UOP RUSSELL LLC

Tulsa, Oklahoma

JOB NO: J-447 **DATE:** 7/14/11

CLIENT: UOP Russell **BY:** JRG

SUBJECT: 60 MMscfd Cryo Plant

CENTRIFUGAL COMPRESSOR

Tag No.			C-141					
Service			Regen Gas Compressor					
			Case 1					
Inlet		PSIA / °F	890	124.7				
Discharge		PSIA / °F	950	▲ 136.5				
FLOW		MMSCFD (14.7 & 60° F)	9.000					
		Lbs/Hr	21257					
Mol Wt.			21.51					
Composition		Mol %	See column at right				Composition - mol %	
							N2	2.40
Efficiency		%	▲ 59.8				CO2	0.03
BHP (compressor)			▲ 51				C1	75.81
Total BHP (note 3)max			▲ 67.7				C2	12.99
Speed RPM			▲ 9010				C3	5.16
Case Material			CS/17-4PH				iC4	0.66
Rotor Material			17-4PH				nC4	1.44
Shaft Material			4140				iC5	0.37
Shaft Seal Type			Tandem dry gas,Flowserve G				nC5	0.44
Oil Cooler Type			Air cooled				C6+	0.68
Fan Motor		HP	▲ 0.75				Total	100.0
Cooling Water		Lbs./Hr	Not available					
Cooling Water	In / Out	°F	N/A	N/A				
Lube Oil Pump		Mfg./Model	Viking GG495					
Lube Oil Pump Motor		P @ RPM	2 hp @ 1750					
Lube Oil Heater		KW	None					
Suction		Size / Rating	3"	600 lb				
Interstage		Size / Rating	N/A	N/A				
Discharge		Size / Rating	2"	600 lb				
Driver Type			Induction Motor					
Motor HP @ RPM			75 @ 3600					
Service Factor / Electricl Power			1.15 / 460v/3ph/60hz					
Area Classification , Enclosure			Cl. I, Div. 2, Grp. D / TEFC		IEEE 841 Features			
Altitude		Ft.	3000 ft MSL					
Ambient Temp.	Min. / Max.	°F	-13	110				
Manufacturer			Sundyne					
Model No.			LMC-311P					
Motor Manufacturer			Reliance					
Frame			365HPZ					

NOTES:

(1) See attached "Scope of Supply".

(2) Design for no negative tolerance, flow or HP.

* data blocks marked with an asterisk to be filled in be the equipment vendor.

(3) Total BHP will include additional horsepower for no negative tolerance and gear losses.

(4) Compressor MAWP is 1189 psig @ 136.5°F

(5) Duplicate of PO 247-13 - but modify to slow down for richer gas.

REVISION	A		▲ 0	
ENGINEER/DATE	JRG	7/14/11	JRG	11/1/13
ISSUED FOR	RFQ		Purchase	

14845 West 64th Avenue • Arvada, Colorado 80007 USA • (303) 425-0800 • Fax (303) 425-0896 • www.sundyne.com

Customer	UOP Russell, LLC
Serial No.	C2754703-01
P.O. No.	4500747768
Item No.	C-141
Model	LMC-311P
Owner/User	TBD
Service	Regeneration Gas Compressor

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Customer	UOP Russell, LLC
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SPECIFICATION SHEET (SUNY-P002)

Applicable for As Built

Purchaser UOP Russell	Date 06/02/17	Rev A	Serial No. C2754703-01
Owner/User TBD	PO No. 4500747768	By J. Boening	Model LMC-311P
Service Regeneration	Quote No. SC149165	No Req'd. 1	Single Stage Centrifugal
Location TBD	Page 1 of 2	Inquiry No. J447	Tag Number: C-141

OPERATING CONDITIONS

	15# SC6 MIX	15# SC20 MIX	
GAS HANDLED			
MMSCFD (14.7 psia & 60F dry)	9.0082	8.7999	
Weight flow (lb/min)	354.30	347.83	
INLET CONDITIONS			
Pressure (psia)	890.0	889.0	
Temperature (F)	125.0	125.0	
Relative Humidity (%)	N/A		
Molecular Weight (MW)	21.42	21.49	
Cp/Cv	1.227	1.227	
Compressibility (Z1 or Zavg)	0.869	0.869	
Volume Flow (ACFM)	101.3	99.2	
DISCHARGE CONDITIONS			
Pressure (psia)	950.0	949.8	
Temperature (F)	136.9	137.1	
Cp/Cv	1.227	1.227	
Compressibility (Z2 or Zavg)	0.872	0.869	
Brake HP Required (losses incl.)	52.0	51	
Brake HP Max	63.6	64	
Surge (ACFM +/- 10% typ.)	47.9	48	
Adiabatic Head (ft-lbf/lbm)	2406	2429	
Adiabatic Efficiency (%)	59.8	60	
Speed (RPM)	9010	9010	

Gas Analysis	MW	15# SC6 Mol. Pct	15# SC20 Mol.Pct	
Nitrogen (N2)	28.02	2.40	2.39	
Carbon Dioxide (CO2)	44.01	0.03	0.30	
Methane (CH4)	16.04	75.81	75.61	
Ethane (C2H6)	30.07	12.99	12.96	
Propane (C3H8)	44.09	5.16	5.15	
i-Butane (IC4H10)	58.12	0.66	0.66	
n-Butane (NC4H10)	58.12	1.44	1.44	
i-Pentane (IC5H12)	72.15	0.37	0.37	
n-Pentane (NC5H12)	72.15	0.44	0.44	
Heptane (C7H16)	100.20	0.68	0.69	
TOTAL		100.00	100.00	
AVG MOL WT		21.42	21.49	

TEST REQUIREMENTS

SHOP TEST	Required	Witnessed
Shop Inspection	Yes	No
Hydrostatic Test at (Psig) 1704	Yes	No
Helium Leak at (psig)	No	No
Mechanical Run for (hrs)	No	No
Impeller Overspeed/Dye Penetrant	No	No
Performance Test w/ Shop Driver	Yes	No

SHOP TEST	Required	Witnessed
Use Shop Lube System	Yes	No
Use Job Seal System	Yes	No
Use Shop Seismic Velocity Probe	Yes	No
Use Job Vibration Displacement Probes	No	No
Disassemble/Inspect Comp. after Test	No	No
Disassemble/Inspect Gearbox after Test	No	No
Lube System Functional Test	Yes	No

SITE DATA

Elevation (ft) 3000.0 Barometric Pressure (psia) _____ Range of Ambient Temp (F) -13 to 110

REMARKS

UOPR Standard Plant Design.

SPECIFICATION SHEET (SUNY-P002)

Applicable for As Built

Purchaser UOP Russell	Date 06/02/17	Rev A	Serial No. C2754703-01
Owner/User TBD	PO No. 4500747768	By J. Boening	Model LMC-311P
Service Regeneration	Quote No. SC149165	No Req'd. 1	Single Stage Centrifugal
Location TBD	Page 2 of 2	Inquiry No. J447	Tag Number: C-141

CONSTRUCTION & MATERIALS

Max. Allowable Working Pressure (Psig): 1136 @150°F based on the seal housing

Compressor Connections: See Kit/Outline drawing KL14AD92
Impeller Diameter (inches): 8.600 Diffuser Section (inches): 1.125
Splined motor adaptor

Nozzles	Size (in)	ANSI Rating	Facing	Finish(RMS)	Position
Suction	3	CL 600	RF	250 - 500	SIDE
Discharge	2	CL 600	RF	250 - 500	SIDE

Build Code A

Casing Carbon Steel
Seal Housing 17-4PH
Diffuser Carbon Steel
Impeller 17-4PH
Shaft 4140
Sleeve 17-4PH
Seal Parts 316 SS
Seal Gaskets PTFE (similar to Teflon)
Comp Gaskets Fluorocarbon
Case Studs 4140 Steel (7/8" Bolts) A193-B7
Seal Rot. Face Silicon Carbide
Seal Stat. Face Metal Filled Carbon (RZ)

MOTOR DRIVE

Power (hp): 75 SF: 1.15 PM: 3550
Manufacturer: Baldor Frame: 365HPZ
Enclosure: TEFC Insulation: F @ 40C Ambient
Phase/Freq./Volts: 3/60/460 FL Amps: 82.8
Electrical Rating: Class 1, Group A,B,C,D, Div 2, T3 LR Amps: 496.0
Type 841XL, Space Heater (1/60/120) with Aux. C/B

TOTAL UTILITY CONSUMPTION

Cooling Water: N/A
Power, Driver (HP): 75
Power, Auxiliaries (hp): 2 lube pump, 3/4 heat exchanger motor
Instrument Air (SCFM): N/A
Steam, Normal and Max (lb/min): N/A

PAINTING

Manufacturer's Standard: Epoxy primer and Polyurethane topcoat
Color: Grey

PROCESS SEALS

Type: Tandem Mechanical Dry Gas
Manufacturer: Flowserve
Lower Seal Part Number: SE04AD22RZ1TA1A
Upper Seal Part Number: SE04AD29RZ1TA1A

Clean Cool Buffer Gas Required? No

Estimated Leakage (SCFM): 0.27

GEARBOX

Input RPM: 3550 Output RPM: 9010
Lubrication: ISO VG 32
Heat Exchanger: Single Type: Air cooled
Model:Young OCH-174
Tube Material: Steel Fin Material: Aluminum
MAWP (Tube side): 300 psia
Note: with .75 hp motor supplied by Young, Ph/Fq/V 3/60/230-460, Explosion Proof

Lube Priming Pump? Yes Manufacturer: Viking, GG495M
Note: 2HP Baldor motor, Ph/Fr/V 3/60/230-460, XP

MOUNTING

Verticle (No Stand): Package A

WEIGHTS (lbs)

Compressor: 490
Gearbox: 270
Driver: 980
Misc.: 150
Max. for Maintenance: 980
Total Shipping Weight: 1890

PREPARATION FOR SHIPPING

Export Boxing

REMARKS

General arrangement and scope of supply are shown on drawing KL14AD92

Sundyne - Parts List
14845 West 64th Ave
Arvada, Colorado 80007
Phone (303) 425-0800 Fax: (303) 425-0896

Customer: UOP Russell, LLC **Cust PO:** 4500747768
Sundyne Model: LMC-311P **Cust Item:** C-141
Serial Number: C2754703-01

PARTS LIST - COMPRESSOR

Part Number	Qty	Loc #	Part Description
02-018DG	3	905E	SCREW,HHC,1/4"-20-UNCX1/2"LG
02-041DG	4	905F	SCREW,HHC,1/4"-20-UNCX5/8"LG
02-391S2	4	905A	SCREW,HHC,3/8"-16-UNCX2"LG
04-062BB	12	914A	NUT,HVY-HEX,7/8"-9 SAME AS
07-010DJ	4	916S	WASHER,LOCK,3/8"
07-015DJ	3	916A	WASHER,LOCK,1/4"
07-015DJ	4	916B	WASHER,LOCK,1/4"
08-014DJ	2	14B	PIN,ROLL,SPIROL,1/4"X1-3/8"LG
12-059BB	12	911	STUD,7/8"-9X3"LG TENSILE TEST
14-004UC	1	936B	O-RING
14-009UC	3	936J	O-RING
14-046UC	1	936C	O-RING
14-047UC	1	936A	O-RING
14-047UC	1	936D	O-RING
14-048UC	1	936E	O-RING
14-053UC	1	936K	O-RING
14-054UC	1	936G	O-RING
14-055UC	2	936H	O-RING
14-056UC	1	936F	O-RING
18-002DJ	4	904	SCREW,DRIVE,#4X3/16"LG
26-039AA	6	924D	PLUG,BULL,1/2"NPTX2-1/2"LG
26-040AA	1	924B	PLUG,BULL,1"NPTX2-1/2"LG
BO03AD07DB5	1	3	BOLT,IMPELLER,STUD & NUT ASSY
CV01AA05AA5	1	15	COVER,DIFFUSER,INSERT,W/REV
DJ09AC95AA1125K	1	13	DIFFUSER,INSERT,CONE
GK01AA02	1	87A	GASKET,THERMAL BARRIER ITEM
HO27AA48AA1ASB1E5M0	1	1	HOUSING,COMPRESSOR
JM01UC15DD08600	1	2	IMPELLER,COMPRESSOR, SOLID-EYE
KE01DV01BB25069	1	4	KEY,IMPELLER
KL14AD92	1	0	KIT,UOP RUSSELL,60-200 MM GAS
PJ01AA01DB	2	148	PIN,ALIGNMENT,INDUCER,ITEM 14B
PL02AD43	1	121	IDENTIFICATION,NAMEPLATE,
PL02AD45	1	122	PLATE,ID,SEAL PORT,311/331
RJ09AD29DDUC	1	51A	ROTATING FACE,FLOWSERVE
RJ09AD29DDUC	1	51C	ROTATING FACE,FLOWSERVE
SE04AD22RZ1TA1A	1	60A	SEAL, GSS1500,
SE04AD29RZ1TA1A	1	60B	SEAL,MECHANICAL, GSS,
SHC2754703-01	1	30	SEAL HOUSING,HO08AD14DD1A
SL01AA12DD	1	50A	SLEEVE,TANDEM LOWER
SL01AD02DD	1	50B	SLEEVE,SHAFT

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Customer: UOP Russell, LLC
Sundyne Model: LMC-311P
Serial Number: C2754703-01

Cust PO: 4500747768
Cust Item: C-141

PARTS LIST - GEARBOX

Part Number	Qty	Loc #	Part Description
02-018DG	3	905L	SCREW,HHC,1/4"-20-UNCX1/2"LG
02-021AF	2	905H	SCREW,HHC,3/8"-16-UNCX1-1/2"LG
02-027DJ	3	905M	SCREW,HHC,#10-24-UNCX1"LG
02-095DJ	3	905N	SCREW,HHC,#10-24-UNCX3/4"LG
02-200AF	7	909B	SCREW,HHC,1/2"-13-UNCX4-1/2"LG
03-349AA	4	102	SCREW,FSHC,#10-24UNC X 1/2"LG
04-001AF	2	914F	NUT,HEX,1/2"-13-UNC P1-2
04-001AF	7	914E	NUT,HEX,1/2"-13-UNC P1-2
06-007AF	2	916J	WASHER,FLAT,NAR,5/8"
06-008AF	14	916H	WASHER,FLAT,NAR,1/2" P1-1
06-084	2	916F	WASHER,FLAT,NAR,1/2" HARDENED
07-003DJ	3	154D	WASHER,LOCK,#10
07-003DJ	3	154E	WASHER,LOCK,#10
07-010AF	2	916D	WASHER,LOCK,3/8"
07-015DJ	3	916K	WASHER,LOCK,1/4"
08-013AF	1	918D	PIN,ROLL,SPIROL,1/4"X5/8"LG
08-050	1	0	PIN,ROLL,COILED,3/16"X1/2"LG
14-040UC	2	936N	O-RING
14-040UC	2	936T	O-RING
14-055UC	1	936P	O-RING
14-223UC	2	936AG	O-RING
19-025	1	947P	CONN,M,3/4"TX3/4"NPT
24-228	1	177	VALVE,NEEDLE,1/4"NPT,STD G/BOX
25-007	1	186	SMALL DESICCANT FILTER
26-008AA	2	924AA	PLUG,PIPE,SH,3/8"NPT
26-008AA	1	0	PLUG,PIPE,SH,3/8"NPT
26-009AA	1	924F	PLUG,PIPE,HH,1/4"NPT P1-29
26-024DH	1	924E	PLUG,PIPE,SQ,1"NPT,3000#
26-036	1	66	PLUG,CAP/PIPE,HH/SQ,3/4"NPT,
26-037DH	1	924K	PLUG,PIPE,SQ,3/4"NPT,2000#
39-235	1	193C	GAUGE,PRESS,2-1/2",PIC,DUAL
AT01AC01B	1	0	ATTACHING KIT,SPLINE DRIVE,
BE09AA01688	1	151A	BEARING,JOURNAL
BE20AA07	1	151B	BEARING,TILT PAD,THRUST
BO03AG01DJ100	2	909C	BOLT,CLOSE TOLERANCE
FJ01AA05	1	947A	FITTING,FILL PORT,GEARBOX,
GA01AA05	1	191	GAUGE,EXTENDED SIGHT GLASS,
HO05AA28B00000	1	101A	HOUSING,G'BOX OUTPUT,O-RING
HO06AA12A000	1	101B	HOUSING,GEARBOX,UPPER,LMV-311,

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Customer: UOP Russell, LLC
Sundyne Model: LMC-311P
Serial Number: C2754703-01

Cust PO: 4500747768
Cust Item: C-141

PARTS LIST - GEARBOX

Part Number	Qty	Loc #	Part Description
LU05AA01	1	174A	LUBE JET,GB
LU05AA01	1	174B	LUBE JET,GB
LU05AA01	1	174C	LUBE JET,GB
LU05AA01	1	174D	LUBE JET,GB
PL01AA99	1	102	PLATE, ANTI-ROTATION
PL02AA09	1	195	PLATE,ID
PL11AA02V1000000	1	102	PLATE,BEARING,CAST LINER
PU01AB06	1	160	PUMP,LUBE
SE03AA01	1	115	SEAL, INPUT SHAFT, SUNDYNE
SE04AA77UCSDRJ	1	60C	SEAL, GSG,GEARBOX
SH01AA03D2	1	A140	SHAFT,IDLER,ASSY,31X
SH01BA01GS	1	A130	SHAFT,HIGH SPEED,ASSY
SH01CA05U1	1	A120	SHAFT,LOW SPEED,ASY,SPLINE,311
SP01AA04A	1	158A	SPACER,THRST BRG,COMPR (.005),
SP01AA04B	1	158B	SPACER,THRST BRG,COMPR (.020),
SP01AA04C	1	158C	SPACER,THRST BRG,COMPR (.030),
SP07AB01	1	23A	SPRING,LUBE PUMP,P3-146,23A
TA01AA02	1	68	TAG,WARNING
TA01AA03	1	67	TAG,WARNING
TU03AA15	1	951V	TUBE SUMP,200 HP GB 951V
WA05AA13A	1	155A	WASHER, THRUST, LUBE CONTROL

Recommended Spares List Per Unit

Compressor

Customer: UOP RUSSELL
P.O. No.: 4500747768
End User/Project: TBD
Service: REGENERATION
Item No.: C-141
Model: LMC-311P
Serial No.: C2754703-01

Loc. No.	Part No.	Description	1	2	3
936B	14-004UC	O-RING	2	2	2
936C	14-046UC	O-RING	2	2	2
3	BO03AD07DB5	BOLT, IMPELLER	0	1	1
87A	GK01AA02	GASKET, THERMAL BARRIER	2	2	2
2	JM01UC15DD08600	IMPELLER	0	0	1
4	KE01DV01BB25069	KEY, IMPELLER	0	1	1
51C	RJ09AD29DDUC	RING, MATING, UPPER	2	2	4
51A	RJ09AD29DDUC	RING, MATING, LOWER	2	2	4
--	RKORC311PUC47	REPAIR KIT, O-RING	2	2	2
60A	SE04AD22RZ1TA1A	SEAL, MECH, LOWER	1	1	2
60B	SE04AD29RZ1TA1A	SEAL, MECH, UPPER	1	1	2
50A	SL01AA12DD	SLEEVE,SHAFT, LOWER	0	1	1
50B	SL01AD02DD	SLEEVE,SHAFT, UPPER	0	1	1

Notes:

Class 1 - Minimum recommended Spare Parts necessary to perform a start-up and inspection of a new unit.

Class 2 - Minimum recommended Spare Parts necessary to cover 1-2 years of normal service.

Class 3 - Minimum recommended Spare Parts necessary for critical service or units that will be installed in remote locations.

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Recommended Spares List Per Unit

Gearbox

Customer: UOP RUSSELL
P.O. No.: 4500747768
End User/Project: TBD
Service: REGENERATION
Item No.: C-141
Model: LMC-311P
Serial No.: C2754703-01

Loc. No.	Part No.	Description	Class 1	2	3
936N	14-040UC	O-RING	2	4	4
936T	14-040UC	O-RING	2	4	4
115	SE03AA01	SEAL, SHAFT, INPUT	1	1	1
115A	14-076UC	O-RING	2	2	2
125A	21-160	BEARING, BALL	0	1	1
125C	21-160	BEARING, BALL	0	1	1
125D	21-160	BEARING, BALL	0	1	1
125B	21-160	BEARING, BALL	0	1	1
185	22-362	FILTER, OIL	3	3	6
151A	BE09AA01688	BEARING, LOWER HIGH-SPEED SHAFT	0	0	1
151B	BE20AA07	BEARING, UPPER HIGH-SPEED SHAFT	0	0	1
936AG	14-223UC	O-RING, HOUSING	4	4	4
174A/B/C/D	LU05AA01	LUBE JET	4	4	4
160	PU01AB06	PUMP, LUBE	0	0	1
60C/51D	SE04AA77UCSDRJ	SEAL ASSY, GEARBOX	1	1	1
158A	SP01AA04A	SPACER, SHIM, THRUST	0	0	2
158B	SP01AA04B	SPACER, SHIM, THRUST	0	0	2
158C	SP01AA04C	SPACER, SHIM, THRUST	0	0	2
23A	SP07AB01	SPRING, LUBE PUMP	0	0	1
155A	WA05AA13A	WASHER, THRUST, LOWER	0	0	1
A130	SH01BA01GS	SHAFT ASSY, HIGH SPEED	0	0	1
110	SH05AA08	SHAFT, INTERCONNECTING	0	0	1
936M	14-043UA	O-RING	0	0	2
A120	SH01CA05U1	SHAFT, LOW SPEED	0	0	1
	MP01AA10	LUBE, SPLINE	2	4	4
186	25-007	FILL & VENT FITTING, DESICCANT TYPE	2	8	4

Notes:

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Customer	UOP Russell, LLC
Serial No.	C2754703-01
P.O. No.	4500747768
Item No.	C-141
Model	LMC-311P
Owner/User	TBD
Service	Regeneration Gas Compressor

MATERIAL CERTIFICATION

We certify that materials and/or parts used in the manufacture of the referenced order(s) are in strict accordance with the following applicable specifications:

Compressor Housing	AA
Seal Housing	DD
Studs	BB
Diffuser	AA
Impeller	DD
Shaft Sleeve, Upper	DD
Shaft Sleeve, Lower	DD
Shaft	BC
O-Rings	UC
Gearbox Housing	356-T77 Aluminum Alloy
Seal Rotating Face	SD
Nuts	DJ

MATERIAL CODE IDENTIFICATION

AA - LOW/MED CARBON STEEL	CASTING - ASTM A216-77 Grade WCB FORGING - ASTM-A668.Grade D
BB - 4140 STEEL	STUDS - ASTM A193, Grade B-7 NUTS - ASTM A194, Grade 7
BC - 4140 STEEL	BAR - AMS-6382
DD - 17-4 PH STAINLESS STEEL	CASTING - ASTM-A747 GRD CB7 CU-1
DJ - ANY 300 SERIES AUSTENITIC STAINLESS STEEL	NUTS - ASTM F594 Alloy Groups 1, 2, & 3
SD - SILICON CARBIDE (ALPHA SINTERED)	
UC - FLUOROCARBON	

Jamie Boening
Sundyne Project Manager

Field Engineering Bulletin

Sundyne

Bulletin No. 40.2.04

Gearbox Lubricant Recommendations

EFFECTIVE DATE: DECEMBER 19, 2014 **REV: J**
AFFECTED MODELS: LMV/BMP/LMC/BMC/HMP/LF/LMG

For years the preferred gearbox lubricant for Sundyne pumps and compressors has been automotive automatic transmission fluid (ATF). However, over time the additives in automatic transmission fluid have changed to coincide with the technical improvements in automobile transmissions. The additives in the new formulations of ATF, such as Dexron III, have been found to have negative effects on Sundyne gearboxes and could compromise mechanical integrity and reliability of the equipment.

ISO Viscosity Grade 32 or 46 general purpose or synthetic oils are the recommended lubricants for Sundyne gearboxes as shown in Table 1 below. ISO VG 46 lubricants are now recommended for high horsepower gearbox models 33X, 33XN, and 34X with spherical roller bearings and high ambient temperature installations. Gearbox lube oil should be changed twice yearly or more frequently in severe environments which may be detrimental to the lubricant. Oxidized oil is frequently characterized by a darkening and/or thickening of the oil. Operation of gearboxes with oxidized lubricant should be avoided.

Synthetic oils possess different characteristics than conventional mineral oils, which make them desirable for various extreme conditions such as high and low temperature operation. Synthetic oils offer very low pour points, high temperature oxidation stability and a higher viscosity index.

The operation of Sundyne equipment in high or low ambient conditions may require special consideration of gearbox lubricant and/or supplemental protective equipment such as heat exchangers or gearbox heaters.

The lubricant chosen must be compatible with gearbox elastomers, Viton and Buna N. Any oil that contains an inert additive such as PTFE, molybdenum disulfide or silicon should not be used in Sundyne gearboxes. **Use of lubricants containing inert additives will void the product warranty.**

Table 1. Recommended Lubricants

Use ISO Viscosity Grade 32 Lubricant **	Use ISO Viscosity Grade 46 Lubricant
Models: LMV/BMP-31X* LMC/BMC-31XF* LMC-BMC-31X* LMV-32X* All Sunflo Gearboxes HMP-3000 HMP-5000 HMP-7000 LF-2000 Pinnacle Compressors LMG-310L	Models: LMV/BMP-33X* / 33XN* LMC/BMC-33XF* / 33XNF* LMC/BMC-33XP* / 33XNP* LMC/BMC-33X* / 33XN* LMV/BMP-34X* LMC/BMC-34XF* LMC/BMC-34XP* LMC/BMC-34X* BMP-33X* / 33XN* BMP-34X* LMG-330L*** LMG-330NL*** LMG-4***

*** ISO VG 32 oil may be substituted for ISO VG 46 on noted units, provided the sump temperature does not exceed 60 °C (140 °F).
** When no heat exchanger is utilized use ISO VG 46 lubricant for high ambient temperatures above 40 °C (100 °F).
* "X" this number defines the pump/compressor case

Table 2. Recommended ISO VG 32 Gearbox Lube Oil Specifications

Gravity, API	28 - 37
Pour Point, °C (°F)	-7 (20) max.
Flash Point, °C (°F)	204 (400) min.
Viscosity, cSt at 40°C cSt at 100°C SUS at 100°F SUS at 210°F	 28.8 to 35.2 5.2 min. 150 to 180 44 min.
Viscosity Index	95 min.
ISO Viscosity Grade	32
Color, ASTM D 1500	1.5
Neutralization Number, Maximum	0.20
Rust Protection, ASTM D 665, A & B	Pass
Demulsibility, ASTM D 1401 Time to 0 ml emulsion at 54°C (130°F) after 30 min. at 82°C (180°F) after 60 min.	 Pass Pass
Foam Limits, ASTM D 892 Sequence 1 Sequence 2 Sequence 3	 25/0 max. 50/0 max. 25/0 max.

Note: No other additives are recommended.

Table 3. Recommended ISO VG 46 Gearbox Lube Oil Specifications

Gravity, API	28 - 37
Pour Point, °C (°F)	-7 (20) max.
Flash Point, °C (°F)	204 (400) min.
Viscosity, cSt at 40°C cSt at 100°C SUS at 100°F SUS at 210°F	 41.4 to 50.6 6.5 min. 217 to 260 48.8 min.
Viscosity Index	95 min.
ISO Viscosity Grade	46
Color, ASTM D 1500	2.0
Neutralization Number, Maximum	0.25
Rust Protection, ASTM D 665, A & B	Pass
Demulsibility, ASTM D 1401 Time to 0 ml emulsion at 54°C (130°F) after 30 min. at 82°C (180°F) after 60 min.	 Pass Pass
Foam Limits, ASTM D 892 Sequence 1 Sequence 2 Sequence 3	 25/0 max. 50/0 max. 25/0 max.

Note: No other additives are recommended.

Field Engineering Bulletin

Bulletin No. 40.2.33

Long-Term Storage and Protection of Sundyne Pumps, Gearboxes and Compressors

EFFECTIVE : FEBRUARY 2009

Rev: C

Introduction

Long term storage and protection of equipment is a very complex subject that must be thoroughly evaluated prior to taking any action. There are many alternatives; those described herein should not be construed as the only acceptable methods. Factors such as cost, facilities, and capabilities must also be considered.

Initial Inspection

Upon receipt of Sundyne equipment, check visually for any damage, which may have occurred during shipment. Notify the carrier and Sundyne promptly if damage has occurred. Closures for critical openings have been installed at the factory; these closures, plus the standard internal component preparation for shipment procedure, will provide adequate protection for normal storage. If shipping closures are removed from any openings for inspection, they must be replaced prior to storage.

Long-Term Storage

Certain long-term storage considerations should be met for any Sundyne unit, which will not be operating for a period of time exceeding six months from date of factory shipment. If followed completely, this action will ensure minimum corrosion damage to the gearbox and fluid-end components. Because of storage location and other unknown site factors beyond our control, Sundyne will not accept any liability for damage to the equipment during the storage period, nor does Sundyne guarantee the quality of the equipment during and after the storage period.

To ensure the original quality of the Sundyne unit prior to commissioning after storage, all components must be inspected by an authorized Sundyne Service Engineer. Any components not of Sundyne's manufacture (except mechanical seals) must be inspected by that particular submanufacturer's authorized service personnel. The cost of such service personnel and any component replacement will be at the Purchaser's expense.

The only factors that affect the quality of an uninstalled Sundyne unit are the humidity/temperature changes and the chemicals in the atmosphere surrounding the equipment. The method employed for long-term storage is to prevent the humidity/temperature changes and airborne chemicals from making contact with the internal components of the equipment.

When the equipment is to be stored in a strong chemical environment or near salt-water, protection procedures should be executed immediately upon receipt of the equipment. For the purpose of evaluating the impact of the environment, the following list itemizes the materials, which will normally be found inside any Sundyne gearbox:

Carbon Steel	Silver
316 Stainless Steel	Carbon with minimal binder material
Bronze	Tungsten Carbide
Copper	BUNA-N
Lead-Tin	Aluminum

The fluid end of the pump or compressor may contain any of the above listed materials. Other materials may be found such as Hastelloy, Titanium, 304 Stainless Steel, and Iconel.

1. Inert Gas Purging

Any inert environment provides excellent protection of the equipment for an indefinite period of time. Nitrogen is one inert gas usually available at any refinery or chemical plant. Nitrogen also absorbs humidity when it is dry and will, therefore, carry it away when permitted to flow.

a) Install nitrogen supply lines to the following locations:

1) Pump or compressor casing drain port.

2) Port #1 seal drain and also Port #2 if more than one mechanical seal is used.

3) Gearbox fill venting.

b) Install blind flanges on suction and discharge flange connection if the unit is installed or seal the flanges if uninstalled.

c) Install a 3/4" NPT plug in the second fill/vent fitting in the gearbox. This plug must have a 1/8" diameter hole drilled through to allow circulation of the gas.

d) Drain the gearbox sump of all oil. Oil may be left in the external lube oil piping.

e) Grease the input shaft and coupling areas with rust preventative grease. Fill the lipseal cavity with grease and wrap the greased area with waterproof barrier paper.

f) Pressurize the gas purge system. NOTE: The pressure in the gearbox must not exceed 5 psig.

g) Allow the gas to flow through for several minutes by opening the flange connection and loosening the plug on Seal Port #7.

h) Completely enclose the entire Sundyne unit with a heavy plastic, tarpaulin, or similar type of protective cloth. Allow the nitrogen to leak out from underneath the covering. Place desiccant bags inside the covering. Store on an elevated surface. Do not allow the weight of the covering to be carried by any instrumentation.

i) Ensure that a minimum of 1 cubic foot per hour gas circulation (usage) is maintained at all times. See Appendix 1 for schematic arrangement drawings.

2. Oil Flooding

Filling the gearbox completely with oil and then sealing it off provides excellent protection against the environment. Using an ISO Viscosity Grade 32 general purpose or synthetic oil (refer to Sundyne Field Engineering Bulletin 40.2.04) will allow starting the equipment without cleaning the internal components of the gearbox by disassembly. The same method can be used without first cleaning the components in the fluid end of pumps. For compressors however, the internal components of the fluid end must be cleaned thoroughly before the compressor is used. Gas seals will require special cleaning or replacement after storage. For both pumps and compressors with the fluid end built in a corrosive resistant material, it is not necessary to further protect the fluid end from the environment. To protect the units with this method, the following procedure should be followed:

a) Install stand pipes on:

1) The gearbox fill opening (3/4" NPT).

2) Seal Port #1 (1/2" NPT)

NOTE: the stand pipes must extend above the extreme top of the gearbox housing. For the LMV-322 and 801 product lines, the stand pipe should be as short as possible.

b) Remove the gearbox pressure gage and remove the 1/4" NPT plug on top of the gearbox.

c) Seal off the pump/compressor process flanges.

d) Remove the bull plugs from Seal Ports #5 and #6.

e) Fill oil through Port #6. When oil seeps out of Port #5, reinstall both plugs on both Ports #5 and #6.

f) Fill the stand pipe to Seal Port #1 completely with oil.

g) Fill the gearbox through the gearbox stand pipe completely with oil.

NOTE: Filling the gearbox is a slow process, which will take a long time.

h) When oil seeps out of the pressure gage fitting, the gearbox is full. Reinstall the pressure gage or pipe plug and top off the stand pipe.

i) Pack the lipseal cavity with grease and grease the input shaft and coupling half. Wrap this greased area with waterproof barrier paper.

j) Cover the entire unit with heavy plastic or a tarpaulin. Place desiccant bags inside the covering and store unit on an elevated surface. Ensure that the weight of the covering is not carried by any instrumentation. See Appendix 2 for arrangement drawing.

3. Desiccant Bags

Where rust preventative oil cannot be tolerated in the fluid end of pumps and compressors, desiccant bags may be utilized to prevent rust. Such bags should be changed every sixty days or as the environmental humidity dictates. The gearbox should be filled with oil as described in the previous procedure. For the fluid end, the following procedure should be followed:

a) Place a drain pipe on Port #1. Oil will seep through the gearbox mechanical seal and must be allowed to drain.

b) Place desiccant bags in the pump or compressor case as necessary.

c) Seal the flanges and ensure that all of the seal ports are closed with a steel plug.

d) Pack the lipseal cavity with grease and grease the input shaft and coupling half. Wrap with waterproof barrier paper.

e) Cover the entire unit with heavy plastic or tarpaulin. Place desiccant bags inside the covering. Store on an elevated surface. Ensure that the weight of the covering is not carried by any instrumentation.

f) Make certain desiccant bags are removed prior to startup.

Installed Equipment and Installed Spare Units

In the event that installed equipment will not be utilized for more than six months, protection should be provided. Any of the previously described methods may be utilized. In the event the gearbox is equipped with an auxiliary lube oil priming kit, the gearbox can be adequately protected by running this lube oil pump continuously with only normal lube oil level in the gearbox. The fluid end will need protection separately from the gearbox. The input shaft should also be turned two or three times every two weeks to protect against brinelling of the ball bearings. Installed spare units should be operationally rotated by the main driver every six to eight weeks to ensure that the gearbox internal parts are oiled adequately to protect them from the environment. No further protection is needed in normal installations.

Protection of Operating Units Against Chemical Attacks

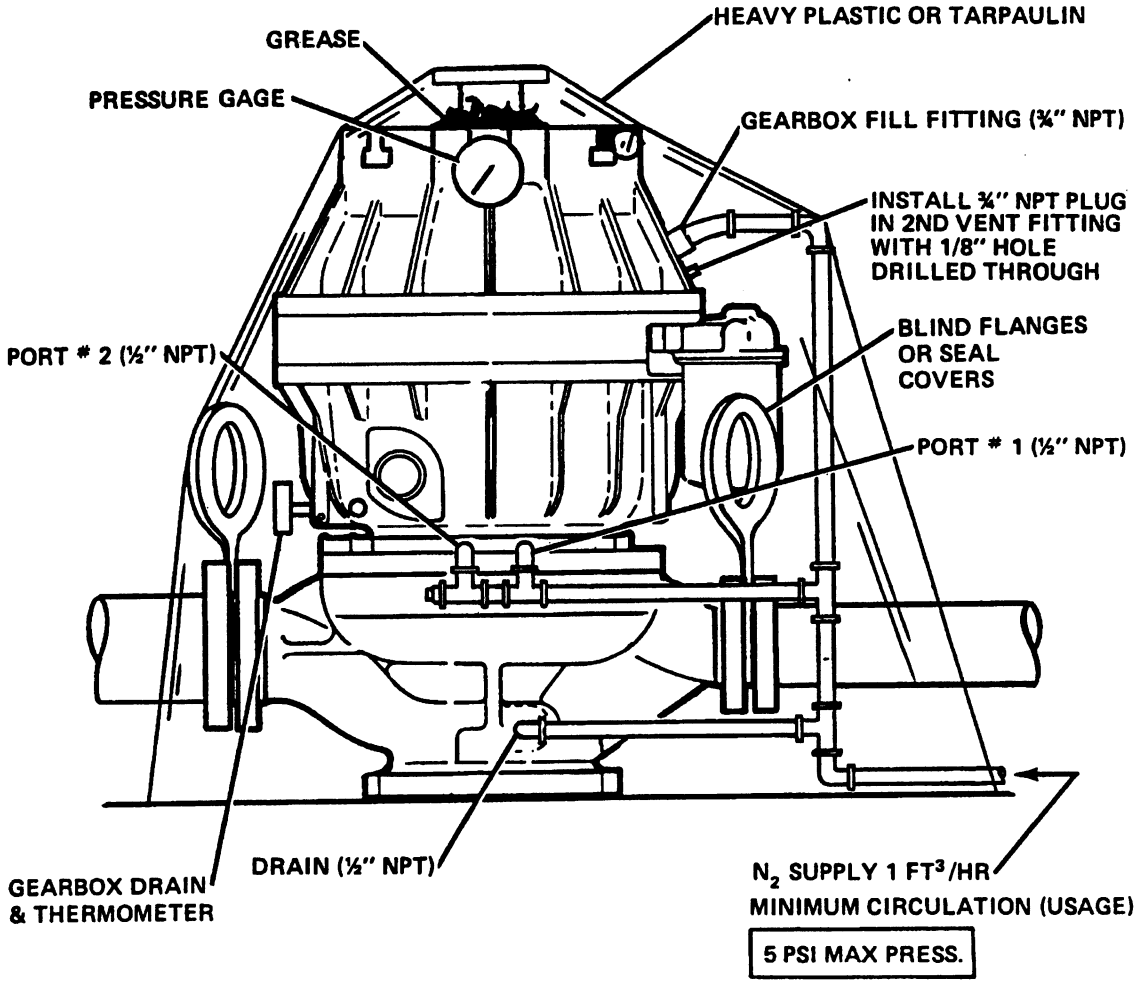
At times it may be necessary to protect the internal gearbox parts against corrosion attack from the environment on a permanent basis. Such protection may be considered in, for example, strong H_2S or ammonia atmospheres or for steam turbine drivers when the turbine is leaking excessive amounts of steam onto the gearbox. In such cases, instrument air or nitrogen may be applied to the gearbox and allowed to escape out through a "U" shaped pipe, which is filled with lubricating oil. See appendix 3 for specific details. By adjusting the air or nitrogen flow such that there is a slight bubble activity in the lube oil, the gearbox will be adequately purged to prevent any entrance of corrosive agents.

Main Drivers and Sub-Component Storage

The long-term storage of motors, steam turbines, etc. and other sub-components of the installation should be per the applicable manufacturer's recommendations.

VERTICAL INSTALLED OR LOCATED SUNDYNE PUMP OR COMPRESSOR INERT GAS PURGING

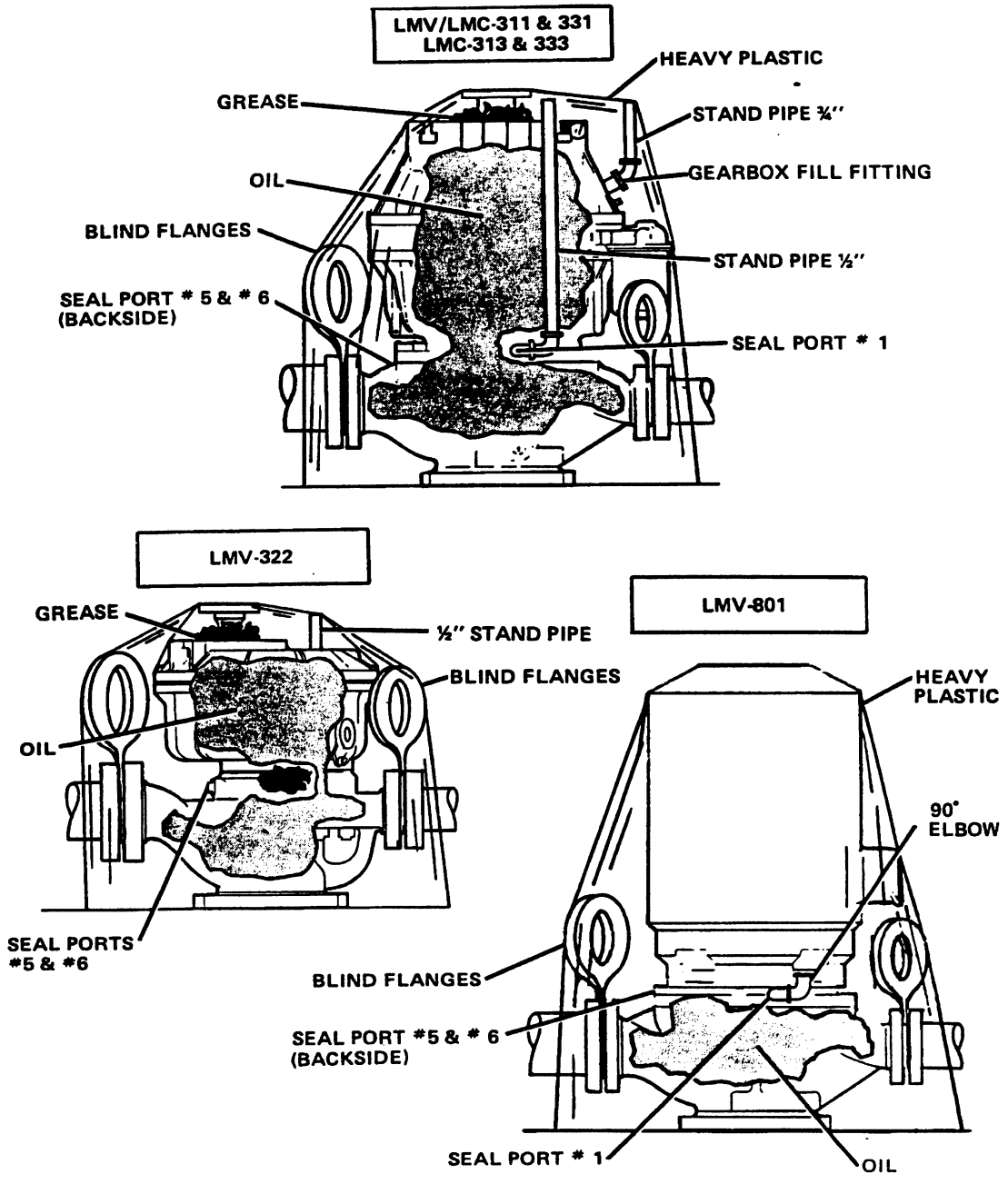
APPENDIX 1, PAGE 1 OF 2



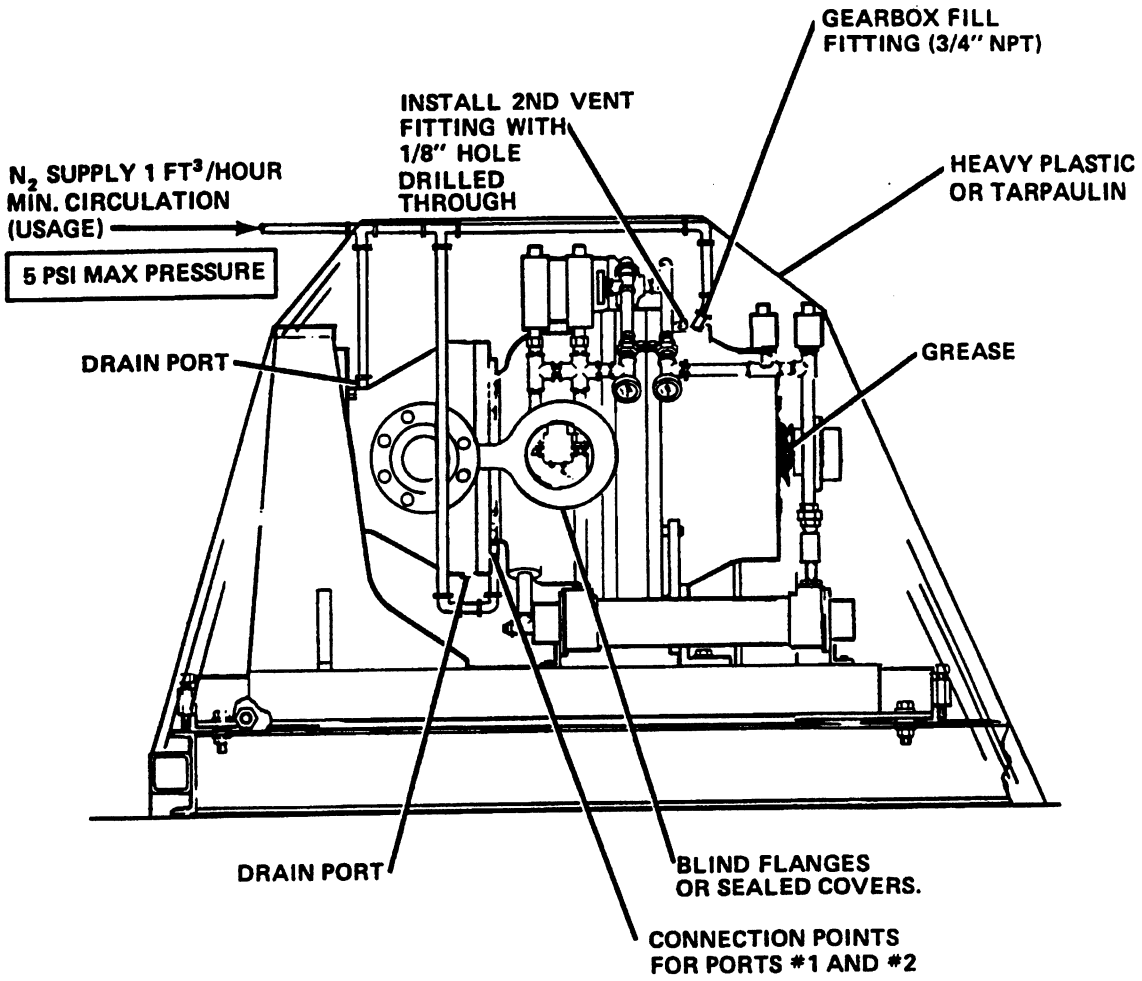
PLACE HEAVY PLASTIC OR TARPAULIN OVER THE UNIT. CONNECT A N_2 SUPPLY AND PURGE WITH N_2 AT MAX 5 PSIG. ALLOW MINIMUM ONE FT^3 OF N_2 CONTINUOUS CIRCULATION.

