected that preclude running temperatures from exceeding the ignition temperatures for the designated hazardous material. In Division 2 or Zone 2 classified locations, thermal limiting devices should only be used for winding protection and not considered for limiting all internal motor temperatures to specific ignition temperatures.

Equipotential Bonding and Shaft Current Reduction

Larger motors (ie WP construction) may require proper bonding between motor enclosures and covers to avoid the risk of stray currents during start up. Fastening methods and bonding straps must not be modified. Bearing currents can exist in some motors for both line-fed and inverter-fed applications. Larger line-fed motors may require at least one insulated bearing to prevent a flow of current through the bearings. Do not defeat such insulation whether the motor is line-fed or inverter-fed applications. Inverter-fed motors may require additional bearing insulation or even a shaft brush. Do not defeat such features. When the motor and the coupled load are not on a common conductive baseplate, it may also be necessary to electrically bond together the stationary parts of the motor and the coupled equipment.

Repair of Motors used in Hazardous Locations

Repair of hazardous certified motors requires additional information, skill, and care. It is the customer's responsibility to select service shops with proper qualifications to repair hazardous location motors. Contact the manufacture for additional repair details. Use only original manufacturer's parts.

Repair of Explosion Proof or Flame Proof Motors Class I Division 1 and Zone 1

In the North American market, recertification programs are offered by Underwriters Laboratories and Canadian Standards Association which allow authorized service shops to mark the rebuilt motors as certified. In the international markets using IEC based requirements, repair should be undertaken only after consulting IEC60079-19 Explosive Atmospheres-Part 19 Equipment repair, overhaul and reclamation. If use of a certified repair facility is desired, consult the IECEx Repair Scheme at

http://www.iecex.com/service_facilities.htm

Explosion proof and flameproof motors achieve their safety based on the mechanical construction - flameproof joints and bearing clearance, and the electrical design including any thermal limiting devices. If it is necessary to repair a flameproof or explosion proof motor, it is critical that the mechanical flameproof joints be maintained. Consult Baldor Electric Company for flameproof joint construction details. Use only Baldor-Reliance supplied parts. Baldor does not recommend reclamation of parts. Since this protection method also relies on temperature being maintained, make sure that any rewinding uses the original electrical designs, including any thermal protection that may be present.

Repair of Dust Ignition Proof Motors - Class II Division 1 and 2, Zone 21 and 22.

For Dust Ignition Proof, proper sealing is required. Do not modify the motor construction to add any additional opening, and ensure that proper sealing is maintained in the connection box and at the shaft seal. Since this protection method also relies on temperature being maintained, make sure that any rewinding uses the original electrical designs, including any thermal protection that may be present.

Repair of Class I Division 2 and Zone 2 motors

For Division 2 and Zone 2, the internal and external temperatures are of concern. Since this protection method also relies on temperature being maintained, make sure that any rewinding uses the original electrical designs, including any thermal protection that may be present. Use only Baldor replacement thermostats, if provided.

Section 3 Maintenance & Troubleshooting

WARNING: UL and EX Listed motors must only be serviced by UL or EX Approved Authorized Baldor Service Centers if these motors are to be returned to a hazardous and/or explosive atmosphere.

General Inspection Inspect the motor at regular intervals, approximately every 500 hours of operation or every 3 months, whichever occurs first. Keep the motor clean and the ventilation openings clear. The following steps should be performed at each inspection:

WARNING: Do not touch electrical connections before you first ensure that power has been disconnected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the installation, operation and maintenance of this equipment.

1. Check that the motor is clean. Check that the interior and exterior of the motor is free of dirt, oil, grease, water, etc. Oily vapor, paper pulp, textile lint, etc. can accumulate and block motor ventilation. If the motor is not properly ventilated, overheating can occur and cause early motor failure.
2. Perform a dielectric with stand test periodically to ensure that the integrity of the winding insulation has been maintained. Record the readings. Immediately investigate any significant decrease in insulation resistance.
3. Check all electrical connectors to be sure that they are tight.

Relubrication & Bearings Bearing grease will lose its lubricating ability over time, not suddenly. The lubricating ability of a grease (over time) depends primarily on the type of grease, the size of the bearing, the speed at which the bearing operates and the severity of the operating conditions. Good results can be obtained if the following recommendations are used in your maintenance program.

Type of Grease A high grade ball or roller bearing grease should be used. Recommended grease for standard service conditions is **Polyrex EM (Exxon Mobil)**. Do not mix greases unless compatibility has been checked and verified.

Ball Bearing Motors

Operating Temperature -25°C (-15°F) to 50°C (120°F)	
EXXON	POLYREX EM (Standard on Baldor motors)
EXXON	UNIREX N2
EXXON	BEACON 325
CHEVRON OIL	SRI NO. 2 (Compatible with Polyrex EM)
CHEVRON OIL	BLACK PEARL
TEXACO, INC.	PREMIUM RB
TEXACO, INC.	POLYSTAR
AMOCO	RYKON # 2
PENNZOIL	PENNZLUBE EM-2
DARMEX	DARMEX 707
DARMEX	DARMEX 711
PETRO-CANADA	PEERLESS LLG
SHELL OIL	DOLIUM BRB
Minimum Starting Temperature -60°C (-76°F)	
SHELL OIL CO.	AEROSHELL 7 (Standard on Baldor motors)
MOBIL	MOBIL 28
MOBIL	MOBILITH SHC 100 (Low Temperature - Arctic Duty)

Roller Bearing Motors

Operating Temperature -25°C (-15°F) to 50°C (120°F)	
TEXACO, INC.	PREMIUM RB
MOBIL	MOBILITH SHC 220 (Standard on Baldor motors)
CHEVRON OIL	BLACK PEARL

Relubrication Intervals Recommended relubrication intervals are shown in Table 3-2. It is important to realize that the recommended intervals of Table 3-2 are based on average use.

Refer to additional information contained in Tables 3-3, 3-4 and 3-5.

Table 3-2 Relubrication Intervals *

NEMA / (IEC) Frame Size	Rated Speed - RPM					
	10000	6000	3600	1800	1200	900
Up to 210 incl. (132)	**	2700 Hrs.	5500 Hrs.	12000 Hrs.	18000 Hrs.	22000 Hrs.
Over 210 to 280 incl. (180)		**	3600 Hrs.	9500 Hrs.	15000 Hrs.	18000 Hrs.
Over 280 to 360 incl. (225)		**	* 2200 Hrs.	7400 Hrs.	12000 Hrs.	15000 Hrs.
Over 360 to 449 incl. (315)		**	*2200 Hrs.	3500 Hrs.	7400 Hrs.	10500 Hrs.

- * Relubrication intervals are for ball bearings.
For vertically mounted motors and roller bearings, divide the relubrication interval by 2.
- ** For motors operating at speeds greater than 3600 RPM, contact Baldor for relubrication recommendations.