SUNDYNE PUMPS AND COMPRESSORS
OIL FLOODING

APPENDIX 2

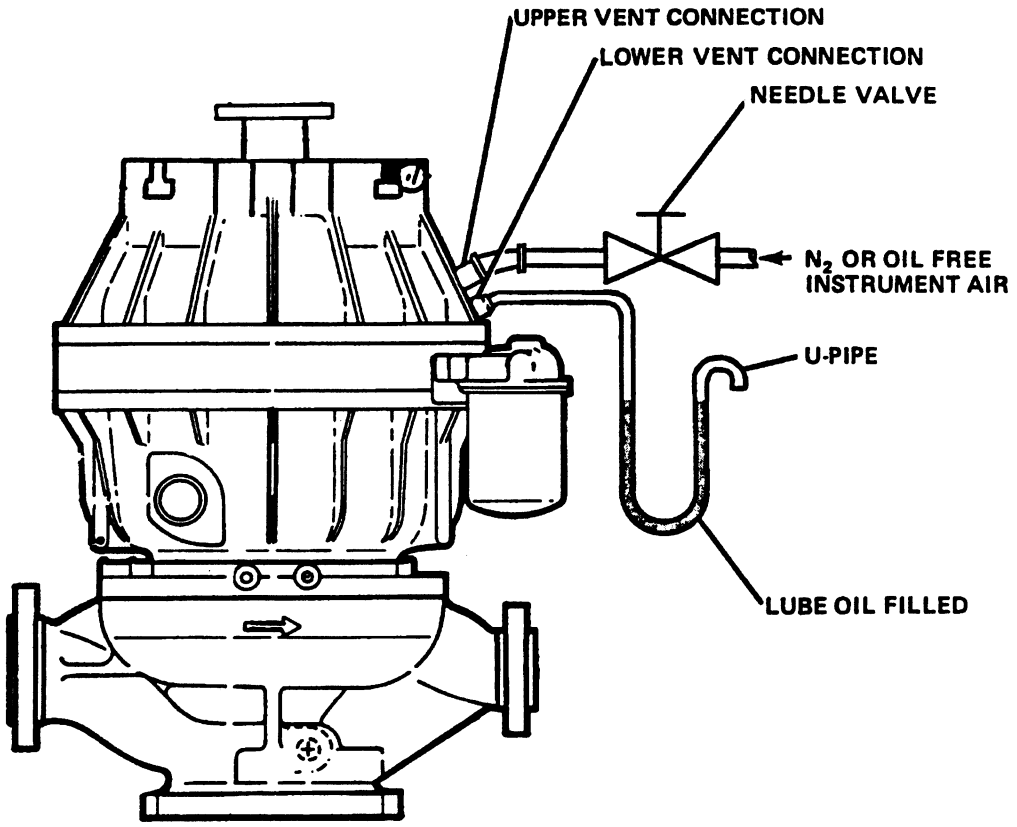


HORIZONTALLY INSTALLED OR LOCATED SUNDYNE PUMP AND COMPRESSOR INERT GAS PURGING



SPECIAL PROTECTION OF OPERATING UNITS AGAINST CHEMICAL ATTACK

APPENDIX 3



Field Engineering Bulletin

Sundyne

Bulletin No. 40.2.70

Startup Procedure for High Suction Pressure Pumps and Compressors

EFFECTIVE DATE: 5-22-2015 **REV: B**
AFFECTED MODELS: Sundyne 31X, 32X, 33X, and 34X

1.0 Pumps or Compressors with Suction Pressure ABOVE 450 PSIA

This section of the bulletin provides guidance in the startup procedure when the pump or compressor has a high suction pressure and as such is equipped with a tilting pad thrust bearing. This document is not intended to replace normal commissioning and start-up procedures and assumes steps such as motor rotation checks, piping blows to clear out debris and moisture, and other permissive start operations have previously been conducted.

The procedure contained herein applies to pumps and compressors equipped with steel backed tilting pads in the thrust bearing. Applicable units and spare bearings delivered after May 1, 1984 are equipped with steel backed tilting pads.

Prior to May 1, 1984 units and spare bearings were equipped with bronze pads. This procedure does not apply to units using the bronze pads. Bronze pads can easily be replaced with steel pads to bring older bearings up to date.

Please consult the Sundyne Installation, Operation and Maintenance (IOM) Manual for the model you are operating. This manual provides helpful instructions for the startup, operation and maintenance of Sundyne pumps and compressors.

Failure to follow this procedure may result in reduced thrust bearing life, and in extreme case, could lead to unit failure.

1.1 New units or units returned after maintenance

1.1.1 Fill the gearbox or reservoir with oil to the recommended level. Operate the lube oil priming pump, validating adequate oil pressure, a minimum of 15 PSIG, for 30 seconds to flood the bearings with oil.
1.1.2 Check oil level and refill oil if necessary, keeping the oil priming pump in operation.
1.1.3 Pressurize the process end and prepare the unit for normal operation.
1.1.4 Start the lube oil priming pump again. Maintain a min. of 15 PSIG lube oil pressure for 15-30 seconds.
1.1.5 Start the unit.
1.1.6 Shut down the lube oil priming pump (time delay as per IOM or control logic dictates), maintain normal operation with normal lube oil pressure (15 PSIG minimum).

1.2 For units in service that have been through the initial start as described above:

1.2.1 Start the lube oil priming pump. Maintain a min. of 15 PSIG lube oil pressure for 15-30 seconds and keep the oil pump running.
1.2.2 Prepare the unit for normal operation.
1.2.3 Start the unit.
1.2.4 Shut down the lube oil priming pump (time delay as per IOM or control logic dictates), maintain normal operation with normal lube oil pressure (15 PSIG minimum).

For units sitting idle under pressure it is recommended to fully depressurize the unit after a period of time and repeat the startup procedure listed under Paragraph 1.1 above. Please use table 1 below to identify the time interval before depressurization is recommended. For units sitting idle under pressure for less than the times shown in table 1, follow the startup procedure listed under Paragraph 1.2 above.

Table 1 – Idle times before depressurization is recommend for various suction pressures.

Suction Pressure (psia)	Max Idle Time Before Depressurization is Recommend (hours)
450 to 700	168
701 to 850	96
851 to 999	48
1000 and above	**Special consideration. See paragraph below.

** - Special considerations must be given for units with suction pressures 1000 psia and above. Due to high thrust loads, it is recommended to limit the idle time before depressurization to one hour. In some extreme cases, a custom start-up procedure may be helpful to avoid bearing damage. Additionally, thrust bearing type and design should be validated prior to start-up.

2.0 Pumps and Compressors with Suction Pressure BELOW 450 PSIA

This section of the bulletin provides guidance in the startup procedure when the pump and compressor have a suction pressure below 450 PSIA.

As such the unit is equipped with a flat plate thrust bearing and an oil reservoir in the shaft providing prelube to the thrust bearing during startup. Tilting pad thrust bearings may also be used.

Some models of pumps and compressors are equipped with an oil priming pump. If so, please follow the startup procedure listed under Paragraphs 1.1 and 1.2 above.

Please consult the Sundyne Installation, Operation and Maintenance (IOM) Manual. This manual provides helpful instructions for the startup, operation and maintenance of Sundyne pumps and compressors.

2.1 New units and units returned after maintenance.

2.1.1 Fill the gearbox with lube oil, to the recommended level, prior to pressurizing the unit.
2.1.2 Pressurize and prepare the unit for normal operation.
2.1.3 Start the unit.
2.1.4 When the unit is new or just back from maintenance, the first 2 starts should be jog starts to verify proper functioning of the internal lube oil pump. After this verification, jog starts are no longer required.
2.1.5 Maintain normal operation with lube oil pressure above 15 PSIG.

2.2 For units already in service and that have been through the initial start as described under paragraph 2.1 above:

2.2.1 Prepare the unit for normal operation.
2.2.2 Start the unit.
2.2.3 Maintain normal operation with lube oil pressure above 15 PSIG.

For units sitting idle under pressure for more than 5 weeks, it is recommended to depressurize the unit and repeat the startup procedure listed under paragraph 2.1 above. Instead of refilling the gearbox, it is only required to drain one quart of oil from the gearbox and pour it back into the gearbox fill fitting.

For units sitting idle under pressure for less than 5 weeks, follow the startup procedure listed under Paragraph 2.2 above.

Sundyne

Customer Performance based on Adiabatic Data (without Velocity Head Correction)

Serial No.: C2754703-01
Model: 311P-Inline Case
Purchaser: UOP Russell
Owner/User: TBD
Service: Regeneration
Location: TBD

Gas: Mix
MW: 21.42
Specific Heat Ratio: 1.227
Compressibility: 0.869
Input Speed: 3550
Output Speed: 9010

Inlet Pressure (psia): 890
Inlet Temperature (°F): 125

Witness : _____

Test Date: 2/13/2017 **Test Technician:** Dan Bryant **Test Engineer :** Kurt Lindgren

		1	2	3	4	5	6	7	8	9	10
Mass Flow	lbm/min	172.8	263.5	326.2	381.3	429.8	473.1	511.1	549.5	586.3	623.4
Inlet Volume Flow	ACFM	49.4	75.3	93.3	109.0	122.9	135.3	146.1	157.1	167.6	178.2
Total Head	ft-lbf/lbm	2401	2645	2555	2441	2316	2079	1742	1314	830	194
Pressure Out	Psia	949.9	956.2	953.8	950.9	947.7	941.7	933.1	922.4	910.4	894.7
Temperature Out	°F	135.4	136.2	136.4	136.3	136.4	136.4	136.5	136.5	136.6	136.6
Eff. Adiabatic	%	67.9%	69.6%	66.2%	63.6%	59.9%	53.8%	44.6%	33.7%	21.1%	4.9%
BHP (incl. Gear Box)	hp	26.91	38.74	46.50	52.73	58.74	63.80	68.85	73.30	78.18	82.83
Gear Box Loss	hp	8.39	8.39	8.39	8.39	8.39	8.39	8.39	8.39	8.39	8.39

	Flow (ACFM)	*Head (ft-lbf/lbm)*	*Power (hp)*	*Eff (%)*	*Surge (ACFM)*	*Stage 1 dia. (inches):*	8.600
Design Point	*101.3*	*2406*	*52.0*	*59.8%*	*47.9*		
Actual	*101.3*	*2495*	*49.6*	*64.9%*	*49.4*		
%	*100%*	*103.7%*	*95.5%*	*108.5%*	*103.1%*		
Acceptance Criteria		*-0% to +105%*	*up to 107%*		*up to 110%*		

Product AcceptanceTest Data Sheet

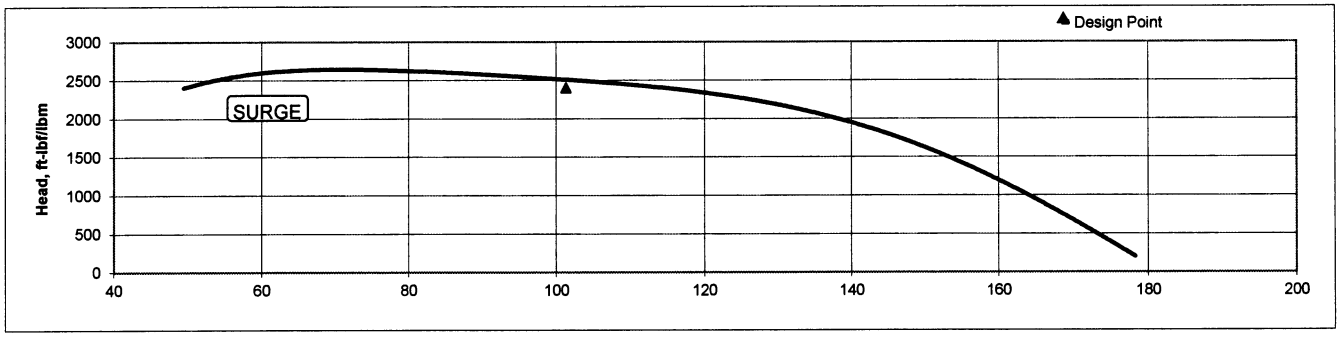
Unit Serial Number		C2754703-01_Test 1_02132017
CPR Configuration		311P-Inline Case
Test Date		2/13/2017
As-tested impeller diameter	inch	8.600
Test Flow Orifice size	inch	3
Test Gas		CO2
Test Motor		100HP M18

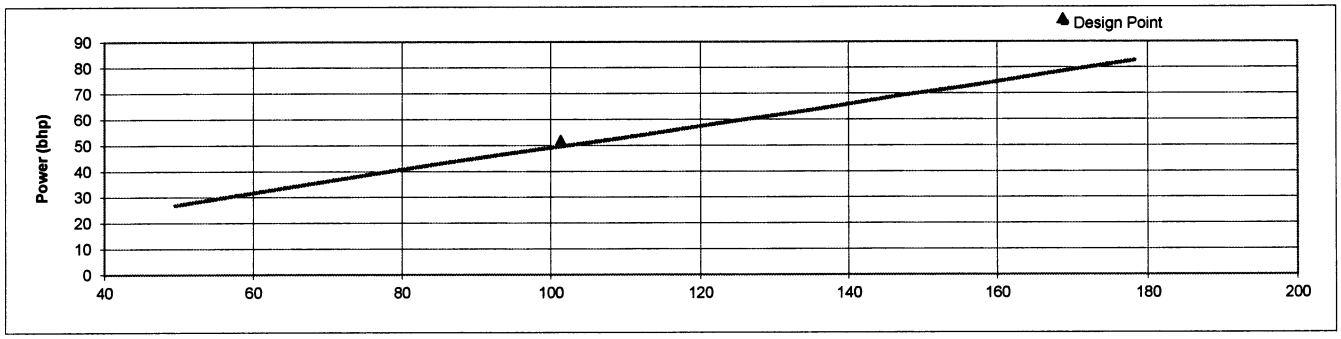
Report Parameter	Units	Description									
Time Stamp	hr:min:sec	time stamp data was taken	10:40 AM	10:48 AM	10:54 AM	11:00 AM	11:06 AM	11:12 AM	11:18 AM	11:24 AM	11:30 AM	11:36 AM
Test Point	#		1	2	3	4	5	6	7	8	9	10
BARO_P	psia	Barometric Pressure	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1
PI_ST	psig	Inlet Pressure, static, gauge	410.5	410.7	410.4	410.2	410.2	410.8	410.6	410.9	410.7	410.9
PD_ST	psi	Discharge Pressure, static	478.1	484.8	481.6	477.9	474.4	468.1	458.1	446.3	432.8	416.0
P1ORF	psig	Orifice Pressure, static, gauge	410.7	411.4	411.3	411.5	411.9	412.9	413.0	413.6	413.7	414.3
DPORF1 or 2 or 3	psi	Orifice Diff Pressure, static, gauge	0.319	0.730	1.115	1.520	1.929	2.333	2.707	3.116	3.525	3.959
TI_ST	deg F	Inlet Temperature, static	84.9	86.5	86.6	86.6	86.3	86.7	87.1	87.4	87.8	88.2
TD_ST	deg F	Discharge Temperature, static	124.5	118.4	117.6	116.8	115.9	115.3	114.6	113.5	112.4	110.8
T1ORF	deg F	Orifice Temperature, static	84.6	85.9	86.1	86.0	85.6	86.1	86.5	86.9	87.4	87.7
MTR_KW	kw	Motor KW	24.7	34.5	41.0	46.3	51.4	55.6	59.7	63.4	67.3	71.0
INPUT RPM	RPM	Input rpm	3593.2	3585.8	3582.7	3580.2	3577.7	3575.6	3573.6	3571.8	3569.8	3568.0
TCAV_P2	deg F	Port 2 Seal Cavity Temperature	106.0	107.0	107.0	108.0	108.0	108.0	108.0	108.0	108.0	108.0
OIL_INF	GPM	Lube Oil Flow Rate	4.4	4.6	4.6	4.6	4.7	4.7	4.7	4.6	4.7	4.7
PL_OIL	psig	Oil Pressure to bearings	41.1	39.3	39.3	39.2	39.1	39.0	39.0	38.9	38.7	38.7
TOIL_IN	deg F	Oil Temperature to bearings	123.1	126.1	126.0	126.2	127.1	127.6	126.7	126.8	127.2	127.4
TOIL OUT	deg F	Oil Temperature from gearbox	123.9	127.7	128.7	129.2	129.8	130.6	130.3	130.4	130.7	131.1
PCAV_P5	psig	Port 5 - Seal Cavity Pressure	418.6	416.7	411.0	408.8	406.6	405.8	404.5	403.7	402.7	402.3
PCAV_P7	psig	Port 7 - Seal Cavity Pressure	157.4	156.5	156.0	155.5	155.1	155.0	154.8	154.6	154.4	154.3
QSO_P1	scfm	Port 1 - Seal Leakage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VEL	in/sec	Gearbox vibration	0.092	0.080	0.084	0.092	0.092	0.088	0.095	0.099	0.107	0.118

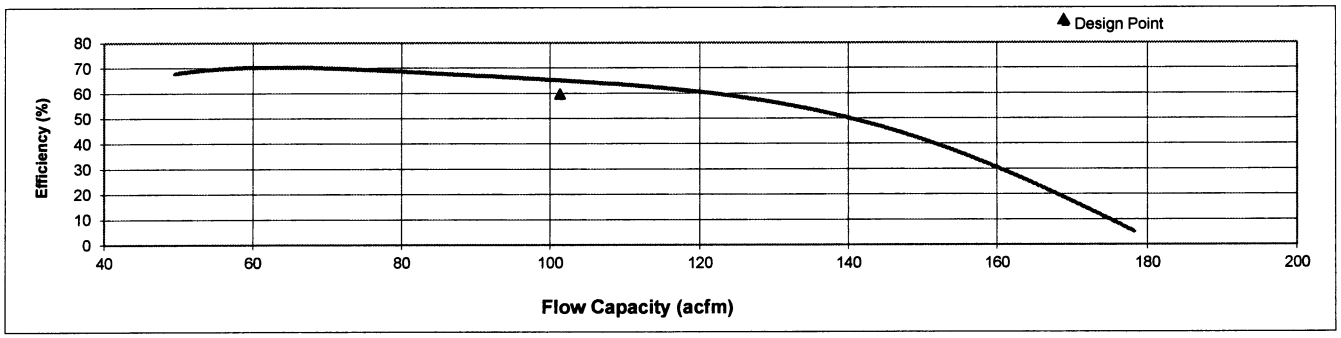
Sundyne
14845 West 64th Avenue, Arvada, Colorado 80007
(303) 425-0800 Fax (303) 425-0896

Adiabatic Performance without Velocity Head Correction

Actual Performance Curve. The Curve is Drawn By Computer and May Reflect Minor Curve Fitting Irregularities







Purchaser:	UOP Russell	Model No.:	311P-Inline Case	Rev:		Pinion 1 Output Speed:	9010
Owner/User:	TBD	Serial No.:	C2754703-01	By:	Kurt Lindgren		
Service:	Regeneration	Item No.:	C-141	MW:	21.42	Inlet Pressure (psia):	890.00
Location:	TBD	Test Date:	2/13/2017	Input Speed:	3550	Inlet Temperature (F):	125

泰鋼合金

泰钢合金（深圳）有限公司

TYCON ALLOY INDUSTRIES (SHENZHEN) CO., LTD.

Radiographic Report/ X 光探伤报告首页

TY/QR/173/E　　C 班

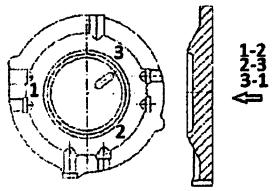
Customer/客户名称：		Report No./报告编号：	
Sundyne Corporation		340003819310/RT20160279	
Customer order No./客户订单号：	Drawing No./产品图号：	Page/页数：	Procedure No./程序号：
2098498	C-H008AD01 REV.G	1	TY/TD/139

Product No./产品编号：	Work order No./作业指令号：	Product Desc./产品名称：	Material/材质：
SKWYL060105	340003819310	HOUSING,SEAL,CSTG	CB7Cu-1
X-Ray Equipment/设备型号：	Shoot Technique/透照技术：	Shoot Extent/扫描范围：	Casting Condition/铸件状态：
MIB-7.5	S.W.S.I.	100%	Tempering
Focus Size/焦点尺寸：	IQI Type/像质计：	Sensitivity/灵敏度：<2%	Evaluation As per/评定参考标准：
0.2*2.0	ASTM 1B 1C	Density/黑白密度：1.8-4.0	ASTM E446 E186
Radioactivity/放射能量：	Film Type/胶片型号：	Developing Temperature/显影温度： 20 ℃	Testing Standard/检验标准：
7.5MeV	Kodak-MX125 Kodak-AA400		ASME V
Exposure Time/曝光时间：	Screen Type/增感方式：	Developing Time/显影时间：	Acceptance Standard/验收标准：
450S	Cu-1.0mm	5min	AMS 2175 Grade C

Heat No.& Ref. No. 炉号和铸件号	Location No. 底片号	Thickness 壁厚 mm	SFD 焦距 mm	Film Size 底片尺寸 mm	Judgement/判定 Ac	Re	Defect Desc. & Remark 缺陷名称及备注
916B007 1#	1-2	25-62	1000	430*175*2	√		NVD
	2-3	25-62	1000	430*350*2	√		NVD
	3-1	25-62	1000	430*350*2	√		NVD
916B007 2#	1-2	25-62	1000	430*175*2	√		NVD
	2-3	25-62	1000	430*350*2	√		NVD
	3-1	25-62	1000	430*350*2	√		NVD
916B007 3#	1-2	25-62	1000	430*175*2	√		NVD
	2-3	25-62	1000	430*350*2	√		NVD
	3-1	25-62	1000	430*350*2	√		NVD

Annotation/注释：
A-Gas, B-Sand, CA-Shrinkage Type-I,CB-Shrinkage Type-II,CC-Shrinkage Type-III,CD-Shrinkage Type-IV,D-Crack, E-Hot Tear, F-Insert, G-Mottling, SD-Surface Depression, NVD- No Viewable Defect.

Sketch/草图：



Evaluated by/评片员	Date/日期	Verified by/审核	Date/日期
Zeng Xuejun RT-II 420122197006290533 ASNT 00426RT2 12-RT2-09319	06 March 2016	Xu Jinli RT-III 22020419690523451X ASNT 00425RT2 12-RT2-09318	06 March 2016

泰鋼合金

泰钢合金（深圳）有限公司

TYCON ALLOY INDUSTRIES (SHENZHEN) CO., LTD.

Radiographic Report/ X光探伤报告首页

TY/QR/173/E　　C班

Customer/客户名称：		Report No./报告编号：	
Sundyne Corporation		340003819310RT20160123	
Customer order No./客户订单号：	Drawing No./产品图号：	Page/页数：	Procedure No./程序号：
2090051	C-H008AD01 REV.G	1	TY/TD/139

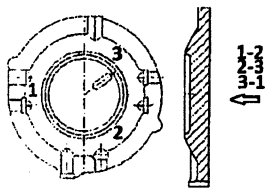
Product No./产品编号：	Work order No./作业指令号：	Product Desc./产品名称：	Material/材质：
SKWYL060105	340003819310	HOUSING,SEAL,CSTG	CB7Cu-1
X-Ray Equipment/设备型号：	Shoot Technique/透照技术：	Shoot Extent/扫描范围：	Casting Condition/铸件状态：
XYD-45010	S.W.S.I.	100%	Tempering
Focus Size/焦点尺寸：	IQI Type/像质计：	Sensitivity/灵敏度：<2%	Evaluation As per/评定参考标准：
3.5*3.5	ASTM 1B 1C	Density/黑白密度：1.8-4.0	ASTM E446 E186
Radioactivity/放射能量：	Film Type/胶片型号：	Developing Temperature/显影温度： 20 ℃	Testing Standard/检验标准：
350KV	Kodak-MX125 Kodak-AA400		ASME V
Exposure Time/曝光时间：	Screen Type/增感方式：	Developing Time/显影时间：	Acceptance Standard/验收标准：
450S	Pb-0.1mm	5min	AMS 2175 Grade C

Heat No.& Ref. No. 炉号和铸件号	Location No. 底片号	Thickness 壁厚 mm	SFD 焦距 mm	Film Size 底片尺寸 mm	Judgement/判定 Ac	Judgement/判定 Re	Defect Desc. & Remark 缺陷名称及备注
916A010 1#	1-2	25-62	1000	430*175*2	√		NVD
	2-3	25-62	1000	430*350*2	√		NVD
	3-1	25-62	1000	430*350*2	√		NVD

Annotation/注释：

A-Gas, B-Sand, CA-Shrinkage Type-I,CB-Shrinkage Type-II,CC-Shrinkage Type-III,CD-Shrinkage Type-IV,D-Crack, E-Hot Tear, F-Insert, G-Mottling, SD-Surface Depression, NVD- No Viewable Defect.

Sketch/草图：



Evaluated by/评片员	Date/日期	Verified by/审核	Date/日期
Zeng Xuejun RT-II 420122197006290533 ASNT 00426RT2 12-RT2-09319	21 January 2016	Xu Jinli RT-III 220204196905234 51X ASNT 00425RT2 12-RT2-09318	21 January 2016

Sundyne

Sundyne Data Sheet Lubrication System Functional Test

All values must be within +/- 10%

Customer UOP RUSSELL **S/N** C2754703-01

Operation _____ **Model Number** LMC-311 **Engineer** JAMIE BOENING / 940-3183

[ ] **Engineering Pre-Test Check complete** ***(must be done prior to beginining)***
[X] **JHA has been reviewed by operator and engineer prior to beginning**

Required **Procedure Ref PN 41.25-08**

[ ] **1) Special Requirements** 1.1.1
Separation Gas Pressure _____ Gas Type _____
Other: _____

Required
[X] **2) Verify Switch / Transmitter Calibration** [X] Completed 1.2

Method: Mfg. Cal Tag [ ] Sundyne Cal Doc [X] Set point, Sundyne tech initials on instrument. Select box that applies

Part Number	Description	Settings	Stamp/ Op. No.	Date	√
93-011	PRESSURE SWITCH PSS	12 PSI INCREASING	John Fuschino	2/15/17	
93-011	PRESSURE SWITCH PSLL	10 PSI DECREASING	John Fuschino	2/15/17	

Add rows here for more components, if required.

Required
[ ] **3) Pressure Relief Valve Set Point Verification:** 1.2.3 & 3.3.2

	Specified	Actual
Auxiliary Pump Discharge (psig) at tag #		
Not Req. Main Pump Discharge (psig)		

Comments: _____

Required
[ ] **4) System Cleanliness Check** ***(for screening test)*** [ ] Cleanliness Test Complete 1.3.1.1
Bypass Gearbox during system cleanliness test
Oil Temp 130° - 140° F
Length of Tes *(1 Hour Minimum* _____ Start Time _____ Stop Time _____ & 2.4
[ ] Engineering Cleanliness Check Complete

5 - 5e are for Functional Test

Required
[X] **5) Lube Functional Test** *(WARNING: Separation Gas May Be Required)* 3.2

Actual Test Times	
Start Time	2:10PM
Stop Time	3:10PM

Normal Conditions -

		Specified	Actual
	Oil Viscosity	ISO-32	ISO-32
	Gearbox Oil Supply Pressure (psig)	20-60	32
At Tag #	Gearbox Oil Supply Temp (F°)	110-160	110
	Minimum Duration of Test (hours)	1	1
Not Req. [X]	Auxiliary Oil Pump Discharge Pressure (psig)		

Required
[ ] **5a) Regulating Valve Adjustment & Check:** 3.2.1

	Specified	Actual
Bypass valve backpressure (psig)		
Pressure reducing valve (psig)		

(with dual pressure systems only: for single pressure systems use bypass regulator only)

ISO2697 REV. B

Sundyne

Sundyne Data Sheet Lubrication System Functional Test

All values must be within +/- 10%

Customer UOP RUSSELL **S/N** C2754703-01

Operation _____ **Model Number** LMC-311 **Engineer** JAMIE BOENING / 940-3183

Required

☐ **5b) Verify Vibration Limits - 0.3 inches per second** 3.3.5

	Actual	*Other*	Actual	*Other*	Actual
Heat Exchanger					
Aux Lube Pumps					

Required

☒ **5c) Verify Motor Amperage** 3.3.5

	Actual	*Other*	Actual	*Other*	Actual
Heat Exchanger Motor					
Aux Lube Pumps Motor	2.6				

Required

☐ **5d) Transfer Valve Test** 3.3.3

(system delivery pressure must not drop below auxiliary pump start pressure during the transfer valve test - Alarm Pressure)

	Specified Aux Pump Alarm Pressure	Actual
Pressure to Gearbox at Tag # _____		

Required

☐ **5e) Regulating Valve Stability with single pump operation:** ☐ Completed 3.3.6

Comments: _____

Required

☒ **6) Leak Check:** ☒ Completed 3.3.1

Comments: _____

Required

☒ **7) Replace Filter Elements** ☒ Completed 3.5

Required

☐ **7a) Clean All Y-Strainers** Qty _____ ☐ Completed

Comments: _____

Required

☐ **8) Additional Requirements:** _____ 4.0

(if applicable)

Comments / Test Notes

Signatures

Sundyne Test Operator Eric Neptune Date 2/14/2017

Sundyne Project Engineer Jamie Boening Date 2/14/17

Customer Witness _____ Date _____

ISO2819 REV D

Sundyne

HYDROSTATIC TEST DATA SHEET

DATE 1/24/2017

[X] NON-WITNESS [ ] WITNESS [ ] SEGMENTAL TEST

S/N C2754703-01 CUSTOMER UOP RUSSELL

MODEL NUMBER LMC-311 TAG # C-141

SH PART # HO08AD14DD1A SH S/N SHC2754703-01 W/O 4264907

CC/PC PART # HO27AA48AA1ASB1E5M0 CC/PC S/N _____ W/O 4264904

TEST REQUIREMENTS

[X] STANDARD PER 19.10- 01 30 MINUTES

[ ] Test with kit to first flange break SEAL HOUSING TEST PSIG 1704

[ ] Test with kit to first flange break COMPRESSOR/PUMP CASE TEST PSIG 1704

[ ] SPECIAL _____

TEST GAUGE # PIHY0828 CALIBRATION DUE DATE 4/17/2017 CHLORIDE READING _____

TEST GAUGE # PIHY0829 CALIBRATION DUE DATE 4/17/2017 CHLORIDE READING _____

AS TESTED RESULTS

SEAL HOUSING (INLET) PRESSURE 1800 PSI

COMPRESSOR/PUMP CASE (DISCHARGE) PRESSURE 1800 PSI

PRESSURE HELD 30 MINUTES

REQUIREMENT CERTIFIED

SUNDYNE OPERATOR MIKE PINKERTON,184 DATE 1/24/2017

CUSTOMER WITNESS _____ DATE _____

Sundyne

NDE INSPECTION DATA SHEET
(MPI, LPI, PMI, RT, UT, Nital Etch)

Customer UOP RUSSELL
SN C2754703-01
Model LMC-311
Work Order Number 4249726

Signature ______________________
Customer Witness

NOTE: Add a row if same part number has repeat inspections at different operations. Call M.E. if you need help.

STANDARD PART NO.	SERIALIZED PART NO.	METHOD	APPLICABLE SPECIFICATION & REVISION	LIQUID PENETRANT TYPE	RESULTS (Pass / Fail)	OPERATION #	INSPECTOR STAMP #	DATE	CUST. WITNESS
SEAL HOUSING									
HO08AD14DD1A	SHC2754703-01								
CHO08AD01DD-XRAY		X-RAY	ASTM E446		pass	30	15	1/12/2017	

ISO2886 REV ORIG

Sundyne

SOAP SOLUTION LEAKAGE TEST DATA SHEET

S / N C2754703-01 [ ] Witness [X] Non-Witness

Model LMC-311 Customer UOP RUSSELL

Test Requirements

Test Pressure 410 PSI PSIG / BARG

Test Gas CO2

Remarks

Pressure at Inlet Flange 410 PSI PSIG / BARG

Pressure at Discharge Flange 450 PSI PSIG / BARG

Test Results

[X] Pass [ ] Fail

Remarks

Operator Matt Gray Date 2/13/2017

Witnessed by _____ Date _____

BALDOR
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BALDOR • RELIANCE

Product Information Packet

SUNDYNE CORP

A36-2576-1545

75HP,3555RPM,3PH,60HZ,365HPZ,A36068M,TEF

Part Detail

Revision:	B	**Status:**	PRD/A	**Change #:**		**Proprietary:**	No
Type:	AC	**Prod. Type:**	A36068M	**Elec. Spec:**	A36WG1544	**CD Diagram:**	
Enclosure:	TEFC	**Mfg Plant:**		**Mech. Spec:**		**Layout:**	
Frame:	365HPZ	**Mounting:**	V1	**Poles:**	02	**Created Date:**	09-18-2012
Base:		**Rotation:**	R	**Insulation:**	F	**Eff. Date:**	10-22-2012
Leads:	3#2	**Literature:**		**Elec. Diagram:**		**Replaced By:**	

Nameplate NP2243L

SPEC NO.	A36-2576-1545	**CAT.NO.**		**FRAME**	365HPZ					
HP	75	**VOLTS**	460	**PHASE**	3	**DESIGN**	B	**TYPE**	P	
RPM	3555	**AMPS**	80.7	**HZ**	60	**AMB**	40	**SF**	1.15	
DRIVE END BEARING	60BC03J30X	**DUTY**	CONT	**INSUL.CLASS**	F					
OPP D.E. BEARING	65BC03J30X	**ENCL**	TEFC	**CODE**	F					
SER.NO.		**POWER FACTOR**	92	**NEMA-NOM-EFFICIENCY**	95					
		MAX CORR KVAR	5	**GUARANTEED EFFICIENCY**	94.1					
		NEMA NOM/CSA QUOTED EFF								
	M01AA01; 28-861			**MOTOR WEIGHT**						

Nameplate 000901002AAA			
	EQUIPPED WITH 120V/130W SPACE	HEATER	
	130 DEG C MAX INSUL TEMP DUE T	O HEATER IN 40 DEG C AMB	

Nameplate NP2496L			
	MOBIL POLYREX EM		

Nameplate 000692000UJ					
TCODE	T3	TEMP	200	CL I DIV 2 GR	ABCD
CL.1,ZONE 2,GR	IIAIIBIIC	CL II DIV 2 GR	X X X		
MOTOR I.D. NO.	A36-2576-1545				

Nameplate 000901002AAA			

Parts List

Part Number	Description	Quantity
SA251300	SA A36-2576-1545	1.000 EA
RA238142	RA A36-2576-1545	1.000 EA
NP2243L	IEEE 841, SS, CSA-C US,CSA EEV LASER	1.000 EA
000901002AAA	N/P (RELEASE QTY 1,500)	1.000 EA
421948051	LABEL, MYLAR	1.000 EA
NP2496L	MOTOR LUBE NAMEPLATE	1.000 EA
000692000FF	N/P (RELEASE QTY 1,000)	1.000 EA
000692000VD	N/P (REL QTY 4000)	1.000 EA
613-6PU	N/P (RELEASE QTY 10,000)	1.000 EA
000692000UJ	N/P	1.000 EA
000901002AAA	N/P (RELEASE QTY 1,500)	1.000 EA
035051012AA	BBLCW W-12	1.000 EA
004824015A	GREASE POLYREX EM	0.540 LB
085922083BH	BRKT 360 085922072WCC KB	1.000 EA
410700004F	WSHR	1.000 EA
702675001C	FAN 360	1.000 EA
078559042AD	F/C 360 078559001A	1.000 EA
034180012DA	KEY 1X4X1/4X1-1/2 L	1.000 EA
412118006A	DRAIN	1.000 EA
415072001B	CLAMP	1.000 EA
415028008E	INPRO SEAL - 360	1.000 EA
423709011C	WASHER	3.000 EA
032018012DK	HHCS 1/2-13X1-1/2 PLTD.	4.000 EA
032018024CK	HHCS 3/8-16X3 PLTD.	3.000 EA

Parts List (continued)

Part Number	Description	Quantity
032018008AK	HHCS 1/4-20X1 PLATED	4.000 EA
034530052AB	P/NIP 1/8X6-1/2 GALV.	1.000 EA
034530032BB	P/NIP 1/4X4" SCHED 40	1.000 EA
415096002A	CPLG 1/8 HEX TYPE	1.000 EA
034630002AB	CPLG 1/4" PLATED	1.000 EA
034600001AA	BUSH 1/4TO1/8 BLACK	1.000 EA
035000001G	GITS GRS CUP,ODE	1.000 EA
085922064A	BRKT 360 087793040WCC	1.000 EA
412118006A	DRAIN	1.000 EA
423709011C	WASHER	3.000 EA
032018012DK	HHCS 1/2-13X1-1/2 PLTD.	4.000 EA
032018036CK	HHCS 3/8-16X4-1/2 PLTD.	3.000 EA
034600001AA	BUSH 1/4TO1/8 BLACK	1.000 EA
035000001G	GITS GRS CUP,ODE	1.000 EA
076708000BB	C/B - 360	1.000 EA
076709000A	C/B CVR - 360	1.000 EA
075456030A	+C/B KB - 440	1.000 EA
075457025A	+CBOX CVR BLKT - 400/440	1.000 EA
415039016A	TERBD, 360-400	1.000 EA
067053000B	GASK 320-400	1.000 EA
415039010A	TERBD 250-440	1.000 EA
065564008A	GASK 250-440	1.000 EA
415000003D	T/LUG 897-777 KPA25/G16	1.000 EA
049455093A	TERBK 440	1.000 EA

Parts List (continued)

Part Number	Description	Quantity
415035049B	T/PLT SUPPORT - 449	1.000 EA
032018010CK	HHCS 3/8-16X1-1/4 PLTD.	4.000 EA
033512008LB	HHTTS 1/4-20X1 PLATED	4.000 EA
032018005AK	HHCS 1/4-20X5/8 PLATED	2.000 EA
032018004AK	HHCS 1/4-20X1/2 PLATED	2.000 EA
032375004GB	SLRHMS 6-32X1/2 PLTD-440	4.000 EA
033512004LB	HHTTS 1/4-20X1/2 PLTD.	1.000 EA
034000014AB	WSH ID.406 OD.812 TH.065	4.000 EA
034530032EA	P/NIP 3/4X4 BLACK	1.000 EA
702641041A	D/CVR 360 SUB PAINT	1.000 EA
405851012AN	SPACE	4.000 EA
032018022CK	HHCS 3/8-16X2-3/4 PLTD	4.000 EA
034017014AB	LCKW 3/8 STD. PLATED	4.000 EA
034000014AB	WSH ID.406 OD.812 TH.065	4.000 EA
418150003A	GREASE FITTING CAP	1.000 EA
418150003A	GREASE FITTING CAP	1.000 EA
035000001A	ALFTG 1/8" 1610-BL	1.000 EA
035000001A	ALFTG 1/8" 1610-BL	1.000 EA
004824003AJD	WILKO 778.50 BLUE GREEN - 55 GAL DRUMS	0.250 GA
609013011C	LFT/P - 360	2.000 EA
033775004EA	DRSCR #6-1/4 304 S.S.	4.000 EA
032018012EK	HHCS 5/8-11X1-1/2L PLTD.	4.000 EA
034017018AB	LCKW 5/8"	4.000 EA
PK5004A02	WOOD BASE 40X32 STACK 2X4 RUNNER	1.000 EA

Parts List (continued)		
Part Number	**Description**	**Quantity**
034000032AA	WSHR -360	3.000 EA
415038028B	BLOCK,SHIPPING	1.000 EA
415038028A	BLOCK,SHIPPING	1.000 EA
032509020C	CARRIAGE BOLT - 360	3.000 EA
PK1061A06	360 BOX 72 X 42 X 45	1.000 EA
PK3622	CRDBRD INSERTS, 314-316FR 23-1/2 LONG	4.000 EA
PK3233	CRDBRD. LINER, 314-316 FR 23-1/2 TALL	1.000 EA

REL. S.O.	FRAME	HP	TYPE	PHASE/ HERTZ	RPM	VOLTS
	365TS	75	P	3/60	3555	460

AMPS	DUTY	AMB °C/ INSUL.	S.F.	NEMA DESIGN	CODE LETTER	ENCL.
80.7	CONT	40/F	1.15	B	F	TEFC-841

E/S	ROTOR	TEST S.O.	TEST DATE	STATOR RES.@25 °C OHMS (BETWEEN LINES)
892018	418141005TE	---	---	.0744

PERFORMANCE

LOAD	HP	AMPERES	RPM	% POWER FACTOR	% EFFICIENCY
NO LOAD	0	19.5	3600	7.12	0
1/4	18.8	27.6	3589	69.2	92.0
2/4	37.5	43.4	3578	85.4	94.6
3/4	56.2	62.1	3567	89.2	95.0
4/4	75.0	82.8	3555	89.5	94.8
5/4	93.8	104	3541	89.4	94.2

SPEED TORQUE

	RPM	TORQUE % FULL LOAD	TORQUE LB.-FT.	AMPERES
LOCKED ROTOR	0	220	243	496
PULL UP	1565	196	217	442
BREAKDOWN	3393	229	254	262
FULL LOAD	3555	100	111	82.8

AMPERES SHOWN FOR 460. VOLT CONNECTION. IF OTHER VOLTAGE CONNECTIONS ARE AVAILABLE, THE AMPERES WILL VARY INVERSELY WITH THE RATED VOLTAGE

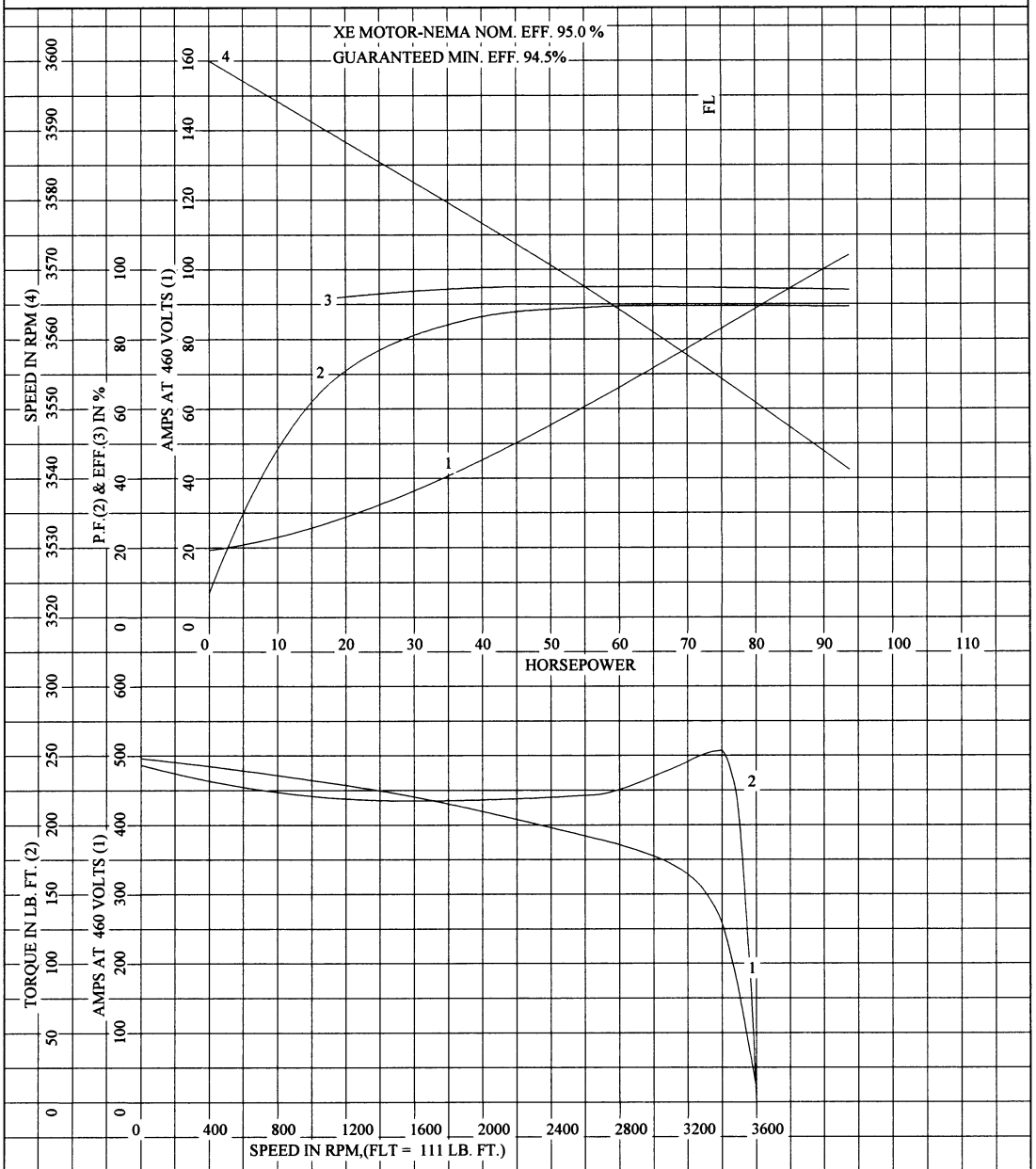
REMARKS: TYPICAL DATA
XE MOTOR-NEMA NOM. EFF. 95.0 %
GUARANTEED MIN. EFF. 94.5%

BALDOR A MEMBER OF THE ABB GROUP

DR. BY G. R. WEBB
CK. BY W. L. SMITH
APP. BY W. L. SMITH
DATE 12/21/10

A-C MOTOR PERFORMANCE DATA A36WG1544-R001
ISSUE DATE 09/13/12

REL S.O.	RPM 3555	S.F. 1.15	ROTOR 418141005TE
FRAME 365TS	VOLTS 460	NEMA DESIGN B	TEST S.O. TYPICAL DATA
HP 75	AMPS 80.7	CODE LETTER F	TEST DATE ---
TYPE P	DUTY CONT	ENCLOSURE TEFC-841	STATOR RES.@ 25 °C .0744
PHASE/HERTZ 3/60	AMB °C/INSUL 40/F	E/S 892018	OHMS (BETWEEN LINES)



AMPERES SHOWN FOR 460 VOLT CONNECTION, IF OTHER VOLTAGE CONNECTIONS ARE AVAILABLE, THE AMPERES WILL VARY INVERSELY WITH THE RATED VOLTAGE.

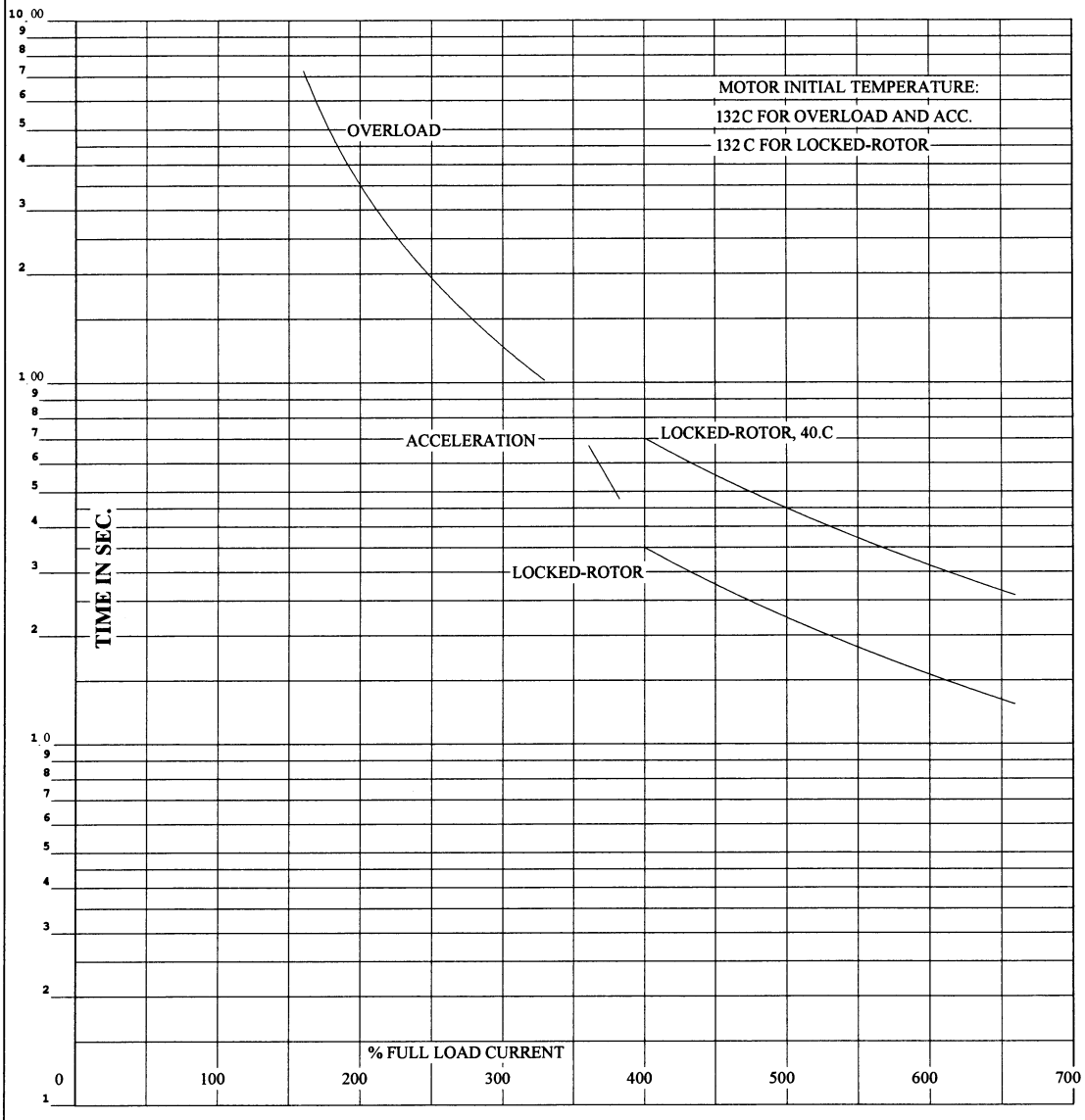
BALDOR
A MEMBER OF THE ABB GROUP

DR. BY	G. R. WEBB
CK. BY	W. L. SMITH
APP. BY	W. L. SMITH
DATE	12/21/10

A-C MOTOR PERFORMANCE CURVES A36WG1544-R001 ISSUE DATE 09/13/12

Printed on 9/13/12 13:14 @ psecs-motoreng

REL. S.O.	RPM 3555	S.F. 1.15	ROTOR 418141005TE
FRAME 365TS	VOLTS 460	NEMA DESIGN B	TEST S.O. TYPICAL DATA
HP 75	AMPS 80.7	CODE LETTER F	TEST DATE ---
TYPE P	DUTY CONT	ENCLOSURE TEFC-841	STATOR RES.@ 25 °C.0744
PHASE/HERTZ 3/60	AMB °C/INSUL 40/F	E/S 892018	OHMS (BETWEEN LINES)



THERMAL LIMIT CURVE

REMARKS: XE MOTOR-NEMA NOM. EFF. 95.0 %

GUARANTEED MIN. EFF. 94.5%

AMPERES SHOWN FOR 460 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 G. R. WEBB CK. BY W. L. SMITH APP. BY W. L. SMITH DATE 12/21/10	A-C MOTOR PERFORMANCE CURVES	A36WG1544-R001 ISSUE DATE 09/13/12

DUTY MASTER ALTERNATING CURRENT MOTORS

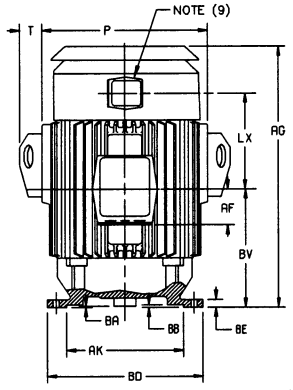
SQUIRREL-CAGE INDUCTION
CAST IRON CONSTRUCTION

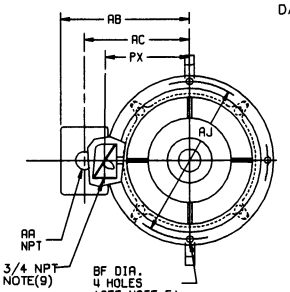
ENCLOSURE: TOTALLY ENCLOSED
MOUNTING: FOOTLESS NEMA "P" BASE

COOLING: FAN COOLED

FRAMES 250HPZ THRU 440HPZ

SUNDSTRAND M01AA01
841-XL





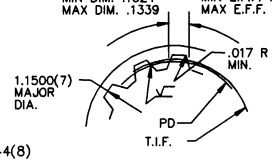
DATA FOR INTERNAL INVOLUTE SPLINES

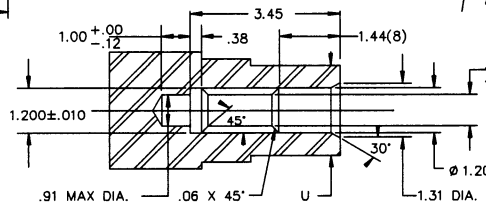
OUT OF ROUNDNESS	.0010
ACCUM.PITCH ERROR	.0015
LEAD ERROR	.0013
PROFILE ERROR	.0010

INSPECTION DIMENSIONS

HARDNESS OF SPLINE	RC 32-38
T.I.F. DIA.(MIN.)	1.083
PRESSURE ANGLE	30°
BASE CIRCLE DIA.	.8660
PITCH FRACTION	12/24
NO. OF TEETH	12
PITCH DIAMETER	1.000

CIRCULAR
MIN DIM. .1324 MAX DIM. .1339
MIN E.F.F. .1309 MAX E.F.F. .1324





DIMENSIONS ARE IN INCHES; SEE SHEET 2 FOR DIMENSIONS IN MILLIMETERS

FRAME	P	T	CAST IRON TERMINAL BOX (10) AA	AB	AC	AF	CAST IRON TERMINAL BOX (11) AA	AB	AC	AF	BA	BB	BD	BE	(5) BF	AJ	(4) AK	(9) LX	(9) PX	RECOM. BOLT
254HPZ-256HPZ	14.00	2.25	1-1/4	10.81	8.81	2.50	1-1/2	11.75	9.31	3.00	.03	.19	10.00	.62	.44	9.12	8.250	6.31	10.50	3/8 X 1.50
284HPZ-286HPZ	15.50	2.25	1-1/2	12.62	10.19	3.00	1-1/2	12.75	10.00	3.19	.03	.19	10.00	.69	.44	9.12	8.250	6.88	11.00	3/8 X 1.75
324HPZ-326HPZ	17.38	2.25	2	15.44	11.69	3.62	3	16.75	12.57	4.12	.03	.25	12.00	.88	.44	9.12	8.250	8.00	12.00	3/8 X 1.75
364HPZ-365HPZ	20.25	2.25	3	18.00	13.81	4.12	4	19.25	14.50	6.00	.03	.25	16.50	.88	.69	14.75	13.500	8.38	13.00	5/8 X 2.25
404HPZ-405HPZ	22.62	2.50	3	19.25	15.06	4.12	4	20.50	15.50	6.00	.03	.25	16.50	.94	.69	14.75	13.500	9.62	14.75	5/8 X 2.25
444HPZ-445HPZ	25.25	2.50	3	22.19	17.44	6.00	4	23.44	18.19	7.00	.03	.25	16.50	1.06	.69	14.75	13.500	11.12	15.56	5/8 X 2.25
(1)																				

FRAME SIZE	AG	BV	U(2)	WEIGHT LBS. (3)
254HPZ	24.69	11.69	2.067	330
256HPZ	24.69	11.69	2.067	340
284HPZ	27.38	13.00	2.254	460
286HPZ	27.38	13.00	2.254	475
324HPZ	31.19	14.88	2.254	610
326HPZ	31.19	14.88	2.254	650
364HPZ	33.38	15.38	2.254	860
365HPZ	33.38	15.38	2.254	980
404HPZ	35.19	15.12	2.439	1310
405HPZ	35.19	15.12	2.439	1310
444HPZ	40.88	18.00	2.442	1690
445HPZ	40.88	18.00	2.442	1890
(1)				

(1) SPECIAL DIMENSIONS APPLYING TO THIS ORDER ON THIS LINE.
(2) "U" VARIES ± .002
(3) MOTOR WEIGHTS MAY VARY BY 15% DEPENDING UPON RATING.
(4) "AK" VARIES — 250HPZ-280HPZ +.003, -.000; 320HPZ-440HPZ +.005, -.000
(5) ON 280HPZ FRAMES MOUNTING HOLES ARE LOCATED 45° FROM POSITION SHOWN.
(6) ø DIA. MUST BE CONCENTRIC TO SPLINE PITCH DIA. TO WITHIN .005 T.I.R.
(7) DIM. VARIES +.0133, -.0000.
(8) DIM. VARIES ± .016
(9) OPTIONAL AUXILIARY CONDUIT BOX SUPPLIED ONLY WHEN SPECIFIED
(10) TERMINAL BOX DIMESIONS FOR MOTORS WITH VOLTAGES OF 380 VOLTS AND HIGHER.
(11) TERMINAL BOX DIMENSIONS FOR MOTORS WITH VOLTAGES OF LESS THAN 380 VOLTS.

IF MOUNTING CLEARANCE DETAILS ARE REQUIRED, CONSULT FACTORY.

FACE RUNOUT AND ECCENTRICITY 250HPZ-320HPZ .004 MAX. T.I.R. 360HPZ-440HPZ .007 MAX. T.I.R.

FRAME-_____ TYPE-_____ CERTIFIED FOR- _____

ORDER-_____ ITEM- _____ HP-_____ RPM-_____ PH- _____ HZ _____VOLTS _____

SALES ORDER-_____ APPROVED BY-_____ DATE _____

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

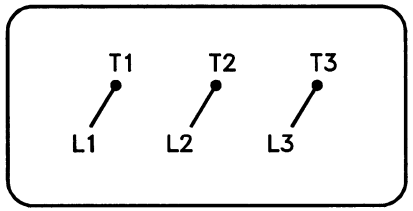
REV. DESC: CHANGE FACE RUNOUT FOR 320HPZ
REV. LTR: B
FILE: \RAG\000005\843
MTL: -
VERSION: 02
REVISED: 08:22:04 08/22/2011
TDR: 000000709090
BY: RAGGDM

BALDOR

DIM SHT TEFC XT FTLS NEMA PBASE 250-440HPZ M01AA01 841XL
SH 1 of 1

416820-036

A-C MOTOR
CONNECTION DIAGRAM
STANDARD 3 LEAD CONNECTED



(N.P. 1575-BA)

416820-036

REV. DESC: LOADED TO BUS, C/R 335225			BALDOR
REV. LTR: -	VERSION: 00	TDR: 000000538207	
FILE: \MGA\00000\682		REVISED: 11:54:06 04/30/2010	CONN DIAG - STANDARD 3 LEAD
MTL: -		BY: RAGRA	SH 1 of 1

BALDOR
A MEMBER OF THE ABB GROUP

Customer Report of Electrical Test

Customer Purch. Order:	
Sales Order No:	
Shop Order No.:	A0317/1128
Catalog no	A36-2576-1545
Serial Number:	A1705112017
Customer Number:	
Manufacturing Plant:	ATHENS

Basic Configuration

Power	Enclosure	Enclosure Enhancement		Efficiency	Frame Size		Duty
75	TEFC	FCXE		94.5	365HPZ		CONT
RPM	Phase / Hertz - Voltage	Design Letter	Poles	Motor Std	Bearing Type DE / ODE		Frame Motor Orientation
3555	3/60-460	B	02	NEMA	N/A		N/A
Mounting Position	Frame Mounting	Multi Speed	Insulation	Service Factor	Maximum Ambient (°C)	Maximum Altitude	Customer Application
V1	N	N	F	1.15	40	3300	GP

Motor Data

Test Date	Elect Design	Mech Design	Drive End Bearing	Opposite Drive End Bearing	Full Load Amps	Locked kVA/HP
05/12/17 00:07:27	A36WG1544	N/A	60BC03J30X	65BC03J30X	80.7	G

Stator Winding Test Results

		AC Hi-Pot		DC Resistance					Deviation From Master		
Sync RPM	Wind Conn	Test Voltage	Leakage mAmp	A-B Ohms	A-C Ohms	B-C Ohms	°C	Test Voltage	A%	B%	C%
3600	0	2754	4.4	0.07412	0.07422	0.07397	25				

Locked Rotor Test Results

Single Phase Locked Values						
			Amps		kWatts	
Sync RPM	Test Voltage	Test Freq	A-B	B-C	A-B	A-C
3600	464	59.705	460.8	455.78	78.77	77.96

Calculated Three Phase Locked Rotor

Three Phase Locked Values				
Calculated From Single Phase				
Sync RPM	Voltage	Amps	kWatts	P.F.
3600	464	549.94	163.23	0.369

No Load Test Results

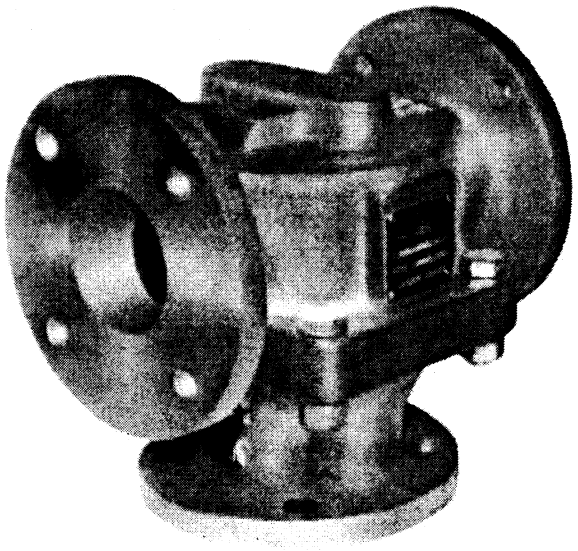
Sync RPM	Test Voltage	Test Amps	Test kWatts
3600	460.23	16.32	1.454

Vibration Test Results

VELOCITY IN/SEC (P)							DISPLACEMENT IN X 1000 (MILS P-P)				
Frequency(Her	Sync RPM	ODE HORI	ODE VERT	DE HORIZ	DE VERT	DE AXIAL	ODE HORIZ	ODE VERT	DE HORIZ	DE VERT	DE AXIAL
54.00 - 66.00	3600	0.0472	0.0293	0.0223	0.0524	0.0790	0.2465	0.1530	0.1168	0.2735	0.4127
114.00 - 126.00	3600	0.0183	0.0034	0.0037	0.0182	0.0109	0.0481	0.0089	0.0097	0.0480	0.0288
5.00 - 1605.00	3600	0.0381	0.0228	0.0204	0.0417	0.0598					

amot

Thermostatic Valves
(Self Actuated Types)
General Information



Features

- **TAMPER-PROOF TEMPERATURE SETTING**
- **NO FRAGILE EXTERNAL BULBS OR TUBING**
- **COMPLETELY SELF-CONTAINED**
- **POSITIVE 3-WAY VALVE ACTION**
- **HOLDS CLOSE REGULATION**
- **NOT SENSITIVE TO PRESSURE**
- **SIMPLE, RUGGED CONSTRUCTION**
- **OPERATES IN ANY POSITION**
- **COMPACT SIZE**
- **LARGE CAPACITY WITH LIGHT WEIGHT**
- **EXCELLENT RELIABILITY EVEN UNDER EXTREME SHOCKS AND VIBRATION**
- **PRACTICALLY NO MAINTENANCE EVER REQUIRED**

How To Order

See back page of this brochure under "Selecting an AMOT Thermostatic Valve."

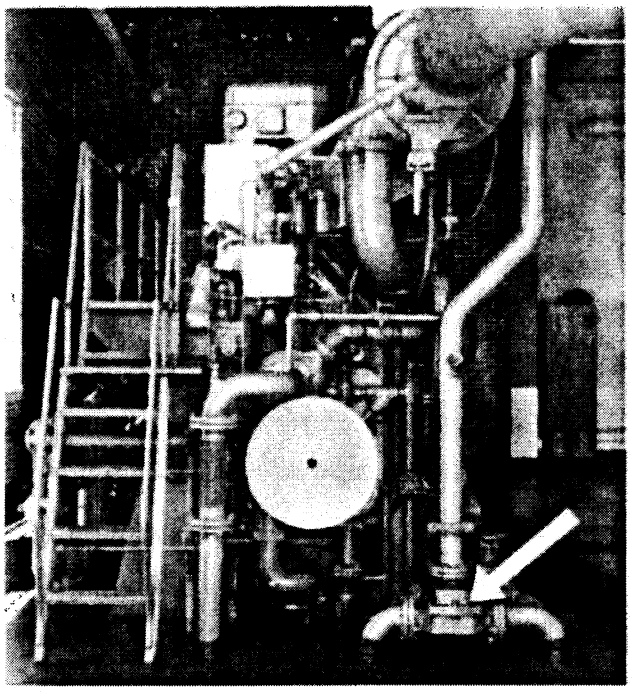
Also refer to the other brochures on the specific valve series of interest.

AMOT Thermostatic Valves provide reliable, automatic control of fluid temperatures in turbines, compressors and engine jacket water and lubrication oil cooling systems. They are suitable for process control and industrial applications where fluids must be mixed or diverted depending on their temperatures. They may also be applied to cogeneration systems to control temperatures in the heat recovery loop assuring proper engine cooling and maximizing heat recovery.

All AMOT Thermostatic Valves are equipped with positive 3-way valve action in which the water or lubricating oil is positively made to flow in the direction required. On jacket water applications when the engine is started up and is cold, the AMOT Thermostatic Valve causes all of the water to be positively by-passed back into the engine, thus providing the quickest warm-up period possible. After warm up, the correct amount of water is by-passed and automatically mixed with the cold water returning from the heat exchanger or other cooling device to produce the desired jacket water outlet temperature. If ever required, the AMOT Thermostatic Valve will shut off positively on the by-pass line for maximum cooling. The 3-way action of the AMOT Thermostatic Valve allows a constant volume of water through the pump and engine at all times with no pump restriction when the engine is cold.

AMOT Thermostatic Valves display excellent reliability even under extreme shocks or vibration and can be qualified to MIL-S-901 and MIL-V-19772.

AMOT Thermostatic Valves are available in pipe sizes from 1/2" to 8" for water flow rates of 2-2800 USGPM.



Typical AMOT Thermostatic Valve installation on a 1200 hp dual fuel engine at the Phillips Pipe Line, Sharpe, Kansas station. Arrow shows the position of a 4" AMOT Thermostatic Valve in the engine water outlet line.

MATERIALS OF CONSTRUCTION

Thermostatic Valve housings in most sizes and series are available in either cast iron, ductile iron, steel, stainless steel, aluminum or bronze. The cast iron models are recommended for most applications because of their cost effective performance. Bronze models are often used on shipboard installations. Steel offers the greatest strength and also the highest pressure ratings. For details on selecting specific valves, refer to the "Selecting an AMOT Thermostatic Valve" section on the last page and then to the brochure covering the valve series which best suits your application.

Standard Temperature Element Assemblies are made of brass and bronze. Standard seals are Buna N. These materials are suitable for most fluids such as cooling water and petroleum-based oils. Certain fluids may be damaging to standard valve body and seal materials. Special materials are available if standard materials are not compatible with the fluids being used.

ADJUSTMENTS & MAINTENANCE

No adjustments are ever required on AMOT Thermostatic Valves. Once installed an AMOT Thermostatic Valve will provide years of trouble-free service. It is entirely self-contained, and there are no external bulbs or lines to become damaged or broken. There are no packing glands to tighten and no parts to oil. The temperature is permanently set at the factory and requires no further adjustment. The operating temperature can be changed only by changing temperature element assemblies which is easily accomplished by unbolting the housing. Element assemblies are all interchangeable within each lettered valve series.

Larger valves in the "B" and "H" series contain multiple element assemblies in one housing. This means that an AMOT temperature element assembly will fit any size AMOT thermostatic valve housing in that series.

TEMPERATURE SETTINGS

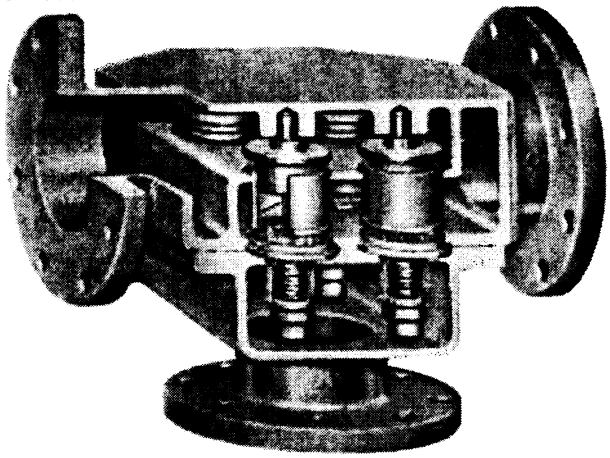
Because AMOT Thermostatic Valves are set to a predetermined temperature at the factory, costly errors due to mistakes of operating personnel are eliminated. After an AMOT Thermostatic Valve has been installed, it is impossible for the operator to arbitrarily change the operating temperature and run the equipment too cold or too hot unless the temperature element assemblies themselves are changed.

The temperature range of AMOT Thermostatic Valves should be selected according to the engine or equipment manufacturer recommendations. This information is usually available from AMOT application engineers who work closely with original equipment manufacturers. A few general recommendations can be made, however. For marine and stationary engines using heat exchangers, radiators, or some other type of closed water system, jacket water outlet temperatures of 160 to 180 °F are most common. For direct salt water cooled marine engines a 120°F setting should be used as this temperature is well below the point at which salt will deposit in the water passages of large diesel engines. Special salt water element assemblies are available. A thermostatic valve size corresponding to the outlet pipe size on the engine or pump is usually satisfactory. However, if flow information is available, Figure 7 can be used to select the proper size.

AMOT Thermostatic Valves are temperature rated for the expected nominal operating temperature in jacket water service. On lubricating oil applications the system operating temperature may be slightly above the nominal rating, depending on the flow rate, oil cooler capacity and other conditions of the system.

A wide range of temperature settings is available from 55°F to 240°F (13°C to 116°C)

For long life, AMOT Thermostatic Valves should not be operated continuously at temperatures more than about 25°F (14°C) above their nominal ratings. If higher continuous overtemperatures are expected, contact the factory for recommendations.



Model 4B Thermostatic Valve
(cutaway view)

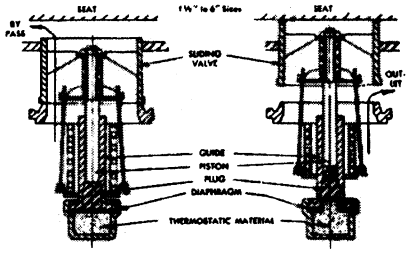
OPERATION

The motive force of operation comes from the expansion of a special wax material which remains in a semi-solid form and which is highly sensitive to temperature changes.

Fig. 1A shows an element assembly of the Model B series with the sliding valve in the cold position. The fluid travels out the by-pass (Port B on the valve) as shown by the arrow.

Fig. 1B shows the sliding valve moved up to the extended or warm position. The by-pass closes off as the sliding valve seats and the water is diverted to the outlet (Port C on the valve) as shown by the arrow. In actual operation, the sliding valve is normally in about the mid-position. When the wax material expands with rising temperature, the rubber plug is forced into a reduced diameter in the piston guide, which multiplies the movement of the piston by an extruding action.

The operating range is determined by the chemical composition of the wax material. The expanding wax develops a pressure that is transmitted directly to the piston, producing a large actuation force, which easily overcomes the return spring force of over 100 lb. Construction is simple and rugged, yet the unit is very sensitive to changes in temperature. Changes in pressure do not affect the element and due to the valve construction, surges in pressure do not tend to upset the stability of the thermostatic valve.



"A" **Fig. 1.** "B"

PIPING DIAGRAMS

The most common piping diagram for jacket water temperature control is shown in Fig. 2. Radiator may be substituted for the heat exchanger. The AMOT Thermostatic Valve will operate in any position and mounting should be made in accordance with convenience.

For lubricating oil temperature control, the AMOT Thermostatic Valve is used directly in the lubricating oil line as shown in Fig. 3. The oil by-passes the heat exchanger when cold and will reach the desired operating temperature rapidly. When warm, the correct amount of oil will automatically be circulated through the heat exchanger to maintain the desired temperature. The system shown in Fig. 3A is similar to the standard jacket water temperature control system with the thermostatic valve used as a diverting valve. In Fig. 3B the AMOT Thermostatic Valve is used as a mixing valve, in which hot oil enters Port B and cold oil enters Port C. The oil is mixed in proportion so as to emerge from Port A at the desired temperature. AMOT thermostatic valves are used in many other applications, examples of which are shown in Fig. 4, 5, and 6. Fig. 6 shows a basic cogeneration heat recovery system using AMOT thermostatic valves to stabilize temperature and maximize heat recovery.

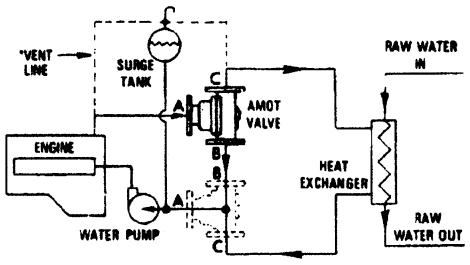


Fig. 2.

Cooling water control - Heat Exchanger Valve shown in "diverting" installation. Mount valve in dotted position for "mixing" applications.

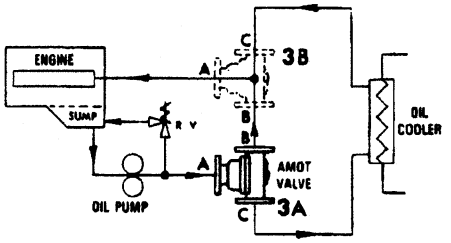


Fig. 3.

Lube Oil Control Valve shown in diverting position to control oil sump temperature. In dotted position valve will "mix" hot and cold flow streams to control supply temperature to engine.

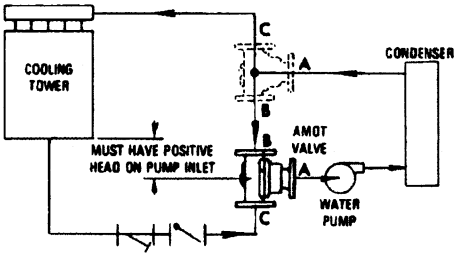


Fig. 4.

Air Conditioning Valve shown in "mixing" position to control temperature of inlet water to refrigeration system condenser. Valve in dotted position controls outlet temperature.

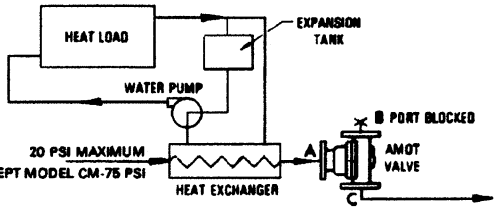


Fig. 5.

Water Saving Applications Valve shown maintains minimum flow through cooler to conserve water; requires internal leak hole to permit small flow for sensing.

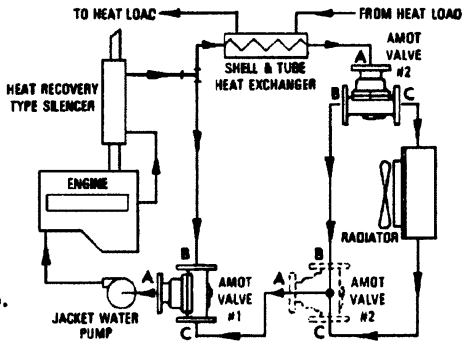


Fig. 6.

Single Pump Cogeneration System Valve # 1 controls the water temperature entering the engine. Valve #2 as shown diverts the flow of excessively hot water to the radiator when the heat exchanger is not removing enough heat from the cooling loop. Valve # 2 in dotted position is an alternative location if mixing instead of diverting service is desired.

Selecting an AMOT Thermostatic Valve

1. Choose appropriate size and model series based on the expected flow rate. Using Fig. 7, select a valve which can handle the desired flow rate. The min. and max. flow rates listed are based on pressure drop through the valve of approximately 2 psi (min.) and 7 psi (max.)

2. Refer to the brochure covering the valve series selected. Select from the standard versions offered, choosing the appropriate valve body material.

   Cast Iron - for most water and oil systems, best value

   Ductile Iron - High strength at lower cost than steel

   Steel - High strength, high pressure rating

   Stainless Steel - Highest corrosion resistance, high strength, high pressure rating

   Bronze - for salt water and Navy applications

   Aluminum - for low cost high pressure service

3. Select nominal temperature from standard temperature settings which are available, commonly between 85°F and 190°F. Temperature settings down to 55°F and up to 240°F are available in some models.

4. Select special features if required. Refer to the specific valve series brochure for availability of special features. Examples include:

- Electroless Nickel plated temperature element assemblies for fluids incompatible with brass or bronze.
- End Connections. NPT threads are standard on most valves 2-inches and smaller. Alternate thread connections include SAE, metric (BSP-tapered or BSP parallel, JIS), etc. Larger valves are typically flanged. Flange standards available including ANSI, Navy, metric (DIN), JIS, etc.
- Element Leak Holes allow a small flow through Port C maintaining flow through the cooler at all times. Leak holes prevent condensation or freezing of cooler, and during start-up slow down the warm-up time. In 2-Way applications with Port B blocked and circuit cold, leak holes are necessary to ensure sensing of temperature changes.
- Alternative seal materials, such as Viton or Neoprene (where standard Buna-N is not compatible with working fluid)
- Manual override allows element to be forced open sending full flow through cooler.
- Special temperature settings.
- Special high-overtemperature element assemblies.
- Salt water temperature element assemblies of stainless steel construction (Model B Series only.)

Fig. 7.

Model No.	Water or Water/Glycol Flow Rate (US gpm) Min	Max	Lubricating Oil SAE 10-20 SSU 170-500 @100°F Flow Rate (US gpm) Min	Max	SAE 30 SSU 500-800 @100°F Flow Rate (US gpm) Min	Max	SAE 40 SSU 800-1000 @100°F Flow Rate (US gpm) Min	Max
1/2 CM	9	18	9	17	8	17	8	16
3/4 CM	13	25	13	24	12	23	12	22
1 CM	14	27	13	26	13	25	13	24
1-1/4 CM	15	30	14	29	14	28	13	27
1-1/2 CM	17	32	16	31	16	30	15	29
1-1/4 CCM	28	54	27	52	26	50	25	48
1-1/4 E	40	70	39	67	37	65	36	63
1-1/2 E	45	75	43	72	42	69	40	67
1-1/2 B	68	125	65	120	63	115	61	110
2 B	70	130	67	125	65	120	63	115
2-1/2 B	130	230	125	220	120	215	115	210
3 B	150	270	145	260	140	250	135	240
4 B	300	540	290	520	280	500	270	480
4 H	345	620	330	600	320	580	310	550
5 B	450	800	430	770	420	740	400	720
5 H	500	920	480	900	460	850	450	822
6 B	680	1200	650	1150	630	1100	610	1100
6 H	745	1350	720	1300	700	1250	670	1200
8 B	900	1750	870	1710	845	1620	810	1500
8 D	1500	2800	1450	2800	1400	2600	1350	2500

Note: Minimum Flow Rate is for 2 psi pressure drop through the valve.
Maximum flow Rate is for 7 psi pressure drop through the valve.

AMOT Thermostatic Valve Series

Model B	1-1/2" to 2" threaded connections 1-1/2" to 8" flanged connections Flow rates of 68 to 1750 gpm Cast Iron, ductile iron, bronze, steel, stainless steel Setting available from 55°F to 240°F See Form 936
Model C	1/2" to 1-1/2" threaded connections 1-1/2" flanged connections Flow rates of 9 to 54 gpm Cast iron, bronze, aluminum, steel or stainless steel Settings available from 65°F to 230°F See Form 193
Model D	8" flanged connections only Flow rates of 1500 to 2800 gpm Cast iron, ductile iron, bronze, steel housings Settings available from 50°F to 230°F See Form 633
Model E	1-1/4" and 1-1/2" threaded or flanged connections Flow rates of 40 to 75 gpm Cast iron, steel or stainless steel housings Settings available from 85°F to 237°F See Form 594
Model H	4", 5" and 6" flanged connections Flow rates of 345 to 1350 gpm Steel or stainless steel housings Setting available from 55°F to 240°F See Form 898
Model J	1/2" and 3/4" threaded connections Flow rates of 2-20 gpm Aluminum or bronze housings Settings from 65-235°F See Form 972
Mode G	Externally actuated (pneumatic or electric) 2" to 16" flanged connections Flow rates of 37 to 8300 gpm Cast iron, ductile iron, bronze, steel, stainless steel See Forms 1166 and 1242

AMOT USA
401 First Street
Richmond, CA 94801
Tel: +1 510 236-8300
Fax: +1 510 234-9950

AMOT
Western Way
Bury St. Edmunds IP33 3SZ
Suffolk England
Tel: +44 1284 762222
Fax: +44 1284 760256

AMOT SINGAPORE
10 Eunos Road 8 # 12-06
Singapore Post Centre
Singapore 408600
Tel: +65 6293 4320
Fax: +65 6293 3307

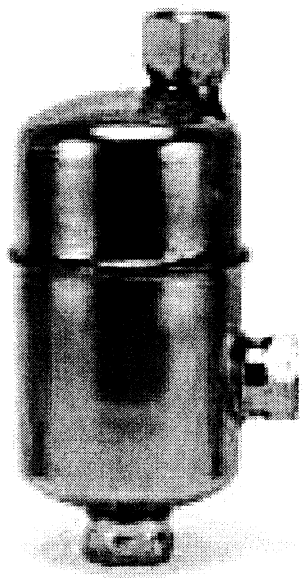
Models 11-AV, 22-AV & 13-AV

Free Floating Lever Air/Gas Vents
Luft/Gas-Entlüfter mit Freischwingendem Hebelmechanismus
Purgeurs d'Air/de Gaz à Levier Libre Non-Guidé
Purgadores de Aire y Gas con Palanca de Flotación Libre
Ontluchters - met Bolvlotter
Eliminatori d'Aria e Gas da Liquidi in Pressione

These instructions should be used by experienced personnel !
Diese Gebrauchsanweisung ist durch Fachpersonal zu benutzen !
Ces instructions devraient être utilisées par du personnel expérimenté !
¡Estas instrucciones deben ser utilizadas por personal experimentado !
Onderhoud uitsluitend uit te voeren door ervaren personeel !
Queste istruzioni devono essere utilizzate da personale esperto !

PRODUCT DESCRIPTION - PRODUKTBESCHREIBUNG - DESCRIPTION DU PRODUIT
DESCRIPCION DEL PRODUCTO - PRODUKT OMSCHRIJVING - DESCRIZIONE DEL PRODOTTO

Model shown on the picture: 22-AV - Die Abbildung zeigt das Modell 22-AV - Photo: modèle 22-AV
Modelo mostrado en la fotografía: 22-AV - Model op foto: 22-AV - Modello in figura: 22-AV



GB Armstrong Stainless Steel Free Floating Lever Air/Gas Vent
2 Connections (Bottom Inlet - Top Outlet) or 3 Connections (Side Inlet - Top Gas Outlet - Bottom Liquid Outlet)

D Armstrong Luft/Gas-Entlüfter aus Schmiedestahl mit Freischwingendem Hebelmechanismus
2 Anschlußarten (Einlaß Unten - Auslaß Oben) oder 3 Anschlußarten (Seitlicher Einlaß - Entlüftung Oben - Abfluß Unten)

F Purgeur d'Air/de Gaz en Acier Inoxydable, à Levier Libre et Non-Guidé
2 Raccordements (Entrée par le Bas - Sortie vers le Haut) ou 3 Raccordements (Entrée sur le côté - Évent Dessus - Sortie Liquide vers le Bas)

E Purgador de Aire y Gas con Palanca de Flotación Libre Armstrong en Acero Inoxidable
2 Conexiones (Entrada Inferior - Salida Superior) o 3 Conexiones (Entrada Lateral - Salida de Gas Superior - Salida de Líquido Inferior)

NL Armstrong Roestvrijstalen Ontluchter met zwevend draaipunt
2 Aansluitingen (Bodem Inlaat - Top Uitlaat) of 3 Aansluitingen (Zijde Inlaat - Top Ontluchting - Bodem Vloeistof Uitlaat)

I Eliminatore d'Aria e Gas da Liquidi in Pressione - In Acciaio Inossidabile
2 Connessioni (Entrata al Fondo - Uscita in Alto) o 3 Connessioni (Entrata Laterale - Uscita Aria in Alto - Scarico Liquido/Bilanciamento sul Fondo)

For detailed material specifications, options, approximate dimensions and weights, see Armstrong literature or consult your local Representative.

Für detaillierte Werkstoffangaben, Zubehör, Abmessungen und Gewichte, sehen Sie die Armstrong Datenblätter oder fragen Sie Ihre Armstrong-Vertretung.

Pour toute spécification détaillée des matières, options, dimensions et poids, veuillez vous référer à la littérature Armstrong ou prendre contact avec votre Représentant local.

Para especificaciones de materiales detalladas, opciones, dimensiones aproximadas y pesos, ver catálogos Armstrong o consultar con su Representante local.

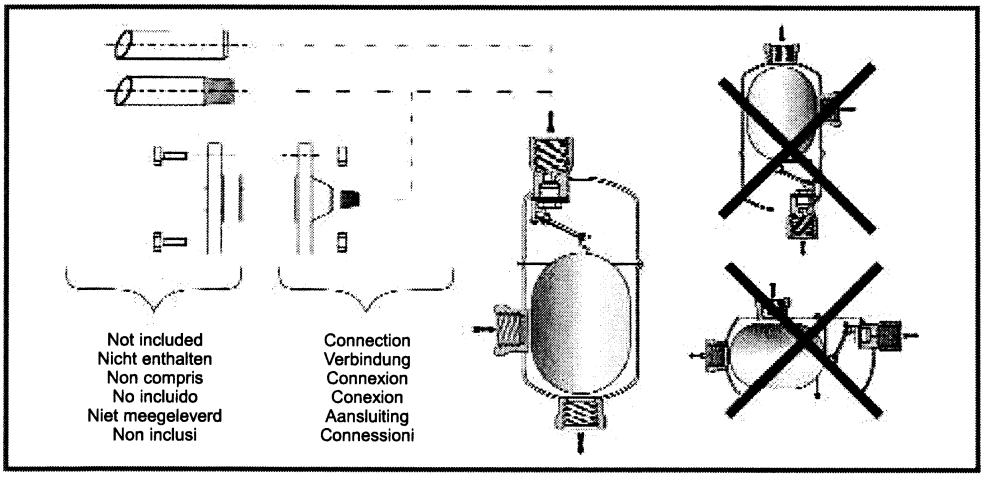
Voor gedetailleerde materiaal specificaties, afmetingen en gewichten, zie de Armstrong documentatie of neem contact op met uw plaatselijke Vertegenwoordiger.

Per la specifica dettagliata dei materiali, accessori opzionali, dimensioni e pesi approssimativi, vedere la documentazione appropriata o contattare il Distributore locale.

INSTALLATION - INSTALLATIONSANWEISUNG - INSTALLATION
INSTALACION - INSTALLATIE - INSTALLAZIONE

Model shown on the drawing: 22-AV - Die Zeichnung zeigt das Modell 22-AV - Schéma: modèle 22-AV
Modelo mostrado en el dibujo: 22-AV - Model op tekening: 22-AV - Modello in figura: 22-AV

Possible connections: screwed, socketweld or flanged - Mögliche Anschlußarten: Muffengewinde, Schweißmuffen oder Flansche
Raccordements possibles: taraudé, à souder ou à brides - Conexiones posibles: roscada, SW o bridada
Mogelijke aansluitingen: draad, las of flens - Connessioni disponibili: filettate, tasca a saldare o flangiate



START-UP PROCEDURE (Side inlet - Top gas outlet - Bottom liquid outlet) - INBETRIEBNAHME (seitlicher Einlaß - Entlüftung oben - Abfluß unten) PROCEDURE DE DEMARRAGE (Entrée sur le côté - Évent dessus - Sortie liquide vers le bas) - PROCEDIMIENTO DE PUESTA EN MARCHA (Entrada lateral - Salida de gas superior - Salida de líquido inferior) - OPSTARTPROCEDURE (Zijde inlaat - Top ontluchting - Bodem vloeistof uitlaat) - PROCEDURA D'AVVIAMENTO (Entrata laterale - Uscita aria in alto - Scarico liquido/Bilanciamento sul fondo)

For detailed hookups and adapted start-up and shut-down procedures, see Armstrong literature or consult your local Representative.

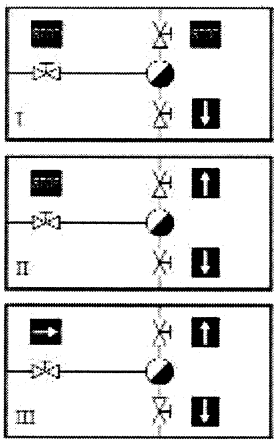
Für detaillierte Informationen über Installation, Inbetriebnahme und Außerbetriebnahme sehen Sie die Armstrong Datenblätter oder fragen Sie Ihre Armstrong-Vertretung.

Pour plus de détails à propos des procédures de démarrage et d'arrêt, ainsi que pour l'installation, veuillez vous référer à la littérature Armstrong ou prendre contact avec votre Représentant local.

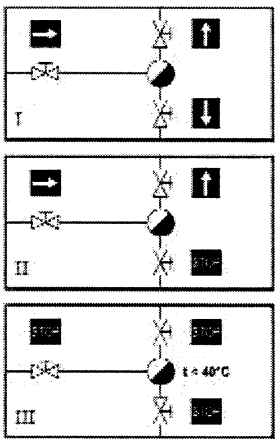
Para posibilidades de conexionado y procedimientos de parada y puesta en marcha, ver catálogos Armstrong o consultar con su Representante local.

Voor gedetailleerde montage en installatie instructies zie het betreffende Armstrong documentatieblad of neem contact op met uw plaatselijke Vertegenwoordiger.

Per procedure dettagliate di collegamento, d'avviamento e di fermata, vedere la documentazione Armstrong o consultare il Distributore locale.