Table 3-3 Service Conditions

Severity of Service	Hours per day of Operation	Ambient Temperature Maximum	Atmospheric Contamination
Standard	8	40° C	Clean, Little Corrosion
Severe	16 Plus	50° C	Moderate dirt, Corrosion
Extreme	16 Plus	>50° C* or Class H Insulation	Severe dirt, Abrasive dust, Corrosion, Heavy Shock or Vibration
Low Temperature		<-29° C **	

- * Special high temperature grease is recommended (Dow Corning DC44). Note that Dow Corning DC44 grease does not mix with other grease types. Thoroughly clean bearing & cavity before adding grease.
- ** Special low temperature grease is recommended (Aeroshell 7).

Table 3-4 Relubrication Interval Multiplier

Severity of Service	Multiplier
Standard	1.0
Severe	0.5
Extreme	0.1
Low Temperature	1.0

Some motor designs use different bearings on each motor end. This is normally indicated on the motor nameplate. In this case, the larger bearing is installed on the motor Drive endplate. For best relubrication results, only use the appropriate amount of grease for each bearing size (not the same for both).

Table 3-5 Bearings Sizes and Types

Frame Size NEMA (IEC)	Bearing Description (These are the "Large" bearings (Shaft End) in each frame size)			
	Bearing	Weight of Grease to add * oz (Grams)	Volume of grease to be added	
			in ³	teaspoon
56 to 140 (90)	6203	0.08 (2.4)	0.15	0.5
140 (90)	6205	0.15 (3.9)	0.2	0.8
180 (100-112)	6206	0.19 (5.0)	0.3	1.0
210 (132)	6307	0.30 (8.4)	0.6	2.0
250 (160)	6309	0.47 (12.5)	0.7	2.5
280 (180)	6311	0.61 (17)	1.2	3.9
320 (200)	6312	0.76 (20.1)	1.2	4.0
360 (225)	6313	0.81 (23)	1.5	5.2
400 (250)	6316	1.25 (33)	2.0	6.6
440 (280)	6319	2.12 (60)	4.1	13.4
5000 to 5800 (315-450)	6328	4.70 (130)	9.2	30.0
5000 to 5800 (315-450)	NU328	4.70 (130)	9.2	30.0
360 to 449 (225-280)	NU319	2.12 (60)	4.1	13.4
AC Induction Servo				
76 Frame 180 (112)	6207	0.22 (6.1)	0.44	1.4
77 Frame 210 (132)	6210	0.32 (9.0)	0.64	2.1
80 Frame 250(160)	6213	0.49 (14.0)	0.99	3.3

* Weight in grams = .005 DB of grease to be added

Note: Not all bearing sizes are listed.

For intermediate bearing sizes, use the grease volume for the next larger size bearing.

Caution: To avoid damage to motor bearings, grease must be kept free of dirt. For an extremely dirty environment, contact your Baldor distributor or an authorized Baldor Service Center for additional information.

Relubrication Procedure Be sure that the grease you are adding to the motor is compatible with the grease already in the motor. Consult your Baldor distributor or an authorized service center if a grease other than the recommended type is to be used.

Caution: Do not over-lubricate motor as this may cause premature bearing failure.

With Grease Outlet Plug

1. With the motor stopped, clean all grease fittings with a clean cloth.
2. Remove grease outlet plug.

Caution: Over-lubricating can cause excessive bearing temperatures, premature lubrication breakdown and bearing failure.

3. Add the recommended amount of grease.
4. Operate the motor for 15 minutes with grease plug removed.
This allows excess grease to purge.
5. Re-install grease outlet plug.

Without Grease Provisions

Note: Only a Baldor authorized and UL or CSA certified service center can disassemble a UL/CSA listed explosion proof motor to maintain it's UL/CSA listing.

1. Disassemble the motor.
2. Add recommended amount of grease to bearing and bearing cavity. (Bearing should be about 1/3 full of grease and outboard bearing cavity should be about 1/2 full of grease.)
3. Assemble the motor.

Sample Relubrication Determination

Assume - NEMA 286T (IEC 180), 1750 RPM motor driving an exhaust fan in an ambient temperature of 43° C and the atmosphere is moderately corrosive.

1. Table 3-2 list 9500 hours for standard conditions.
2. Table 3-3 classifies severity of service as "Severe".
3. Table 3-5 shows that 1.2 in³ or 3.9 teaspoon of grease is to be added.

Note: Smaller bearings in size category may require reduced amounts of grease.

Table 3-6 Troubleshooting Chart

Symptom	Possible Causes	Possible Solutions
Motor will not start	Usually caused by line trouble, such as, single phasing at the starter.	Check source of power. Check overloads, fuses, controls, etc.
Excessive humming	High Voltage.	Check input line connections.
	Eccentric air gap.	Have motor serviced at local Baldor service center.
Motor Over Heating	Overload. Compare actual amps (measured) with nameplate rating.	Locate and remove source of excessive friction in motor or load. Reduce load or replace with motor of greater capacity.
	Single Phasing.	Check current at all phases (should be approximately equal) to isolate and correct the problem.
	Improper ventilation.	Check external cooling fan to be sure air is moving properly across cooling fins. Excessive dirt build-up on motor. Clean motor.
	Unbalanced voltage.	Check voltage at all phases (should be approximately equal) to isolate and correct the problem.
	Rotor rubbing on stator.	Check air gap clearance and bearings. Tighten "Thru Bolts".
	Over voltage or under voltage.	Check input voltage at each phase to motor.
	Open stator winding.	Check stator resistance at all three phases for balance.
	Grounded winding.	Perform dielectric test and repair as required.
	Improper connections.	Inspect all electrical connections for proper termination, clearance, mechanical strength and electrical continuity. Refer to motor lead connection diagram.
Bearing Over Heating	Misalignment.	Check and align motor and driven equipment.
	Excessive belt tension.	Reduce belt tension to proper point for load.
	Excessive end thrust.	Reduce the end thrust from driven machine.
	Excessive grease in bearing.	Remove grease until cavity is approximately $\frac{3}{4}$ filled.
	Insufficient grease in bearing.	Add grease until cavity is approximately $\frac{3}{4}$ filled.
	Dirt in bearing.	Clean bearing cavity and bearing. Repack with correct grease until cavity is approximately $\frac{3}{4}$ filled.
Vibration	Misalignment.	Check and align motor and driven equipment.
	Rubbing between rotating parts and stationary parts.	Isolate and eliminate cause of rubbing.
	Rotor out of balance.	Have rotor balance checked and repaired at your Baldor Service Center.
	Resonance.	Tune system or contact your Baldor Service Center for assistance.
Noise	Foreign material in air gap or ventilation openings.	Remove rotor and foreign material. Reinstall rotor. Check insulation integrity. Clean ventilation openings.
Growling or whining	Bad bearing.	Replace bearing. Clean all grease from cavity and new bearing. Repack with correct grease until cavity is approximately $\frac{3}{4}$ filled.

Suggested bearing and winding RTD setting guidelines for Non-Hazardous Locations ONLY

Most large frame AC Baldor motors with a 1.15 service factor are designed to operate below a Class B (80°C) temperature rise at rated load and are built with a Class H winding insulation system. Based on this low temperature rise, RTD (Resistance Temperature Detectors) settings for Class B rise should be used as a starting point. Some motors with 1.0 service factor have Class F temperature rise.