SHUT-DOWN PROCEDURE (Side inlet - Top gas outlet - Bottom liquid outlet) - AUßERBETRIEBNAHME (seitlicher Einlaß - Entlüftung oben - Abfluß unten) - PROCEDURE D'ARRET (Entrée sur le côté - Évent dessus - Sortie liquide vers le bas) - PROCEDIMIENTO DE PARADA (Entrada lateral - Salida de gas superior - Salida de líquido inferior) - UIT BEDRIJFNAME (Zijde inlaat - Top ontluchting - Bodem vloeistof uitlaat) - PROCEDURA DI FERMATA (Entrata laterale - Uscita aria in alto - Scarico liquido/Bilanciamento sul fondo)



MODELS WITH CE MARKING - MODELLE MIT CE KENNZEICHNUNG - MODELES MARQUES CE
MODELOS CON LA MARCA CE - MODELLEN MET CE KEUR - MODELLI CON MARCATURA CE

Model	PMA	TMA	Volume	Orifice	PMO
Modell	PMA	TMA	Volumen	Ventilgröße	PMO
Modèle	PMA	TMA	Volume	Orifice	PMO
Modelo	PMA	TMA	Volumen	Orificio	PMO
Model	PMA	TMA	Volume	Klepdoorlaat	PMO
Modello	PMA	TMA	Volume	Orifizio	PMO
13-AV	39 bar	260°C	1,46 l	Check on the order Entsprechend Ihrer Bestellung Voir la commande Chequear con el pedido Kijk op de order en documentatie Verificare su ordine	Depends on orifice Von der Ventilgröße abhängig Dépend de l'orifice Depende del orificio Afhankelijk van klepdoorlaat Dipende dall'orifizio

Armstrong International S.A., Parc Industriel des Hauts-Sarts, 4040 Herstal - Belgium Ph: +32.4.240.90.90 Fax: +32.4.240.40.33

BALDOR

BALDOR • RELIANCE

Product Information Packet

SUNDYNE CORP

M7041T

2//1.5HP,960/1160RPM,3PH,50/60HZ,184T

Part Detail							
Revision:	R	**Status:**	PRD/A	**Change #:**		**Proprietary:**	No
Type:	AC	**Prod. Type:**	3636M	**Elec. Spec:**	36WGY788	**CD Diagram:**	
Enclosure:	XPFC	**Mfg Plant:**		**Mech. Spec:**	36N004	**Layout:**	
Frame:	184T	**Mounting:**	F1	**Poles:**	06	**Created Date:**	
Base:	RG	**Rotation:**	R	**Insulation:**	B	**Eff. Date:**	08-20-2009
Leads:	9#16	**Literature:**		**Elec. Diagram:**		**Replaced By:**	

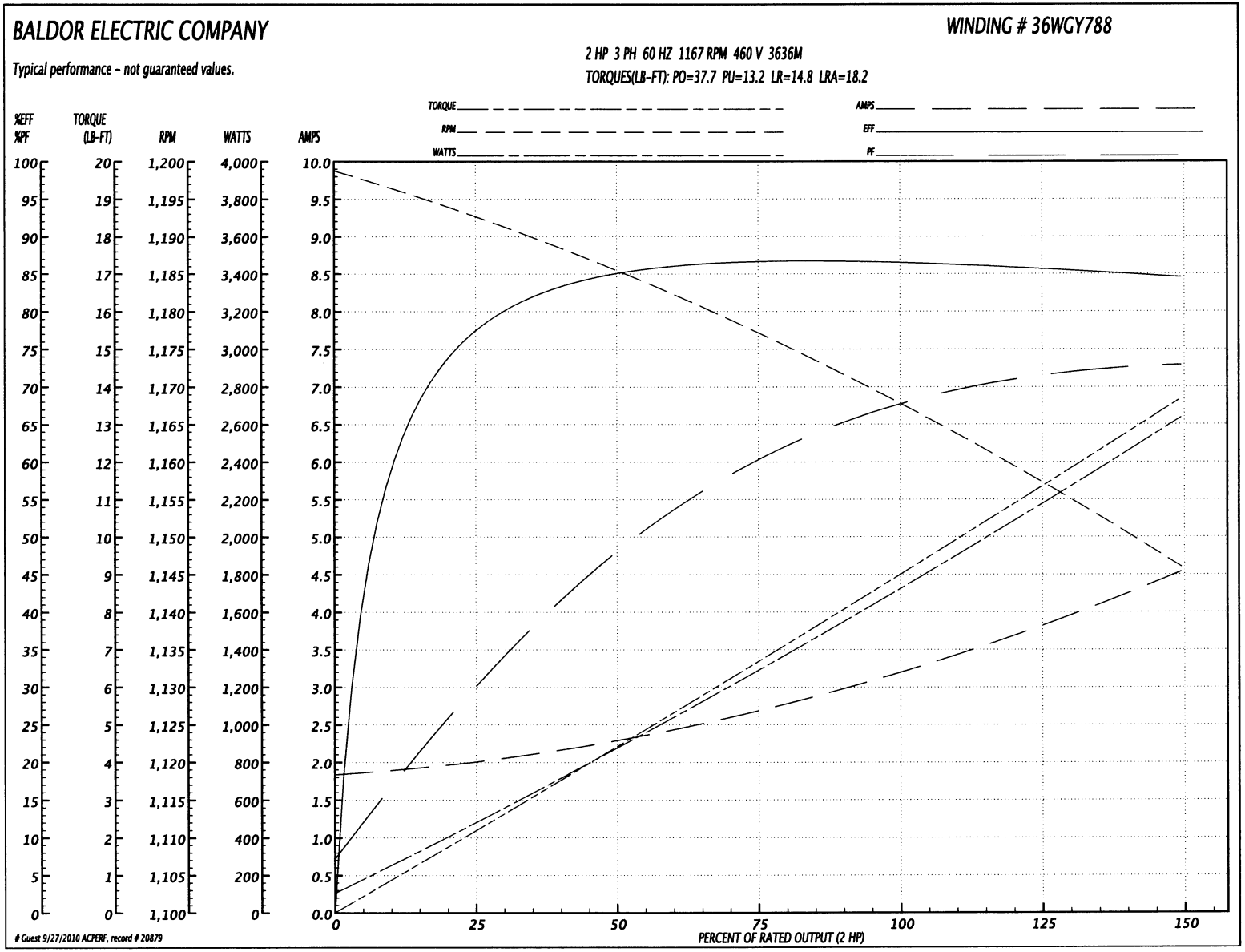
Nameplate NP1426XP					
NO.		**CC**	010A		
SER.					
SPEC.	36N004Y788H1				
CAT.NO.	M7041T				
HP	2//1.5	**T. CODE**	T3C		
VOLTS	230/460//190/380				
AMPS	6.6/3.3//6/3				
RPM	1160//960				
HZ	60//50	**PH**	3	**CL**	B
SER.F.	1.00	**DES**	B	**CODE**	J
RATING	40C AMB-CONT				
FRAME	184T	**NEMA-NOM-EFF**	86.5	**PF**	67
USABLE AT 208V	6.8				

Parts List		
Part Number	**Description**	**Quantity**
SA047254	SA 36N004Y788H1	1.000 EA
RA042525	RA 36N004Y788H1	1.000 EA
35CB3001A02SP	EXPL PROOF CONDUIT BOX, 3/4"PIPE TAP LEA	1.000 EA
11XW1032G06	10-32 X .38, TAPTITE II, HEX WSHR SLTD U	1.000 EA
HW3001B01	BRASS CUP WASHER, FOR #8 SCREW	1.000 EA
36EP3700A01	FR ENDPLATE, MACH	1.000 EA
HW4500A19	1/4-28X1/4 SLOTTED PLUG F/S	2.000 EA
HW5100A05	WVY WSHR F/205 & 304 BRGS	1.000 EA
36EP3701A01	PU ENDPLATE, MACH	1.000 EA
HW4500A19	1/4-28X1/4 SLOTTED PLUG F/S	2.000 EA
XY3816A12	3/8-16 FINISHED NUT	4.000 EA
51XB1214A16	12-14X1.00 HXWSSLD SERTYB	1.000 EA
36FH4009A02	IEC FH NO GREASER, W/ AUTOPHERETIC PRIME	1.000 EA
51XW1032A06	10-32 X .38, TAPTITE II, HEX WSHR SLTD S	3.000 EA
35CB3500A01SP	CONDUIT BOX LID, MACH	1.000 EA
10XN2520A16	1/4-20 X 1 HEX HEAD CAP SCR, ZINC PLATED	4.000 EA
HW1001A25	LOCKWASHER 1/4, ZINC PLT .493 OD, .255 I	4.000 EA
HW2501E16	KEY, 1/4 SQ X 1.750	1.000 EA
HA7000A02	KEY RETAINER RING, 1 1/8 DIA, 1 3/8 DIA	1.000 EA
85XU0407S04	4X1/4 U DRIVE PIN STAINLESS	6.000 EA
NP0018	NP- XP CONDUIT BOX	1.000 EA
MJ1000A02	GREASE, POLYREX EM EXXON	0.050 LB
36FN3000A01SP	EXFN, PLASTIC, 7.00 OD, .912 ID	1.000 EA
MG1025Z20	ACTIVATOR WILKOFAST 060.32	0.010 GA

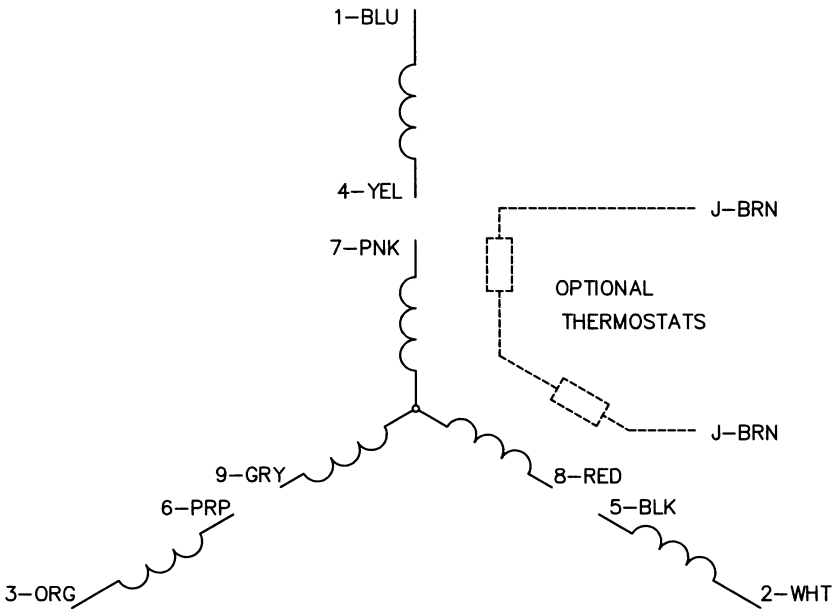
Parts List (continued)		
Part Number	**Description**	**Quantity**
MG1025G29	PAINT 789.205 DARK GRAY METALLIC (USE W/	0.022 GA
HA3105A09	THRUBOLT 3/8-16 X 12.000	4.000 EA
LB1119	WARNING LABEL	1.000 EA
LB1125C04	STD-E (STOCK CTN LABEL STD-E WITH FLAG)	1.000 EA
LC0145B01	CONNECTION LABEL	1.000 EA
NP1426XP	UL/CSA, CLI GP-D,CLII GP-F&G,CC	1.000 EA
36PA1001	PACKAGING GROUP	1.000 EA

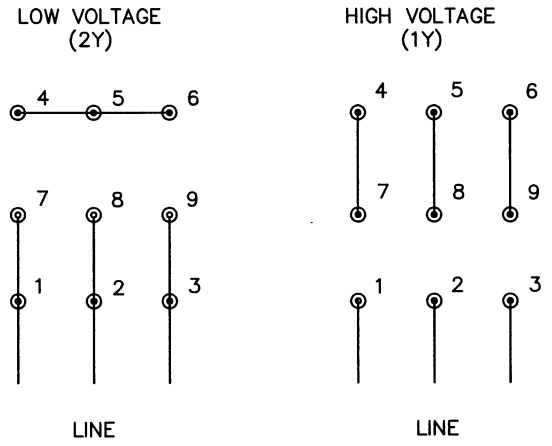
Performance Data at 460V, 60Hz, 2.0HP (Typical performance - Not guaranteed values)							
General Characteristics							
Full Load Torque:	9.13 LB-FT			**Start Configuration:**		DOL	
No-Load Current:	1.85 Amps			**Break-Down Torque:**		37.7 LB-FT	
Line-line Res. @ 25°C.:	5.01 Ohms A Ph / 0.0 Ohms B Ph			**Pull-Up Torque:**		13.2 LB-FT	
Temp. Rise @ Rated Load:	37 C			**Locked-Rotor Torque:**		14.8 LB-FT	
Temp. Rise @ S.F. Load:				**Starting Current:**		18.2 Amps	
Load Characteristics							
% of Rated Load	**25**	**50**	**75**	**100**	**125**	**150**	**S.F.**
Power Factor:	32.0	49.0	60.0	67.0	71.0	73.0	0.0
Efficiency:	77.9	84.8	86.6	86.7	85.8	84.4	0.0
Speed:	1192.0	1185.0	1177.0	1167.0	1157.0	1146.0	0.0
Line Amperes:	2.0	2.31	2.7	3.25	3.86	4.52	0.0

Performance Graph at 460V, 60Hz, 2.0HP Typical performance - Not guaranteed values



CD0005





NOTES:

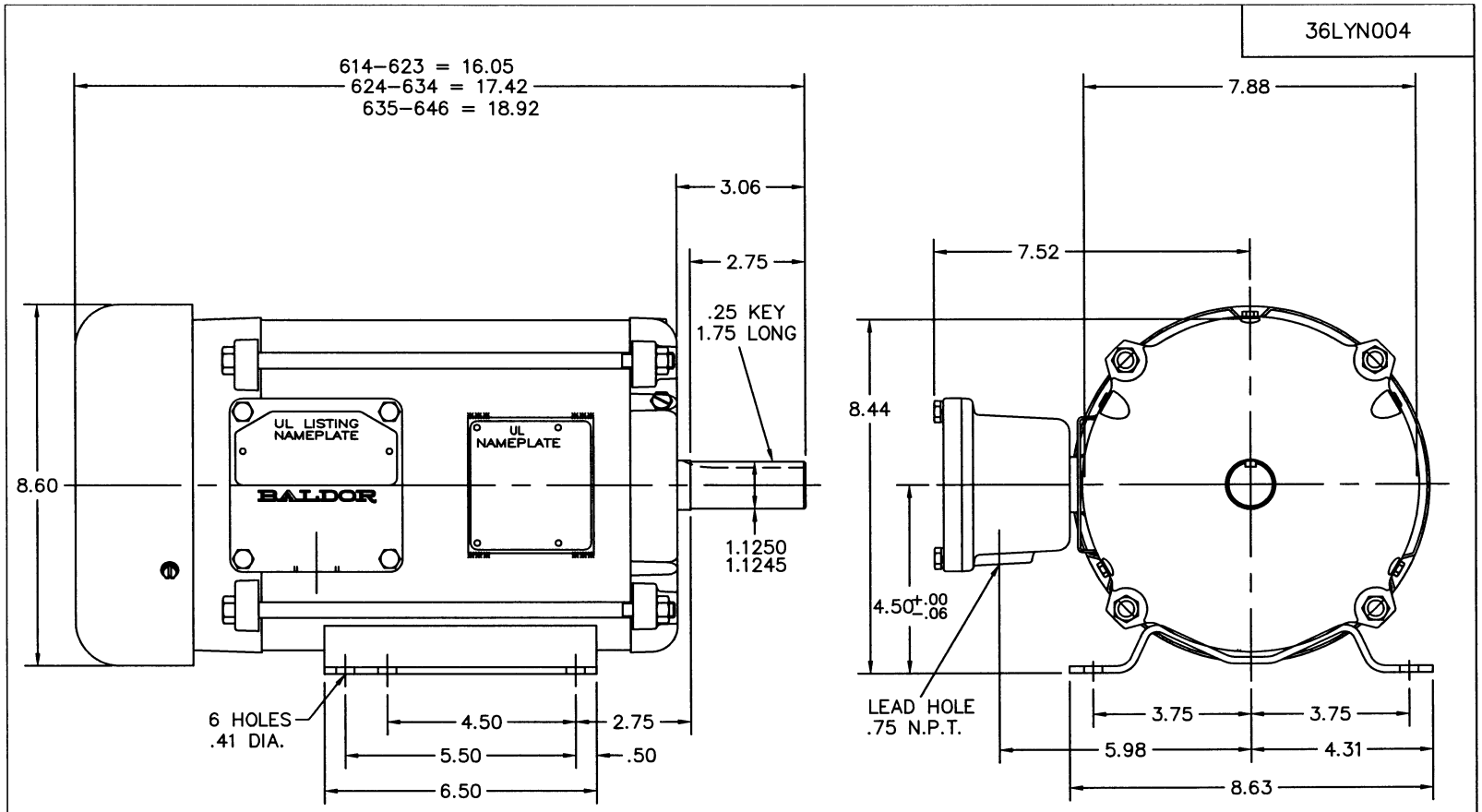
1. INTERCHANGE ANY TWO LINE LEADS TO REVERSE ROTATION.
2. OPTIONAL THERMOSTATS ARE PROVIDED WHEN SPECIFIED.
3. ACTUAL NUMBER OF INTERNAL PARALLEL CIRCUITS MAY BE A MULTIPLE OF THOSE SHOWN ABOVE.
4. LEAD COLORS ARE OPTIONAL. LEADS MUST ALWAYS BE NUMBERED AS SHOWN.

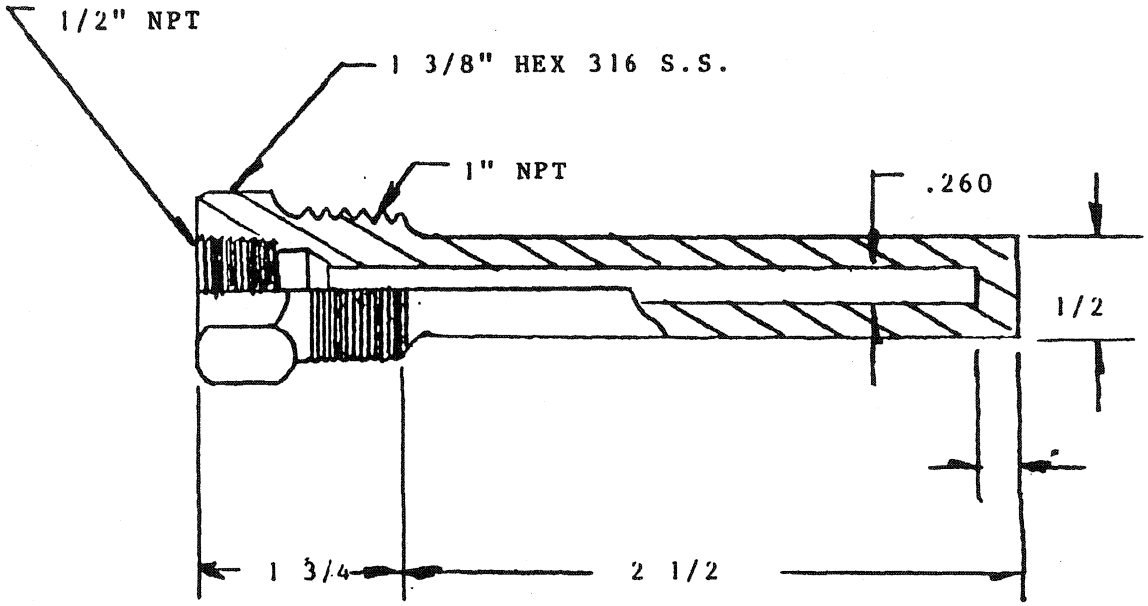
CD0005

REV. DESC: REVISE TO SHOW OPTIONAL COLORS			
REV. LTR: E	BY: JLP	REVISED: 01/19/99 10:15	TDR: 0171435
CD0005		FILE: AAA00005140	MDL: –
		MTL: –	

BALDOR ELECTRIC Co.

3PH, DV, 9 LEADS

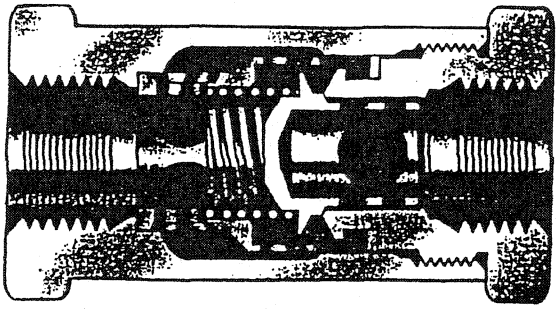

36LYN004
614–623 = 16.05
624–634 = 17.42
635–646 = 18.92
3.06
2.75
.25 KEY
1.75 LONG
8.60
UL LISTING NAMEPLATE
BALDOR
UL NAMEPLATE
1.1250
1.1245
6 HOLES
.41 DIA.
4.50
2.75
5.50
.50
6.50
7.88
7.52
8.44
4.50 +.00 -.06
LEAD HOLE
.75 N.P.T.
3.75
3.75
5.98
4.31
8.63
UL CLASS I – GROUP D – CLASS II – GROUPS F & G
CUST. NAME
CUST. P.O.
CERTIFIED BY
MODEL
INSUL
AMB
H.P.
MTG
TYPE
R.P.M.
VOLTS
ENCL
PHASE
FREQ
FRAME
REV. DESC: CHG'D FAN HOUSING TO 36FH4009A02
REV. LTR: F
BY: JED
REVISED: 06/05/99 10:52
TDR: 0183314
FILE: AAA00004620
MDL: –
MTL: –
BALDOR ELECTRIC Co.
HORZ 182–4T TEFC X36M CL I–GP D–CL II–GP F&G
36LYN004



PART # 41-147

OUR # 1"-B-260-U2 1/2-316 S.S.

Wherever perfect sealing is required, the proven reliability of Circle Seal precision valves provides the one complete answer—a combination of absolute leakproof sealing when closed and virtually maintenance-free operation.



CIRCLE SEAL

precision valves

CHECK VALVES

200 Series
0-3000 PSI
H200 Series
0-6000 PSI

DESIGNED TO PROVIDE PERFECT SEALING WITH VIRTUALLY ANY LIQUID OR GAS SERVICE

The principle of the Circle Seal Check Valve is outstanding in its simplicity—unequaled in its dependability. The wide range of adaptability of Circle Seal Check Valves provides in one check valve all of the qualities which are of primary importance in modern concepts of fluid systems. The patented sealing principle effects complete leakproof closing under all pressure conditions.

OPERATING CHARACTERISTICS

NO LEAKAGE WHATSOEVER AT ANY DIFFERENTIAL PRESSURE—Circle Seal Check Valves are absolutely bubble tight in leakage tests.

QUICK OPENING—POSITIVE CLOSING—Even at extremely low pressure differential. Opening pressures are as low as .1 psi. The poppet closes at zero flow before the return flow starts.

MAINTENANCE FREE DEPENDABILITY—The resilient "O" Ring absorbs the shock and automatically compensates for normal wear. There are no special seats which require replacing or refacing.

EXCELLENT FLOW CHARACTERISTICS—The streamlined poppet and full ports offer minimum restriction to flow. The spring retainer has ample ports to allow full flow even when surge pressure forces the poppet against the stop.

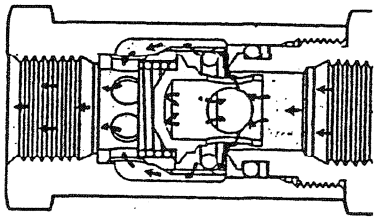
NO CHATTER OR HAMMER—The pulsating action of shock waves and hammer is absorbed by minor expansion and contraction of the "O" Ring. The use of the resilient "O" Ring seal together with the careful poppet design insures cushioned, quiet closing.

SATISFACTORY PERFORMANCE UNDER ADVERSE CONDITIONS—Foreign particles in the fluid stream do not prevent proper seating. Temperature variations do not affect proper functioning of the valves. Can be supplied to withstand temperatures from -320° to 500°F.

ADAPTABLE TO MOST FLUIDS—Metallic and non-metallic parts can be supplied to withstand the action of most commonly used exotic fluids. No special wear resisting materials are required, eliminating the problems of differential expansion and electrolytic action from dissimilar metals.

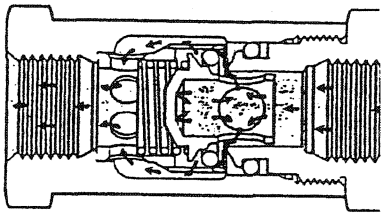
COMPACT, EASILY INSTALLED—Efficient straight line design reduces weight and size. Permits mounting in any position. All valves are marked with an arrow to indicate direction of flow.

HOW IT WORKS



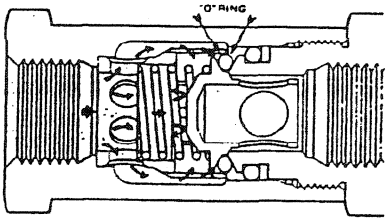
OPEN

Full flow passages offer minimum r
striction to flow. Spring is complete
removed from flow path.



CLOSING

Floating "O" Ring automatically estal
lishes line contact with conical met
surfaces of poppet and seat to cushic
closing and insure perfect sealing.



CLOSED

"O" Ring only seals. Full pressure loa
is carried by metal-to-metal seat. Ir
creasing pressure increases sealin
efficiency—metal seat prevents an
possibility of deformation or extrusio
of "O" Ring.

JAMES, POND & CLAR
Division of Circle Seal Corporation

CHECK VALVES

TECHNICAL DATA

200 Series OPERATING PRESSURE

ALUMINUM 1/8" to 1-1/2" .. 0-3000 psi (to 200°F)
BRASS 1/8" to 1-1/2" ..... 0-3000 psi (to 300°F)
BRASS 2" ..... 0-1500 psi (to 300°F)
STEEL 1/8" to 2" ..... 0-3000 psi (to 300°F)
STAINLESS STEEL ⅛" to 2"... 0-3000 psi (to 450°F)

H200 Series OPERATING PRESSURE

ALUMINUM–
(Tube) 1/4"-1-1/4" ..... 0-6000 psi (to 200°F)
(Pipe) 1/8"-1" ..... 0-6000 psi (to 200°F)
BRASS–
(Tube) 1/4"-1-1/4" ..... 0-5000 psi (to 300°F)
(Pipe) 1/8"-1" ..... 0-5000 psi (to 300°F)
STEEL–
(Tube) 1/4"-1-1/4" ..... 0-5000 psi (to 300°F)
(Pipe) 1/8"-1" ..... 0-5000 psi (to 300°F)
STAINLESS STEEL–
(Tube) 1/4"-1-1/4" ..... 0-6000 psi (to 450°F)
(Pipe 1/8"-1" ..... 0-6000 psi (to 450°F)

PROOF PRESSURE... 1-1/2 times operating pressure

BURST PRESSURE... 2-1/2 to 4 times operating pressure

LEAKAGE from Zero Pressure to max. operating pressure ..... Zero
(Exception: 220A, 220B and 220S with gases–5 cc/min. Max. @ 0 to 50 psi; 1 cc/min. above 50 psi.)

CONSTRUCTION

BODY ..... Bar stock
STEM ..... 302 Cres.
SEALS..... Synthetic Rubber or Teflon

SPECIAL MATERIALS, END CONNECTIONS, "O" RINGS AND SPRINGS

200 Series Check Valves can be manufactured of materials other than those shown in tables, or with special end connections (in production quantities only).
Special "O" Rings may be required for service not shown in the Model Number and Service Recommendations Table.
Consult local representative or the factory for service not shown or for valves of special materials or with special end connections.

VALVES WITH SPECIAL SPRINGS CAN BE FURNISHED TO ORDER

MINIMUM CRACKING PRESSURE AVAILABLE . 0.1 psi
MAXIMUM STANDARD CRACKING PRESSURE . 8.0 psi
NOTE: Cracking pressure is defined as pressure at which flow is 5cc/min., except for 220 Series for which flow is approximately .02 cfm. When ordering a cracking pressure within the standard range or below the standard range of cracking pressure, the dash number is a "maximum." Example: 279A-4TT-3 (C.P. tolerance will be +0%, -50%). When ordering a cracking pressure equal to or greater than the upper limit of the standard C.P. shown in the Service Recommendations Table C.P. tolerance will be ±10%. Example: 299A-4TT-5.
Cracking pressures over 8 psi should not be specified without consulting the factory. Where 200 Series valves are supplied with higher cracking pressures, a shroud ring may be used to confine the "O" Ring.

SERVICE RECOMMENDATIONS

MODEL NUMBER	O-RING MATERIALS	OPERATING TEMPERATURES	CRACKING PRESSURE	SERVICE
249	Buna N (MIL-P-5510)	-65° to 212°F	2-4 psi	Air, Acetylene, Alcohol, Ammonia, Carbon Dioxide, Gasoline, Helium, Hydrogen, Hydraulic Fluid (Mineral Base), Natural Gas, Nitrogen, Water.
259	Buna N (MIL-P-25732)	-65° to 275°F	.5-1 psi	Same as 299 (which is preferred except where low cracking pressure is required and where surge flows or heavy pulsating flows not encountered).
269	Buna N (MIL-P-5315)	-40° to 250°F	.5-1 psi	Aircraft Fuels, Aromatic Fuels, Gasoline, Kerosene, Natural Gas.
253	Neoprene (AMS 3209)	-40° to 300°F	.5-1 psi	Oxygen, Acetylene, Freon 12, Freon 22.
224	Silicone (AMS 3304)	-70° to 500°F	.5-1 psi	Air, Vacuum, Water.
264	Fluorosilicone (MIL-R-25988)	-80° to 350°F	.5-1 psi	Air, Aircraft & Jet Fuel, OS-45, Vacuum, Hydraulic, Lube Oil.
262	Ethylene Propylene	-65° to 300°F	2-4 psi	Skydrol, Air, Steam.
232	Viton (MIL-R-83248)	-40° to 400°F	.5-1 psi	Aircraft & Jet Fuels, Aromatics, Carbon Tet.
220	Teflon (MIL-12-8791)	-100° to 450°F	8 psi max.	Chemically inert. Suitable for nearly all fluids.
K220T	Teflon (MIL-R-8791)	-320° to 165°F	8 psi max.	Especially assembled & LOX cleaned.
280T	Teflon (MIL-R-8797)	-320° to 165°F	8 psi max.	No cryogenic processing.

HOW TO ORDER

PART NUMBER DESIGNATION — H 249 S-4TT (030)

VARIATION
H—Modified construction for 6000 psi service (1/4"-1" tube & 1/8"-1" pipe size)
K—Cryogenic service (stainless steel valves only) (Specially manufactured, cleaned and tested for cryogenic temperatures)
P—Modified construction for high pressure gas or liquid service where surge flows are encountered. (Standard on Models 299 & 262)

BASIC MODEL NUMBER

MATERIAL
A —Aluminum 2024-T351
A1—Aluminum 6061-T6
B —Brass
S —Steel
T —Stainless Steel 303
T1—Stainless Steel 316

END CONNECTIONS—Inlet/Outlet
(Pipe in 1/8's, Tube in 1/16's)
B—Tube, Female AND 10050*
C—Circle Lok
E—Tube, Male, MS33514
P—Pipe, Female, Modified Dry Seal
T—Tube, Male MS33656
U—Bulkhead, MS33657
(Female tube inlet and outlet not available in Aluminum H200 Series)
*Female tube per MS33644 Designated by the Letter "J."

DESIGNATES ORIFICE DIAMETER
In inches in poppet head.

NON-STANDARD CRACKING PRESSURE

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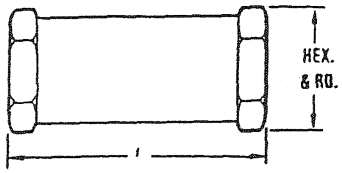
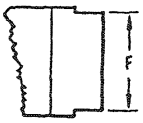
POST OFFICE BOX 3666

PP-FEMALE PIPE





OPTIONAL*

DIMENSIONS
Female Pipe Inlet and Outlet

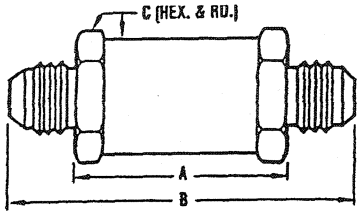
PIPE SIZE	L	HEX. & RD.	F*
1/8	1-11/16	13/16	–
1/4	2-1/4	1	–
3/8	2-7/16	1-1/8	–
1/2	2-15/16	1-1/2	1-1/4"
3/4	3-3/8	1-3/4	1-1/2"
1	4	2	1-3/4"
1-1/4	4-1/2	2-3/4	–
1-1/2	5-3/8	2-3/4	2-1/4"
2	6-1/8	3-1/2	2-3/4"

*Across Flats—optional design based on stock availability.

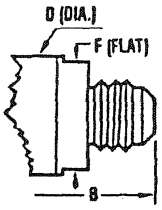
VALVE WEIGHTS
(in pounds)

PIPE SIZE	ALUMINUM	BRASS	STEEL (Including Stainless)
1/8	.05	.15	.14
1/4	.12	.36	.34
3/8	.15	.46	.43
1/2	.32	.98	.92
3/4	.49	1.50	1.41
1	.73	2.25	2.11
1-1/4	1.60	5.00	4.80
1-1/2	1.73	5.34	4.97
2	2.60	8.00	7.50

TT-MALE TUBE



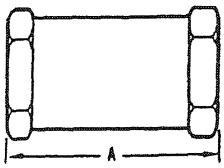
200-*TT SHOWN

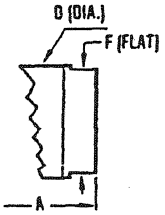


TUBE SIZE		A ±.030	B (ref.)	C	OPTIONAL DIMENSIONS D	OPTIONAL DIMENSIONS F	WEIGHT (lbs.) ALUMINUM	WEIGHT (lbs.) STEEL
200-TT	3/16	.97*	1.93*	.56*	–	–	.03	.08
	1/4	1.53	2.63	.75	–	–	.07	.18
	5/16	1.53	2.63	.813	–	–	.07	.20
	3/8	1.53	2.64*	.813	–	–	.07	.20
	1/2	1.81	3.12	1.00	–	–	.13	.35
	5/8	2.06	3.58	1.12	–	–	.18	.49
	3/4	2.50	4.23	1.50	1.75	1.50	.35	1.00
	1	2.87	4.69*	1.75	2.00	1.75	.53	1.50
	1-1/4	3.37	5.29	2.00	2.25	2.00	.79	2.30
	1-1/2	4.04	6.20*	2.75	2.75	2.25	1.80	5.22

*Exceptions: 200T-3TT ("A" dim.) is 1.00; ("B" dim.) is 1.96; ("C" dim.) is .625. "B" dimensions: (200T-6TT) is 2.63; (200T-16TT) is 4.70; (200T-24TT) is 6.21.

BB-FEMALE TUBE

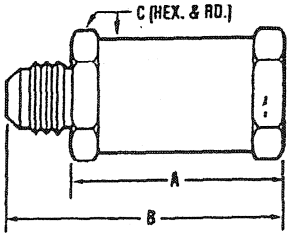


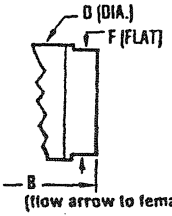


OPTIONAL*

200-BB	1/4	1.98	–	.75	–	–	.06	.16
	5/16	2.07	–	.81	–	–	.08	.22
	3/8	2.44	–	.81	–	–	.08	.22
	1/2	3.06	–	1.00	–	–	.13	.37
	5/8	3.42	–	1.12	–	–	.18	.50
	3/4	3.83	–	1.50	1.75	1.50	.34	.88
	1	4.37	–	1.75	2.00	1.75	.52	1.50
	1-1/4	4.99	–	2.00	2.25	2.00	.68	2.18
	1-1/2	5.75	–	2.75	2.75	2.25	2.05	5.95

SPECIAL END CONNECTION





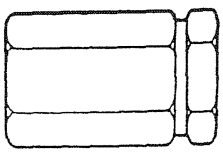
OPTIONAL*

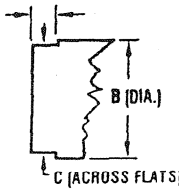
TUBE SIZE		A ±.030	B (ref.)	C	OPTIONAL DIMENSIONS D	OPTIONAL DIMENSIONS E	WEIGHT (lbs.) ALUMINUM	WEIGHT (lbs.) STEEL
200-8T	1/4	1.53	2.08	.75	–	–	.06	.15
	3/8	1.98	2.54	.81	–	–	.08	.21
	1/2	2.37	3.04*	1.00	–	–	.12	.34
	3/4	3.00	3.86	1.50	1.75	1.50	.32	.96
	1	3.50	4.41	1.75	2.00	1.75	.50	1.46
	1-1/4	3.97	4.93	2.00	2.25	2.00	.68	1.90
	1-1/2	4.73	5.81	2.75	2.75	2.25	1.82	5.31

*Exceptions: "B" dimensions: (200T-6BT) is 3.03; (200T-4TB) is 2.56.

200-TB	1/4	1.98	2.53*	.75	–	–	.07	.20
	5/16	1.98	2.53	.81	–	–	.07	.20
	3/8	1.98	2.54	.81	–	–	.08	.21
	1/2	2.49	3.15	1.00	–	–	.14	.37
	5/8	2.80	3.56	1.12	–	–	.18	.50
	3/4	3.33	4.19	1.50	1.75	1.50	.37	1.07
	1	3.74	4.65	1.75	2.00	1.75	.55	1.60
	1-1/4	4.39	5.35	2.00	2.25	2.00	.80	2.30
	1-1/2	5.06	6.14	2.75	2.75	2.25	2.03	5.90

H200 SERIES





OPTIONAL* CONFIGURATION

H200 SERIES DIMENSION

Refer to 200 Series Pipe or Tube dimensions for overall length

MATERIAL	ALUMINUM	BRASS	STAINLESS STEEL	STEEL		
END CONNECTION	STOCK SIZE HEX	STOCK SIZE HEX	STOCK SIZE HEX	"B" DIA.	"C" ACROSS FLATS ±.015	"F" ±.015
3T&3C	.625	.625	.625	.650	.560	.220
4T,4B	.875	.875	.812	.875	.750	.280
1P;5&6T,6B;1M	.937	.937	.875	.960	.813	.280
2P;8T,8B;2M	1.125	1.250	1.125	1.250	1.000	.300
3P;10T,10B;3M	1.375	1.375	1.250	1.375	1.125	.350
4P;12T,12B;4M	1.750	1.875	1.750	1.875	1.625	.450
6P;16T,16B;6M	2.000	2.250	2.000	2.125	1.875	.500
8P;20T,20B;8M	2.250	2.500	2.250	2.500	2.125	.620

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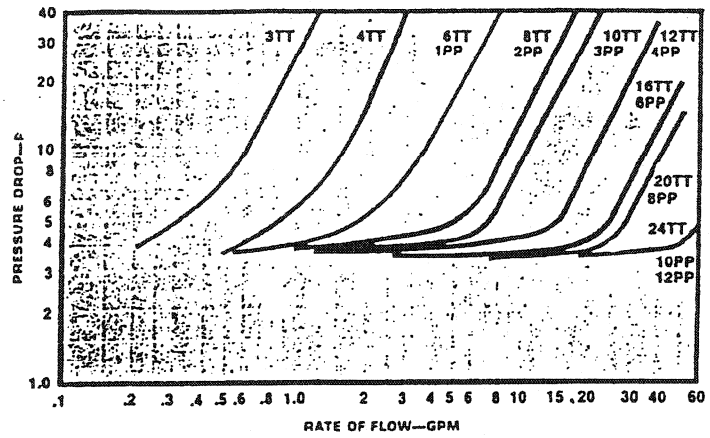
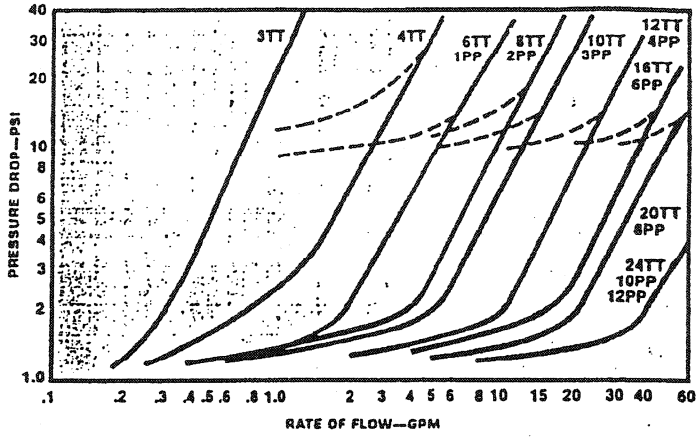
TYPICAL FLOW CURVES

MODEL 299-262
HYDRAULIC FLUID (MIL-H-5606)

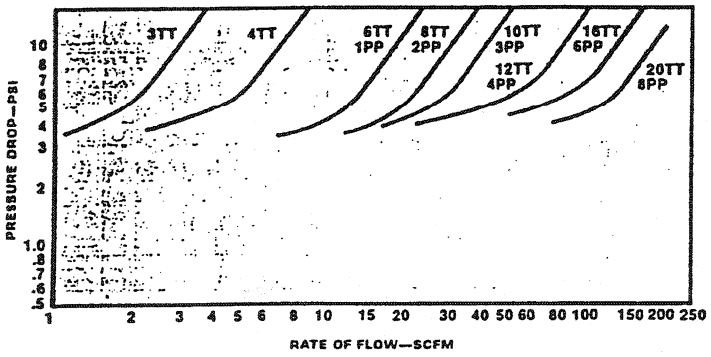


MODEL 277-269
HYDRAULIC FLUID (MIL-H-5606)

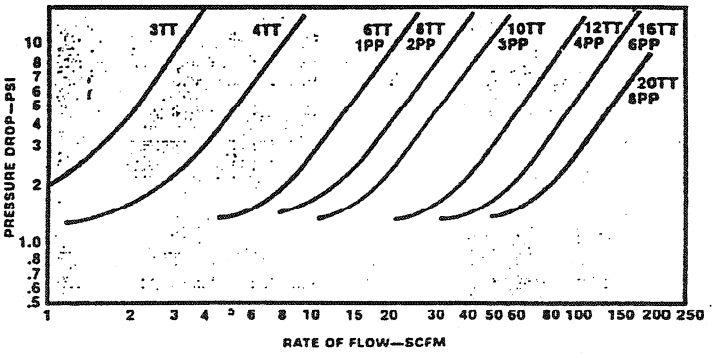


————220 APPROXIMATELY 6 PSI HIGHER AT LOW FLOWS.

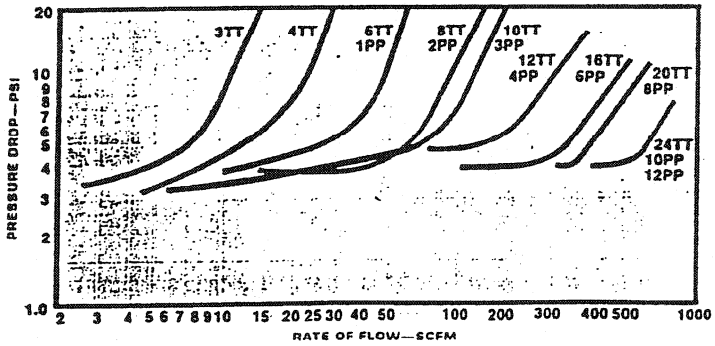
MODEL 299-262
AIR (DISCHARGE TO ATMOSPHERE)



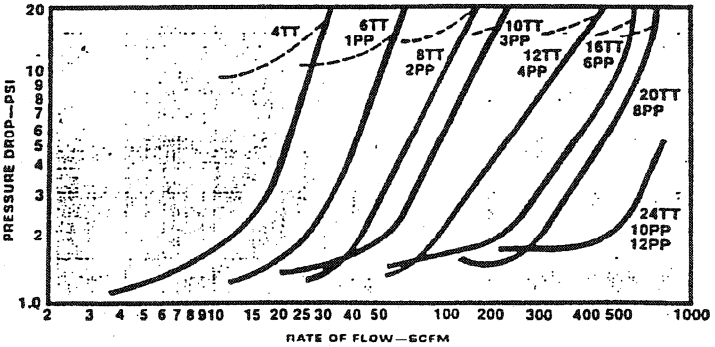
MODEL 277-269
AIR (DISCHARGE TO ATMOSPHERE)



MODEL 299-262
AIR (100 PSI INLET PRESSURE)



MODEL 277-269
AIR (100 PSI INLET PRESSURE)



————220 APPROXIMATELY 6 PSI HIGHER AT LOW FLOWS.

RATED FLOWS						
PIPE SIZE	1PP	2PP	3PP	4PP	6PP	8PP
HYDRAULIC FLUID, GPM	2.5	5.0	7.0	14.0	24.0	30.0
AIR @ 100 PSI INLET, SCFM	35	60	80	150	280	380

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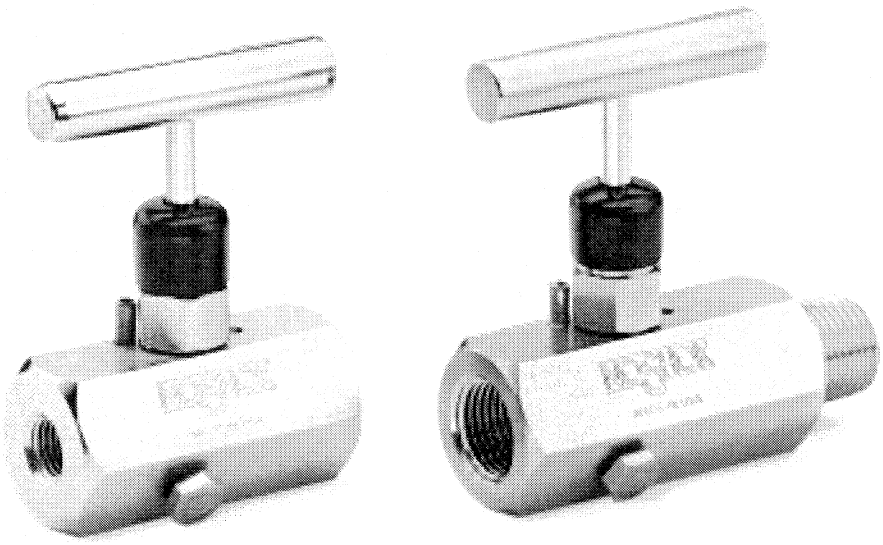
Printed in U.S.A.

600&700 SERIES
block & bleed VALVES
HARD & SOFT SEAT



NOSHOK Block & Bleed Valves allow pressure to be bled off without disturbing the permanent piping installation thereby enabling the user to quickly and easily remove and/or replace instruments.

HARD SEAT VALVE FEATURES

- **Metal to metal hard seat design is *100% Helium leak tested* to 1 x 10^{-4} ml/s at 200 psi.**
- **10,000 psi pressure rating (@ 200°F maximum)**

SOFT SEAT VALVE FEATURES

- **Soft seat design is *100% Helium leak tested* to 1 x 10^{-4} ml/s at 200 psi.**
- **6,000 psi pressure rating (@ 200°F maximum)**
- **Replaceable Delrin seat.**
- **Straight through porting for bi-directional, high capacity flow and easy roddable cleaning.**

STANDARD FEATURES FOR HARD SEAT and SOFT SEAT VALVES

- Blow-out proof stem that provides a secondary stem seal in the full open position.
- Stem packing below the threads prevents thread galling and contamination.
- Viton® O-Ring & Teflon® back-up ring stem seals.
- All 316SS stems (even in steel valves) for longer life.
- Stem and bonnet threads are rolled for greater strength and smoother operation.
- One piece bonnet with a metal to metal seal to the valve body below the bonnet threads.
- Bonnet lock pin to prevent accidental loosening.
- Vinyl bonnet and stem dust cap.
- .187 inch orifice size.
- Optional panel mount bonnet and panel nuts.
- Electroless Nickel plated finish on carbon steel valves.
- Electropolish finish on stainless steel valves.

Ordering Information

600 SERIES - HARD SEAT BLOCK & BLEED VALVES

PART NUMBER	CONNECTION	MATERIAL
602 MFC	1/4 NPT Male-Female	Steel
604 MFC	1/2 NPT Male-Female	Steel
602 MFS	1/4 NPT Male-Female	Stainless Steel
604 MFS	1/2 NPT Male-Female	Stainless Steel
602 FFC	1/4 NPT Female-Female	Steel
604 FFC	1/2 NPT Female-Female	Steel
602 FFS	1/4 NPT Female-Female	Stainless Steel
604 FFS	1/2 NPT Female-Female	Stainless Steel

700 SERIES - SOFT SEAT BLOCK & BLEED VALVES

PART NUMBER	CONNECTION	MATERIAL
702 MFC	1/4 NPT Male-Female	Steel
704 MFC	1/2 NPT Male-Female	Steel
702 MFS	1/4 NPT Male-Female	Stainless Steel
704 MFS	1/2 NPT Male-Female	Stainless Steel
702 FFC	1/4 NPT Female-Female	Steel
704 FFC	1/2 NPT Female-Female	Steel
702 FFS	1/4 NPT Female-Female	Stainless Steel
704 FFS	1/2 NPT Female-Female	Stainless Steel

NACE MR0175-99 CERTIFICATION (Consult Factory)

When ordering options please refer to the Part Number Construction guide below for the appropriate suffix. Please note that the standard O-Ring in all the **NOSHOK** Valves are Viton® and the standard handles are: "T" handles.

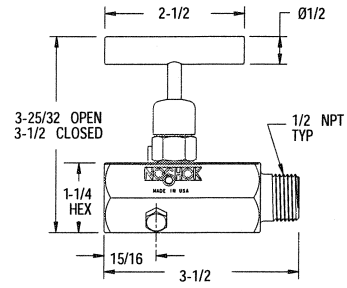
Part Number Construction: **702 FFC** - PM2 - EM1 - HL5

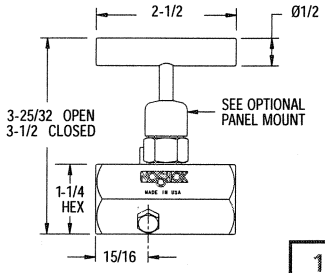
Panel Mount Options
PM1 - Panel Mount (1 nut)
PM2 - Panel Mount (2 nuts)

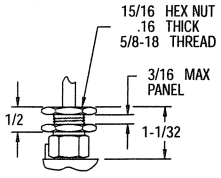
O-Ring Options
EM1 - EPDM 80
KZ1 - Kalrez® 3018

Handle Options
HL1 - Mini "T"
HL2 - "T"
HL3 - Round Knurled
HL4 - 1-3/8 Phenolic
HL5 - 1-3/4 Phenolic

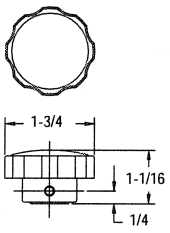
General Dimensions





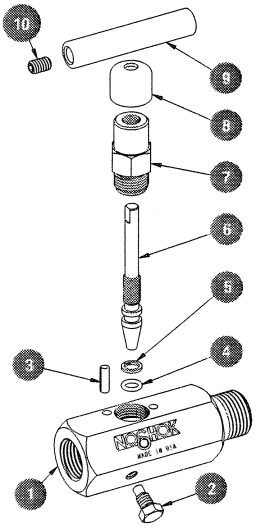


PANEL MOUNT DETAIL



PHENOLIC HANDLE HL5

1 Valve Body
2 Bleed Screw
3 Bonnet Lock Pin
4 Viton® O-Ring
5 Teflon® Back-up Ring
6 Valve Stem
7 Valve Bonnet
8 Dust Cap
9 Valve "T" Handle
10 Handle Set Screw



Hard Seat Technical Data:

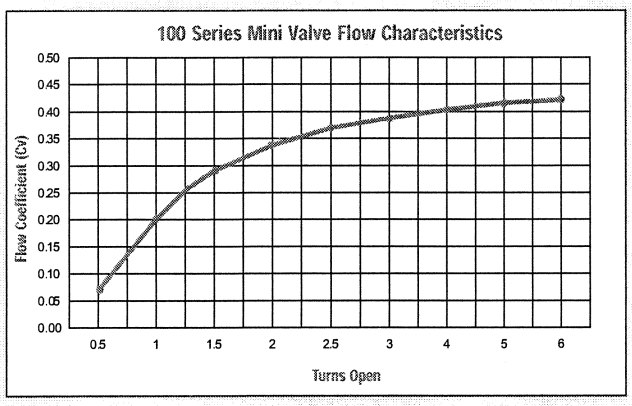
Maximum Pressure Rating:		**Orifice size:**	0.187"
Steel:	10000 psi	**Flow Coefficient:**	0.44
Stainless Steel:	10000 psi	**Standard O-Ring:**	Viton®
		Standard Back-up Ring:	Teflon®

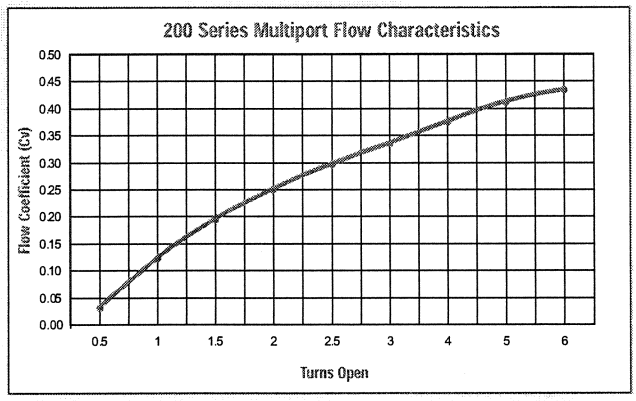
Soft Seat Technical Data:

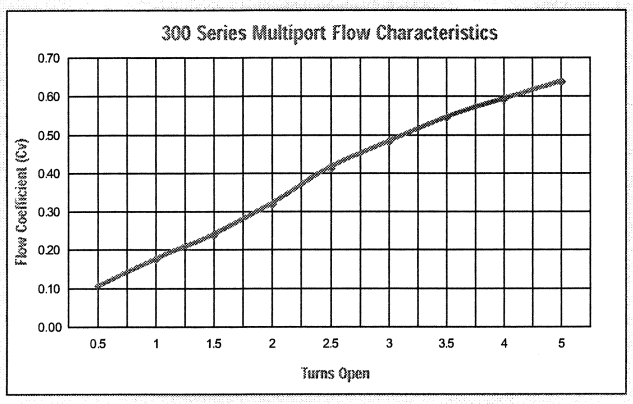
Maximum Pressure Rating:		**Orifice size:**	0.187"
Steel:	6000 psi	**Flow Coefficient:**	0.76
Stainless Steel:	6000 psi	**Standard O-Ring:**	Viton®
		Standard Back-up Ring:	Teflon®

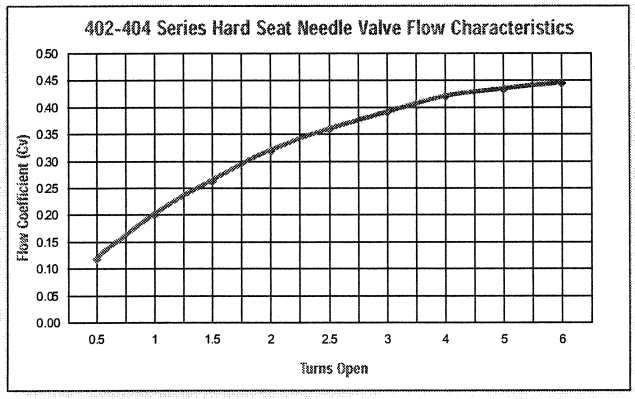
For flow characteristics refer to page 14

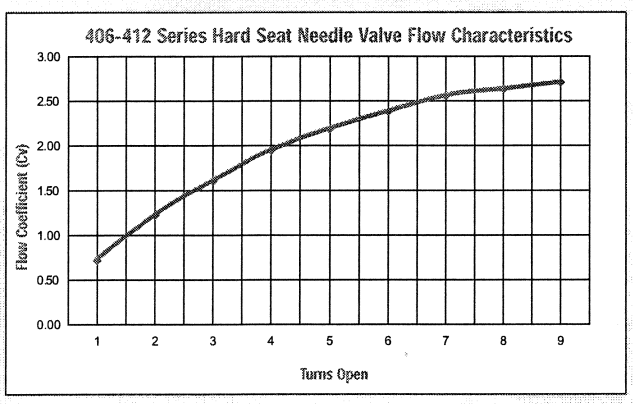
FLOW CHARACTERISTICS

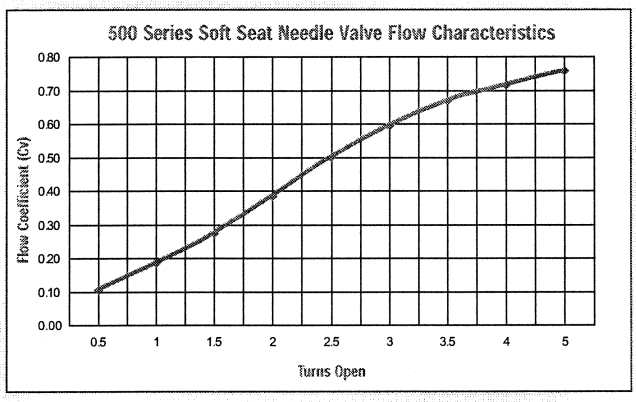


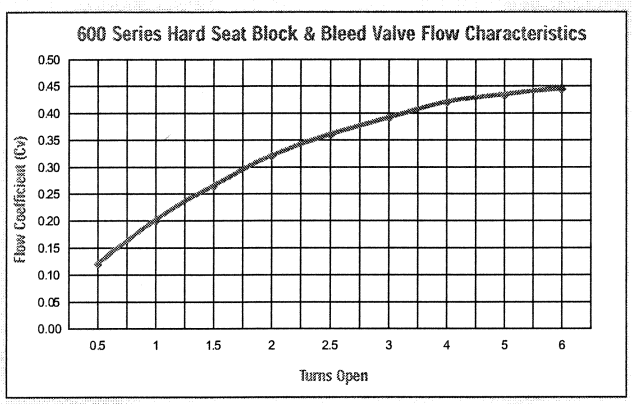


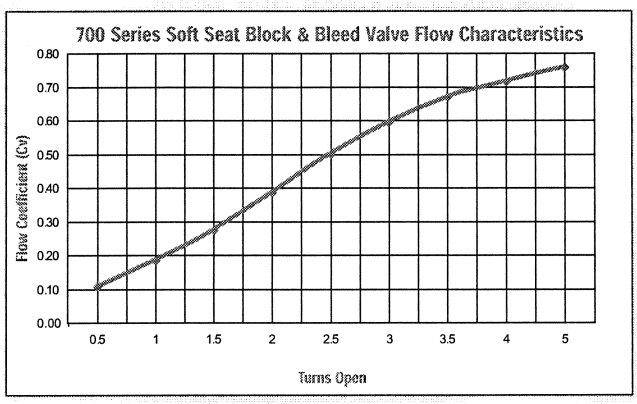












NOTES

Mini-Hermet Pressure Switches

Mini-Hermet pressure switches

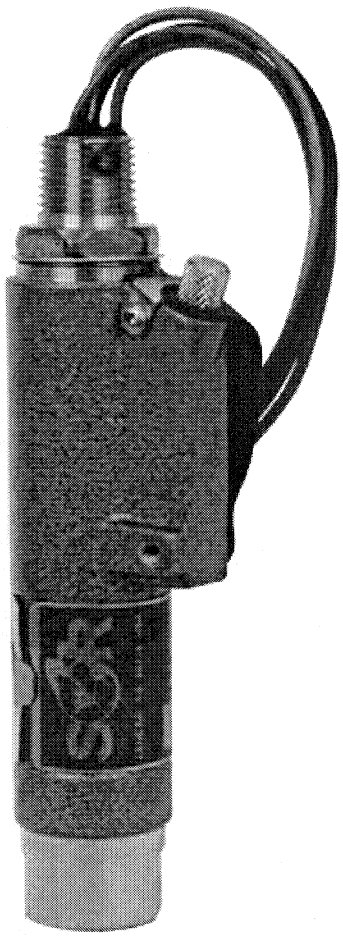
are robust field-mounted instruments. The pressure sensing assembly is similar to a conventional SOR type. The main difference is that the switching element assembly is hermetically sealed in an explosion proof steel capsule. Switching elements are SPDT or DPDT. See Principle description on page 2.

Application Information

The pressure switches in this catalog are suitable for a variety of process applications in hazardous locations and hostile environments where stainless steel exterior parts are required and where space is limited. Basic models with standard wetted parts are normally suitable for air, oil, water and non-corrosive process fluids. See the Quick Selection Guide on page 4.

Corrosive service and particular user requirements may require optional components. See How to Order on page 3. Adjustable ranges to accommodate lower Set Points, switching elements to handle heavier electrical loads and user preference may require Big Hermet models.

High pressure fluid power (hydraulic) applications where high shock pressures and high cycle rates are expected normally require Pivot Seal type pressure switches.

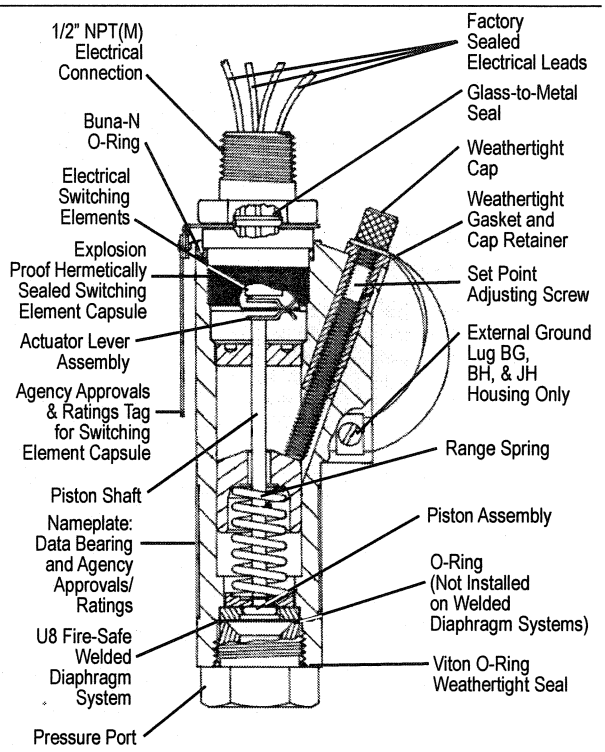


Mini-Hermet Pressure Switches

Principle

The pressure sensing element of the SOR Pressure Switch is a force-balance, piston-actuated assembly. The sensing element is sealed by a flexible diaphragm and a static o-ring. There are only three wetted parts in this arrangement: a pressure port, a diaphragm and an o-ring. A wide selection of wetted parts materials for media compatibility and containment are available. A metal diaphragm may be welded to the pressure port for certain applications, thereby eliminating the o-ring (Designators U8 and U9).

Media pressure on the piston counteracts the force of the range spring (adjustable by the adjusting screw) which moves the piston shaft only a few thousandths of an inch to directly actuate the electrical snap-action switching element that is enclosed in the hermetically sealed steel capsule. This design results in low friction and virtually no wear. The electrical switching element is isolated from corrosive atmospheres.



Features and Benefits

Built-In Quality
- Rigid quality standards maintained from raw material to finished product.

Explosion Proof Hermetically Sealed Switching Capsule
- Isolates switching elements from corrosive, hostile and hazardous environments and virtually eliminates problems from corrosion.

UL Listed, CSA Certified, ATEX and SAA Approved Models
- Meet most code and customer requirements.

Safety Certified to IEC 61508 (SIL)
- SOR products are certified to IEC 61508 for non-redundant use in SIL1 and SIL2 Safety Instrumented Systems for most models. For more details or values applicable to a specific product, see the Safety Integrity Level Quick Guide (Form 1528).

Field Adjustable Set Points
- Full range adjustability without disconnecting electrical power while maintaining explosion proof integrity, self-locking adjustment, no charge for factory calibration.

Warranty
- 3 years from date of manufacture.

Instrument Quality
- High resolution of Set Points, high repeatability, narrow dead band, negligible temperature effect, high overrange and proof pressures.

Robust Construction
- High cycle rate tolerance, long life, not critical to vibration, protected internal hermetically sealed switching element capsule.

Cost Effective
- Simple, fast installation without special tools, long service life. Periodic service or spare parts not required.

Delivery
- Routine shipments 7 to 10 working days. Emergency shipments via air within 48 hours.

Service
- Factory service engineers and area factory rep resentatives provide effective and prompt worldwide service.

Model Number System

6AG-EF3-M4-C2A-YY

Piston	Housing	Switching Element	Range Spring	Diaphragm & O-Ring	Pressure Port	Accessories

Quick Selection Guide

Basic Mini-Hermet pressure switches in AG or AH housings with standard wetted parts are normally suitable for air, oil, water and non-corrosive process applications in hazardous locations and hostile environments where space is limited. Refer to the Quick Selection Guide section on page 4 for a basic model number. Corrosive service and particular customer requirements may require optional components. Refer to the How to Order section below to build a customized model number or the dedicated page to locate optional components, such as: switching elements, diaphragm systems, pressure ports and accessories. Each position in the model number, except Accessories, must have a designator.

Applications

Mini-Hermet pressure switches in the AG and AH housings are normally suitable for a variety of process applications in hazardous locations and hostile environments because the electrical switching elements are hermetically sealed in a stainless steel capsule that is UL Listed, CSA Certified, ATEX and SAA Approved as an explosion-proof snap switch. Specific customer or code requirements for the complete pressure switch to be UL Listed, CSA Certified or ATEX Approved can normally be met by specifying an AP, AS, BG, BH or JH housing and U8 diaphragm system. See pages 6, 7, 8 and 10 for details. Other application requirements can normally be met by selecting optional components, such as: switching elements, diaphragm systems and pressure ports. Certain applications may require customized specials. Consult the factory or the SOR representative in your area. Conventional explosion-proof pressure switches for process applications are shown in Form 216.

High-pressure fluid power (hydraulic) applications where high shock pressure and high cycle rates are expected normally require Pivot Seal type pressure switches. Refer to SOR Catalog 219.

How to Order

Information and data in this catalog are formatted to provide a convenient guide to assist instrument engineers, plant engineers and end users in selecting pressure switches for their unique applications.

Steps 1 through 5 required. Step 6 optional. Orders must have complete model numbers, i.e. each component must have a designator.

Step 1: Select Piston-Spring Adjustable Range/Set Point from **Specification** (page 5). (Piston/Spring combination determines adjustable range.)

Step 2: Select **Housing** for type of pressure switch and service (page 6).

Step 3: Select electrical **Switching Element** for electrical service (page 7).

Step 4: Select **Diaphragm and O-Ring** for process compatibility and containment (page 8).

Step 5: Select **Pressure Port** for process compatibility and connection (page 9).

Step 6: Select **Accessories** required for service (page 11).

If Agency Approved, Certified or Listed pressure switches are required, see page 12 for components that must be specified.

Mini-Hermet Pressure Switches

Quick Selection

Basic Mini-Hermet pressure switches with AG - Aluminum or AH - Stainless Steel housings and standard wetted parts are normally suitable for air, oil, water and non-corrosive processes in hazardous locations and hostile environments. The Set Point must be within the adjustable range. Refer to How to Order section on page 3 to locate optional components. Each position in the model number, except Accessories, must have a designator.

Pressure

Model Number	Adjustable Range psi	Typical Dead Band psi	Overrange psi	Proof psi
6AG - EF2 - N4 - F1A	7 to 30	1.6	1500	2500
6AG - EF3 - N4- F1A	12 to 100	2.7		
6AG - EF5 - N4 - F1A	20 to 180	4.2		
6AG - EF45 - N4 - F1A	25 to 275	5.7		
5AG - EF3 - N4 - F1A	25 to 240	6.6		
5AG - EF5 - N4 - F1A	35 to 375	9.3		
5AG - EF45 - N4 - F1A	45 to 550	11.7		
9AG - EF4 - N4 - F1A	100 to 500	15.9	2500	6000
9AG - EF5 - N4 - F1A	200 to 1000	27.6		
9AG - EF45 - N4 - F1A	200 to 1750	45		
1AG - EF45 - N4 - F1A	500 to 4000	294	5000	6000

Vacuum

Model Number	Adjustable Range in. Hg vacuum to pressure	Typical Dead Band in. Hg	Overrange psi	Proof psi
56AG - EF216 - M2 - C1A	30 - 0 - 20	2.5	1500	2500
56AG - EF316 - M2 - C1A	30 - 0 - 160	3.5		

Standard Construction

1. Housing: AG–Aluminum or AH - Stainless Steel. See Housing and Dimensions pages for details.
2. Switching element: EF–SPDT 5A 250 VAC. See Switching Element page for optional switching elements.
3. Diaphragm & O-Ring: N4–primary (wetted) diaphragm TCP, o-ring (wetted) Buna-N. See Diaphragm & O-Ring page for optional diaphragm and o-ring systems.
4. Pressure port: F1A–Carbon steel 1/4" NPT(F). When AH - Stainless Steel housing is specified, pressure port must be C1A - 316SS 1/4" NPT(F). See Pressure Port page for optional pressure ports.
5. Dead band values are expressed as typical expected at mid-adjustable range with the standard EF switching element assembly installed. See Dead Band Considerations on page 7.

Step 1: Pressure Specification

6AG-EF3-M4-C2A-YY

This table is a listing of piston-spring combinations and the corresponding adjustable ranges, dead bands, overrange and proof pressures. Adjustable range is expressed for increasing pressure; the Set Point must be within the adjustable range. Dead band is expressed as typical. See Dead Band Considerations at the bottom of switching element page 7.

Piston-Spring Designator	Adjustable Range		Typical Dead Band		Overrange		Proof	
	psi	bar	psi	bar [mbar]	psi	bar	psi	bar
6 - 2	7 to 30	0.5 to 2	1.6	[114]	1500	100	2500	170
6 - 3	12 to 100	0.8 to 7	2.7	[184]				
6 - 5	20 to 180	1.4 to 12	4.2	[289]				
6 - 45	25 to 275	1.7 to 19	5.7	[393]				
5 - 3	25 to 240	1.7 to 16	6.6	0.5				
5 - 5	35 to 375	2.4 to 26	9.3	0.6				
5 - 45	45 to 550	3.1 to 38	11.7	0.8				
9 - 4	100 to 500	7 to 35	15.9	1.0	2500	170	6000	410
9 - 5	200 to 1000	14 to 70	27.6	1.9				
9 - 45	200 to 1750	14 to 120	45	3.1				
1 - 45	500 to 4000	35 to 275	294	20.3	5000	340	6000	410

Step 1: Vacuum Specification

56AG-EF216-M4-C2A-YY

This table is a listing of piston–spring combinations and the corresponding adjustable ranges, dead bands, overrange and proof pressures. SOR vacuum switches are compound; they will operate in either vacuum or pressure modes. Adjustable range is expressed from maximum vacuum decreasing to zero gauge and increasing to maximum pressure. Dead band is expressed as typical. See Dead Band Considerations on bottom of page 7. The Set Point must be within the adjustable range. A vacuum switch is generally better suited than a pressure switch for Set Points very near zero guage.

Piston-Spring	Adjustable Range Vacuum - O Pressure		Typical Dead Band Vacuum Mode		Overrange		Proof	
	in. Hg	bar	in. Hg	[mbar]	psi	bar	psi	bar
56 - 216	30 - 0 - 20	1.0 - 0 - 0.7	2.5	[85]	1500	100	2500	170
56 - 316	30 - 0 - 160	1.0 - 0 - 5.4	3.5	[120]				

Notes

1. Dead band values are expressed as typical expected at mid-range with the standard EF switching element assembly installed. When optional switching elements are specified, corresponding dead band multipliers shown on page 7 must be applied.
2. Special ranges may be possible. Consult the factory or the SOR representative in your area.
3. Diaphragms may have an additional effect on dead band. Consult the factory. See Notes on page 8.
4. Metric bar (mbar) values are practical equivalents of the reference English values; not necessarily exact mathematical conversions. This data appears on the product nameplate when metric engineering units are specified.

Design and specifications are subject to change without notice. For latest revision, see www.sorinc.com.

Step 2: Housing

6AG-EF3-M4-C2A-YY

Service	Description	Designator
Hazardous Locations (UL Listed, CSA Certified & SAA Approved Snap Switch)	Housing contains explosion-proof snap switch for hazardous locations and hostile environments. UL Listed, CSA Certified Class I, Group A, B, C, D; Class II, Group E, F, G, Divisions 1& 2 and SAA Approved Ex s Zone 2 IIC T4 IP65, Ex tD A22 T105°C IP65. See details Note 3, page 7. Electrical conduit connection 1/2" NPT(M). NEMA 4, 4X, IP65, IP66, IP67. Material: Copper-free aluminum*.	AG
Hazardous Locations (UL Listed, CSA Certified & SAA Approved Snap Switch)	Housing contains explosion-proof snap switch for hazardous locations and hostile environments. UL Listed, CSA Certified Class I, Group A, B, C, D; Class II, Group E, F, G; Divisions 1 & 2 and SAA Approved Ex s Zone 2 IIC T4 IP65, Ex tD A22 T105°C IP65. See details Note 3, page 7. Electrical conduit connection 1/2" NPT(M). NEMA 4, 4X, IP65, IP66, IP67. Material: Stainless steel.	AH
Hazardous Locations (UL Listed/CSA Certified Pressure Switch)	UL Listed and CSA Certified pressure switch Class I, Group A, B, C, D; Class II, Group E, F, G; Divisions 1 & 2 for hazardous locations and hostile environments. See details, page 12. U8 fire-safe diaphragm system designator required. Electrical conduit connection 1/2" NPT(M). NEMA 4, 4X, IP65, IP66, IP67. Material: Copper-free aluminum*.	AP
Hazardous Locations (UL Listed/CSA Certified Pressure Switch)	UL Listed and CSA Certified pressure switch Class I, Group A, B, C, D; Class II, Group E, F, G; Divisions 1 & 2 for hazardous locations and hostile environments. See details, page 12. U8 fire-safe diaphragm system designator required. Electrical conduit connection 1/2" NPT(M). NEMA 4, 4X, IP65, IP66, IP67. Material: Stainless steel.	AS
Flammable Atmospheres (ATEX Approved Pressure Switch)	ATEX Approved pressure switch EEx d IIC T5 or T6 per EN 50-014 & 018 for flammable atmospheres and hostile environments. See details, page 12. Electrical conduit connection 1/2" NPT(M). NEMA 4, 4X, IP65. Material: Copper-free aluminum*.	BG
Flammable Atmospheres (ATEX Approved Pressure Switch)	ATEX Approved pressure switch EEx d IIC T5 or T6 per EN 50-014 & 018 for flammable atmospheres and hostile environments. See details, page 12. Electrical conduit connection 1/2" NPT(M). NEMA 4, 4X, IP65, IP66, IP67. Material: Stainless steel.	BH

Note
Mini-Hermet pressure switches with AG and AH housings are not agency listed, certified or approved. However, the hermetically sealed electrical switching element capsules in them are UL Listed, CSA Certified and SAA Approved as explosion-proof snap switches for hazardous locations. See page 14 for dimensional details.

*Consult the factory.

Step 3: Switching Element

6AG-EF3-M4-C2A-YY

Service	Contact Form	Electrical Connection	AC Rating (See Note 1) volts	AC Rating (See Note 1) amps	DC Rating (See Note 1) volts	DC Rating (See Note 1) amps	DC Rating (See Note 1) volts	DC Rating (See Note 1) amps	Dead Band Multiplier	Designator
Normal AC/DC	SPDT	18" 18 AWG Color-Coded Standard Wire Leads	250	11	125	.5*	30	5	1.5	AF
				5	125	.5*	30	5*	1.0	EF
	DPDT			11	125	.5*	30	5	3.0	AG
				5	125	.5*	30	5*	2.0	EG
Gold Contacts for Low Power Data Acquisition Interface	SPDT	1/2" NPT(M) Conduit Connection	125	1	-	-	30	1	1.0	JF
	DPDT			1	-	-	30	1	2.0	JG

Notes

1. AC/DC electrical ratings in the table above are UL Listed, CSA Certified, ATEX, SAA and JIS/RIIS Approved with the following conditions and exceptions:
   a) JF and JG are not SAA and JIS/RIIS Approved.
   b) DC electrical ratings are for resistive loads only.
   c) DC ratings marked with an asterisk (*) are not agency approved, certified or listed but have been verified by testing or experience.
   d) AF, AG, JF and JG are also ATEX Approved for 0.5 amps 125 VDC (resistive) when used with a BG or BH housing.
2. Switching Elements AG, EG and JG have two separate SPDT switching elements that are operated by a single lever for DPDT switching action. Simultaneous actuation or deactuation occurs at both increasing and decreasing Set Points. Two independent electrical circuits can be simultaneously switched, i.e. one AC and one DC.
3. The hermetically sealed switching element capsule is UL Listed, CSA Certified, ATEX and SAA Approved as an explosion-proof snap switch per the table to the right.
4. Ambient Temperature Limits: –40 to 167°F (–40 to 75°C)
5. Electrical connections are 18" 18 AWG color-coded stranded wire leads unless Accessory TB, HT, HB or HMBE (electrical junction box with screw terminals) are specified.

Agency	Hazardous Location Conditions	Designator
UL Listed CSA Listed	Class I, Group A, B, C, D Class II, Group E, F, G; Divisions 1 & 2	AF, EF, AG, EG, JF, JG
SAA Approved	Ex s Zone 2 IIC T4 IP65 Ex tD A22 T105°C IP65	AF, EF, AG, EG, JF, JG
ATEX Approved	II 2 G EEx mII	AF, EF, AG, EG, JF, JG

6. Wire Lead Color Code

EF, AF, JF	Red	NC	(Normally Closed)
	Black	NO	(Normally Open)
	Blue	C	(Common)
	Green	G	(Ground - Earth)
EG, AG, JG	Red	NC1	(Normally Closed - 1)
	Black	NO1	(Normally Open - 1)
	Blue	C1	(Common - 1)
	Orange	NC2	(Normally Closed - 2)
	Brown	NO2	(Normally Open - 2)
	Yellow	C2	(Common - 2)
	Green	G	(Ground - Earth)

CAUTION: The hermetically sealed switching element capsule assembly has been precisely positioned in the housing; over-travel has been precisely adjusted and secured at the factory for optimum performance. Field replacement of the capsule is not practical and is not recommended. Removal or breakage of the tack weld voids the warranty. Movement of the capsule in the housing will degrade performance and could render the device inoperative.

Dead Band Considerations

1. Dead band values are expressed as typical expected at mid-range with the standard EF switching element assembly installed. When optional switching elements are specified, corresponding dead band multipliers must be applied.
2. Dead bands are fixed (non-adjustable).
3. Dead band can be widened by selecting an optional switching element with a multiplier greater than 1.0.
   Example: Model 5AH-AG3-M4-C2A-YY
   Typical Dead Band: 6 psi
   AG Switching Element multiplier = 3.0
   Typical Dead Band corrected for AG switching element:
   6 x 3.0 = 18 psi

Switching Element Designators	Multiplier
EF, JF	1.0
AF	1.5
EG, JG	2.0
AG	3.0

Step 4: Diaphragm and O-Ring

6AG-EF3-M4-C2A-YY

Notes

1. N4 diaphragm system is standard, but requires a designator in the model number. It is normally suitable for air, oil, water and non-corrosive processes. M2 diaphragm system is standard on Number 56 vacuum switches.
2. U8 designates the welded fire-safe diaphragm system. U8 must be specified for the complete pressure switch to be UL Listed and CSA Certified; it may be specified on ATEX Approved models. See pages 10 and 12. 316SS is stocked. Not available on Number 1 piston or vacuum switches. Example: U8-C2A is a 316SS fire-safe welded diaphragm system.
3. U9 designates a welded diaphragm system. Not available on vacuum switches. Example: U9-A1A is a Monel welded diaphragm system. See page 10.
4. Other diaphragm and o-ring combinations may be available. Consult the factory or the SOR representative in your area for more information.
5. Wetted parts have been selected as representing the most suitable commercially available material for use in the service intended. However, they do not constitute a guarantee against corrosion or permeation, since processes vary from plant to plant and concentration of harmful fluids, gases or solids vary from time to time in a given process. Empirical experience by users should be the final guide. Alternate materials based on this are generally available.
6. Specify N3 diaphragm system for high cycle rate, high shock applications where Buna-N and TCP are compatible with the process.
7. This table shows allowable minimum and maximum temperatures for o-rings. Consult the factory for temperatures down to −65°F on fire-safe and welded metal diaphragm systems.

O-Ring Material	°F	°C
Viton	32 to 400	0 to 204
Viton GLT	-20 to 400	-29 to 204
Kalrez*	5 to 400	-15 to 204
Aflas	25 to 400	-4 to 204
Buna-N Neoprene EPR	-30 to 200	-34 to 93
Fire-Safe/Welded Disphragm System	-30 to 400	-34 to 204
TCP-Teflon Coated Polyimide Diaphragm	-30 to 400	-34 to 204

*Kalrez or equivalent Perfluoroelastomer (FFKM) o-rings

8. Dead bands are slightly higher when using H, N3, N6, J4, J6, U or W series diaphragm options. Consult Factory.
9. Diaphragm systems U8, U9 are not available on Number 56 vacuum switches.
10. M9 diaphragm system is suitable for steam applications up to 400°F.

O-Ring (Wetted)	Diaphragm (Wetted)	Designator
Viton	Monel	A4
Kalrez		A6
Viton	Hastelloy-B	H4
Kalrez		H6
Viton	Hastelloy-C	J4
Kalrez		J6
Viton	Carpenter-20	L4
Kalrez		L6
Viton GLT	316L SS	M1
Buna-N		M2
Viton		M4
Neoprene		M5
Kalrex		M7
Aflas		M8
EPR		M9 (See Note 10)
Viton	TCP Teflon-Coated Polyimide	N1
Buna-N		N3 (See Note 6)
Buna-N		N4 Standard (See Note 1)
Kalrez		N5
Kalrez	Kalrez	N6
EPR	TCP Teflon-Coated Polyimide	N7
Aflas		N8
Buna-N	Buna-N	P1
Neoprene	Neoprene	R1
Viton	Viton	S1
Viton GLT		S2
Buna-N	Tantalum	W2
Viton		W4
Neoprene		W5
Kalrez		W6
EPR Ethylene Propylene	EPR Ethylene Propylene	Y1
None	Fire-Safe Welded	U8 (See Note 2)
None	Welded	U9 (See Note 3)

Step 5: Pressure Port

6AG-EF3-M4-C2A-YY

	Piston	6, 5, 9, 1			56	
	Process Connection Size	1/4" NPT(F)	1/2" NPT(F)	3/4" NPT(M)	1/4" NPT(F)	1/2" NPT(F)
Pressure Port Material	Carbon Steel Ledloy AX Wrought	**F1A** (Standard)	**F2A**	**F3A**	N/A	N/A
	316SS/316LSS Wrought	**C1A**	**C2A**	**C3A**	**C1A**	**C2A**
	347 Stainless Steel Wrought	E1A	E2A	E3A	Consult the factory for availability of Pressure Port Material and Process Connection Size	
	Carpenter 20 Stainless Steel Wrought	L1A	L2A	L3A		
	316L Stainless Steel Low Carbon	Z1A	Z2A	N/A		
	Brass (See Note 4) Half Hard Yellow Wrought	**D1A**	D2A	D3A		
	Hastelloy B	H1A	H2A	H3A		
	Hastelloy C	J1A	J2A	J3A		
	Monel	**A1A**	**A2A**	A3A		

Notes

1. Select designator for material and connection size. Large bold face designators denote those items generally available from stock. Small light face designators denote items with limited stock and possible long delivery.
2. 1/4" and 1/2" tapered BSP(F) pressure (designated B instead of A in the 3rd position) ports are available.
3. The standard material and connection size for Numbers 6, 5, 9 & 1 pressure ports with: aluminum housing is F1A - 1/4" NPT(F) carbon steel; stainless steel housing is C1A - 1/4" NPT(F) 316SS.
4. Brass not available on Piston Numbers 9 and 1.
5. Other materials such as PVC, Kynar, etc., are available. Denote unlisted material by specifying an X followed by the required connection size, and describe the material.

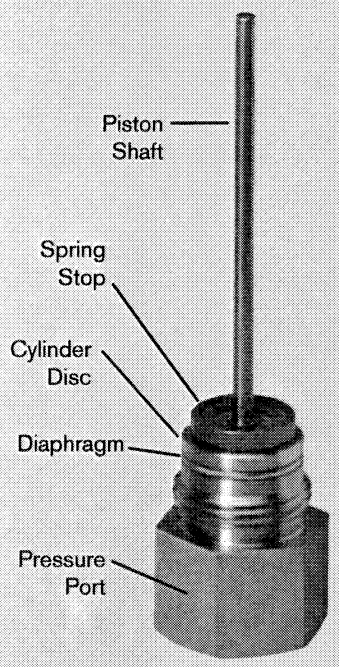
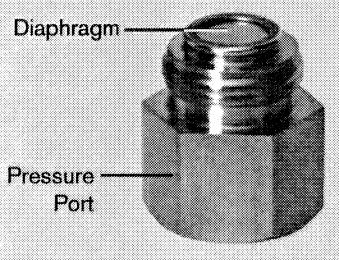
Examples:

X2A = PVC pressure port with 1/2" NPT(F) connection.

X1A = Titanium pressure port with 1/4" NPT(F) connection.

Non-metal pressure ports generally reduce proof pressure and may reduce overrange pressure. The pressure port material may limit the process temperature. Delivery may be longer than normal.

See the next page for presentation of welded diaphragm and FM Approved fire-safe systems.

Designator	Description
U8 	**Fire-Safe Welded Diaphragm System** **Factory Mutual System Approved-** **U.S. Patent Number 4,438,305** **Approved** Tested in flames at 1900°F for periods up to 30 minutes while pressurized to the rated overrange pressure. A metal diaphragm, the cylinder disc and the pressure port are welded as a unit, thereby, eliminating the o-ring. This arrangement may be indicated for extremely corrosive, hot, harsh or volatile process where o-rings are not suitable. See the fire-safe definition on page 13. 316SS is standard. Hastelloy B and C, Monel are available with possible longer lead times: The pressure port designator determines the material. Example: U8-C2A U8 = Fire-safe welded diaphragm system C2A = 1/2" NPT(F) 316SS pressure port **Note** 1/2" NPT(F) is stocked; 1/4" NPT(F) is not stocked and has a longer lead time. Not available on Number 1 piston and vacuum switches.
U9 	**Welded Diaphragm System** A metal diaphragm is welded to the pressure port, thereby, eliminating the o-ring. This arrangement may be indicated for extremely corrosive, hot or harsh process where o-rings are not suitable. 316SS is standard. Hastelloy B and C, Monel are available with possible longer lead times: The pressure port designator determines the material. Example: U9-A2A U9 = Welded diaphragm A2A = 1/2" NPT(F) Monel pressure port **Note** Not available on vacuum switches.

Step 6 : Accessories

6AG-EF3-M4-C2A-YY

Accessory/Option & Description	Designator
Wetted parts are cleaned for industrial oxygen service.	BB
Canadian Registration Number (CRN) - Process ratings may be affected. Consult the factory for details.	CV
CSA Dual Seal Approval. See Agency Listings on page 12 for details.	DS
Universal terminal box, 1/2" NPT(F). 316SS. Explosion proof. ATEX Certified EEx d IIC T4, T5, T6.	HB
Universal terminal box, M20 x 1.5(F). 316SS. Explosion proof. ATEX Certified EEx d IIC T4, T5, T6.	HBME
Universal terminal box, 1/2" NPT(F). 316SS. Explosion proof. FM Approved; CSA Certified.	HT
Vacuum protector plate. Retains diaphragm system in pressure switch if subjected to intermittent vacuum greater than 10 in. Hg. If a pressure switch is subjected to continuous, rapid changes of vacuum, other protection may be available (consult factory). Material matches or exceeds pressure port material. N/A on Pistons 52, 54, or 56.	MM
Compliance to NACE Certification MR0175/ISO 15156.	NC*
Pipe (stanchion) mounting kit for (1-1/2 to 2" pipe.)	PK
Tag, fiber. Attached with plastic wire to housing. Printed with customer-specified tagging information.	PP
Powder coat epoxy coating. No coating on stainless steel parts or plated screws. (500 hours-salt spray)	PY
Tag, stainless steel. Attached with stainless steel wire to housing. Stamped with customer-specified tagging information. (2 lines, 18 characters and spaces per line.)	RR
Explosion-proof and weathertight electrical junction box with screw terminals. Aluminum 3/4" NPT(F) top, left or right conduit connections as required. UL Listed and CSA Certified Class I, Groups A, B, C, D; Class II, Groups E, F, G; Divisions 1 & 2. (TA housing.) Includes cover o-ring for weathertight applications. Not available with BG, BH or JH housings.	TB
Oversize stainless steel nameplate or separate stainless steel tag. Permanently attached to housing. Stamped with customer-specified tagging information.	TT
Fungicidal varnish. Covers exterior and interior except working parts.	VV
Epoxy coating. Exterior only. Polyamide epoxy with 316SS pigment. (200 hours-salt spray)	YY
"X" is used as a suffix to the model number for special requirements not keyed elsewhere in the model number by an "X". Each "X" must be completely identified in the text of the order or inquiry. When more than one "X" is required, use "X" followed by the number of such items. For example, "X3" means three separate otherwise unidentifiable requirements.	X

*Consult factory for materials other than A105, A106B, 316/316L, or 304/304L.

Test Certificates

Certificates	C1	C2	C3	C4	C5	C6	C8	B1	B4	B5	B6	B7	A1	A2	A3	A4	A5	A6	A7	A8
Calibration	◆							◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Hydrostatic Pressure Test		◆						◆	◆					◆	◆	◆	◆	◆	◆	◆
Inspection Report			◆					◆	◆	◆	◆	◆			◆	◆		◆	◆	◆
Compliance / Conformance				◆								◆	◆	◆		◆	◆			◆
Dielectric Test					◆				◆	◆									◆	
Insulation Resistance						◆			◆	◆	◆							◆	◆	◆
Typical Material of Wetted Parts							◆	◆	◆				◆				◆	◆		

Agency Approval

The chart below shows authorized combinations of components so that the complete pressure switch is approved, certified or listed by the cognizant agencies. Components or combinations of them may acquire additional approval, certification or listing prior to revision of this catalog. Contact the factory for the most current information.

UL Listed

For Hazardous Locations Class I, Groups A, B, C, D; Class II, Groups E, F, G; Divisions 1 & 2

Piston	Housing	Switching Element	Spring	Diaphragm System	Pressure Port Material and Connection Size	Accessories Options
5, 6, 9	AP, AS	AF, AG, EF, EG, JF, JG	2, 3, 4, 5, 45	U8	C1A C2A	BB, NC, NN, PK, PP, RR, TB, TT, VV, YY

Note: UL Listed models are suitable for handling petroleum-based, flammable and combustable liquids and gases, air, oxygen and water at fluid temperatures not exceeding 40°C and ambient temperatures not exceeding 40°C.

CSA Certified

For Hazardous Locations Class I, Group A, B, C, D; Class II, Groups E, F, G; Divisions 1 & 2

Piston	Housing	Switching Element	Spring	Diaphragm System	Pressure Port Material and Connection Size	Accessories Options
5, 6, 9	AP, AS	AF, AG, EF, EG, JF, JG	2, 3, 4, 5, 45	U8	C1A C2A	BB, HT, NC, PK, PP, RR, TB, TT, VV, YY

For Dual Seal Approval

Piston	Housing	Switching Element	Spring	Diaphragm System	Pressure Port Material and Connection Size	Accessories Options
1, 5, 6, 9, 56	AG, AH, AP, AS	AF, AG, EF, EG, JF, JG	2, 3, 4, 5, 45, 316	M2, M4, N4, U8, U9	C1A C2A	DS Required CV, NC, PP, RR, TT, YY

ATEX Approved

For Flammable Atmospheres: Rating: EEx d IIC T5 or T6 per EN 50-014 & 018

Piston	Housing	Switching Element	Spring	Diaphragm System	Pressure Port Material and Connection Size	Accessories Options
5, 6, 9	BG, BH	AF, AG, EF, EG, JF, JG	2, 3, 4, 5, 45	U8, U9	All	BB, HB, HBME, PP, RR, TT, VV, YY
1, 5, 6, 9			2, 3, 4, 5, 45	A4, M1, M2, M4, M5, M7, M8, N1, N3, N4, N5, N6, N7, N8, P1, R1, S1, S2 W2, W4, W5, W6, Y1		

* Refer to Mini-Hermet Form 168 for special conditions for safe use.

Glossary of Terms

SOR recognizes that there is no industry convention with respect to terminology and definitions pertinent to pressure switches. This glossary applies to SOR pressure with hermetically switching element capsules.

Pressure Switch

A bi-stable electromechanical device that actuates/deactuates one or more electrical switching element(s) at a predetermined discrete pressure/vacuum (Set Point) upon rising or falling pressure/vacuum.

Adjustable Range

The span of pressure between upper and lower limits within which the pressure switch can be adjusted to actuate/deactuate. It is expressed for increasing pressure.

Set Point

That discrete pressure at which the pressure switch is adjusted to actuate/deactuate on rising or falling pressure. It must fall within the adjustable range and be called out as increasing or decreasing pressure.

Dead Band

The difference in pressure between the increasing Set Point and the decreasing Set Point. It is expressed as typical, which is an average with the increasing Set Point at mid range for a pressure switch with the standard K switching element. It is normally fixed (non-adjustable).

Overrange

The maximum input pressure that can be continuously applied to the pressure switch without causing permanent change of Set Point, leakage or material failure.

Proof Pressure

The maximum input pressure that can be continuously applied to the pressure switch without causing leakage or catastrophic material failure. Permanent change of Set Points may occur, or the device may be rendered inoperative.

Repeatability

The ability of a pressure switch to successively operate at a Set Point that is approached from a starting point in the same direction and returns to the starting point over three consecutive cycles to establish a pressure profile. Repeatability on SOR switches will be smaller than 1% of full scale per ISA/ANSI S51.1.

SPDT Switching Element

Single-Pole, Double Throw (SPDT) has three connections: C – Common, NO – Normally Open and NC – Normally Closed, which allows the switching element to be electrically connected to the circuit in either NO or NC state.

DPDT Switching Element

DPDT is two synchronized SPDT switching elements which actuate together at increasing Set Point and deactuate together at decreasing Set Point. Discrete SPDT switching elements allow two independent circuits to be switched; i.e., one AC and one DC.

The synchronization linkage is factory set, and is not field adjustable. Synchronization is verified by connecting test lamps to the switching elements and observing them go "On" simultaneously at actuation and "Off" simultaneously at deactuation.

Fire-Safe

The ability of a welded seal pressure sensor to contain the process at elevated temperatures up to 1200°F at the rated overrange pressure, unsupported by the body of the pressure switch.

Hermetically Sealed

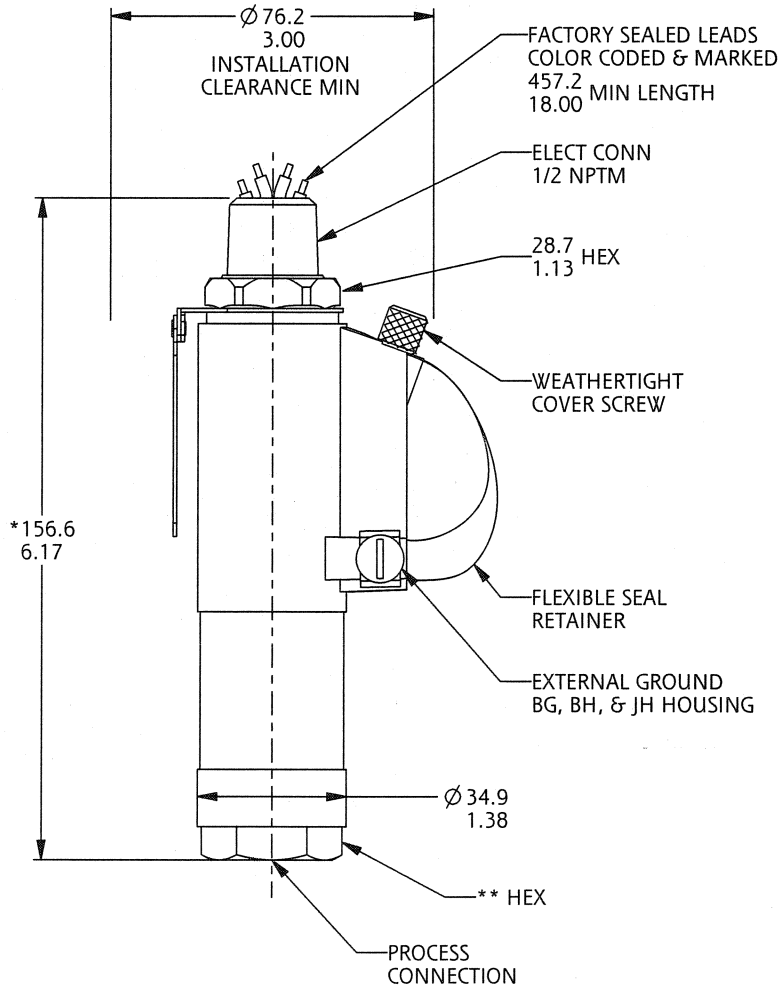
A welded steel capsule with glass-to-metal, factory-sealed, electrical leads that isolates the electrical switching element(s) from the environment.

Dimensions in this catalog are for reference only. They may be changed without notice. Contact the factory for certified drawings for a particular model number.

Notes

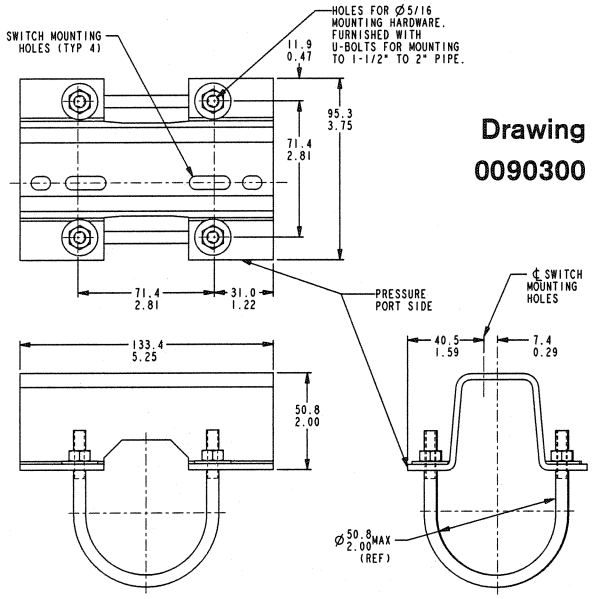
1. Dimensions on pages 14 and 15 are expressed as millimeters over inches (Linear = mm/in.).
2. Dimensions marked A-Length on housing dimension drawings vary with respect to process connection size. The chart below lists A-Lengths with reference to piston number and process connection size.