The following tables show the suggested alarm and trip settings for RTDs. Proper bearing and winding RTD alarm and trip settings should be selected based on these tables unless otherwise specified for specific applications.

If the driven load is found to operate well below the initial temperature settings under normal conditions, the alarm and trip settings may be reduced so that an abnormal machine load will be identified.

The temperature limits are based on the installation of the winding RTDs imbedded in the winding as specified by NEMA. Bearing RTDs should be installed so they are in contact with the outer race on ball or roller bearings or in direct contact with the sleeve bearing shell.

Winding RTDs – Temperature Limit In °C (40°C Maximum Ambient)

Motor Load	Class B Temp Rise ≤ 80°C (Typical Design)		Class F Temp Rise ≤ 105°C		Class H Temp Rise ≤ 125°C	
	Alarm	Trip	Alarm	Trip	Alarm	Trip
≤ Rated Load	130	140	155	165	175	185
Rated Load to 1.15 S.F.	140	150	160	165	180	185

Note: • Winding RTDs are factory production installed, not from Mod-Express.

• When Class H temperatures are used, consider bearing temperatures and relubrication requirements.

Bearing RTDs – Temperature Limit In °C (40°C Maximum Ambient)

Bearing Type Oil or Grease	Anti-Friction		Sleeve	
	Alarm	Trip	Alarm	Trip
Standard*	95	100	85	95
High Temperature**	110	115	105	110

Note: * Bearing temperature limits are for standard design motors operating at Class B temperature rise.

** High temperature lubricants include some special synthetic oils and greases.

Greases that may be substituted that are compatible with Polyrex EM (but considered as "standard" lubricants)

include the following:

- Texaco Polystar
- Mobilith SHC-100
- Darmex 707
- Rykon Premium #2
- Pennzoil Pennzlube EM-2
- Darmex 711
- Chevron SRI #2
- Chevron Black Pearl
- Petro-Canada Peerless LLG

See the motor nameplate for replacement grease or oil recommendation.

Contact Baldor application engineering for special lubricants or further clarifications.

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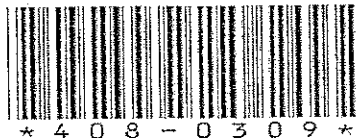
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AC & DC Motor Installation & Maintenance

Safety Notice Be sure to read and understand all of the Safety Notice statements in MN408. A copy is available at:
http://www.baldor.com/support/literature_load.asp?ManNumber=MN408

ACCEPTANCE

Thoroughly inspect this equipment before accepting shipment from the transportation company. If any damage or shortage is discovered do not accept until noted on the freight bill. Report all damage to the freight carrier.

SAFETY

Eye bolts, lifting lugs or lifting openings, if provided, are intended only for lifting the motor and motor mounted standard accessories not exceeding, in total 30% of the motor weight. These lifting provisions should never be used when lifting or handling the motor and driven equipment. Eye bolt lifting capacity rating is based on a lifting alignment coincident with eye bolt center line. Eye bolt capacity reduces as deviation from this alignment is increased. Be sure eye bolts are tight and prevented from turning before lifting.

INSTALLATION OUTSIDE THE USA:

Refer to MN408 and MN1383 for Compliance with European Directives. Copies are available at:

http://www.baldor.com/support/literature_load.asp

MOTOR ENCLOSURE

ODP, Open drip proof motors are intended for use in clean, dry locations with adequate supply of cooling air. These motors should not be used in the presence of flammable or combustible materials. Open motors can emit flame and/or molten metal in the event of insulation failure.

TEFC, totally enclosed motors are intended for use where moisture, dirt and/or corrosive materials are present in indoor and outdoor locations.

Explosion protected motors, as indicated by a Nationally Recognized Testing Laboratory Certification mark and marking with Class, Division and Temperature Code are intended for installation in hazardous locations as described in Article 500 of the NEC. Refer to MN408 for more details.

MOUNTING

Foot mounted machines should be mounted to a rigid foundation to prevent excessive vibration. Shims may be used if location is uneven.

Flange mounted machines should be properly seated and aligned. Note: If improper rotation direction is detrimental to the load, check rotation direction prior to coupling the load to the motor shaft.

For V-belt drive, mount the sheave pulley close to the motor housing. Allow clearance for end to end movement of the motor shaft. Do not overtighten belts as this may cause premature bearing failure or shaft breakage.

Direct coupled machines should be carefully aligned and the shaft should rotate freely without binding.

GENERAL

The user must select a motor starter and overcurrent protection suitable for this motor and its application. Consult motor starter application data as well as the National Electric Code and/or applicable local codes. Special motors for use by United States Government including special specifications, master plans, etc. refer to the applicable master plans and specifications involved.

On motors received from the factory with the shaft blocked, remove blocking before operating the motor. If motor is to be reshipped alone or installed to another piece of equipment, the shaft block must be installed to prevent axial movement and prevent brinelling of the bearings during shipment.

TESTING

If the motor has been in storage for an extensive period or has been subjected to adverse moisture conditions, check the motor insulation resistance with a meg ohm meter. Depending on storage conditions it may be necessary to regrease or change rusted bearings. Contact Baldor District Office if resistance is less than 5 meg ohms.

WARNING: Do not touch electrical connections before you first ensure that power has been disconnected. Electrical shock can cause serious or fatal injury.

WARNING: Be sure the system is properly grounded before applying power. Electrical shock can cause serious or fatal injury.

INSTALLATION

This motor must be installed in accordance with National Electric Code, NEMA MG-2, IEC standards and local codes.

WIRING

Connect the motor as shown in the connection diagrams. If this motor is installed as part of a motor control drive system, connect and protect the motor according to the control manufacturers diagrams. Refer to MN408 for additional details on lead marking. The wiring, fusing and grounding must comply with the National Electrical Code or IEC and local codes. When the motor is connected to the load for proper direction of rotation and started, it should start quickly and run smoothly. If not, stop the motor immediately and determine the cause. Possible causes are: low voltage at the motor, motor connections are not correct or the load is too heavy. Check the motor current after a few minutes of operation and compare the measured current with the nameplate rating.

GROUNDING

Ground the motor according to NEC and local codes. In the USA consult the National Electrical Code, Article 430 for information on grounding of motors and generators, and Article 250 for general information on grounding. In making the ground connection, the installer should make certain that there is a solid and permanent metallic connection between the ground point, the motor or generator terminal housing, and the motor or generator frame. In non-USA locations consult the appropriate national or local code applicable.

ADJUSTMENT

The neutral is adjustable on some DC motors. AC motors have no adjustable parts.

Noise

For specific sound power or pressure level information, contact your local Baldor representative.

VIBRATION

This motor is balanced to NEMA MG1, Part 7 standard.

BRUSHES (DC Motors)

Periodically, the brushes should be inspected and all brush dust blown out of the motor. If a brush is worn $1/2$, (length specified in renewal parts data), replace the brushes. Reassemble and seat the new brushes using a brush seating stone. Be sure the rocker arm is set on the neutral mark.

WARNING: Guards must be installed for rotating parts such as couplings, pulleys, external fans, and unused shaft extensions, should be permanently guarded to prevent accidental contact by personnel. Accidental contact with body parts or clothing can cause serious or fatal injury.

INSPECTION

Before connecting the motor to an electrical supply, inspect for any damage resulting from shipment. Turn the shaft by hand to ensure free rotation. Motor leads must be isolated before the shaft will turn freely on permanent magnet motors.

DRAIN PLUGS

Condensation drain plugs are provided at four points on each endplate for various motor mounting configurations. For Washdown and totally enclosed, fan cooled or non-ventilated motors, the plugs in the lowest portion of the ends shields should be removed for operation (unless the motor has special stainless steel drains). All drains are located in the lowest portion of the ends shields.

MOUNTING

Mount the motor on a foundation sufficiently rigid to prevent excessive vibration. Grease lubricated ball bearing motors may be mounted with the feet at any angle. After careful alignment, bolt motor securely in place. Use shim to fill any unevenness in the foundation. Motor feet should sit solidly on the foundation before mounting bolts are tightened.

IP (Ingress Protection)

IP designations include two numerals, the first characteristic numeral is for ingress solid bodies and from dust. The second for ingress protection from liquid - water. Motors marked less than IP23 require additional protection from water.

GUARDING

After motor installation is complete, a guard of suitable dimensions must be constructed and installed around the motor/gearmotor. This guard must prevent personnel from coming in contact with any moving parts of the motor or drive assembly but must allow sufficient cooling air to pass over the motor.

If a motor mounted brake is installed, provide proper safeguards for personnel in case of brake failure. Brush inspection plates and electrical connection cover plates or lids, must be installed before operating the motor.

STARTING

Before starting motor remove all unused shaft keys and loose rotating parts to prevent them from flying off. Check direction of rotation before coupling motor to load. The motor should start quickly and run smoothly and with little noise. If the motor should fail to start the load may be too great for the motor, the voltage is low or the motor has been miswired. In any case immediately shut motor off and investigate the cause.

ROTATION

To reverse the direction of rotation, disconnect and lockout power and interchange any two of the three AC power leads for three phase motors. For two-phase four wire, disconnect and lockout power and interchange the AC line leads on any one phase. For two phase three wire, disconnect and lockout power and interchange phase one and phase two AC line leads.

Maintenance Procedures

WARNING: Do not touch electrical connections before you first ensure that power has been disconnected. Electrical shock can cause serious or fatal injury.

WARNING: Surface temperatures of motor enclosures may reach temperatures which can cause discomfort or injury to personnel accidentally coming into contact with hot surfaces. Protection should be provided by the user to protect against accidental contact with hot surfaces. Failure to observe this precaution could result in bodily injury.

Lubrication Information

This is a ball or roller bearing motor. The bearings have been lubricated at the factory. Motors that do not have regrease capability are factory lubricated for the normal life of the bearings. Washdown motors can not be lubricated.

Lubricant

Baldor motors are pregreased, normally with Mobil Polyrex EM unless stated on nameplate. Do not mix lubricants due to possible incompatibility. Look for signs of lubricant incompatibility, such as extreme souppiness visible from the grease relief area. If other greases are preferred, check with local Baldor representative for recommendations.

Relubrication Intervals (For motors with regrease capability)

New motors that have been stored for a year or more should be relubricated. Lubrication is also recommended at these intervals.

LUBRICATION INSTRUCTIONS

Cleanliness is important in lubrication. Any grease used to lubricate anti friction bearings should be fresh and free from contamination. Properly clean the grease inlet area of the motor to prevent grease contamination.

1. Select service condition from Table 1.
2. Select lubrication frequency from Table 2.

LUBRICATION PROCEDURE

Bearings should be lubricated while stationary and the motor is warm.

1. Locate the grease inlet, clean the area, and replace the pipe plug with a grease fitting.
2. Locate and remove the grease drain plug, if provided.
3. Add the recommended volume of recommended lubricant until clean grease appears at the grease drain, at the grease relief, or along the shaft opening.
4. Replace the grease inlet plug and run the motor for two hours.
5. Replace the grease drain plug.

SPECIAL APPLICATIONS

For special temperature applications, consult your Baldor District Office.

Table 1 Service Conditions

Severity of Service	Ambient Temperature Maximum	Atmospheric Contamination	Type of Bearing
Standard	40° C	Clean, Little Corrosion	Deep Groove Ball Bearing
Severe	50° C	Moderate dirt, Corrosion	Ball Thrust, Roller
Extreme	>50° C* or Class H Insulation	Severe dirt, Abrasive dust, Corrosion	All Bearings
Low Temperature	<-30° C**		

* Special high temperature grease is recommended. ** Special low temperature grease is recommended.

Table 2 Lubrication Frequency (Ball Bearings)

NEMA / (IEC) Frame Size	Rated Speed - RPM					
	10000	6000	3600	1800	1200	900
Up to 210 incl. (132)	**	2700 Hrs.	5500 Hrs.	12000 Hrs.	18000 Hrs.	22000 Hrs.
Over 210 to 280 incl. (180)		**	3600 Hrs.	9500 Hrs.	15000 Hrs.	18000 Hrs.
Over 280 to 360 incl. (225)		**	* 2200 Hrs.	7400 Hrs.	12000 Hrs.	15000 Hrs.
Over 360 to 5000 incl. (300)		**	*2200 Hrs.	3500 Hrs.	7400 Hrs.	10500 Hrs.

* Relubrication intervals are for ball bearings. For vertically mounted motors and roller bearings, divide the relubrication interval by 2.

** For motors operating at speeds greater than 3600 RPM, contact Baldor for relubrication recommendations.

Table 3 Lubrication Interval Multiplier

Severity of Service	Multiplier
Standard	1.0
Severe	0.5
Extreme	0.1
Low Temperature	1.0

Table 4 Amount of Grease to Add

Frame Size NEMA (IEC)	Bearing Description (Largest bearing in each frame size)					
	Bearing	OD D mm	Width B mm	Weight of grease to add ounce (gram)	Volume of grease to add	
					inches ³	teaspoon
Up to 210 incl. (132)	6307	80	21	0.30 (8.4)	0.6	2.0
Over 210 to 280 incl. (180)	6311	120	29	0.61 (17.4)	1.2	3.9
Over 280 to 360 incl. (200)	6313	140	33	0.81 (23.1)	1.5	5.2
Over 360 to 5000 incl. (300)	NU322	240	50	2.12 (60.0)	4.1	13.4

Weight in grams = 0.005 DB

Typical IEC vs NEMA Lead Marking

Single Phase Non-Reversible

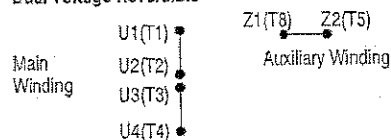
Refer to the connection diagram provided on the Baldor motor.



Single Phase Reversible



Dual Voltage Reversible



DC Motors

Lead markings can be translated between IEC and NEMA designations as follows:

	NEMA	IEC
Armature	A1, A2	A1, A2
Series Field	S2, S2	D1, D2
Shunt Field	F1, F2	E1, E2

Refer to the connection diagram provided on the Baldor motor.

Three Phase

For single winding 3 phase motors, lead markings can be directly translated between IEC and NEMA designations.