Process Connection Size	A-Length	
	Piston Number 6, 5, 9, 1	Piston Number 56
1/4" NPT(F)	156.6mm / 6.17 inch	174.9mm / 6.89 inch
1/2" NPT(F)	169.8mm / 6.69 inch	
3/4" NPT(M)	179.7mm / 7.08 inch (outline not shown)	N/A



Drawing 0090119

Pipe Mounting Bracket - PK

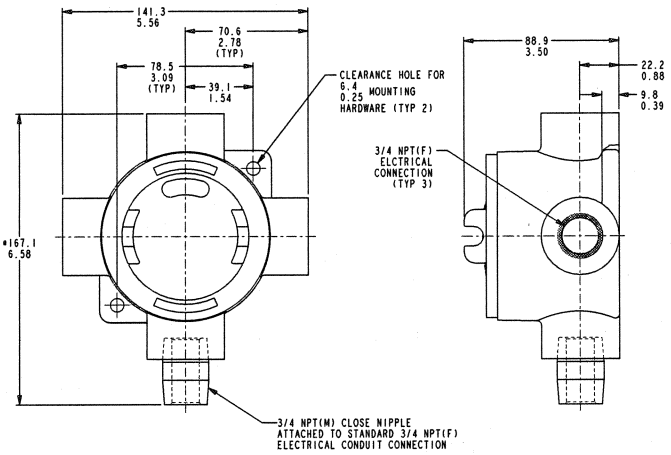


Drawing 0090300

Perpendicular Mounting

Parallel Mounting

Junction Box with Terminal Block - TB



*Dimension shown is approximate and based on a 5-thread engangement.

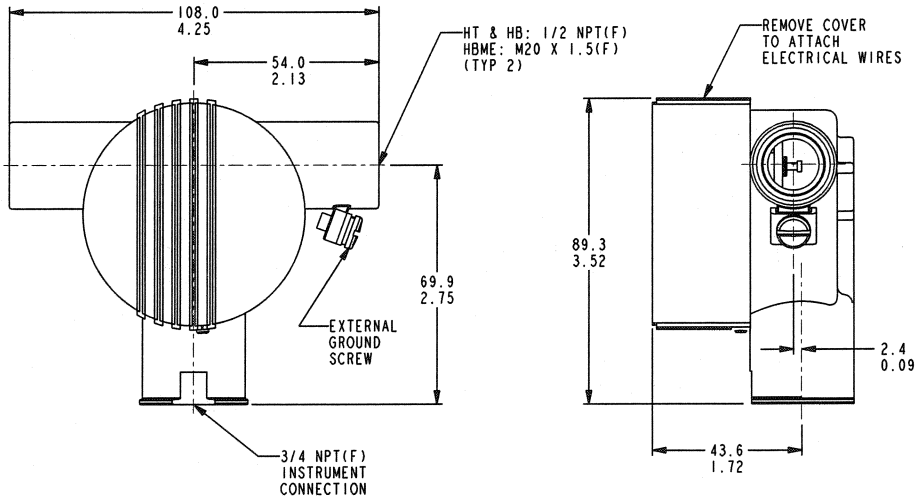
Drawing 0091353

Terminal Boxes
H Series

Dimensions Shown are for Reference Only. Contact the Factory for Certified Dimension Drawings.

Linear = mm/in.

Drawing 0090763



Approximate Weight

Component	Designator	Weight (lbs)	(kgs)
Housing	AG, AP, BG	1.5	[0.7]
Housing	AH, AS, BH, JH	2.0	[1.0]
Junction Box	TB	(Add to housing) 5	[2.25]
Pipe Mounting Kit	PK	(Add to housing) 1.5	[0.7]
Terminal Box	HB, HBME, HT	(Add to housing) 2.0	[1.0]

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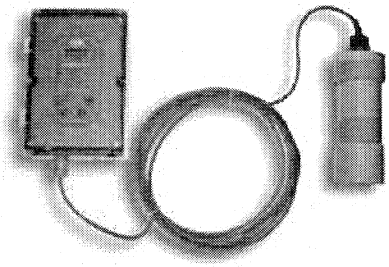
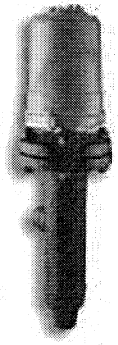


Level
Switches



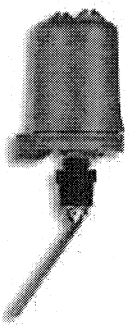
Level

Temperature

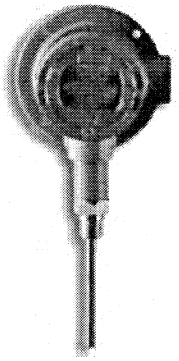
Pressure

Flow

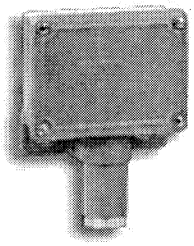
Flow
Switches



Temperature
Switches



Pressure
Switches



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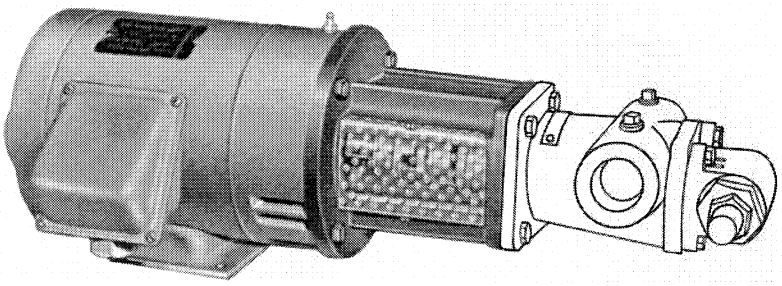
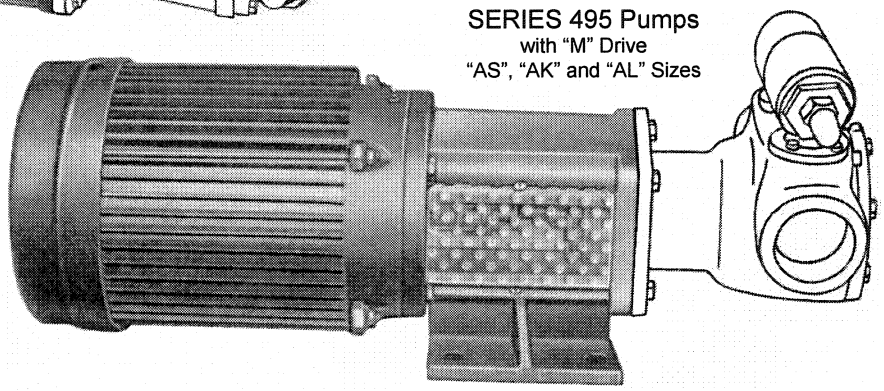
VIKING® HEAVY DUTY PUMPS
SERIES 495
STANDARD CONSTRUCTION

Section	144
Page	144.5
Issue	F

FLANGE BRACKET MOUNTED UNITS ("M" DRIVE)



SERIES 495 Pumps
with "M" Drive
"G", "GG", H", "HJ" and "HL" Sizes



SERIES 495 Pumps
with "M" Drive
"AS", "AK" and "AL" Sizes

For a compact horizontal mounting, the face mounted 495M heavy-duty pump units in all eight sizes include a combination motor "C" flange and square pump flange bracket with coupling connecting motor and pump.

The three larger size pumps are equipped with ductile iron pump gears (rotor and idler) and automatic pressure lubrication system. All sizes have O-Ring head and valve gaskets and mechanical seals as standard construction. These pumps are also available with steel externals, see Section 154.

Dimensions for "M" Drive—See Page 144.9 and 144.10.
Performance Data for "M" Drive—See Pages 144.13 through 144.26.

SPECIFICATIONS — "M" DRIVE UNITS

Pump Model	Port Size (NPT)	Nominal Capacity at Maximum Rated Speed 22 cSt (100 SSU) Liquid ①				Maximum Pressure ⑤	Maximum Hydrostatic Pressure		Steel Fitted Construction Recommended Above This Viscosity ③	Maximum Recommended Temperature ②		Approximate Shipping Weight	
		60 Hz Motor Speed		50 Hz Motor Speed									
	Inch	GPM	RPM	M³/hr	RPM	PSI (BAR)	PSI	BAR	SSU (cSt)	Deg. F	Deg. C	Lb.	Kg.
G495M	1	8 5	1800 1200	1.5 1	1500 1000	100 (7)—below 38 SSU 150 (10)—38 to 100 SSU 250 (17)—above 100 SSU	400	28	7500 (1619)	225	107	28	13
GG495M	1	10 7	1800 1200	2 1.3	1500 1000		400	28	7500 (1619)	225	107	28	13
H495M	1½	15 10	1800 1200	2.9 2	1500 1000		400	28	25000 (5500)	225	107	50	22
HJ495M	1½	20 14	1800 1200	4 2.6	1500 1000		400	28	7500 (1619)	225	107	50	22
HL495M	1½	30 20	1800 1200	6 4	1500 1000		400	28	④	225	107	50	22
AS495M	2½	35	1200	10.4 6.6	1500 1000		400	28	④	225	107	90	41
AK495M	2½	50	1200	15.7 10	1500 1000		400	28	⑧	225	107	90	41
AL495M	3	75	1200	21.2 13.6	1500 1000		400	28	④	225	107	95	43

① Nominal capacities based on handling thin liquids.
② With special construction, temperatures to + 350°F. (177°C.) can be handled with this series.
③ For viscosities above 15,000 SSU (3,300 cSt), provide details for recommendations.
④ These models have ductile iron rotors; steel fitted rotors not necessary.
⑤ If suction pressure exceeds 100 PSIG (7 BAR), consult factory.

Metric conversions are based on US measurements and rounded to the nearest whole number.

Young Touchstone
A Wabtec company

2825 Four Mile Rd
Racine, WI 53404
PH: (262) 639-1010
FX: (262) 504-2001

OCH Oil Coolers
Installation, Operation, and Maintenance Instructions

RECEIVING

Inspection:
Inspect unit for shipping damage (especially core) before unpacking. Rotate fan, which should move freely. Note that one blade is wired to guard on some models for shipping. Remove wire before rotating fan.

Handling:
Exercise care to avoid damage to core. All units are shipped with a wood box on a skid facilitating forklift handling.

Storage:
Units normally have one coat of medium gray, semi-gloss enamel paint suitable for indoor storage. All openings are sealed with appropriate pipe plugs, pipe caps, thread protectors, and flange covers at the factory. Be sure these are in place.

INSTALLATION

Location:
Avoid locating cooler in a corrosive atmosphere as rapid deterioration of casing, cooling element, fan and motor may take place resulting in shortened life and unnecessary replacement expense.

If cooler is to utilize waste heat for space heating, it should be mounted 7 to 14 feet above the floor for proper heat distribution.

Foundation And Mounting:
Cooler may be suspended from 1/2-13 UNC tapped holes in top by threaded rods, or may be base-mounted from 1/2-13 UNC tapped holes in bottom. In either case, mount for horizontal airflow to maintain proper cooling of fan motor and venting of internal passages.

Piping should be sized based on design flow and pressure drop requirements and not on oil cooler supply and return connection sizes.

A strainer or filter located ahead of the cooler or the heat source, depending on the type of service, should be installed to trap scale, dirt or sludge that may be present in piping and equipment, or that may accumulate from oil breakdown.

A thermostatic or spring loaded by-pass relief valve installed ahead of the cooler will be found helpful to hasten warm-up and relieve the system of excessive pressures, as well as to control the oil temperature in certain installations. These accessories should be considered in the original heat rejection and piping computations. OCH oil coolers are designed For Oil Operating Pressures Up To 300 Psi Maximum At 400 F°.

Motor Connection:
Connect motor to power supply for voltage and frequency (Hertz) on motor nameplate only, and according to diagram furnished with motor. Connect two-speed switch when furnished, according to diagram included with two-speed switch. Before turning on electric power, rotate fan by hand, making sure it has proper clearance and has not been damaged. Turn on electric power. Make sure fan is rotating counterclockwise (looking down the air stream) and drawing air over the motor, through the heating element and out the louvers or discharge opening.

If motor is to be protected against over current through motor starter or other over current device, select over current relays or heaters based on actual measured current draw of motor on completed installation.

DO NOT USE NAMEPLATE AMPERES. (Motor load on this cooler is based on actual safe temperature test of motor).

Young Touchstone
A Wabtec company

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Racine, WI 53404
PH: (262) 639-1010
FX: (262) 504-2001

OCH Oil Coolers
Installation, Operation, and Maintenance Instructions

Start Up Precautions – Piping Connections
All OCH coolers are manufactured with standard single (1) or two (2) pass pipe connections. All piping connections are capped at the factory for shipment. Prior to start up, check the unused connection to assure that the pipe cap is secure to prevent leaks during system operation.

MAINTENANCE

Lubrication:
Lubricate motor according to instructions furnished with motor.

External Cleaning:
Dirt on cooling element fins reduces airflow and cooling capacity. Dirt on fan blades reduces air output and may throw fan out of balance and overload motor. Dirt on motor reduces motor ventilation and cooling, causing overheating and possible burnout.

At least once each year, remove dust and greasy deposits from cooling element fins, motor, fan blades and fan shroud. Use a stiff brush or air nozzle for loose dirt or a mild organic alkaline cleaning solution with brush for solid or greasy deposits. Do not bend or damage cooling element fins. Care must be taken not to damage fan blades as resulting out-of balance condition may cause vibration, damage to motor bearings, and possible motor burnout due to overheating.

To clean heavy deposits on outside of core, remove core from cabinet, plug all openings, and immerse in a mild organic alkaline solution such as Fine Organics 2223 or Keychem 06000. A 10% concentration with water is typical and solution should be heated to 160 to 180F to increase effectiveness. Agitation of the core increases effectiveness and ultrasonic equipment can be effective for breaking up deposit particles. The length of time required to accomplish cleaning is dependent upon the degree of fouling. Do not use a caustic solution boil out tank for cleaning, as damage to the core fins will result.

Internal Cleaning:
Once a year, piping should be disconnected and a degreasing agent or flushing oil circulated through the unit to remove sludge from turbulators and internal tube surfaces to return the unit to full capacity. For degreasing, Fine Organics 2223 or Keychem 06000 as indicated above may be used. A pump and filtration system can be used to circulate the degreasing agent or flushing oil and capture deposit particles. Ideally the solution should be circulated in reverse direction to the normal flow. If degreasing solution as recommended above is used, an oil flush of the core should follow soon after to avoid rust on steel surfaces. A thorough cleaning of the entire system is preferable to avoid carry over from uncleaned piping, pump and accessories. If this is done, filter or strainer should be removed and necessary adjustment or removal of by-pass valve effected. Regular cleaning or replacement of filter or strainer will help maintain a clean and efficiently operating system.

Young Touchstone
A Wabtec company

200 Smith Lane, Jackson, TN 38301 Phone: 731-424-5045 Fax: 731-265-2302

INSTALLATION INSTRUCTIONS FOR OCH OIL COOLERS

LOCATION

Avoid locating cooler in a corrosive atmosphere as rapid deterioration of casing, cooling element, fan and motor may take place resulting in shortened life and unnecessary replacement expense.

If cooler is to utilize waste heat for space heating, it should be mounted 7 to 14 feet above the floor for proper heat distribution.

FOUNDATION AND MOUNTING

Cooler may be suspended from 1/2-13 UNC tapped holes in top by threaded rods, or may be base-mounted from 1/2-13 UNC tapped holes in bottom. In either case, mount for horizontal airflow to maintain proper cooling of fan motor and venting of internal passages.

Piping should be sized based on design flow and pressure drop requirements and not on oil cooler supply and return connection sizes.

A strainer or filter located ahead of the cooler or the heat source, depending on the type of service, should be installed to trap scale, dirt or sludge that may be present in piping and equipment, or that may accumulate from oil breakdown.

A thermostatic or spring loaded by-pass relief valve installed ahead of the cooler will be found helpful to hasten warm-up and relieve the system of excessive pressures, as well as to control the oil temperature in certain installations. These accessories should be considered in the original heat rejection and piping computations. OCH oil coolers are designed for oil operating pressures up to 300 psi maximum at 400 F°.

Figure 1, page 3 shows typical one pass cooler connections for high oil flow rates. Figure 2, shows typical two pass cooler connections for low oil flow rates. If connection type is not provided in specification documents, consult the factory or a factory representative as damage or inefficient operation can result.

MOTOR CONNECTION

Connect motor to power supply for voltage and frequency (Hertz) on motor nameplate only, and according to diagram furnished with motor. Connect two-speed switch when furnished, according to diagram included with two-speed switch. Before turning on electric power, rotate fan by hand, making sure it has proper clearance and has not been damaged. Turn on electric power. Make sure fan is rotating counterclockwise (looking down the air stream) and drawing air over the motor, through the core and out the louvers or discharge opening.

If motor is to be protected against over current through motor starter or other over current device, select over current relays or heaters based on nameplate amperes. If motor is 1.15 Service Factor, actual operating amperes may exceed nameplate amperes by up to 15%. In this case select protection devices based on actual operating amperes.

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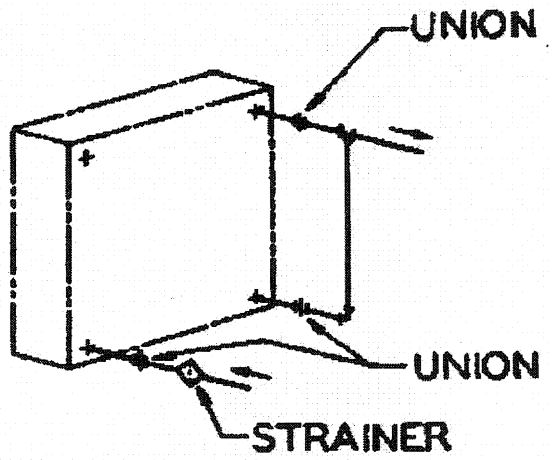
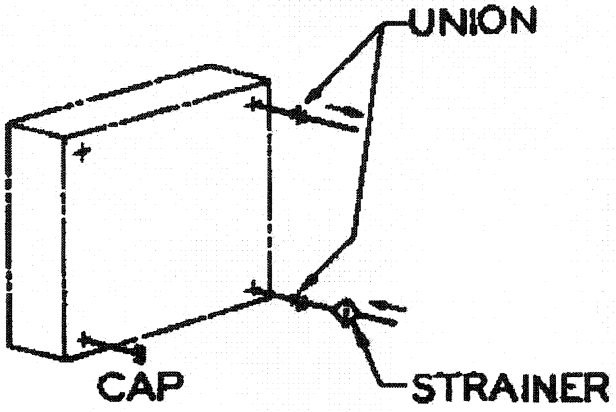
200 Smith Lane, Jackson, TN 38301 Phone: 731-424-5045 Fax: 731-265-2302

INSTALLATION INSTRUCTIONS FOR OCH OIL COOLERS



TYPICAL ONE PASS CONNECTIONS
FIGURE 1



TYPICAL TWO PASS CONNECTIONS
FIGURE 2

Young Touchstone
A Wabtec company

200 Smith Lane, Jackson, TN 38301 Phone: 731-424-5045 Fax: 731-265-2302

MAINTENANCE INSTRUCTIONS FOR OCH OIL COOLERS

LUBRICATION

Lubricate motor according to instructions furnished with motor.

EXTERNAL CLEANING

Dirt on cooling element fins reduces airflow and cooling capacity. Dirt on fan blades reduces air output and may throw fan out of balance and overload motor. Dirt on motor reduces motor ventilation and cooling, causing overheating and possible burnout.

At least once each year, remove dust and greasy deposits from cooling element fins, motor, fan blades and fan shroud. Use a stiff brush or air nozzle for loose dirt or a mild organic alkaline cleaning solution with brush for solid or greasy deposits. Do not bend or damage cooling element fins. Care must be taken not to damage fan blades as resulting out-of-balance condition may cause vibration, damage to motor bearings, and possible motor burnout due to overheating.

To clean heavy deposits on outside of core, remove core from cabinet, plug all openings, and immerse in a mild organic alkaline solution such as Fine Organics 2223 or Keychem 06000. A 10% concentration with water is typical and solution should be heated to 160 to 180F to increase effectiveness. Agitation of the core increases effectiveness and ultrasonic equipment can be effective for breaking up deposit particles. The length of time required to accomplish cleaning is dependent upon the degree of fouling. Do not use a caustic solution boil out tank for cleaning, as damage to the core fins will result.

INTERNAL CLEANING

Once a year, piping should be disconnected and a degreasing agent or flushing oil circulated through the unit to remove sludge from turbulators and internal tube surfaces to return the unit to full capacity. For degreasing, Fine Organics 2223 or Keychem 06000 as indicated above may be used. A pump and filtration system can be used to circulate the degreasing agent or flushing oil and capture deposit particles. Ideally the solution should be circulated in reverse direction to the normal flow. If degreasing solution as recommended above is used, an oil flush of the core should follow soon after to avoid rust on steel surfaces. A thorough cleaning of the entire system is preferable to avoid carry over from uncleaned piping, pump and accessories. If this is done, filter or strainer should be removed and necessary adjustment or removal of by-pass valve effected. Regular cleaning or replacement of filter or strainer will help maintain a clean and efficiently operating system.

SERVICE

When ordering replacement part or making inquiry regarding service, always provide model, part, and serial numbers which can be obtained from the nameplate located on the plenum panel on the back side of the cooler.

Young Touchstone
A Wabtec company

2825 Four Mile Rd
Racine, WI 53404
PH: (262) 639-1010
FX: (262) 504-2001

Standard Product One Year Limited Product Warranty
Effective: May 1, 2003
(Applies to all products except DS1 Radiator)

Contact the factory Service Department immediately through your local Young Touchstone Representative. In all communications include complete nameplate data. Returned product Will Not be accepted without prior written authorization from the factory Service Department.

Young Touchstone products have been manufactured and inspected with care by experienced crafts people. Young Touchstone warrants your purchase to be free from defects in materials and workmanship to the original purchaser for a period of one year from date of shipment subject to the following terms and conditions:

Warranty

Young Touchstone, hereinafter referred to as the "Company", warrants that its products will be free from defects in materials and workmanship under normal use and service for a period of one year in each case from the date of shipment from the Company's plants.

Repair, replacement, or appropriate adjustment, at the Company's option, will be provided if, upon the Company's inspection, the equipment is found to be properly installed, maintained, and operated in accordance with specifications to which the equipment was manufactured. The Company shall have no liability for costs relating to removal or reinstallation of defective components.

Any and all returns or repairs under this Warranty must be authorized in writing by the Company prior to return or repair completion. Shipping costs for any product delivered to the Company's plant and subsequently returned to customer will be at the customer's expense. This Warranty does not apply to malfunctions caused by damage, unreasonable use, misuse, repair or service by unauthorized persons, or normal wear and tear.

No Other Express Warranty Applies

Warranty Exclusions

- Warranty on components or accessories furnished by suppliers to the Company shall be limited to the warranty of the respective supplier.
- Warranty shall not extend beyond the warranty offered by the end customer.
- Warranty does not apply to
  1) the affects of physical or chemical properties of water/coolant used in the equipment and
  2) paint provided on the equipment or the cosmetic appearance of the equipment as this is a maintenance issue.
- Expenses for service, labor or other matters incurred by the buyer, its customers or agents without prior approval or authorization by the Company, will not be accepted.
- The Company shall not be liable for any contingent, incidental, punitive, or consequential damages. Changes or repairs attempted or made in the field without written authorization from the Company void this warranty.

The Company, which is committed to continuous improvement, reserves the right to improve its products through changes in design or material as it may deem desirable without being obligated to incorporate such changes in products of prior manufacture.

Revised March. 2006
Part Number 362000

SUNDYNE
LMC/BMC 311P / 331P

Instruction and Operation Manual

August 2007

Sundyne CORPORATION®

Visit our website at www.sundyne.com

WARRANTY

Sundyne Corporation warrants to Buyer for a period of twelve (12) months from the date of being placed in service (but not to exceed eighteen (18) months after the date of shipment) that the equipment at the time of shipment will be free from defects of design, material and workmanship. If any defects or malperformance occur during the warranty period, Sundyne's sole obligation shall be limited to alteration, repair or replacement at Sundyne's expense, F.O.B. Factory, of parts or equipment, which upon return to Sundyne and upon Sundyne's examination prove to be defective. Equipment and accessories not manufactured by Sundyne are warranted only to the extent of and by the original manufacturers' warranty. Sundyne shall not be liable for damage or wear to equipment caused by abnormal conditions, vibration, failure to properly prime or to operate equipment without flow or caused by corrosives, abrasives or foreign objects. THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, WHETHER EXPRESSED OR IMPLIED INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. In no event shall Sundyne be liable for consequential or incidental damages.

TABLE OF CONTENTS

ILLUSTRATIONS

SAFETY

Equipment and Safety Precautions

Sundyne Corporation manufactures centrifugal pumps to exacting International Quality Management System Standards (ISO 9001) as certified and audited by Lloyd's Register Quality Assurance Limited. Genuine parts and accessories are specifically designed and tested for use with these products to ensure continued product quality and performance. Sundyne cannot test all parts and accessories sourced from other vendors; incorrect design and/or fabrication of such parts and accessories may adversely affect the performance and safety features of these products. Failure to properly select, install or use authorized Sundyne pump parts and accessories is considered misuse and damage or failure caused by misuse is not covered by Sundyne's warranty. Additionally, modification of Sundyne products or removal of original components may impair the safety of these products and their effective operation.

CAUTION

Note: *Sundyne pumps may handle hazardous, flammable, and/or toxic fluids. Proper personal protective equipment should be worn. Precautions must be taken to prevent physical injury. Pumpage must be handled and disposed of in accordance with applicable environmental regulations.*

CAUTION

Note: *Safety procedures must be applied prior to any installation, maintenance, or repair of a Sundyne pump. Failure to follow safety precautions may lead to injury!*

Wearing Personal Protective Equipment

To ensure safety, protective equipment must be worn at all times when installing, performing maintenance, or repairing equipment. The following safety recommendations must be adhered to for optimum safety:

- Safety glasses, with the minimum requirement of side shields, must be worn at all times.
- Steel-toed shoes must be worn when lifting equipment greater than 15 pounds (7 kg) or if pallet jacks or forklifts are operated.
- Hearing protection is strongly recommended at all times when noise levels exceed 85 dB during an eight (8.0) hour period.

CAUTION

Note: *Chemical resistant gloves must be used if chemicals are utilized (refer to Using Chemicals for additional information).*

CAUTION

Note: *A dust mask respirator must be worn if chemicals have warning labels regarding fumes, dust, or mists.*

When using more than one piece of protective equipment, consider their compatibility. For example, safety glasses will not interfere with hearing protection equipment. Be sure to clean all pieces of personal protective equipment immediately after each use.

Using Forklifts

Any persons operating a forklift must have an active recognized operator license.

CAUTION

Note: *Before initializing forklift operation, verify that the lift is in a safe operating position.*

Ensuring Electrical Safety

All electrical sources must be powered-off before installation, service, or repair of equipment occurs.

CAUTION

Note: *Sundyne recommends that a Lock-out/Tag-out program be followed prior to altering the equipment. Locks or tags must be provided to warn employees that equipment is temporarily unavailable.*

Once all work has been completed, the person installing the lock or tag must remove it according to company procedure.

Testing Equipment

Prior to performing a test on newly installed, maintained, or repaired equipment; all personnel in the immediate area must be warned.

CAUTION

Note: *Follow company procedures prior to equipment testing at all times.*

Using Chemicals

Any chemicals to be used must be accompanied by a relevant material safety data sheet (MSDS), in accordance with government legislation. If applicable, use chemical proof gloves.

CAUTION

Note: *An eye wash station (or equivalent) should be available in the event of injury. If any hazardous or flammable chemicals pass through the equipment, a complete decontamination of the equipment is required.*

Protection from Falling

Fall protection and associated preventative measures is required when working on equipment located six feet or higher from the ground.

CAUTION

Note: *Follow company fall prevention procedures prior to working on equipment.*

Preventative Machine Guards

Preventative guards must remain in place on all equipment.

CAUTION

Note: *Only remove the guards while performing maintenance or repair.*

Replace the guards immediately after working on the equipment and prior to start up.

CAUTION

EXPLOSION/FIRE HAZARD

Never use an acetylene torch, open flame, or heat to attempt to remove parts that have seized together in Sundyne equipment. Any residual process gas or liquid that is flammable can result in an explosion or fire with potential for serious injury or death.

CAUTION

INTRODUCTION

This manual presents installation, servicing, troubleshooting, maintenance and spare parts information for the latest configuration of the Sundyne LMC/BMC-311 & 331 compressors.

The primary difference between the LMC and the BMC models is the method of mounting the compressor and the starting procedures.

Parenthetical numbers included in the text correspond to item numbers on the illustrated figures. The item number of a part is based on the part's function and location. The correct spare part can be ordered for any generation pump by referencing the item and serial numbers.

Information that may be required regarding performance, alterations, or detailed technical data which is not included herein, may be found in the final data package accompanying the unit, or may be obtained from your Sundstrand Fluid Handling representative.

Custom-made auxiliary equipment cannot be shown in this manual. Refer to the final data package specifics.

INSTALLATION

1. INSPECTION

Upon receipt of Sundyne equipment, check for any damage which may have occurred during shipment. Notify the carrier and Sundstrand promptly if damage has occurred.

NOTE

The shaft may not turn freely due to seal drag and speed increasing gear meshes; however, if rotation is "bumpy" this would indicate some disorder or damage and requires investigation for cause.

2. STORAGE

If the compressor, is not to be installed immediately, it should be protected from exposure to moisture and dust. Shipping covers installed at the factory (for casing flanges and seal ports) must be kept securely in place. Storage instructions provided by the driver (motor or turbine) manufacturer should be observed.

3. LONG-TERM STORAGE

Certain long-term storage considerations should be met for any Sundyne compressor which will not be operating for a period of time exceeding six months from date of factory shipment. This action will insure minimum corrosion damage to the gearbox and fluid-end components. Because of storage location and other unknown site factors beyond our control, Sundstrand will not accept any liability for damage to the equipment during the storage period, nor does Sundstrand guarantee the condition of the equipment during and after the storage period.

To insure the original quality of the Sundyne compressor prior to commissioning after storage, all components must be inspected by an authorized Sundstrand service engineer. Any components not of Sundstrand manufacture (except mechanical seals) must be inspected by that particular submanufacturer's authorized service personnel. The cost of such service personnel and any component replacement will be at the purchaser's expense.

Factors which affect the quality of an uninstalled Sundyne compressor are the humidity/temperature and the chemicals in the atmosphere surrounding the equipment. The method employed for long-term storage is to prevent the humidity/temperature and air-borne chemicals from making contact with internal components of the equipment.

When the equipment is to be stored in strong chemical environments or near salt water, protection should be executed immediately upon receipt of the equipment.

Following is the Sundstrand preferred list of recommended long-term storage procedures:

A. Indoor, climate controlled building (maintains constant temperature and humidity).

B. Inert gas purging of component internals.

C. Oil flooding of component internals.

D. Desiccant bags.

CAUTION

Because long-term storage of equipment is of a highly critical nature, it is recommended that Sundstrand be contacted to provide more details on the above procedures.

4. SUCTION AND DISCHARGE PIPING

A. The suction line should be clean and a strainer should be installed to protect the impeller from damage by mill scale, welding slag, or other foreign particles during initial startup.

B. All piping must be supported independently of the compressor. The piping should always line up with the compressor flanges. Never draw the piping into place by the use of force at the flanged suction and discharge connections as this may impose excessive strains on the unit.

C. The piping, both suction and discharge, should have no unnecessary elbows, bends, and fittings, as they increase friction losses in the piping. The size of pipe and fittings should be selected carefully and be sufficient to keep the friction losses as low as practical .

D. Piping must not be connected to the compressor until after compressor hold-down bolts have been tightened.

E. The use of elbows near the suction flange should be avoided. When used, elbows should be long radius. A straight pipe run of at least three times the pipe diameter is desirable between an elbow and the suction flange.

F. Suction pipe should never be of smaller diameter than the compressor suction inlet.

G. Block valves (both suction and discharge) are recommended to isolate the compressor during shut-down, to minimize process leakage during the shut-down condition, and to prevent possible reverse rotation due to back flow through the compressor.

5. SEAL ENVIRONMENTAL CONTROL SYSTEM

Depending upon the compressor seal arrangement and application, a seal environmental control system may be required. The compressor seal environment must always be maintained as specified on the specification sheet which accompanies each unit delivery. For many applications, a standard system can be supplied from the factory. Insure that the seal environmental control system specified is installed properly and that ports (refer to figure 21), are open or plugged as shown on the outline drawing. **Port 1 must always be free to drain and vent.**

A. LIQUID BUFFER SYSTEM - A liquid buffer system is used with double liquid seals. The buffer liquid is introduced into port 7, allowed to flow through the seal cavity, and out port 2.

Buffer flow should be 0.5 to 3 gpm (2 to 12 liters/min) with an inlet temperature of 60° to 120°F (16° to 49°C), and inlet pressure as indicated on the specification sheet. The liquid must be clean to 5 μ MICRON.

If a closed loop buffer system is used, the buffer must be cooled prior to returning to port 7. Otherwise, heat generated by seal friction will build up in the buffer, resulting in shorter seal life. If an open loop system is used, an orifice or valve on port 2 should be used to regulate flow to proper value.

B. SEAL COOLING - If the normal process discharge temperature exceeds 350°F (177°C), it is recommended that the seal housing water jacket be utilized to lower seal cavity temperature. Cooling fluid is piped into port 3 and out port 4 of the seal housing. Contact the factory for recommended coolant temperature, flow and pressure. Use of cooling jacket may extend seal life in high temperature applications.

6. GEARBOX HEAT EXCHANGER

Most units having heat exchangers will conform to a configuration illustrated in Figure I. This is a Sundstrand Fluid Handling assembly and should not be rearranged. THE HEAT EXCHANGER NEVER MOUNTED HIGHER THAN THE FILTER .

A. The standard heat exchanger is a shell and tube water-cooled type.

B. Cool water should be provided at 150 psig (11 kg/cm2) maximum pressure to the tube side. Coolant flow should be controlled to maintain a gearbox sump temperature between 140°F to 200°F (60°C to 93°C).

C. The optional air cooled heat exchanger should be controlled to maintain the same gearbox sump temperature as above.

MOUNTING

For all vertical units without stands, a mounting base is recommended. Vertical units with drivers of 100 horsepower or less may be line mounted if desired.

The vertical or horizontal stand should be mounted on a rigid concrete foundation, secured in position by one-inch diameter bolts and grouted in place. The bolts should be installed in the foundation as shown on the installation drawing. The length of the bolts should be sufficient to extend at least 1/2-inch above the nut.

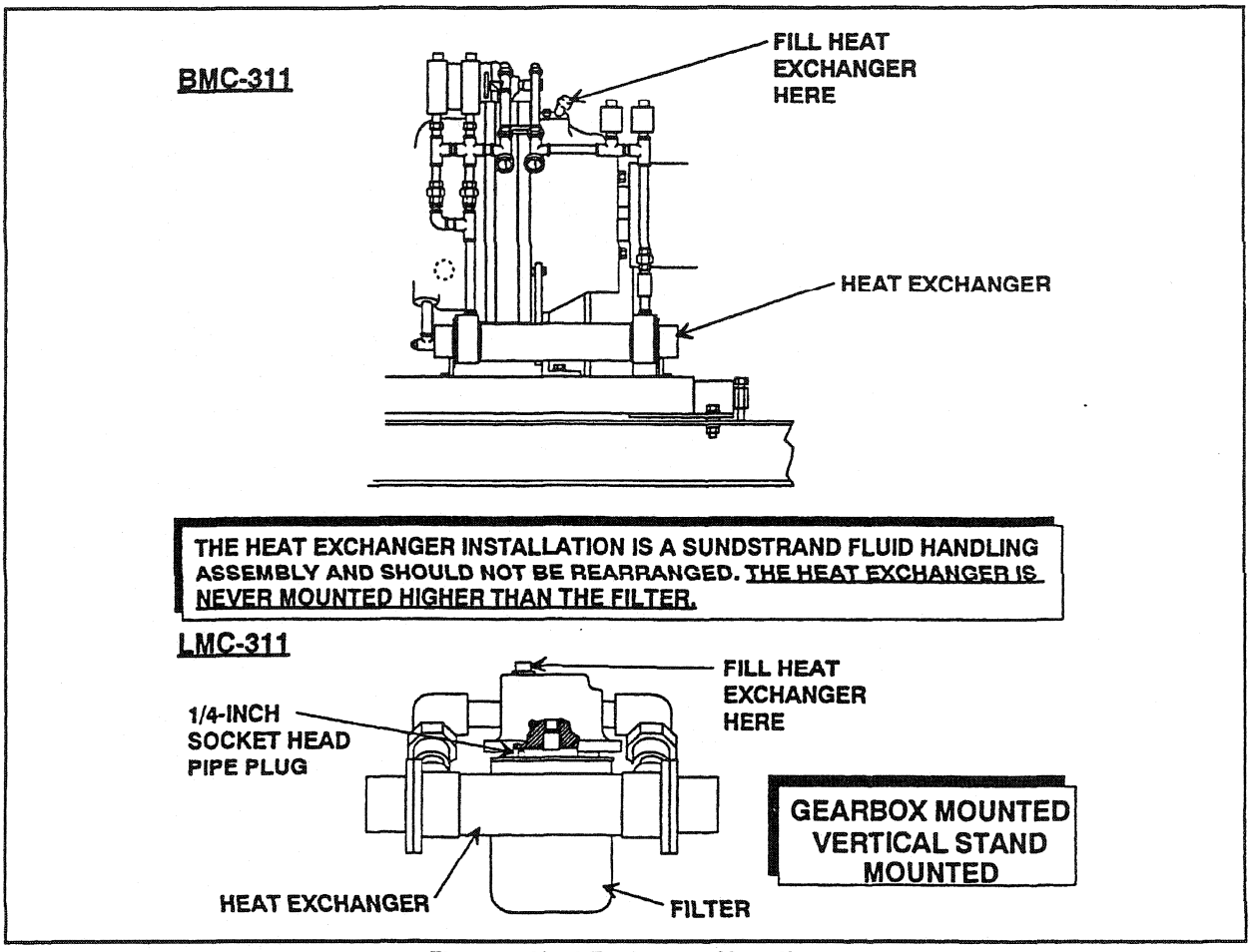


Figure 1. Heat Exchanger Mounting

A. LMC UNITS WITH VERTICAL STANDS

The top of the stand (driver mounting surface) should be leveled by shimming under the base prior to grouting the channels are to be filled with grout through the access holes. The nuts on the foundation bolts should not be tightened until the grout has set for at least 48 hours.

B. BMC UNITS - The base plate should be leveled prior to grouting. Grout must be allowed to set for at least 48 hours before tightening foundation bolts.

7. DRIVER AND COUPLING

Drivers are normally shipped separately from the gearbox and compressor. When a splined interconnecting shaft is supplied, this shaft must be lubricated at each end with one tube (5cc) of antifretting compound (Sundstrand Part Number MP01AA10) Also available are solid shaft drivers coupled to the gearbox with a flexible coupling. See Section 9 for further coupling information.

Drivers are to be installed and maintained in accordance with the manufacturer's instructions.

8. FLEXIBLE COUPLING

A. LMC UNITS WITHOUT VERTICAL STAND

(1) If other than Sundstrand supplied couplings are used, they must be flexible disc or gear type couplings capable of tolerating reasonable amounts of parallel and angular misalignment, and axial end float. Refer to coupling manufacturer's recommendations for installation and maintenance.

CAUTION

Lock out starting switch on driver prior to working on coupling.

(2) Coupling installation for turbine drivers is identical to that for motors.

(3) The gearbox coupling hub will normally be mounted at the factory. The driver coupling hub will be

mounted on all motors and turbines shipped from the Sundstrand factory. If the driver hub is mounted upon receipt of the unit, skip to Section 5 or 6 (Page 2 or 3) for installation instructions.

(4) If the driver coupling hub is not mounted, the following procedure should be followed for Falk or Thomas couplings:

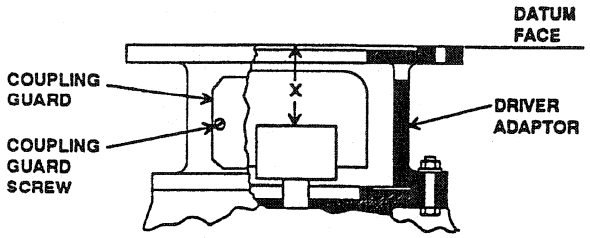


Figure 2. Gearbox Coupling Hub

(a) Measure the distance from the top surface of the gearbox hub to the datum face of the driver adaptor (Figure 2). This will be called the "X" dimension.

(b) From Table 1 or 2, determine the end gap (distance between coupling hubs) for the size of coupling provided.

(c) Subtract the end gap value from the "X" dimension to determine the distance from the driver datum face to the coupling hub face ("Y" dimension - Figure 3). Scribe the shaft to show the "Y" dimension.

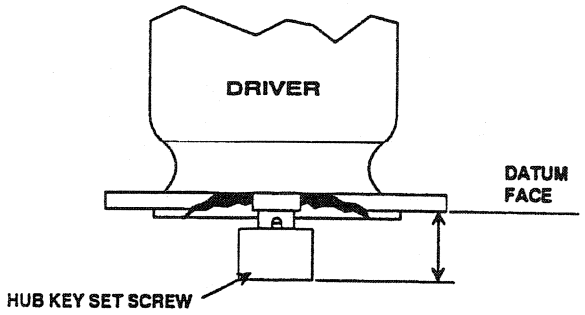


Figure 3. Driver Coupling Hub

(d) Make sure the coupling hub bore, keyways, and shaft are clean, free from burrs, and that the key will fit in the keyways. Heat the hub in an oil bath or oven to approximately 250°F (121°C), or more if necessary, so the hub will slide onto the motor shaft. Position the hub at the scribed line on the shaft and tighten the hub key set screw.

NOTE

On Thomas couplings, before the hub is installed check to see if it is possible to assemble the coupling bolts and washers (Figure 8) from the motor side of the hub when installed If this is not possible, assemble the short bolts with bevel washers into the hub flange before fitting in onto the shaft.

(5) Falk Steelflex Installation Instructions

(a) The driver adaptor has coupling guard plates which must be removed and stored while installing coupling.

NOTE

The coupling seals should have a light coating of grease before installation and assembly. When mounting or remounting the coupling hub, for any reason, always put the seal ring on the gearbox or driver shaft first. Then install the coupling hub. The coupling will not seal properly if these rings are omitted (Figure 4).

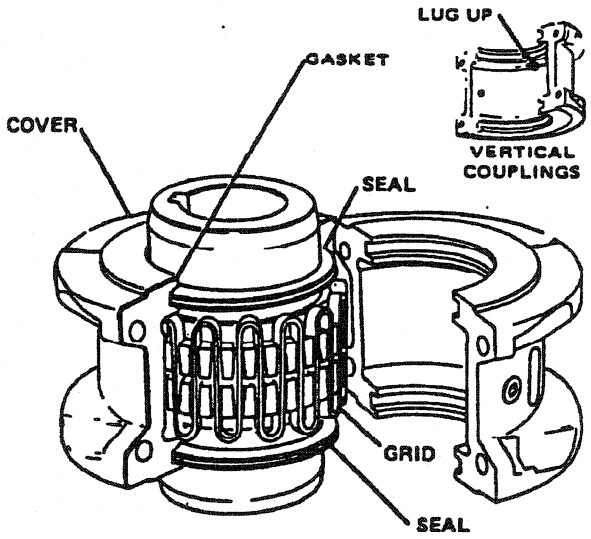


Figure 4. Falk Steelflex Coupling

(b) Mount the driver on the driver adaptor and tighten the attaching bolts.

(c) From Table 1, determine the end gap (distance between coupling hubs) for the size of coupling provided.

(d) Using a feeler gauge, check the actual end gap (Figure 5) to verify that it is within the limits given in Table 1. If it is not, loosen the hub key set screw and move the hub up or down until the end gap is within limits. Retighten the set screw.

FALK COUPLING SIZE	END GAP			COVER BOLT TORQUE
	MINIMUM	NORMAL	MAXIMUM	
40T10	0.062 in. (1.57mm)	0.125 in. (3.17mm)	0.188 in. (4.77mm)	100 lb. - in. (1.15 kg - m)
50T10	0.062 in. (1.57mm)	0.125 in. (3.17mm)	0.188 in. (4.77mm)	200lb. - in. (2.30 kg - m)
60T10	0.062 in. (1.57mm)	0.125 in. (3.17mm)	0.188 in. (4.77mm)	200lb. - in. (2.30 kg - m)
70T10	0.062 in. (1.57mm)	0.125 in. (3.17mm)	0.188 in. (4.77mm)	200lb. - in. (2.30 kg - m)
80T10	0.062 in. (1.57mm)	0.125 in. (3.17mm)	0.250 in. (6.35mm)	200lb. - in. (2.30 kg - m)

Table 1. Coupling Specification (Falk Steelflex Type)

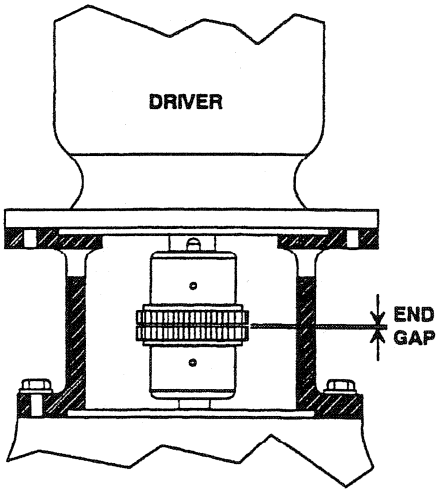


Figure 5. End Gap

(e) It is good practice to coat the coupling assembly and shafts with grease or some form of protection in order to minimize the chance of corrosion.

(f) Replace the coupling guards and secure them with the screws provided.

(6) Servicing of Falk Steelflex Coupling

(a) Couplings should be lubricated at least once a year. Lubricate more often when the coupling is exposed to excessive moisture or extreme temperatures.

Remove both lube plugs and insert one grease

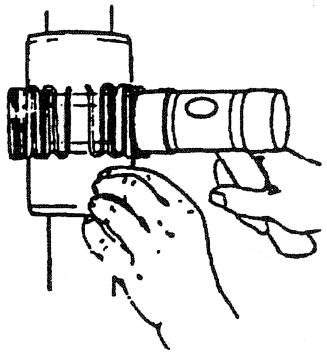


Figure 6. Grid Disassembly

fitting. Fill with grease until excess appears at opposite hole. Remove fitting and replace plugs.

(b) For operation in ambient temperatures of 0° to 150°F (-18° to 66°C), grease with the following specifications should be used:

DROPPING POINT - 300° F (149° C) or higher.
CONSISTENCY - NLGI #2 with worked penetration value in the range of 250 to 300.