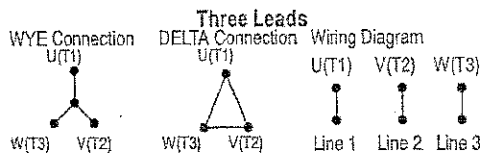
For these motors, the lead markings are:

U1=T1 U2=T4 U3=T7 U4=T10

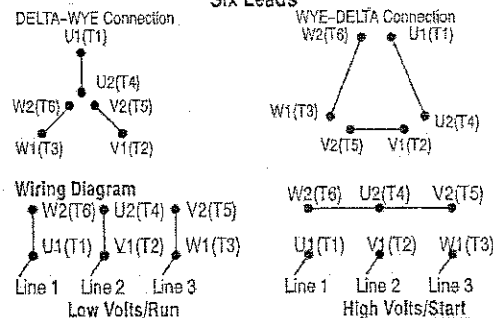
V1=T2 V2=T5 V3=T8 V4=T11

W1=T3 W2=T6 W3=T9 W4=T12

Refer to the connection diagram provided on the Baldor motor. Some examples are as follows:



Six Leads



BALDOR

World Headquarters

P.O. Box 2400 Fort Smith, AR 72902-2400 USA Ph: (1) 479.646.4711, Fax: (1) 479.648.5792

www.baldor.com

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3/10



Document Front Sheet

e-mail: cu.canada.doccontrol@spx.com
web: www.spx.com

> ClydeUnion Pumps

4151 North Service Road
Burlington
Ontario L7L 4X6
Canada

Page 1 of 3

Document Title: Performance Test Data & Curves
ClydeUnion Ref: A-K01
Client Reference: K01 (CC130189A-1 - 6x8x26 CUP-OH2 (Item No. P-436))
Contract: CC130189 (Spectrum Process Systems Inc)
Client PO No: 002020
Revision: 1 Reason: For approval
Comment:

Document History

Revision	Sent Date	Reason	From

FA: For Approval
FI: For Information
AB: As Built
C: Approved with Comments
A: Approved - No Comments
I: Accepted for information
SF: Submit final as built
R: Rejected

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ClydeUnion Pumps

Performance Test Certificate

ORDER INFORMATION		PUMP INFORMATION		
Serial Number:	CC130189A1	Size and Type:	6X8X26A CUP-OH2	
Item Number:	P-436	Sales Curve Number:	6826a1	
Service:	Condensate Booster Pumps	Impeller Pattern Number:	D 90198	
Customer:	SPECTRUM PROCESS SYSTEMS	Imp Dia (Max/Min/Rated):	25.87	18.0 23.00
Customer P.O.:	002020	Impeller Test Dia.(inch):	23.50	

TEST EQUIPMENT		SPECIAL INSTRUCTIONS		
Suct Pipe Dia:	8 in.	Note: NPSHr tested @ 1750 rpm		
Disch Pipe Dia:	6 in.			
Motor Number:	B			
Torquemeter:	70,000 lbf-in.			

RECORDED TEST POINTS						PERF. CORREC. TO RATED RPM FOR TEST IMP. DIA.			
NO	SUCTION psia	DIFF psi	FLOW US GPM	TORQUE lbf-in.	SPEED RPM	FLOW US GPM	VEL HEAD ft	TDH ft	POWER BHP
1	22.2	44.3	1253	3955	875	1253.0	2.1	104.5	40.1
2	24.6	67.0	542	2445	876	541.4	0.4	154.8	24.7
3	22.4	68.8	404	2150	876	403.5	0.2	158.8	21.7
4	22.0	69.3	290	1890	876	289.7	0.1	159.8	19.1
5	21.9	69.9	0	1385	876	0.0	0.0	161.1	14.0

PERFORMANCE CORRECTED TO RATED CONDITION FOR FINAL IMPELLER DIA.						OVERALL VIBRATION		
NO	FLOW US GPM	HEAD ft	POWER BHP	EFFY % (REF ONLY)	NPSHR ft	HORIZONTAL in./ sec	VERTICAL in./ sec	AXIAL in./ sec
1	1226.3	100.1	37.6	60.2	13.08	0.03	0.03	0.02
2	529.9	148.3	23.2	62.5	2.10	0.03	0.02	0.02
3	395.0	152.1	20.4	54.3	1.77	0.03	0.03	0.02
4	283.5	153.1	17.9	44.6	1.47	0.03	0.03	0.02
5	0.0	154.3	13.1	0.0				

PERFORMANCE TOLERANCES				
CONDITION	RATED	TESTED	DEVIATION	ACCEPT
Specific Gravity :	0.73			
Speed - RPM :	875	876	0.1%	± 3%
Flow - US GPM :	528	529.9	0.4%	± 5%
TDH - ft :	145	148.3	2.3%	-2% / +5%
Power - BHP :	25.34	23.2	-8.5%	+ 4%
NPSHR - ft :	3.0	2.1	-30.0%	+ 0%

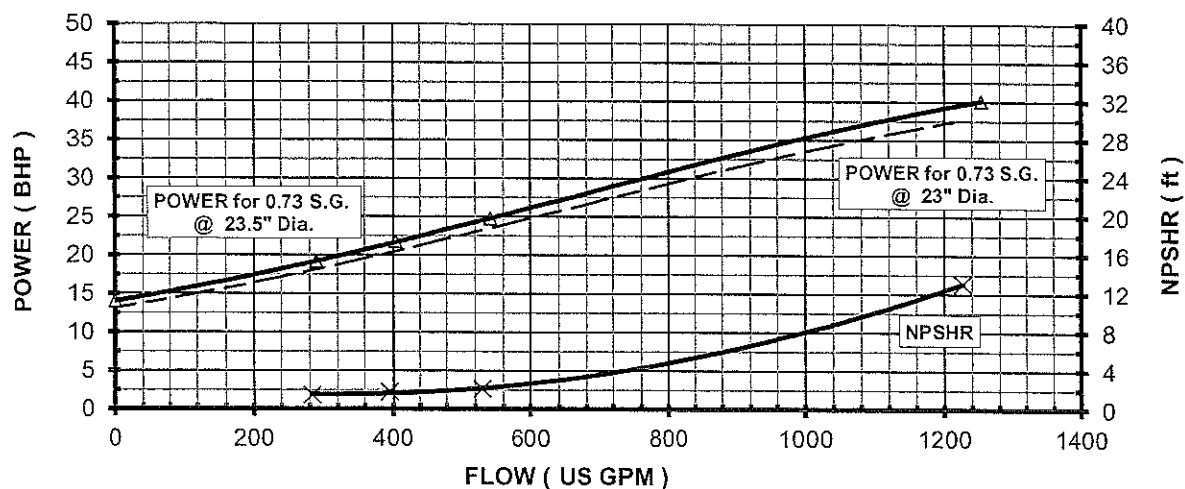
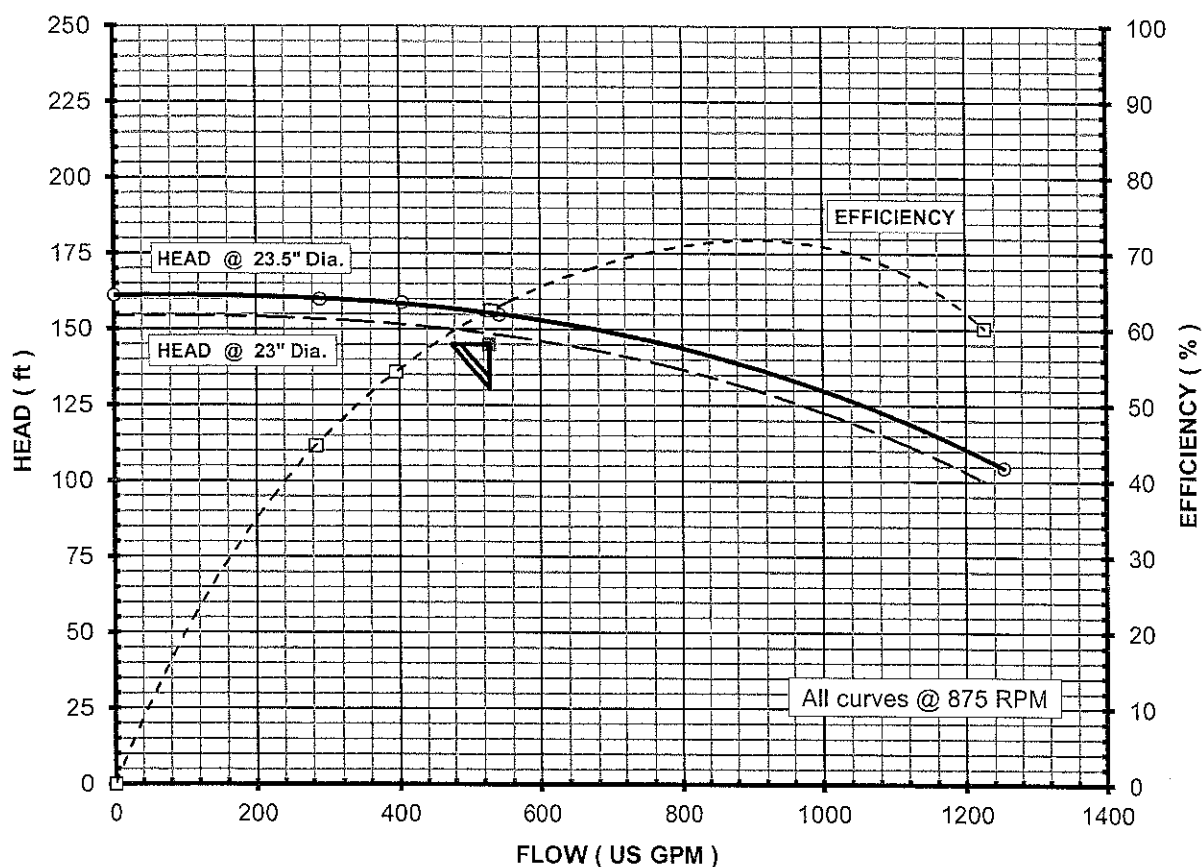
CERTIFICATION	
Tested By/Date	DK / FEB 10, 2014
Witnessed By/Date	
Engineering App	RB / Feb. 11, 2014



> ClydeUnion Pumps

Performance Test Certificate

ORDER INFORMATION		PUMP INFORMATION		
Serial Number:	CC130189A1	Size and Type:	6X8X26A CUP-OH2	
Item Number:	P-436	Sales Curve Number:	6826a1	
Service:	Condensate Booster Pumps	Impeller Pattern Number:	D 90198	
Customer:	SPECTRUM PROCESS SYSTEMS	Imp Dia (Max/Min/Rated):	25.87	18.0 23.00
Customer P.O.:	002020	Impeller Test Dia.(inch):	23.50	





Hydrostatic Test Certificate

ClydeUnion Pumps

HYDROSTATIC TEST DATA

Pump Casing/Cover	730	PSIG for	30	minutes
Fluid Cylinder		PSIG for		minutes
Suction Manifold		PSIG for		minutes
Discharge Manifold		PSIG for		minutes
Other		PSIG for		minutes

☒ NON-WITNESSED

Tested By: Pierre Trinh

Date: January 29, 2014

☐ WITNESSED (when applicable)

Witnessed By: _____ Date: _____

Representing: _____

REMARKS

Verified By:

Signature: Lynn Richmond *L. Richmond*

Representing: Clyde Union Canada Limited

CUSTOMER:	Spectrum Process Systems Inc.
CUSTOMER P.O.	'002020
CERTIFIED/DATE	LR / 3/6/14
PUMP SERIAL NO:	CC130189A-1
PUMP ITEM NO:	P-436

Hydrotest Certificate	DWG NO	NO OF PGS	ISSUE
	CC130189A-K02	1	01



Document Front Sheet

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web: www.spx.com

ClydeUnion Pumps
4151 North Service Road
Burlington
Ontario L7L 4X6
Canada

Page 1 of 8

Document Title: Material Test Certificates
ClydeUnion Ref: A-L01
Client Reference: L01 (CC130189A-1 - 6x8x26 CUP-OH2 (Item No. P-436))
Contract: CC130189 (Spectrum Process Systems Inc)
Client PO No: 002020
Revision: 1 Reason: For Information
Comment :

Document History

Revision	Sent Date	Reason	From	Comment

FA: For Approval
FI: For information
AB: As Built
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A : Approved - No Comments
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R : Rejected

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P# C139694

9R042C43827

PP# 28968

RESOURCE METALS & ALLOYS INC P.O. - 20478 S.O. - 638361

RESOURCE METALS.

PART# 9R042C43827

Steel Certificate of Test

1835 Duesper Ave. S.W.
Canton, Ohio 44706

ID #0329480-1

Page 1 of 2

TIMKEN

Where You Turn

12/20/2012

S Eaton Steel Corporation
O T 10221 Capital
L O OAK PARK, MI 48237 USA
DS LATER
H T LATER
I O LATER
P DOMESTICCustomer Order: 137141 10899 TBD Customer Part Number: 10899
Timken Order: 28974-C (1837476) Heat Number(s): N6264

Description of Material

DIAMETER: 4.250 in (107.950 mm)

Shape:

Sales Type: 4142

Int Quality: ELECTRIC FURNACE-VACUUM DEGAS-CALCIUM TREATED

Condition: HOT ROLL - FORGING QUALITY

Specification

- EATON STEEL 10899 Rev. 006 02/23/2012 EXCEPT AS NOTED, EXCEPT ACTUAL MACROETCH, EXCEPT ACTUAL NON-METS
- ASTM A 322 Rev. 07
- ASTM A 304 Rev. 11
- ASTM A 29 / A 29M Rev. 11a

Chemistry Information

	%C	%Mn	%P	%S	%Si	%Cr	%Ni	%Mo	%Cu	%Al	%V	%Ca	%Nb	%N
SPEC Ladle Min:	.40	.75			.15	.80		.15						
SPEC Ladle Max:	.43	1.00	.025	.025	.35	1.10	.25	.21	.35					
N6264 Ladle:	.41	.98	.014	.014	.32	1.06	.13	.15	.18	.036	.007	.0006	.002	.0090

Metallurgy Information

SPEC: Chemistry (Info Only)

Heat N6264 DI Caterpillar: 6.09

SPEC: Grain Size SIZE FINE

FINE

SPEC: MacroEtch Std SURFACE 2 Max RANDOM 2 Max CENTER 2 Max

MACROETCH RATINGS EQUAL TO OR BETTER THAN STATED REQUIREMENTS BASED ON PERIODIC TESTING.