SEPARATION AND RESISTANCE Low oil separation rate and high resistance to separation from centrifuging.

LIQUID CONSTITUENT - Good lubricating properties equivalent to a high quality, well refined, petroleum oil.

INACTIVE - Must not corrode steel or cause swelling or deterioration of neoprene.

CLEAN - Free from foreign inclusions.

For ambient down to -30° F (-34° C), a grease with worked penetration value of 310-340 should be used. For ambients above or below those given, consult the Falk Corporation.

(c) If it should be necessary to disassemble the coupling, the following procedure should be followed. Remove the cover halves from the coupling. Use a round rod (or screwdriver) that will fit into the open loop ends of the grid. Begin at the open end of grid and pry the grid radially in even, gradual stages, proceeding alternately from side to side. See Figure 7.

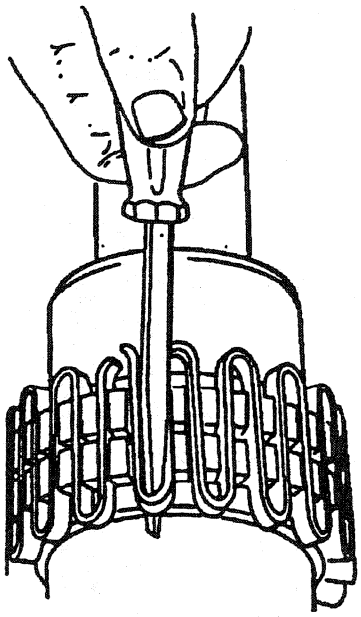


Figure 7. Coupling Disassembly

NOTE

If other than Sundstrand supplied couplings are used, refer to manufacturer's recommendations for maintenance and lubricating procedures.

(7) Thomas Type DBZ Installation Instructions.

(a) The driver adaptor has coupling guard plates that must be removed and stored while installing coupling.

NOTE

The coupling is shipped with the center assembly assembled as shown in Figure 9 (initial view). If it is necessary to completely disassemble the center assembly, tie a wire through the bolt holes to maintain the order of the disc packs. Be careful to note the arrangement of the parts so that the coupling can be reassembled with the parts in the same order.

(b) Mount the driver on the driver adaptor and tighten the attaching bolts.

(c) From Table 2, determine the end gap (distance between coupling hubs) for the size of coupling provided.

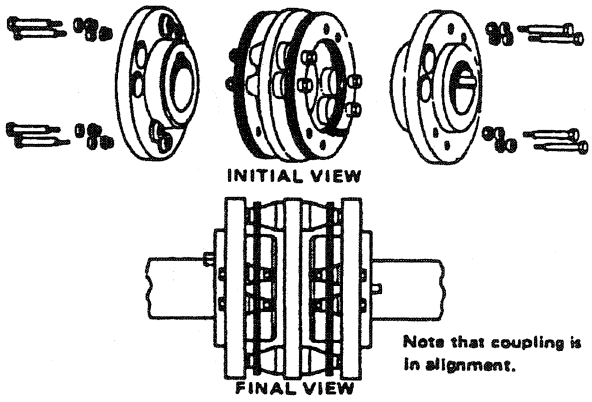


Figure 8. Thomas Coupling Alignment

(d) Using a proper gauge, check the actual end gap (Figure 9) to verify that it is within the limits given in Table 2. If it is not, reposition the hub up or down until the end gap is within limits.

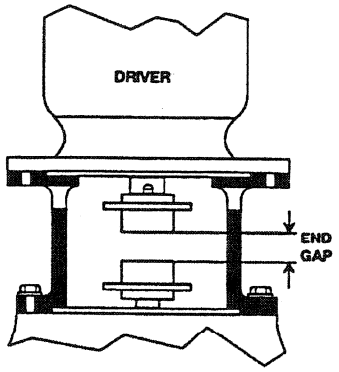


Figure 9. End Gap

THOMAS COUPLING SIZE	END GAP			COVER BOLT TORQUE
	MINIMUM	NORMAL	MAXIMUM	
163	0.876 in. (22.24mm)	0.938 in. (23.81mm)	1.005 in. (25.41mm)	156 lb. - in. (1.80 kg -m)
201	0.876 in. (22.24mm)	0.938 in. (23.81mm)	1.005 in. (25.41mm)	300 lb. - in. (3.46 kg - m)
226	1.126 in. (28.59mm)	1.188 in. (30.18mm)	1.251 in. (31.76mm)	516 lb. - in. (5.95 kg - m)
263	1.219 in. (30.97mm)	1.313 in. (33.35mm)	1.407 in. (35.73mm)	756 lb. - in. (8.72 kg - m)
301	1.406 in. (35.72mm)	1.500 in. (38.10mm)	1.594 in. (40.48mm)	1140 lb. - in. (13.15 kg - m)

Table 2. Coupling Specification (Thomas Type DBZ)

NOTE

Generally, the gearbox hub is easier to adjust than the driver hub. If the hub does not move easily, use a bearing puller and heat the hub. DO NOT heat hub any more than is absolutely necessary to loosen it.

(e) Assemble the center assembly to the hubs using the bolts, nuts, and washers provided keeping the proper order of parts as noted in step (a). (See Figure 10).

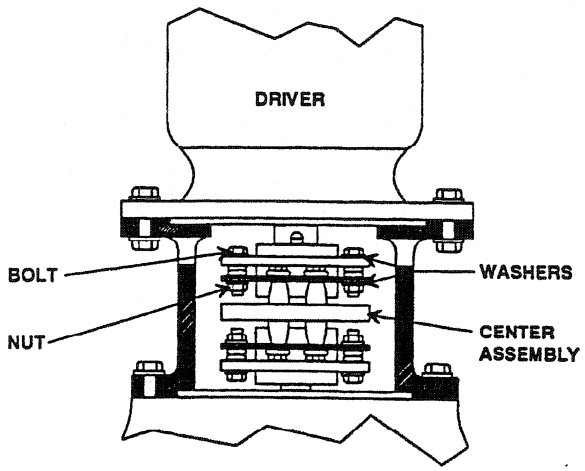


Figure 10. Final Assembly

(f) It is good practice to coat the coupling assembly and shafts with grease or some form of protection in order to minimize the chance of corrosion.

(g) Replace the coupling guard plates.

(h) Removal for Maintenance - It may not always be possible to remove or install the center disc pack after the driver is installed. For easy removal, loosen the four lower bolts holding the lower disc pack to the gearbox coupling hub. Remove the mounting bolts holding the driver adaptor to the gearbox. Remove the driver, the driver adaptor and upper coupling as a total assembly. For assembly, follow this procedure in reverse.

B. UNITS WITH VERTICAL OR HORIZONTAL STANDS-ALIGNMENT

(1) If other than Sundstrand supplied couplings are used, they must be flexible disc or gear type couplings capable of tolerating reasonable amounts of parallel and angular misalignment, and axial end float. Refer to coupling manufacturer's recommendation for installation and maintenance.

CAUTION

Lock out starting switch on driver prior to working on coupling.

(2) Coupling installation for turbine drivers is identical to that for motors.

(3) The gearbox coupling hub is normally mounted at the factory. The driver coupling hub will be mounted on all

motors and turbines shipped from the Sundstrand factory. If the driver hub is mounted upon receipt of the unit refer to Section 8 or D (Page 4)for installation instruction.

(4) If the driver coupling hub is not mounted, the following procedure should be followed for Falk or Thomas couplings:

Make sure the coupling hub bore, keyways, and shaft are clean, free from burrs, and that the key will fit in the keyways. Heat the hub in an oil bath or oven to approximately 250°F (121°C), or more if necessary, so the hub will slide onto the motor shaft. Position the hub flush with the end of the driver shaft.For Thomas couplings, alignment procedures may necessitate adjustments to this flush position .

NOTE

On Thomas couplings, before the hub is installed check to see if it is possible to assemble the coupling bolts and washers (Figure 10) from the driver side of the hub when installed. If this is not possible, assemble the bolts and washers into the hub flange before fitting it onto the shaft.

(5) DO NOT align from gearbox end. The gearbox input shaft is manufactured such that it is free to move radially and axially. Prior to alignment, position the shaft at its dead position; then align.

C. UNITS WITH VERTICAL STANDS

(1) Install stand per Section 7 (Page 3). Tighten foundation bolts prior to coupling installation and alignment.

(2) Make sure that the surface of the stand which the driver sits on is free of paint, weld splatter, etc. Mount the driver on top of the stand, making sure that the driver flange does not bind on the adjusting bolts.

(3) Coupling alignment should be done prior to connecting suction and discharge piping. It is normally good practice to leave a section of piping on the suction and discharge of the compressor casing to be fabricated after alignment has been completed. A recheck of alignment should be done after piping is installed.

(4) Falk Double Gear Coupling

(a) Refer to Figure 11. Pack the sleeve teeth with grease and lightly coat with grease before assembly. See paragraph (4) (E) page 9 for lubricant requirements.

(b) To set angular alignment, remove the stiffening brackets (Figure 13), and attach a dial indicator

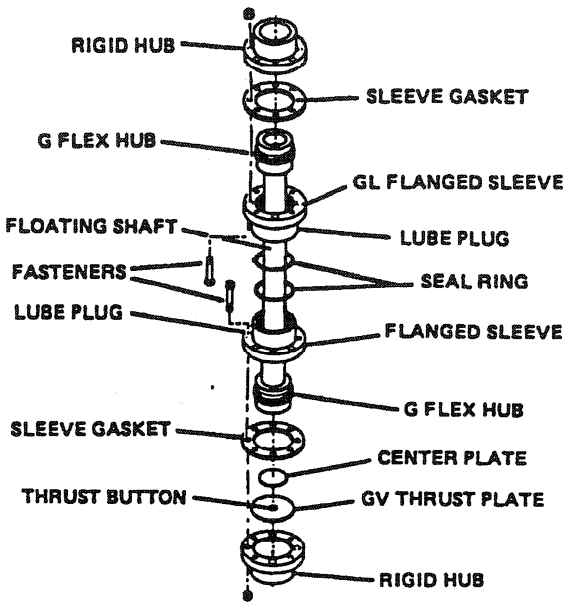


Figure 11. Falk Double Gear Coupling - Vertical

with extension arm to the driver hub. Set the dial indicator on the gearbox hub face outside the bolt circle (Figure 14) . Rotate the driver shaft (do not rotate gearbox shaft) to sweep the gearbox hub face. Using shims and the jack screws at the base of the compressor, adjust compressor to hold the total indicator reading within the angular limit specified in Figure 13 (Page 10).

(c) To set offset alignment, attach the dial indicator to the driver hub, and position indicator to sweep the O.D. of the gearbox coupling hub flange (Figure 14). Rotate the driver shaft (do not rotate gearbox shaft). Using the driver jack screws, adjust driver to hold the total indicator reading within the offset limit specified in Table 3. Recheck angular alignment to insure it is still within limits.

(d) Stagger the keyways on mating coupling hubs by 180 . Install the floating shaft assembly, including the centerplate with thrust button and the thrust plate in the lower coupling, and bolt the coupling in place. Torque bolts to values given in Table 3 (Page 11).

(e) Remove both lube plugs from each sleeve and add grease until an excess appears at an open hole. Replace all lube plugs. It is good practice to coat the coupling assembly and shafts with grease or some form of protection in order to minimize the chance of corrosion.

(f) Tighten all mounting bolts and stiffening brackets and install coupling guard.

(5) Service of Falk Double Gear Coupling

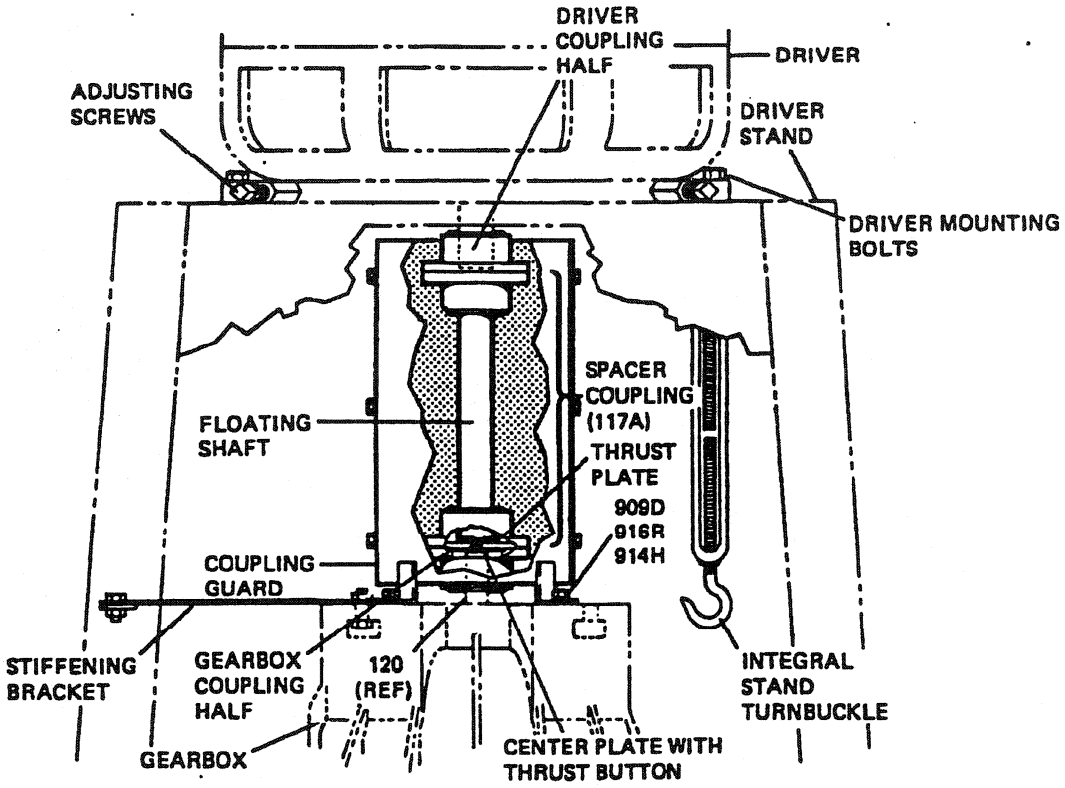


Figure 12. Vertical Stand Assembly

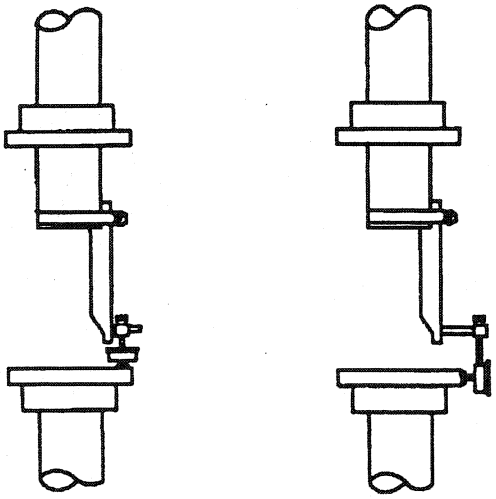


Figure 13. Checking Angular Alignment

Figure 14. Checking Offset Alignment

(a) Couplings should be lubricated at least once every six months. Lubricate more often when the coupling is exposed to excessive moisture or extreme temperatures. Remove both lube plugs from each sleeve and add grease until an excess appears at an open hole. Replace all lube plugs.

(b) For operation in ambient temperatures of -30°F to 200°F (-34°C to 93°C), grease with the following specifications should be used:

DROPPING POINT - 300°F (149°C) or higher.

CONSISTENCY - NGLI #I EP grease with worked penetration value in the range of 310-340.

SEPARATION AND RESISTANCE Low oil separation rate and high resistance to separation from centrifuging.

TEXTURE - Smooth or fibrous.

MINIMUM TIMKEN O.K. LOAD 30 pounds.

INACTIVE - Must not corrode steel or cause swelling or deterioration of Neoprene or Buna N.

CLEAN - Free from foreign inclusions.

DO NOT use cup grease.

(6) Thomas SN Type Spacer Coupling

(a) The motor coupling hub is fitted very tightly onto the driver shaft, making it very difficult to adjust

FALK COUPLING SIZE	OPERATING LIMITS (TOTAL INDICATOR LIMIT)		BOLT TORQUE
	OFFSET (MAX.)	ANGULAR (MAX.)	
15GL 15GV	0.005 in. (0.127mm)	0.005 in. (0.127mm)	280 lb. - in. (3.22 kg - m)
20GL 20GV	0.005 in. (0.127mm)	0.005 in. (0.127mm)	420 lb. - in. (4.83 kg - m)

Table 3. Coupling Specifications (Falk Double Gear Type - Vertical)

after installation. Prior to alignment, mount the driver hub such that when the complete coupling is installed, there is a gap of 1/4 inch (6.4mm) between the gearbox hub and gearbox housing.

The method of installation is such that the coupling will hang on the motor hub and slide on the gearbox input shaft. This will cause the disc pack to sag by the weight of the coupling. This sag is normally 1/16 inch (1.6mm), and it must be taken into consideration when adjusting the shaft end gap. Be sure that the coupling does not touch the gearbox when in operation.

(b) To set angular alignment, loosen the stiffening brackets (Figure 13) and attach a dial indicator with extension arm to the driver hub. Set the dial indicator on the gearbox hub face outside the bolt circle (Figure 14). Rotate the driver shaft (do not rotate gearbox shaft) to sweep the gearbox hub face. Using shims and the jack screws at the base of the compressor, adjust compressor to hold the total indicator reading within the angular limit specified in Table 5 (Page 13).

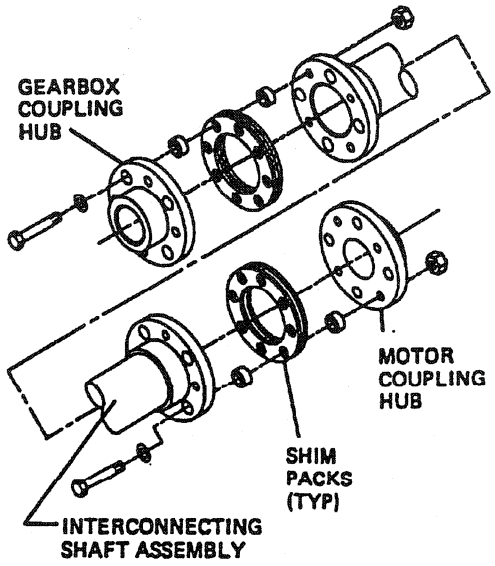


Figure 15. Thomas SN Type Spacer Coupling

(c) To set offset alignment, attach the dial indicator to the driver hub, and position indicator to sweep the O.D. of the gearbox hub flange (Figure 14). Rotate the driver shaft (do not rotate gearbox shaft). Using the motor jack screws, adjust motor to hold the total indicator reading within the offset limit specified in Table 4. Recheck angular alignment to insure it is still within limits.

(d) Refer to Figure 12. Measure the length of the floating shaft between hub faces. Measure the distance between the motor and gearbox hub faces. The floating shaft must be shorter than the distance between shaft hub faces by the sum of

THOMAS COUPLING SIZE	END GAP			OPERATING LIMITS TOTAL INDICATOR READING		BOLT TORQUE
	MINIMUM	NORMAL	MAXIMUM	OFFSET (MAXIMUM)	ANGULAR (MAXIMUM)	
SN226	0.563 in. (14.30mm)	0.594 in. (15.09mm)	0.625 in. (15.88mm)	0.005 in. (0.127mm)	0.005 in. (0.127mm)	516 lb. - in. (5.95 kg - m)
SN262	0.438 in. (11.13mm)	0.469 in. (11.91mm)	0.500 in. (12.70mm)	0.005 in. (0.127mm)	0.005 in. (0.127mm)	516 lb. - in. (5.95 kg - m)
SN312	0.469 in. (11.91mm)	0.500 in. (12.70mm)	0.531 in. (13.49mm)	0.005 in. (0.127mm)	0.005 in. (0.127mm)	756 lb. - in. (8.72 kg - m)

Table 4. Coupling Specifications

the end gaps specified in Table 4. If the length difference is not within the limits specified in Table 4, adjust the hubs until within limits. If necessary, heat the hub and use a bearing puller to move it. DO NOT heat hub any more than is absolutely necessary to loosen it.

NOTE

On some units there are different size couplings on each end of the floating shaft. Be sure to use the proper end gap values for the respective couplings.

(e) Stagger the keyways on mating coupling hubs by 180. Assemble and bolt in the disc pack assembly. Torque bolts to values given in Table 4.

NOTE

Disc packs must be assembled in the coupling exactly as received. If it is necessary to completely disassemble the disc pack, tie a wire through the bolt holes to maintain the proper order.

(f) It is good practice to coat the coupling assembly and shafts with grease or some form of protection in order to minimize the chance of corrosion.

(g) Tighten all mounting bolts and stiffening brackets and install coupling guard.

D. UNITS WITH HORIZONTAL STANDS

(1) Install stand per Section 8 (Page 3). Tighten foundation bolts prior to coup ling installation and alignment.

(2) Make sure that the driver mounting pads are free of paint, weld splatter, etc. Set the driver on the pads, but do not bolt down .

(3) Coupling alignment should be done prior to connecting suction and discharge piping. It is normally good practice to leave a section of piping on the suction and discharge of the compressor casing to be fabricated after alignment has been completed. A recheck of alignment should be done after piping is installed.

(4) Alignment should be checked when equipment is at normal operating temperature to verify that alignment is still within specified limits. Make any necessary corrections.

(5) Rough Alignment - Center the driver over the driver bolt holes in the base and align the compressor to driver using the jack screws provided. Connect process piping and proceed with final alignment.

NOTE

When adjusting a motor, the motor rotor must be at its electrical center axially. This is usually marked on the motor shaft. If it is not, run the motor and scribe a reference line on the motor shaft.

(6) Final Alignment - Position the gearbox input shaft so it is extended as far as possible toward the driver. All final adjustments must be made from the driver end ONLY.

(7) Falk Double Gear Coupling

(a) Pack the sleeve teeth with grease and lightly coat seals with grease before assembly. See Paragraph (6) (a) (Page 9) for lubricant requirements.

(b) To set final angular alignment, attach a dial indicator with extension arm to driver hub. Set the dial indicator on the gearbox hub face outside the bolt circle (Figure 13).

Rotate the driver shaft (do not rotate gearbox shaft) to sweep the gearbox hub face. Using shims and jack screws provided, adjust the driver to hold the total indicator reading within the angular limit specified in Table 5.

FALK COUPLING SIZE	END GAP			OPERATING LIMITS TOTAL INDICATOR READING		BOLT TORQUE
	MINIMUM	NORMAL	MAXIMUM	OFFSET (MAXIMUM)	ANGULAR (MAXIMUM)	
15G	0.140 in. (3.56mm)	0.156 in. (3.96mm)	0.172 in. (4.36mm)	0.005 in. (0.127mm)	0.005 in. (0.127mm)	280 lb. - in. (3.22 kg - m)
20G	0.140 in. (3.56mm)	0.156 in. (3.96mm)	0.172 in. (4.36mm)	0.005 in. (0.127mm)	0.005 in. (0.127mm)	420 lb. - in. (4.83 kg - m)

Table 5. Coupling Specifications (Falk Double Gear Type)

(c) To set final offset alignment, attach the dial indicator to the driver hub and position indicator to sweep the O.D. of the gearbox hub flange (Figure 14). Rotate the driver shaft (do not rotate gearbox shaft). Using shims and jack screws provided, adjust the driver to hold the total indicator reading within the offset limit specified in Table 5. Recheck angular alignment and distance between shaft ends to insure they are still within limits.

(d) Refer to Figure 17. Measure the length of the floating shaft. Adjust the driver so the distance between driver and gearbox shaft ends is greater than the length of the floating shaft by the sum of the end gaps specified in Table 5.

(e) Stagger the keyways on mating coupling hubs by 180. Install the floating shaft assembly, including the gap discs at each end, and bolt the coupling in place. Torque bolts to values given in Table 5.

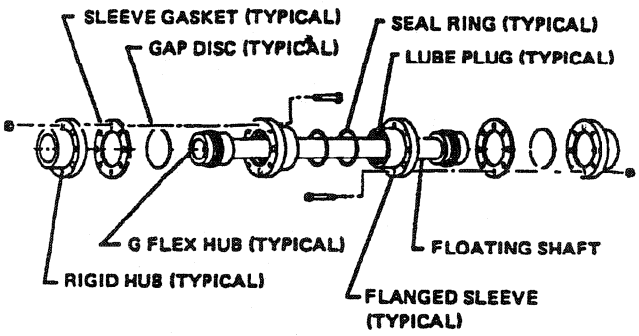


Figure 16. Falk Double Gear Coupling - Horizontal

(f) Remove both lube plugs from each sleeve and add grease until an excess appears at an open hole. Replace all lube plugs. It is good practice to coat the coupling assembly and shafts with grease or some form of protection in order to minimize the chance of corrosion.

(g) Tighten all mounting bolts and install coupling guard.

(8) Service of Falk Double Gear Coupling.

Refer to paragraph 5, page 9.

(9) Thomas SN Type Spacer Coupling.

(a) The motor coupling hub is shrunk onto the driver shaft, making it very difficult to adjust after installation. Prior to alignment, mount the driver hub so that when the complete coupling is installed, there is a gap of 1/4 inch (6.4mm) between the gearbox hub and gearbox housing.

(b) To set final angular alignment, attach a dial indicator with extension arm to driver hub. Set the dial indicator on the gearbox hub face outside the bolt circle (Figure 13, Page 10). Rotate the driver shaft (do not rotate gearbox shaft) to sweep the gearbox hub face. Using shims and jack screws provided, adjust the driver to hold the total indicator reading within the angular limit specified in Table 4 (Page 12).

(c) To set final offset alignment, attach the dial indicator to the driver hub and position indicator to sweep the O.D. of the gearbox hub flange (Figure 14, Page 10).

Rotate the driver shaft (do not rotate gearbox shaft). Using shims and jack screws provided, adjust the driver to hold the total indicator reading within the offset limit specified in Table 4. Recheck angular alignment to insure it is still within limits.

(d) Refer to Figure 17 (Page 14). Measure the length of the floating shaft. Adjust the driver so the distance between driver and gearbox shaft ends is greater than the length of the floating shaft by the sum of the end gaps specified in Table 4 (Page 12).

NOTE

On some units there are different size couplings on each end of the floating shaft. Be sure to use the proper end gap values for the respective couplings.

(e) Stagger the keyways on mating coupling hubs by 180. Assemble and bolt in the disc pack assembly. Torque bolts to values given in Table 4.

NOTE

Disc packs must be assembled in the coupling exactly as received. If it is necessary to completely disassemble the disc pack, tie a wire through the bolt holes to maintain the proper order.

(f) It is good practice to coat the coupling assembly and shafts with grease or some form of protection in order to minimize the chance of corrosion.

(g) Tighten all mounting bolts and install coupling guard.

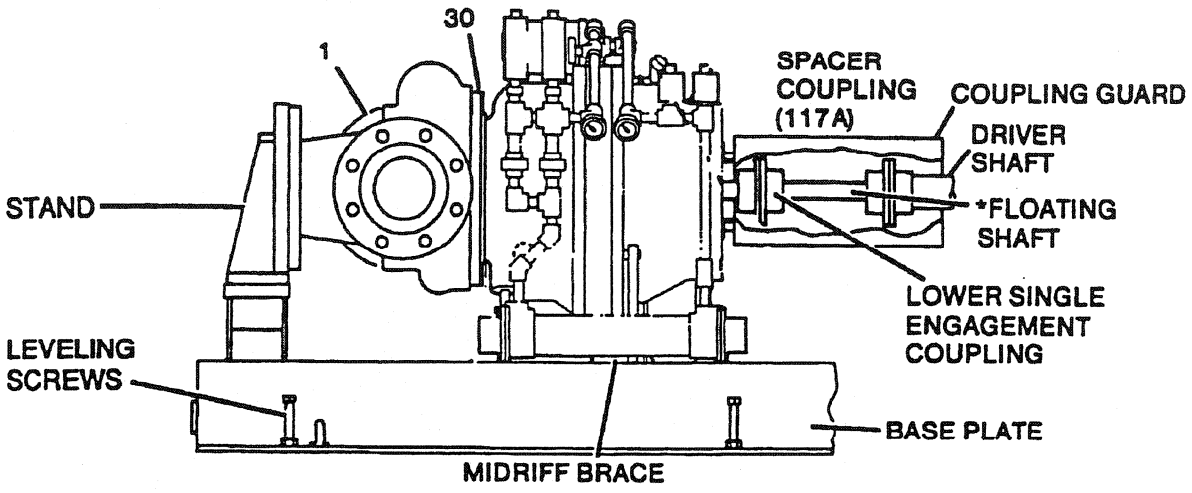


Figure 17. Horizontal Stand Assembly

I I. LUBE SYSTEM

DESCRIPTION

The integral Sundyne lube oil system consists of the following major components: gearbox sump, main lube pump, oil heat exchanger and oil filter. Oil is taken from the sump by the lube pump, then passed through internal passages to an externally mounted manifold through the heat exchanger, then through the filter, and back into the gearbox to the bearings After passing through the bearings, the oil drains back to the sump.

The gearbox sump holds approximately seven U.S. quarts (6.6 liters) of oil not including auxiliary piping and heat exchanger. The oil level should always be maintained within the black circle in the sight glass. DO NOT overfill gearbox, as this will cause excessive foaming and overheating.

The main lube pump is a constant displacement geartype pump directly driven by the input shaft.

The standard heat exchanger is a shell and tube water cooled type mounted on the gearbox manifold. Cold water should be provided at 150 psig (11 kg/cm2) maximum pressure. See the specification sheet for cooling water requirements. Coolant flow should be controlled by a hand valve installed in the cooling fluid discharge line to maintain a gearbox sump temperature between 140°F to 200°F (60°C to 93°C). Approximately one hour may required to stabilize temperature.

The oil filter is a disposable pleated paper element type. Gearbox oil and filter should be changed every six months. See Figure 20 for oil specilications.

1. OPTIONAL LUBE OIL SYSTEM AUXILIARIES

A. LUBE OIL PRIMING KIT

This prelube system is required on some LMC-311 compressors. The kit consists of a motor driven positive displacement pump, check valve, gauges, and necessary piping. To start compressor, operate the prelube pump at least 30 seconds with a minimum of 5 psig (0.35 kg/cm2) indication prior to starting the main driver. (If oil piping has been drained several minutes operation is suggested to allow trapped air to bleed from the system.

The prelube pump is to shutdown only after main driver is at full operating speed.

B. REMOTE HEAT EXCHANGER

Some large water cooled and all air cooled heat exchangers are mounted away from the gearbox. Except for packaged units, the interconnecting pip-

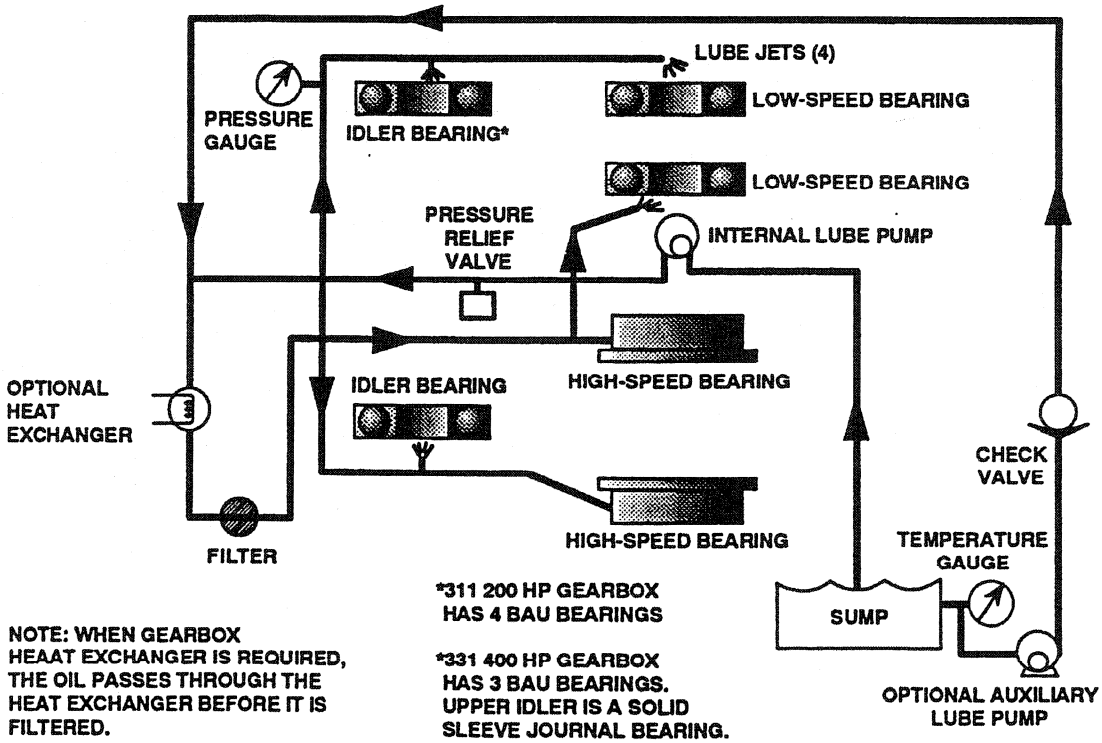


Figure 18. Typical Lube Oil Schematic

ing is the purchaser's responsibility. The heat exchanger MUST be mounted lower than the oil manifold; otherwise, air pockets may be present in the lube oil lines at start-up, causing oil starvation at the bearings. Equivalent length of piping and fittings must not exceed 20 feet(6 m), using a minimum of 5/8 inch (16 mm) I.D. tubing or pipe. If greater pipe lengths are required, pipe diameter must be increased accordingly.

C. GEARBOX SUMP HEATER

A sump heater is required when ambient temperatures may fall below +10°F or process temperatures are below -20°F. At these temperatures the gearbox oil becomes too viscous for proper lube pump operation. Both steam and electric sump heaters are available. The lube oil priming kit MUST be operated to circulate oil around the heater when the main drive motor is not running.

2. OIL PRESSURE

Depending upon the bearing configuration and the characteristics of the lube oil used The gearbox internal lube pump will maintain oil pressure between 15 and 60 psig (1.0 and 4.2 kg/cm2) during normal operation. The gearbox should never be operated with less than 10 psig oil pressure.

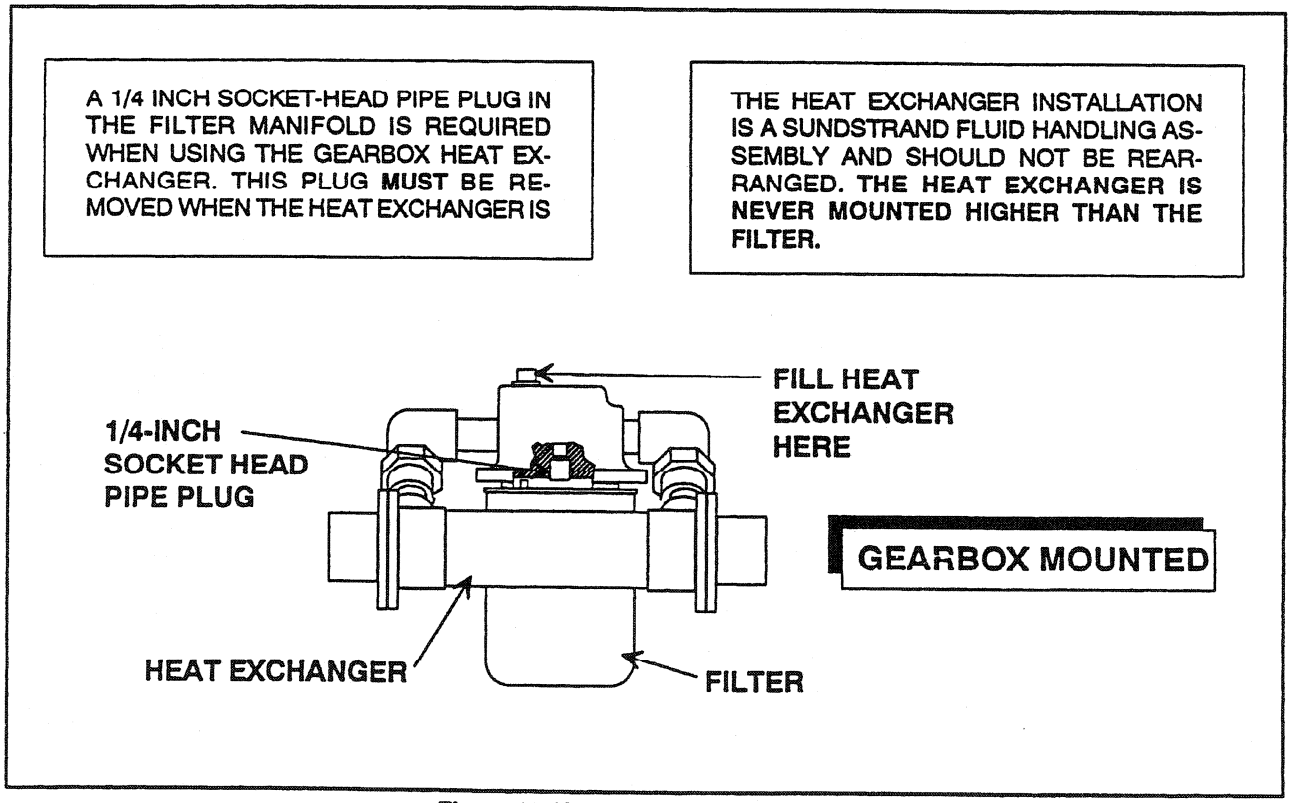


Figure 19. Heat Exchanger Mounting

III. STARTING

Refer to Figure 19. Perform the following tasks to start the SUNDYNE Compressor:

1. Check to insure that the driver has been serviced per instructions provided by the driver manufacturer.

2. Auxiliaries - Check utility connections; verify that auxiliary piping is per Sundstrand drawings; verify switch and instrument connections and set points; calibrate flow instruments and other transmitters.

3. Flushing screens should be installed in all field assembled piping connections.

4. If buffer fluid or external seal flush auxiliary piping is required, this system should be pressurized prior to admitting process gas into the compressor. If the buffer fluid is not pressurized, process gas will leak out of the compressor into the gearbox or atmosphere and damage to the mechanical seals will occur. If the seal flush is not pressurized, contaminants may cause seal face damage.

5. The compressor casing should be drained (blown down) prior to starting.

6. Remove the gearbox fill-vent plug and the filter breather cap from the fill opening fitting on the gearbox. Fill the reservoir with clean lubricating oil (see Table 6 for oil specifications) until the fluid level is at the top of the black circle in the sight glass. Lube system capacity will vary with the heat exchanger and piping configuration. Replace the filter breather cap on the fill opening fitting and replace the fill-vent plug.

   A. UNITS WITHOUT AUXILIARY LUBE PUMP - Remove 1/2" pipe plug (refer to Figure 2) and fill heat exchanger and filter with clean lube oil.

   B. UNITS WITH AUXILIARY LUBE PUMP - Operate the auxiliary lube pump to fill the heat exchanger and filter. Add oil as necessary through the fill opening fitting until the oil level stabilizes in the sight glass.

7. Prime lube oil system (Paragraph 7A.) prior to opening suction and discharge valves.

CAUTION

Start compressor with discharge valve fully open and throttle with suction valve one-third (1/3) open, to prevent compressor surge.

Prime the lube oil system by one of the following methods:

A. On units with an auxiliary lube system, start the auxiliary lube pump and allow it to operate at least thirty seconds with a minimum of 5 psig (0.35 kg/cm^2) indication prior to starting the main driver.

B. If the auxiliary lube system is operated automatically, the following sequence is recommended:

   (1.) When start button is pushed, priming kit starts.

   (2.) When a 5 psig (0.35 kg/cm2) pressure switch verifies lube oil pressure, a thirty second timer and a forty second timer are started.

   (3.) The main drive motor starts at the end of thirty seconds.

   (4.) The priming kit turns off at the end of forty seconds.

   It is not normally recommended to operate the priming kit for an extended period with the main driver operating. Certain applications involving variable speed drivers (steam turbines, variable speed electric motors, etc.) will require special lube oil systems where the auxiliary lube pump may be required to run for an extended period of time.

CAUTION

Check the driver for proper rotation. Wrong rotation will result in insufficient process flow, insufficient pressure increase or headrise. The driver shaft and compressor impeller rotate in the same direction. Correct rotation is counter clockwise when viewed from the driver end (see Figure 21). Rotation must be in the same direction as the arrow on the outside of compressor casing

NOTE

8. If the unit includes a heat exchanger kit, adjust the heat exchanger cooling flow to regulate the gearbox sump temperature between 140° and 200°F (60° and 93° C). Approximately one hour may be required to stabilize the temperature.

CRITICAL STARTUP CHECK LIST

KNOW YOUR MACHINE:

Prior to servicing and start-up of the Sundyne Compressor, carefully review the specification sheet, outline drawing, performance curves and the instruction manual. It is important you become familiar with the compressor configu;ation before starting and operating the compressor.

DRIVER INSTRUCTIONS:

Follow installation and starting instructions of the driver manufacturer.

AUXILIARIES:

Check utility connections; verify that auxiliary piping is per SUNDSTRAND drawings verify switch and instrument connections and set points; calibrate flow instruments and othe; transmitters.

GEARBOX SERVICING:

Fill gearbox within 1/4 inch from top of oil level sight glass with lube oil which conforms to the specs shown in Table 6 (Page 19). UNITS WITHOUT AUXILIARY LUBE PUMP - Remove fill opening fitting and add approximately one quart of clean oil to filter. UNITS WITH AUXILIARY LUBE PUMP - Operate auxiliary lube pump to fill heat exchanger and filter. Add oil as necessary (approximately 7 U.S. quarts) through fill opening fitting until oil level stabilizes in sight glass.

ENVIRONMENTAL CONTROL SYSTEM:

Install seal environmental control system, if required, and verify that Port 1 is properly vented. Drain compressor casing if unit is equipped with double liquid seals.

PRESSURIZE FLUID LOOP:

Pressurize double seal buffer fluid loop, or external seal flush, if required, prior to admitting process gas into compressor casing.

CHECK DRIVER ROTATION:

Check driver rotation at this time. Rotation must be in same direction as arrow stamped on compressor case.

START COMPRESSOR:

(1) Suction Throttling (PREFERRED METHOD) - Start compressor with discharge valve open while throttling suction valve, to bring compressor to design operating point.

(2) Discharge Throttling - Start compressor with suction valve completely open while throttling discharge valve, to bring compressor to design operating point.

(3) Other methods - Insure compressor does not go into surge (flow too low), or that design horsepower is not exceeded (flow too high) while starting or operating the compressor.

HEAT EXCHANGER:

If gearbox heat exchanger is installed, adjust cooling flow to maintain gearbox sump temperature of 140°F to 200°F (60°C to 93°C).

CHECK:

Check head rise, flow rate, and power consumption against compressor specification sheet. Check that inlet pressure, temperature, and molecular weight are in accordance with specification sheet. These conditions will significantly alter performance of the compressor.

IV. SERVICING

GENERAL

The normal operating routine, including both minor and major overhaul intervals, depends to a great extent upon the service and duty cycle of the compressor. The operating life of any piece of machinery is, under normal circumstances, determined by the careful and proper actions of the operator. All operating parameters should be frequently observed and logged. Any deviation from normal operating values should be investigated immediately to determine the cause, and corrective measures taken where necessary.

In addition to the major equipment, all lube pumps, heat exchangers, instrumentation, etc. must be checked periodically for correct performances per manufacturer's recommendations.

Specifically, the following items should be serviced at the intervals indicated See Figure 22 for location of service check points.

1. GEARBOX OIL LEVEL

The oil level should be checked prior to initial start-up, and periodically thereafter. The fluid level must be maintained within the black circle in the sight glass Oil may be added while the compressor is in operation.

Overfilling the gearbox will cause excess foaming and overheating.

2. OIL PRESSURE

Depending upon the bearing configuration and the characteristics of the lube oil used, the gearbox internal pump will maintain oil pressure between 15 and 60 psig (1.0 and 4.2 kg/cm2) during normal operation. A gearbox should never be operated with less than 10 psig oil pressure.

The following lube oil specifications must be met by any oil used in Sundyne gearboxes:

Gravity, API	29.5 nominal
Viscosity, SSU	
@100°F	165-235
@ 210°F	43-46
Viscosity Index	90 minimum
ISO Viscosity Grade	32, 46
Flash Point, °F	360 minimum
Pour Point, °F	-20 minimum
Rust Test, ASTM D-665, Procedure B	Pass
Oxidation Test, ASTM D-943, hours to 2.0 Neutralization number	2000
EP Additive	Present
Foam Limits, ASTM D-892 milliliters	
Maximum Sequence 1	25/0
2	50/0
3	25/0

Note: No additional additives are recommended.

In gereral, 10 weight turbine oils and automatic transmission fluid (ATF) will meet these specifications. Properties should be verified by oil manufacturer prior to use. Some synthetic oils are suitable for use. Turbine oil viscosity usually changes less with use than ATF and would be preferred for most gearboxes.

Figure 20. Lube Oil Specifications

3. GEARBOX OIL AND FILTER-CHANGE

Oil in the gearbox and the oil filter should be changed every six months.

4. SEAL LEAKAGE

Seal leakage out of port 1 should be checked periodically. Seals should be replaced if leakage increases to an unacceptable level. With double seals, buffer pressure and usage should be monitored to insure that seals are functioning properly. For specific seal information, please contact the factory or your local Sundyne representative.

5. ANTIFRICTION BEARINGS

Antifriction ball bearings on the gearbox idler shaft and low speed shaft should be replaced after three years, or whenever the unit is being overhauled

Care must be exercised to insure that the correct replacement bearings are installed. Incorrect replacement bearings will jeopardize mechanical integrity of the unit Replacement bearings should be purchased from Sundstrand to insure proper quality and fit.

6. DRIVER

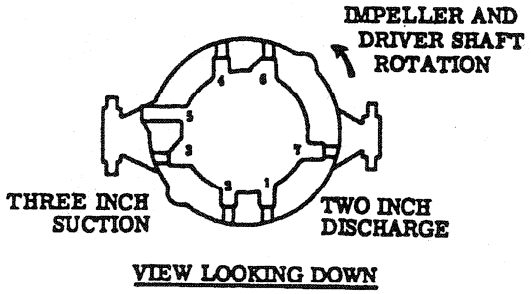
Refer to driver manufacturer's specifications.

7. COUPLING

If a flexible coupling is used (see compressor specification sheet), refer to the manufacturer's service recommendations.

INTERCONNECTING SHAFT

When the interconnecting shaft is used, the splines should be lubricated when the driver is removed for normal maintenance. Prior to lubricating, remove all dry grease from the male and female splines. Apply 5 cc. of antifretting compound (Sundstrand Part Number MPOIAA10) to the spline at each end of the shaft. Be sure that both "O"rings are installed on splined shaft.