SPEC: Jominy English 4142H

Location:	1	2	3	4	5	6	7	8	9	10	12	14	16	18	20	24	28	32	36	40
SPEC Min:	55	55	54	53	53	52	51	50	49	47	44	41	39	37	36	34	34	33		
SPEC Max:	62	62	62	61	61	61	60	60	60	59	58	57	56	55	54	53	51	50		

N6264 A1-01: 59 58 58 57 57 57 56 56 56 56 55 54 53 51 50 47 45 44 43 43

SPEC: NonMet SD S 5 Max O 5 Max

SO TYPE NONMETALLIC INCLUSION RATINGS EQUAL TO OR BETTER THAN STATED REQUIREMENTS BASED ON PERIODIC TESTING.

When shipping document is attached it becomes part of this certification.

We certify the above materials have been inspected and tested in accordance with the methods prescribed in the governing specifications and consistent with our Standard Commercial Terms and Conditions for Sale, Manufacture, and Shipping, which are incorporated into and made part of this certification. The results of such inspections and tests conform with the applicable requirements including the purchase order, specification(s) and exception(s). This certificate or report shall not be reproduced except in full, without the written approval of the Timken Corporation.

Notarized:

NOTARY PUBLIC

by

Steve Breehl

Steve Breehl, SUPERVISOR-PROD MET LAB

THE TIMKEN CORPORATION

20478

7pgs.

SHAFT

PP# 28968

CC 130189A-1

P-436

1/7

Steel Certificate of Test

1835 Dueber Ave. S.W.
Canton, Ohio 44706

ID #0329480-1

Page 2 of 2

TIMKEN

Where You Turn

12/20/2012

Customer Order: 137141 10899 TBD Customer Part Number: 10899
Timken Order: 28974-C (1837476) Heat Number(s): N6264

Heat N6264 Melt Source: USA
Manufacturing: USA
REDUCTION RATIO - 55.2:1

Material melted and produced in the USA

The Timken Company certifies that there is no mercury or radio-active material used in the melting or processing.

"INGOT CAST PROCESS"

No welding of this material has occurred.

THE TIMKEN CORPORATION

Lab Services Report

10221 CAPITAL AVENUE
OAK PARK MI 48237
(248) 543-3578 telephone
(248) 398-1434 facsimile

Bill To:
001000
Apollo Heat Treating and Processing
10221 Capital Avenue
Oak Park MI 48237

Ship To:
Apollo Heat Treating and Processing
10400 Capital Avenue
Oak Park MI 48237

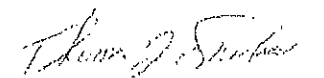
Attn:
Randy Gail
savery@titanmetallurgy.com

Report Date:
01/21/2013

This report contains results for the indicated services performed on the following sample(s):

Customer Sample #	Report	
Titan Sample #	Section	Service #
WO 737112 Job 137 PN: 10899 - 10089 Size 4-1/4 RD Grade 4140/42 Heat N6264		
13-TML-0146-01 1	03 - Mechanical Testing - ASTM E 8-01 (1 Test)	
WO 737112 Job 137 PN: 10899 - 10089 Size 4-1/4 RD Grade 4140/42 Heat N6264		
13-TML-0146-01 2	09 - Hardness - ASTM E 10-01 (Brinell)	
WO 737112 Job 137 PN: 10899 - 10089 Size 4-1/4 RD Grade 4140/42 Heat N6264		
13-TML-0146-01 3	10 - Sample Preparation	
WO 737112 Job 137 PN: 10899 - 10089 Size 4-1/4 RD Grade 4140/42 Heat N6264		
13-TML-0146-01 4	28 - UT Testing - Under 4 in	

Any services within a section marked with * are not part of Titan Metallurgy's current A2LA accreditation.



Thomas J. Snabes, Metallurgist

All testing performed by Titan Metallurgy was done at ambient (room) temperature.
The results in this laboratory report relate only to the items tested.

For questions or comments contact us at 248-543-3578 or QandA@titanmetallurgy.com.

Report # 13-TML-0146

Cover Page

Report # 13-TML-0146

Section 1 of 4 sections

03 Mechanical Testing Results - ASTM E 8-08



Certificate Number: 2087.01
Testing Laboratory

Sample ID: 13-TML-0146-01

Comments:
WO 737112 Job 137

PN: 10889 - 10089 Size 4-1/4 RD Grade 4140/42 Heat N6264

Bundle: 029-1143886A / 029-1143886A / 029-1145103A
029-1145104A / 029-1145105A / 029-1145106A

The following results are to ASTM E 8-08.

0.2% Offset Yield Test Report

0.2 % Offset Yield psi	107900
Ultimate Tensile psi	128800
Elongation Manual %	18
Reduction Area %	60
Hardness Brinell	-

Italian Metallurgy's uncertainty values for this test are maintained on file and are available upon request.

Entered by: Steve Avery
Entered Date: 01/18/2013

Approved by: Tom Snabes
Approved Date: 01/21/2013

Report # 13-TML-0146

Section 2 of 4 sections

09 Hardness Results - ASTM E 10-01



Certificate Number: 2087.01 (3,000 lb.)
Testing Laboratory

Sample ID: 13-TML-0146-01

Comments:
WO 737112 Job 137

PN: 10899 - 10089 Size 4-1/4 RD Grade 4140/42 Heat N6254

Bundle: 029-1143885A / 029-1143886A / 029-1145103A
029-1145104A / 029-1145105A / 029-1145106A

The following results are in the BHN scale.

1	275
2	-

Mean	275
Std Dev	-
Lowest	-
Highest	-
Range	-
Total Tests	1
Rejected	0

Titan Metallurgy's uncertainty values for this test are maintained on file and are available upon request
Entered by: Steve Avery
Entered Date: 01/18/2013

Approved by: Tom Snabes
Approved Date: 01/21/2013

Report # 13-TML-0146

Section 3 of 4 sections

10 Sample Preparation*

Sample ID: 13-TML-0146-01

Comments:

Entered by: Steve Avery
Entered Date: 01/18/2013

Approved by: Steve Avery
Approved Date: 01/18/2013

Report # 13-TML-0146

Section 4 of 4 sections

28 Ultrasonic Testing (Under 4")

Sample ID: 13-TML-0146-01
Confirmation of Ultrasonic Testing.
Comments:

Straight Beam

WO 737112 Job 137

PN: 10399 - 10089 Size 4-1/4 RD Grade 4140/42 Heat N6264

The following Bundles accepted.

Bundle: 029-1143885A / 029-1143886A / 029-1145103A
029-1145104A / 029-1145105A / 029-1145106A

Sample described above is certified as conforming to:
ASTM E114

Entered by: Steve Avery
Entered Date: 01/18/2013

Approved by: Tom Snabes
Approved Date: 01/21/2013

Report # 13-TML-0146

End of Report

Document Title: Magnetic Particle Inspection (MPI) Certificate
ClydeUnion Ref: A-L02
Client Reference: L02 (CC130189A-1 - 6x8x26 CUP-OH2 (Item No. P-436))
Contract: CC130189 (Spectrum Process Systems Inc)
Client PO No: 002020
Revision: 1
Reason: For Information
Comment :

Document History

Revision	Sent Date	Reason	From	Comment

FA: For Approval
FI: For information
AB: As Built
C : Approved with Comments
A : Approved - No Comments
I : Accepted for information
SF: Submit final as built
R : Rejected

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To, SPX Clyde Union Pumps
Document Control Group
(address as above)



Inspection Services Ltd.

1486 Wallace Road
Oakville, Ontario L6L 2Y2
Phone: 905-844-9448
Fax: 905-844-6697

Magnetic Particle Inspection Report MT

Specification - Acceptance Criteria

As per ASME Sec VIII Div. 1 Appx 6

General Data

Customer	Clyde Union Canada	Date	January 24, 2014		
Location	Burlington, ON	P. O. #	C144792		
Project	Casing	Shop Order #	CC 130189 A		
Procedure	NDT #3 Rev. 02	Worksheet #	38431		
Technician	Chris Veeneman	CGSB Reg #	6651	ASNT/SNT-TC-1A Level	II

Technical Data - Magnetic Particle (MT)

Material Type	☒ Carbon Steel	☐ Other	Material Thickness	
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Test Method

☒ Dry	☐ Wet	☐ Wet Fluorescent
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Test Equipment

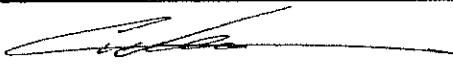
Indicators	☒ 825 R - Red	☐ 66 - Yellow	☐ Magnaglow 20B Fluorescent
	☐ 3A - Black	☐ 803/1- Black Ink	☐ 8800A Fluorescent
Background	☒ 8901W Contrast Aid	☐ Developer	
Equipment	☒ AC Yoke	☐ Calibrated Blacklight	☐ Other
Method	☒ Continuous	☐ Residual	
Light Meter	Type: EA 31	Serial # 80613518	Intensity 1280 Lx

Lighting Equipment Description: Yoke Light

Inspection

Description: Casing

Item #	Description of Weld/Test Area	Technique	Defect Location	Interpretation
CH130189 A1	Casing - machined surfaces	L & T		Acceptable to specifications

V Inspection Technician		Date	January 24, 2014
Customer Representative		Date	



Document Front Sheet

email: cu.canada.doccontrol@spx.com

web: www.spx.com

>ClydeUnion Pumps

4151 North Service Road

Burlington

Ontario L7L 4X6

Canada

Page 1 of 3

Document Title: Recommended Spares (2 Years & Commissioning)
ClydeUnion Ref: A-S01
Client Reference: S01 (CC130189A-1 - 6x8x26 CUP-OH2 (Item No. P-436))
Contract: CC130189 (Spectrum Process Systems Inc)
Client PO No: 002020
Revision: 1 **Reason:** For Information
Comment :

Document History

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> ClydeUnion Pumps

Serial No.: CC130189A-1 Tag No.: P-436

Customer: SPECTRUM PROCESS SYSTEMS Date of Issue: 7-Mar-14

PUMP SIZE 6X8X26A CUP-OH2, MATERIAL CLASS S-5 (IIIB)			QUANTITY		
SECT REF	DESCRIPTION OF PART	PART NUMBER	START UP	1 YEAR	2 YEAR
805	Impeller	805 D 90198 01 B44500			1
806	Wear Ring - Impeller	806 A 01746 02 E11500		2	2
808	Wear Ring - Casing	808 A 01719 00 E11501		2	2
815-1	Casing Gasket	815 B 90342 04 R20500	1	2	4
815-5	Shim Assembly	16494	1	1	1
820	Shaft	820 E 03270 01 C43801		1	1
823	Mechanical Seal	9421X002260		1	1
829-1	Bearing Isolator - Inboard	9411X000108	1	1	1
829-3	Bearing Isolator - Outboard	9411X000109	1	1	1
881-1	Bearing - Radial	9608X021801	1	1	1
881-2	Bearing - Thrust	9608X731716	2	2	2
847-1	Throat Bushing	847 C 13071 00 E21100		1	2

NOTES:

- (1) Quantities listed are the minimum recommendation for one pump.
- (2) Part numbers are subject to change.
- (3) In order to serve you better, please contact your Local Sales Representative for current pricing.



4151 North Service Road
Burlington, Ontario
L7L-4X6
PH: 905-315-3800
Fax: 905-315-3843

> ClydeUnion Pumps

CANADIAN COMMERCIAL FIELD SERVICE RATES

SERVICE REP	TRAVEL RATES		WORK RATES			STANDBY RATES
	WEEKDAYS	WEEKENDS & HOLIDAYS	WEEKDAY DAY SHIFT	WEEKDAY OVERTIME	SATURDAYS SUNDAYS & HOLIDAYS	
DOMESTIC SERVICE						
TECHNICIAN	\$136/HOUR	\$198/HOUR	\$1168/8 HOURS	\$198/HOUR	\$208/HOUR	\$1168/DAY
Tech. Supervisor	\$167/HOUR	\$240/HOUR	\$1328/8 HOURS	\$240/HOUR	\$250/HOUR	\$1328/DAY
FOREIGN SERVICE						
TECHNICIAN	\$172/HOUR	\$277/HOUR	\$1655/8 HOURS	\$260/HOUR	\$310/HOUR	\$1655/DAY
Tech. Supervisor	\$283/HOUR	\$380/HOUR	\$2718/8 HOURS	\$432/HOUR	\$502/HOUR	\$2718/DAY
CANADIAN OFFSHORE SERVICE						
TECHNICIAN	\$136/HOUR	\$198/HOUR	\$2200/12 HOURS	\$2200/12 HOURS	\$2200/12 HOURS	\$2200/12 HOURS
Tech. Supervisor	\$167/HOUR	\$240/HOUR	\$2400/12 HOURS	\$2400/12 HOURS	\$2400/12 HOURS	\$2400/12 HOURS

Specialty Equipment

Laser Alignment Machine - \$350.00 per day.

PER DIEM RATES:

The following per diem rates for meals, business calls, etc. will be applied to all service jobs:

Domestic service per diem \$105, foreign service per diem \$168.

Living and travel expenses: Actual cost + 10%.

Mileage is charged at \$.90 per kilometer

*Domestic is defined as any Rig, Platform or Barge accessed from the coast of Canada.

Domestic Air Travel: Economy / Coach class unless otherwise dictated by service requirements (flight and seat availability etc.)

International Air Travel: Economy / Coach class for air travel less than 8 hours on one leg. Business Class travel for trips with

one leg greater than 8 hours or total air travel greater than 10 hours within a 24 hour period.

NOTE: Rates may vary based on prevailing location / hardship.

VALID THROUGH DECEMBER 2014