PORT	DESCRIPTION
1	SEAL DRAIN, GEARBOX OIL ALWAYS OPEN
2	SEAL DRAIN (SINGLE SEAL) OR BUFFER FLUID OUT (SELF CIRCULATING) OR PLUG (TANDEM SEAL WHEN SPECIFIED)
3	COOLING IN (NORMALLY PLUGGED)
4	COOLING OUT (NORMALLY PLUGGED)
5	SEAL FLUSH
6	SEAL FLUSH
7	SEAL DRAIN (SINGLE SEAL) OR BUFFER FLUID IN (SELF CIRCULATING) OR PLUG (TANDEM SEAL WHEN SPECIFIED)

Figure 21. Seal Housing Port Identification

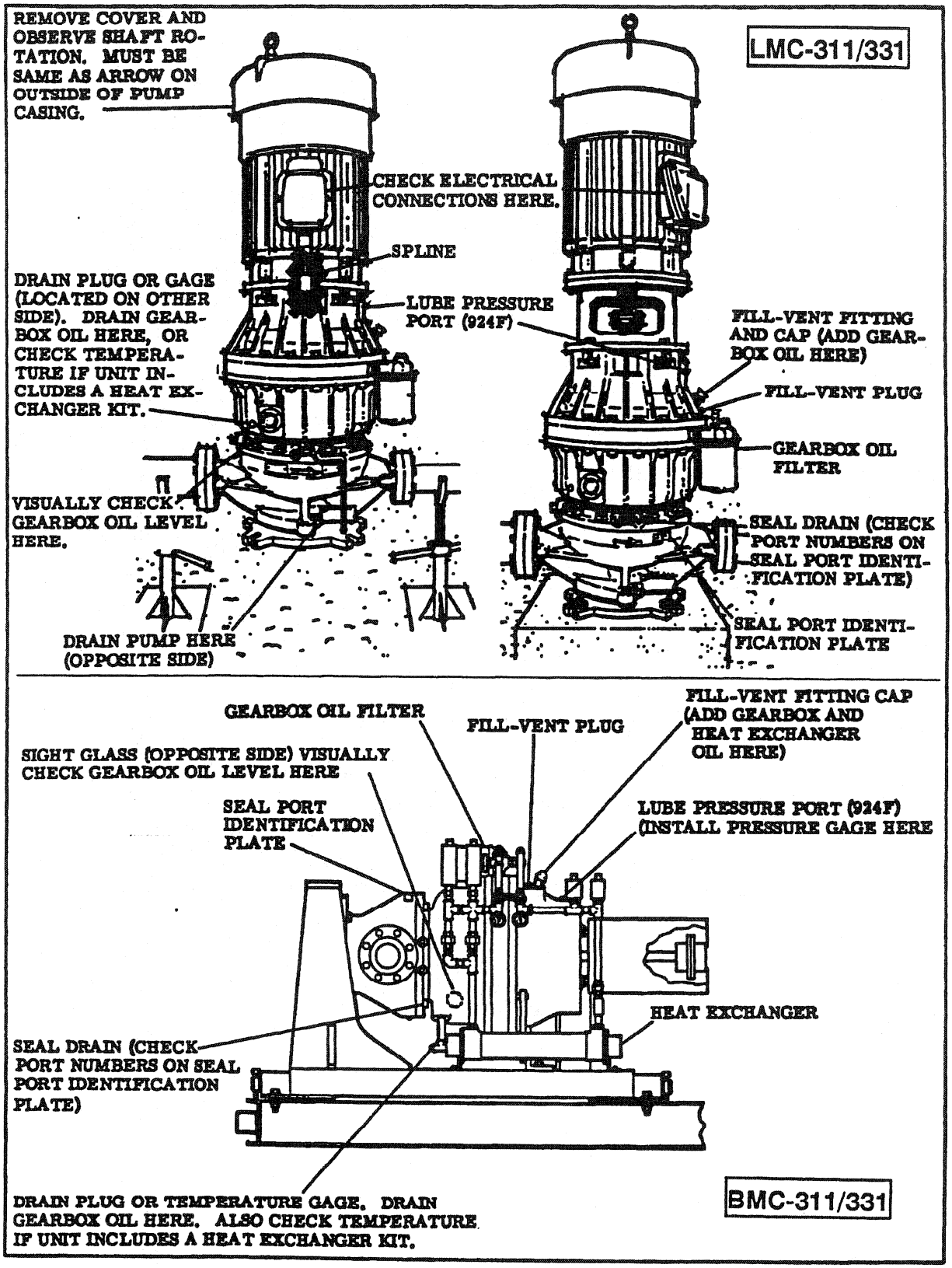


Figure 22. Service Check Points

V. OPERATION

Some form of control is required for the majority of SUNDYNE compressor applications. The purpose of control is twofold: 1) to achieve the desired performance as required by process conditions and 2) to protect the compressor from mechanical damage due to surge or overload conditions.

This section is a general guideline on controls; a control system should be selected only after completion of a detailed analysis of the specific installation.

SUNDYNE compressors can be controlled by one of several methods to achieve the desired performance.

1. Surge Control - It is recommended that a surge control system be installed whenever there is any chance that the process flow could decrease appreciably from design flow. In most surge control systems a flow sensor is placed in the suction line to the compressor. The signal from this sensor is input to a controller which controls a valve in the bypass loop. When the minimum safe flow is reached, this valve opens and the flow through the compressor is kept above the surge point. Again, the recycled gas must be cooled to prevent heat build-up. Both pneumatic and electrical surge control systems are available.

2. Suction Throttling (Figure 23) - Suction throttling is generally the most economical control method with a constant speed drive. Throttling the control valve on the suction side causes a reduction of inlet pressure to the compressor. Although the compressor creates the same compression ratio as if it were unthrottled, the discharge pressure is reduced. The net result is to lower the total head output to the system. The reduction of inlet pressure correspondingly decreases inlet gas density, and thus, power consumption. Suction throttling also has the advantage of slightly lowering the compressor surge point.

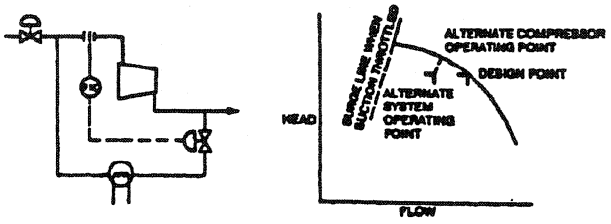


Figure 23. Suction Throttling

3. Discharge Throttling (Figure 35) - Discharge throttling is controlled by means of a valve placed at the compressor discharge. A constant speed compressor will always operate on its design head-flow curve. For a given system operating point, the compressor will operate at the system flow rate, thus producing more head than the system requires. This excess head is throttled by the discharge valve. Since the throttling occurs downstream of the compressor, there is no power savings by this method. Discharge throttling offers no real advantages over suction throttling, but is none-the-less an acceptable control method.

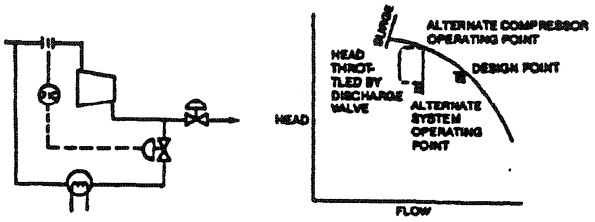


Figure 24. Discharge Throttling

4. Speed Control (Figure 25) - Speed control is the most efficient means of compressor control. To operate at points below the design head-flow curve, the driver speed may be reduced accordingly. This creates an infinite "family" of head flow curves on which the compressor may operate. Since consumed horsepower, assuming constant inlet conditions, varies as the cube of the speed, substantial power savings can be realized. Also, the compressor surge point is lowered proportional to the speed decrease. This method is used mainly on turbine driven units although variable speed motors or mechanical drives are available. Since the main lube oil pump in a SUNDYNE compressor is driven by the gearbox input shaft, provision must be made so the speed is not reduced to a point where adequate lube oil pressure is no longer present.

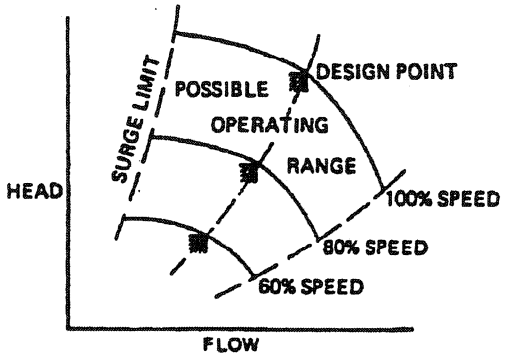


Figure 25. Speed Control

5. Flow Bypass (Figure 26) - Flow bypass requires a recycle line from the compressor discharge to suction. The compressor is operated at the desired flow or discharge pressure and the excess flow not required by

the process is recycled through the bypass. A cooler is required in the loop to cool the recycled gas to normal suction temperature. This method is generally less efficient than other methods discussed, but may be warranted in some special situations.

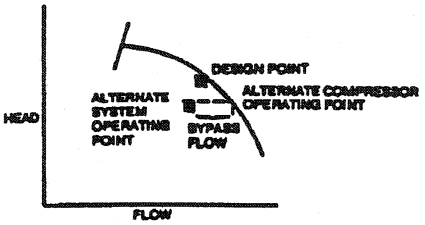


Figure 26. Flow Bypass

6. Other aspects which should be considered in compressor operation are:

   A. Series Compressor Control (Figure 27) - Inlet throttling on the first stage is the most practical method of controlling compressors in series. It is necessary to throttle only the first stage, which in turn acts as a throttle for the second stage. Inlet throttling between stages offers no advantages and should be avoided. Efficiency gains by variable speed control of series units will seldom justify its cost and complexity.

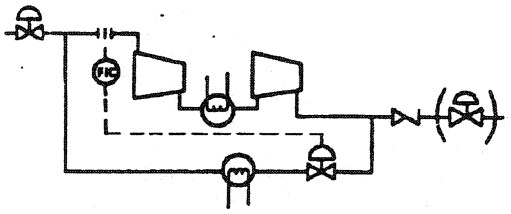


Figure 27. Series Units with Suction Throttling (Discharge Throttling)

Surge control on series units consists of a flow sensor and controller in the suction line of the first stage. This sends a signal to the control valve in a bypass loop around both compressors. It must be determined which compressor surges at the lowest inlet flow to the first unit so the flow controller can be set such that neither compressor will surge. A more complex system which offers maximum machine protection consists of separate bypass loops for each unit which are operated by separate flow controllers.

B. Parallel Compressor Control (Figure 28) - The control of two or more compressors operating in parallel would appear to be relatively simple. More than likely, though, no two compressors ever operate identically across their entire flow range. To produce identical discharge pressures, one compressor could be operating at a different flow than the unit in parallel with it. As a result, the control system would

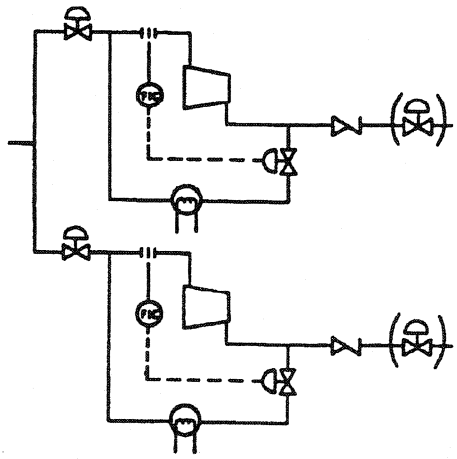


Figure 28. Parallel Units with Suction Throttling (Discharge Throttling)

have to include a separate flow controller for each unit. Either suction or discharge throttling may be used, but again, suction throttling is the preferred method. If variable speed drivers are used, extreme care must be taken to insure that the speeds can be precisely controlled. In any case, check valves must be installed in the discharge line of each compressor to prevent possible back flow due to any slight imbalance in the characteristics of the compressors. Separate surge control systems for each compressor should be considered for maximum unit protection.

VI. TROUBLESHOOTI NG

1. GEARBOX AND COMPRESSOR

Compressor performance is affected strongly by sys tem factors such as suction pressure, temperature molecular weight, driver speed, flow rate and dis charge control characteristics. These factors, as wel as possible compressor internal problems, should be considered carefully when analyzing compressor system performance. Compressor performance characteristics are shown on the specification sheet and performance curve. Table 7 presents information which is useful in the analysis of gearbox and compressor performance problems. Repair procedures appear under "MAINTENANCE".

TROUBLE	POSSIBLE CAUSE	INVESTIGATIVE/CORRECTIVE ACTION
No flow, no pressure at startup.	Failure of drive component, such as interconnecting shaft or impeller key, or item missing from assembly.	Disassemble and inspect
	Wrong direction of driver shaft rotation .	Direction of driver shaft rotation must be as shown by arrow on compressor casing. Note: Compressor impeller and driver shaft rotate in the same direction.
	Suction or discharge valves closed.	Check valving - refer to "STARTING" instructions.
Insufficient flow or head rise.	Flow too high.	Check head rise and flow rate against performance curve.
	Wrong direction of driver shaft rotation .	Direction of driver shaft rotation must be as shown by arrow on compressor casing. Note: Compressor impeller and driver shaft rotate in the same direction.
	Low suction pressure.	Check specification sheet.
	Excessive recirculation from discharge to inlet.	Check flow through external piping
	Molecular weight different from that for which the unit was sized.	Check actual molecular weight against value listed on specification sheet. Low molecular weight will result in low discharge pressure.
	Driver speed too low.	Check speed against value listed on specification sheet.
	Pressure gages or flowmeters in error.	Calibrate instrumentation
Driver overloaded.	Molecular weight higher than values listed on specification sheet.	Check actual molecular weight against value listed on specification sheet.
	Electrical failure in electric power unit.	Check circuit breaker heater size and setting.

Table 6. Gearbox and Compressor Troubleshooting

TROUBLE	POSSIBLE CAUSE	INVESTIGATIVE/CORRECTIVE ACTION
Driver overloaded. (Continued)	Check voltage.	Current for each phase should be balanced within three percent.
	Mechanical failure in driver, gearbox, or compressor.	Disconnect spacer coupling and check for freedom of rotation of compressor, driver, and gearbox shafts.
		Drain oil and remove gearbox oil level sight glass and inspect bottom of sump for wear particles. Bearings are probably not damaged if no wear particles are present.
		Disassemble compressor end and search for any mechanical failure.
	Corrosion pitting on surface o diffuser adjacent to impeller blades. Head rise is reduced by this condition.	Disassemble and inspect. Check diffuser bowl area, cover plate and diffuser throat for material buildup. Clean these areas of all obstructions and restore surfaces to a smooth polished finish (use emery cloth) free of all corrosion pitting. Edge of diffuser throat must be sharp. If damage is more severe (i.e. impeller is deformed or has come in contact with diffuser) replace the damaged parts.
	High suction pressure.	Check specification sheet. Increase suction pressure and corresponding mass flow rate will result in high horsepower consumption.
Excessive discharge pressure pulsation.	Flow rate too low (surge).	Increase flow rate through compressor. Add controlled bypass to suction, if necessary.
	Defective flow control valve.	Check control valve.
Change of gearbox automatic transmission fluid color from normal color to milky pink or yellow.	Gearbox oil contaminated with water or process fluid.	Inspect gearbox heat exchanger for leakage.
		Check for excessive compressor seal leakage.
		Inspect shaft sleeve "O"rings.
Shaft sleeve rubs on inside diameter of seal.	Gearbox journal bearing failure	Install replacement exchange gearbox or repair gearbox as outlined under "MAINTENANCE".
Excessive gearbox automatic transmission fluid consumption.	Low speed shaft seal (115) leakage.	Check drain port for leakage. Replace shaft seal if required.
	High speed shaft mechanical seal (60C) leakage.	Check for fluid leakage from port 1.
	Leakage through heat exchange into cooling fluid.	Pressure test heat exchanger and replace if required.

Table 6. Gearbox and Compressor Troubleshooting (Continued)

TROUBLE	POSSIBLE CAUSE	INVESTIGATIVE/CORRECTIVE ACTION
Excessive oil foaming.	High oil level.	Shut down the unit and check oil level.
	Low gearbox temperature.	Adjust coolant to heat exchanger, keeping oil temperature above 140°F. (60°C.).
Low gearbox oil pressure.	Faulty pressure gage.	Check accuracy of gage.
	Failure of internal lube pump.	Check for proper alignment of upper drive roll pin (in lube pump) or lower driver roll pin (in bearing plate) in 200 hp gearbox. Check installation of low speed shaft on lube pump drive pin in 400 hp gearbox.

Table 6. Gearbox and Compressor Troubleshooting (Continued)

2. COMPRESSOR MECHANICAL SEALS

Table 8 contains troubleshooting procedures for single seal equipped units. The information also is applicable to double and tandem seal units. Repair procedures for mechanical seals are listed in the "MAINTENANCE" section of this manual.

TROUBLE	POSSIBLE CAUSE	INVESTIGATIVE/CORRECTIVE ACTION
Sudden increase in seal leakage.	Operation at too low a flow rate (surge), causing vibration and bouncing of seal face, resulting in chipping of carbon seal nose.	Insure that compressor always operates above the minimum flow rate specified on the specification sheet.
	Seal stationary face spring action is rough and sticky.	If process gas contamination (from entrained solids) causes a sticky seal, a seal flush, double seals, or tandem seals may be required.
	Worn or damaged seal.	Disassemble seal and rebuild or replace per instructions in "MAINTENANCE" section.
	Wear pattern on seal rotating faces not uniform.	Lightly lap surfaces on shaft sleeve and impeller hub which contact rotating seal face to remove high spots. Install new seal faces. Insure no more than a total of 0.010 inch (0.25mm) is removed from shaft sleeves and rotating faces.
	Wear pattern on stationary face smooth but not uniform.	Lap flat or replace seal.

Table 7. Mechanical Seal Troubleshooting

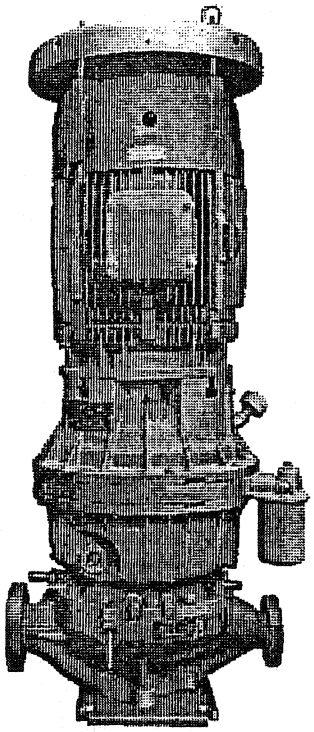
TROUBLE	POSSIBLE CAUSE	INVESTIGATIVE/CORRECTIVE ACTION
Sudden increase in seal leakage. (Continued)	Seal rotating face cracked or broken. May have been caused by damage at assembly or by heating due to lack of leakage (cooling) past seal.	Insure operation above specified minimum flow rate at all times.
		Check seal environment to insure a leakage path of process or buffer fluid across the compressor seal(s) and that there exists a differential across the seal(s) to force this leakage. Replace damaged seal.
	Chemical attack of seal faces, seal parts, or "O"rings.	Investigate process gas properties and determine suitable materials for replacement.
	Seal icing on low temperature compressors or heavy condensation on atmospheric side of seal.	Use purge of dry nitrogen gas on atmospheric side of seal.

Table 7. Mechanical Seal Troubleshooting (Continued)

VII. MAINTENANCE

The following procedures apply to all configurations of the Sundyne LMC -311 centrifugal compressor. Refer to the specification sheet to determine the specific configuration and optional equipment included in your unit. Parenthetical numbers in the text correspond to item numbers in the illustrations and parts lists.

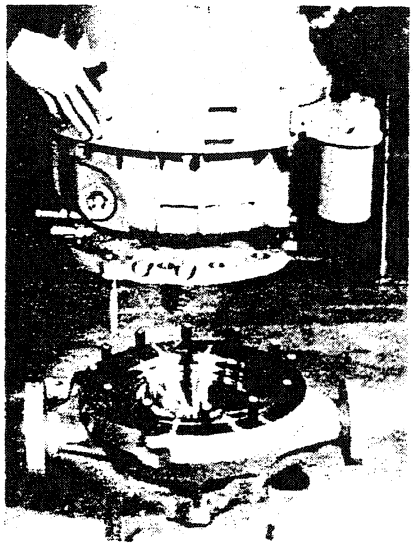
1. PROCEDURE FOR DISASSEMBLING THE COMPRESSOR



The following replacement parts will be required as a result of pump disassembly for maintenance as shown in this section.

PART	ITEM NO.	QTY.
Thermal Barrier Gasket	87A	
"O" Ring Repair Kit for the pump end consisting of:	RKORP311	XX-XXXX
• "O" Ring Packing	936A	
• "O" Ring Packing	936D	
• "O" Ring Packing	936E	
• "O" Ring Packing	936F	
• "O" Ring Packing	936G	
• "O" Ring Packing	936H	
• "O" Ring Packing	936J	
• "O" Ring Packing	936K	
• "O" Ring Packing	936P	
• "O" Ring Packing	936V	
• "O" Ring Packing	936Z	
Technical Seal RepaTr Kits	See Seal Graphics	
High Seal Rotating Faces:		
• Single	51A	
• Tandem	51A/51C	2
• Double	51C	
"O" Ring Packing	936B*	1
"O" Ring Packing	936C*	1

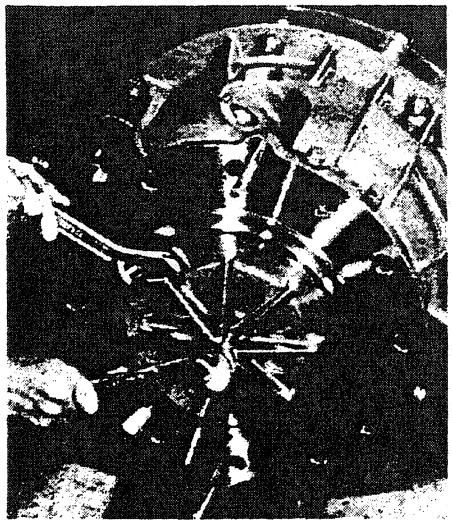
**"O" Rings 936B & 936C are NOT INCLUDED in the "O" Ring Repair Kit. Must be purchased seperately.



STEP 1

Remove attaching hardware and lift driver from gearbox. Remove nuts (914A) from compressor casing studs. Lift the gearbox and seal housing from the compressor casing, taking care not to damage the impeller. Place the gearbox on a suitable support with the impeller inclined upward.

On all BMC units, disconnect the piping between the heat exchanger and filter. Attach a hoist to the gearbox using an eyebolt in the tapped hole on the bearing plate. Remove nuts (914A) from the compressor casing studs and disconnect midriff braces. Remove, the gearbox and seal housing from the compressor casing by moving them toward the driver until the impeller and inducer (if applicable) clears the casing. Place gearbox on a suitable support with the impeller facing upward.



NOTE

The gearbox can be worked on while in a horizontal position. However, the diffuser cover must be supported to prevent its falling off when the impeller is removed.

STEP 2

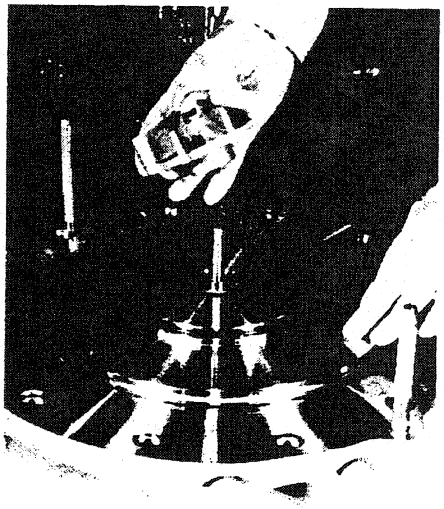
Prevent impeller from rotating and remove inducer (9). Note that impeller has a LEFT-HAND THREAD.

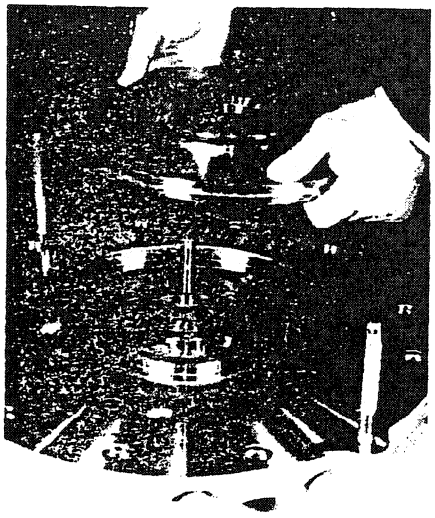
STEP 3

Remove impeller (2).

CAUTION

The impeller is dynamically balanced and should be replaced or rebalanced if it shows any sign of damage.



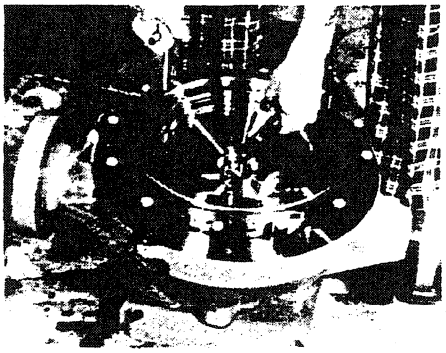


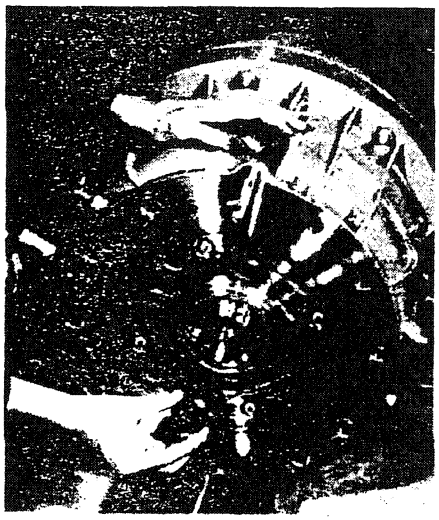
STEP 4

Remove diffuser cover (15) from seal housing.

STEP 5

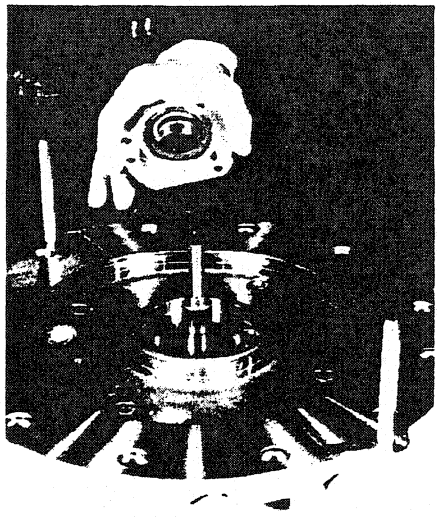
If diffuser removal is required, insert three eyebolts (customer furnished 5/16-18 UNC) into tapped holes in the surface of diffuser (13). Loosely thread a length of rope through these bolts and tie ends together. Grasp the rope between bolts and lift the diffuser. This step will require that "O" rings 936B and 936C be replaced.





STEP 6

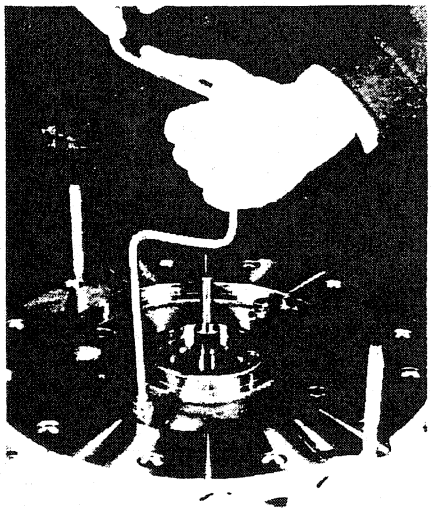
Remove the seal rotating face (51A) of single or tandem seal arrangements or the lower shaft sleeve (50A) on units equipped with double seals.



STEP 7

Remove the single seal (60A) of the single seal arrangement or the lower mechanical seal (60A) and seal spacer (52) of the double seal arrangement or the lower mechanical seal of the tandem seal arrangement.

If pump has a single seal arrangement, remove seal housing (30) and gasket (87A). Remove hex head cap screws (905F) and washers (916B). Remove throttle bushing (21B).

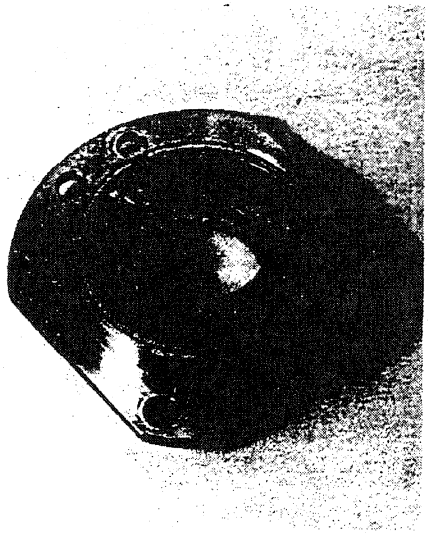


STEP 8

If upper seal of double or tandem seal arrangement requires removal, detach seal housing (30) and gasket (87A) from the gearbox by removing hex head cap screws (905A).

DOUBLE SEAL - Remove hex head cap screws (905F), washers (916B), upper mechanical seal (60B), and seal rotating face (51C).

TANDEM SEAL - Remove hex head cap screws (905F), washers (916B), upper mechanical seal (60B) and seal rotating face (51C).



STEP 9

Carefully inspect the seals for abrasive particles, excessive seal face wear and any binding of the seal face washer.

Replace or rebuild a faulty mechanical seal. Seals may be rebuilt by replacing the seal face washer, wedge rings, "O"ring, and springs. A seal repair kit is available.

Replace or lap the seal rotating face if the wear track is rough or worn to a depth greater than 2 helium light bands.

STEP 9 (Continued)

A combined total of 0.010-inch (0.25mm) maximum may be removed from the surfaces of the compressor and gearbox seal rotating faces. Excess material removal will result in incorrect seal face loading causing increased seal lea kage.

Remove any high spots on the end surfaces of the lower shaft sleeve and impeller hub to insure that the seal rotating face will not be distorted by clamping force of the impeller bolt.

Reassemble the seals, throttle bushing, if used, seal housing, and impeller using an "O" Ring Repair Kit. All "O" rings that were disturbed by disassembly should be replaced. During reassembly, carefully check the torque values listed in Table 8.

The impeller may rub on the diffuser cover plate (15) until "O" rings (936D and 936E) are compressed by tightening hex nuts (914A). Check the gearbox input shaft for freedom of rotation after the compressor is assembled and all bolts are tightened per Table 9.

2. PROCEDURE FOR DISASSEMBLING GEARBOX

The following replacement items will be required as a result of gearbox disassembly.

PART	ITEM NO.	QTY.
Gearbox Oil Filter	185	
Input Shaft Lip Seal	115	
Housing Gasket	105	2
"O" Ring Packing	936M	2
"O" Ring Packing	936N	2
"O" Ring Pachng	936T	2
*ShimSpacers	158Series	As Required
AntifrettingCompound	MP01AA10	Tube

(Available in sets of five 0.005-inch (0.1 3mm), 0.01 0-inch (0.25mm), .015-inch (0.38mm).

NOTE

In order to disassemble the gearbox, it is necessary to complete steps one through seven under **"PROCEDURE FOR DISASSEMBLING".**

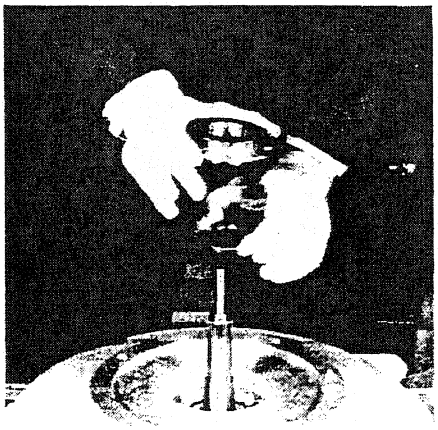
STEP 1

Drain oil from the gearbox.

STEP 2

Remove upper shaft sleeve (50B) on double or tandem seal arrangements or sleeve (50) on single seal equipped units.

Remove any high spots on the end surfaces of the shaft sleeve to insure that the seal rotating face will not be distorted by the clamping force of the impeller bolt. Ensure that the end faces shaft sleeves are parallel within .0003 in (.0076 mm)



STEP 3

Remove hex head cap screws (905L) and washers (916K). Remove gearbox mechanical seal (60C) rotating face (51 D), and "O" ring (936P) .

The gearbox mechanical seal may be rebuilt or replaced as described in STEP 8 under **"PROCEDURE FOR DISASSEMBLING COMPRESSOR"**

Replace or lap the seal rotating face if the wear track is rough or worn to a depth greater than 2 HE light bands.

A combined total of 0.010-inch (0.25mm) maximum may be removed from the surfaces of the pump and gearbox seal rotating faces. Excess material removal will result in incorrect seal face loading causing increased seal leakage.

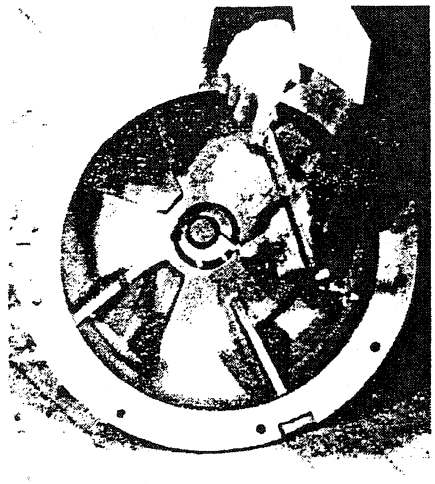
During reassembly, install the gearbox seal rotating face with the large chamfer on the inside diameter inserted toward the gearbox to clear the radius on the shaft shoulder.

STEP 4

Remove the fill vent piping by unscrewing the 3/4-inch pipe elbow (947A).

STEP 5

Remove bolts (909B and 909C) and remove the gearbox input housing (101B) by lifting and tapping on the underside of the input housing with a soft mallet.



STEP 6

Using a hammer and punch, remove input shaft lip seal (115) . Exercise care to avoid damaging the gearbox housing.

NOTE

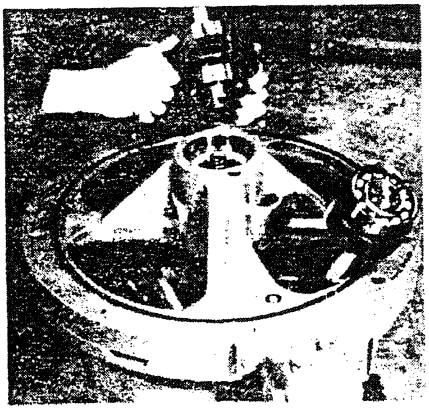
If the aluminum housing bore, for lip seal, is scratched, apply a light coat of oil-proof gasket cement to the outside diameter of the new shaft seal before replacing.

CAUTION

Use tool TO01M04 to replace the lip seal with. Assembly of lipseal being the last step.

STEP 7

Lift the idler shaft (140) out of the lower bearing liner, disengaging upper idler and input shaft gears.



STEP 8

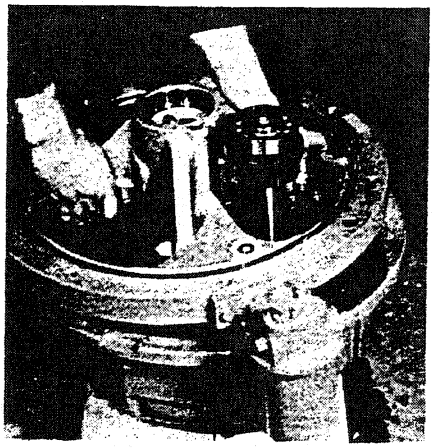
Remove the low speed shaft (120) from the gearbox bearing plate (102).

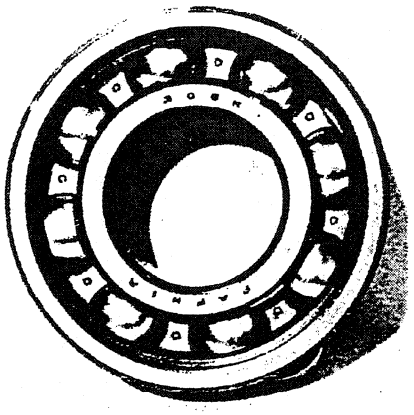
STEP 9

Remove the internal lube oil pump (160) and spring (23A).

STEP 10

Remove gearbox bearing plate (102).





STEP 11

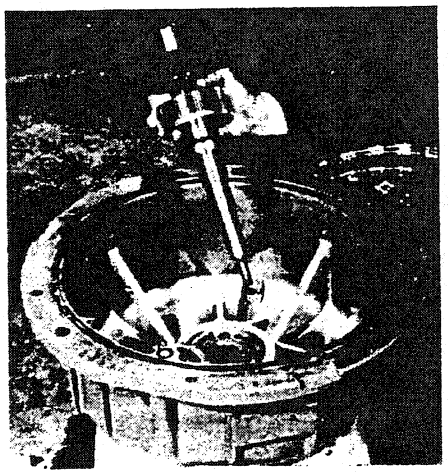
Inspect antifriction bearing (125A, 125C and 125D) for smooth rotation, worn outside diameter of outer races and snugness of the inner races on the shafts. Replace if bearings have been in operation for more than three years, if rotation is not smooth, or if outside or inside diameters are worn.

CAUTION

It is essential to replace antifriction bearings with the manufacturer's approved replacement bearings. Non-approved replacement bearings may jeopardize mechanical integrity of the gearbox/pump.

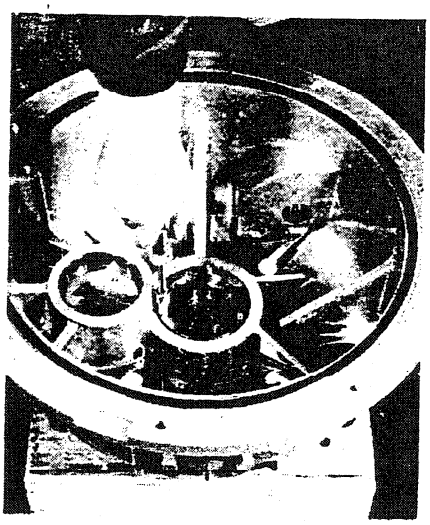
Antifriction bearings should be pressed onto the shaft using a press which contacts only the inner race. Bearing damage will occur by pressing or pulling the outer race. No more than 0.001-inch (0.03mm) gap should exist between bearings, spacers, gears and shaft shoulders.

Inspect liner and shaft diameters per Figure 29.



STEP 12

Remove the high speed shaft (130) from the gearbox output housing (101A).



STEP 13

Remove the upper journal bearing (151B) and thrust washer (155B) if used. Remove the lower journal bearing (151 A) and thrust washer (155A) if used .

NOTE

Upon removal of the upper and lower journal bearing assemblies, tag the bearings so that they can be reinstalled in their proper location.

STEP 14

Inspect upper and lower thrust washers (155B and 155A) or tilting pad bearing assembly (151B). If metal is smeared into radial lube grooves of the washer face, install a new washer. If tilting pads do not tilt freely, or if they show signs of metal pickup or overheating, install a new bearing assembly.

Inspect the thrust runner (133B) and high speed shaft at thrust washer and journal bearing contact areas. It the outside diameter of the shaft is less than 1.4960 inches (Figure 29), or if the shaft has bearing or washer material on its surface, or shows signs of overheating or wear to a depth greater than 0.001-inch (0.03 mm), install a new shaft and gear assembly.

STEP 15

Inspect upper & lower thrust washers or tilt pad bearing assembly, if metal is smeared into radial lube grooves or bearing surface install new thrust washers.

REASSEMBLY IS IN REVERSE ORDER.

PROCEDURE FOR CHECKING HIGH-SPEED SHAFT END PLAY

If a new high-speed shaft assembly, output housing, journal bearing, thrust washer or bearing assembly is installed, end play of the shaft assembly must be measured and shim spacers (158 Series) installed as required to obtain correct shaft end play.

NOTE

For accurate checking of shaft end play, all parts must be dry and free of oil.

STEP 1
Install the lower journal bearing (151A) into the gearbox output housing (101A). With no shim spacers installed, tighten screws (905M).

STEP 2
Install the upper journal bearing or bearing assembly (151B) into the bearing plate (102). With no shim spacers installed, tighten screws (905N).

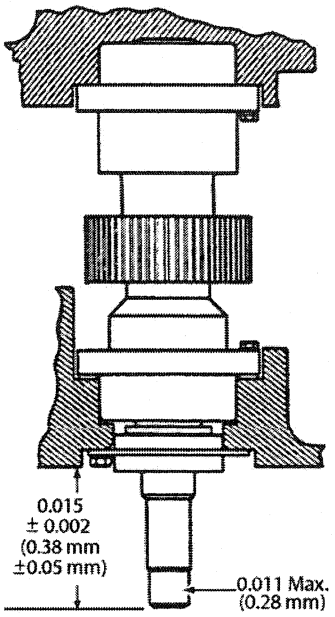
STEP 3
If used, place both upper and lower thrust washers (155B and 155A) into lower journal bearing. Place the high-speed shaft assembly into the gearbox output housing.

STEP 4
With the aid of two large-diameter alignment bolts (909C), install bearing plate (102) without o-ring and gasket. Clamp the bearing plate to output housing with two "C" clamps or bolts.

STEP 5
With the shaft in a vertical position, move the shaft up and down while measuring the total end play with a dial indicator or depth micrometer. Shaft end play must be 0.015 + 0.002 inch (0.38 + 0.05 mm). If end play is not within this limit, calculate the shim thickness required to place the shaft within the proper clearance range. Select the required thickness shim using 158 Series shim spacer sizes.

STEP 6
Remove the alignment bolts (909C) and bearing plate (102) with upper journal bearing (151B).

STEP 7
Remove high-speed shaft, thrust washers (if used) and lower journal bearing.



STEP 8
Install the required shim spacers in place on the gearbox output housing and replace the lower journal bearing. Install attaching bolts (905M) and tighten.

STEP 9
Install the lower thrust washer (155A - if used) with the flat side on the bearing surface and replace the high-speed shaft.

STEP 10
Install the upper thrust washer (155B - if used) with the flat side on the upper journal bearing surface. A light grease may be used to hold the thrust washer in place.

CAUTION

Shims are never installed behind the upper journal bearing.

STEP 11
Continue reassembly of the gearbox by placing idler shaft (140) in the lower half of the gearbox. The idler shaft lower ball bearing should not be allowed to slide into the bearing retainer at this point in assembly.

STEP 12
Position bearing plate (102) on the lower half of the gearbox. Insure that lube passage o-rings (936T) and housing gaskets (105) are positioned correctly.

STEP 13
Install the low-speed shaft assembly into the bearing plate, bearing liner with the shaft aligned so that the lube pump drive pin slips into the slot in the low-speed shaft. Top surface of the bearing should be even with the top of the bearing liner. At this time the idler shaft should be allowed to drop into the lower bearing liner, engaging the four gears.

Continue reassembly reversing steps 1 through 6.

Table 8. Torque Values

Gearbox *Sundyne Standard Steel Screws & Bolts and NACE Compliant Steel Screws/Bolts (BG Material)*				
			Torque Values	
Item #	**Location**	**Size**	**English**	**Metric**
905H	Oil Filter Manifold	3/8 - 16 x 1/2	22 - 25 ft-lbs	30 - 34 N-m
905L	Gearbox Seal	1/4 - 20 x 1/2	75 - 80 in-lbs	8.5 - 9.0 N-m
905M, N	Journal Bearings	#10 - 24 x 1	35 - 40 in-lbs	4.0 - 4.5 N-m
905T	Chemical Barrier Gasket	1/4 - 20 x 5/8	75 - 80 in-lbs	8.5 - 9.0 N-m
909B	Gearbox Halves	1/2 - 13 x4	60 - 65 ft-lbs	81 - 88 N-m
909C	Gearbox Halves, Alignment	5/8 - 18 x 4 17/64	60 - 65 ft lbs	81 - 88 N-m
906B	Sight Glass	#8 - 32 x 1/2	10 - 12 in-lbs	1.0 - 1.4 N-m
*Pumps & Compressors** *Sundyne Standard Steel Screws and Bolts*				
			Torque Values	
Item #	**Location**	**Size**	**English**	**Metric**
3	Impeller Bolt/Inducer:			
	LMV/BMP-801, 802, 806, 322, 311, 331	1/2 - 20	36 - 40 ft-lbs	49 - 54 N-m
	LMV/BMP-341, 346	1/2 - 20	65 - 70 ft-lbs	88 - 95 N-m
	LMV-313, 343, BMP-338, 348 (High Flow)	3/4 - 10	85 - 90 ft-lbs	115-122 N-m
	LMC/BMC 3X1P, 3X1F, 3X3, 3X6P, 3X7	1/2 - 20	36 - 40 ft-lbs	49 - 54 N-m
906D	Diffuser Attaching Screws	1/4 - 20	95 - 102 in-lbs	11 - 11.5 N-m
905E	Mechanical Seal No. Spacer	1/4 - 20 x 12	95 - 102 in-lbs	11 - 11.5 N-m
905F	Throttle Bushing/Mechanical Seal	1/4 - 20 x 12	9 5- 102 in-lbs	11 - 11.5 N-m
905G	Double Seal with Spacer	1/4 - 20 x 3/4	95 - 102 in-lbs	11 - 11.5 N-m
914A	Case Nuts	3/4 - 10	250 - 275 ft-lbs	340 - 375 N-m
914A	Case Nuts	7/8 - 9	300 - 330 ft-lbs	405 - 445 N-m
905A	Seal Housing to Gearbox	3/8 - 16 x 1 3/4	35 - 40 ft-lbs	47 - 54 N-m
905P	Separator	1/4 - 20 x 5/8	95 - 102 in-lbs	11 - 11.5 N-m
Pumps & Compressors *NACE Compliant Steel Screws / Bolts (BG Material)*				
			Torque Values	
Item #	**Location**	**Size**	**English**	**Metric**
3	Impeller Bolt/Inducer:			
	LMV/BMP-801, 802, 806, 322, 311, 331	1/2 - 20	36 - 40 ft-lbs	49 - 54 N-m
	LMV/BMP-341, 346	1/2 - 20	65 - 70 ft-lbs	88 - 95 N-m
	LMV-313, 343, BMP-338, 348 (High Flow)	3/4 - 10	85- 90 ft-lbs	115 - 122 N-m
	LMC/BMC 3X1P, 3X1F, 3X3, 3X6P, 3X7	1/2 - 20	36 - 40 ft-lbs	49 - 54 N-m
906D	Diffuser Attaching Screws	1/4 - 20	70 - 75 in-lbs	8.0 - 8.5 N-m
905E	Mechanical Seal No. Spacer	1/4 - 20	70 - 75 in-lbs	8.0 - 8.5 N-m
905F	Throttle Bushing/Mechanical Seal	1/4 - 20	70 - 75 in-lbs	8.0 - 8.5 N-m
905G	Double Seal with Spacer	1/4 - 20	70 - 75 in-lbs	8.0 - 8.5 N-m
914A	Case Nuts	3/4 - 10	160 - 200 ft-lbs	217 - 270 N-m
914A	Case Nuts	7/8 - 9	225 - 245 ft-lbs	305 - 332 N-m
905A	Seal Housing to Gearbox	3/8 - 16 x 1 3/4	27 - 30 ft-lbs	47 - 54 N-m
905P	Separator	1/4 - 20 x 5/8	70 - 75 in-lbs	8.0 - 8.5 N-m
* When using Teflon® o-rings, allow 15 minutes between torquing for the Teflon® to cold flow. Repeat torquing until there is no change in torque.				

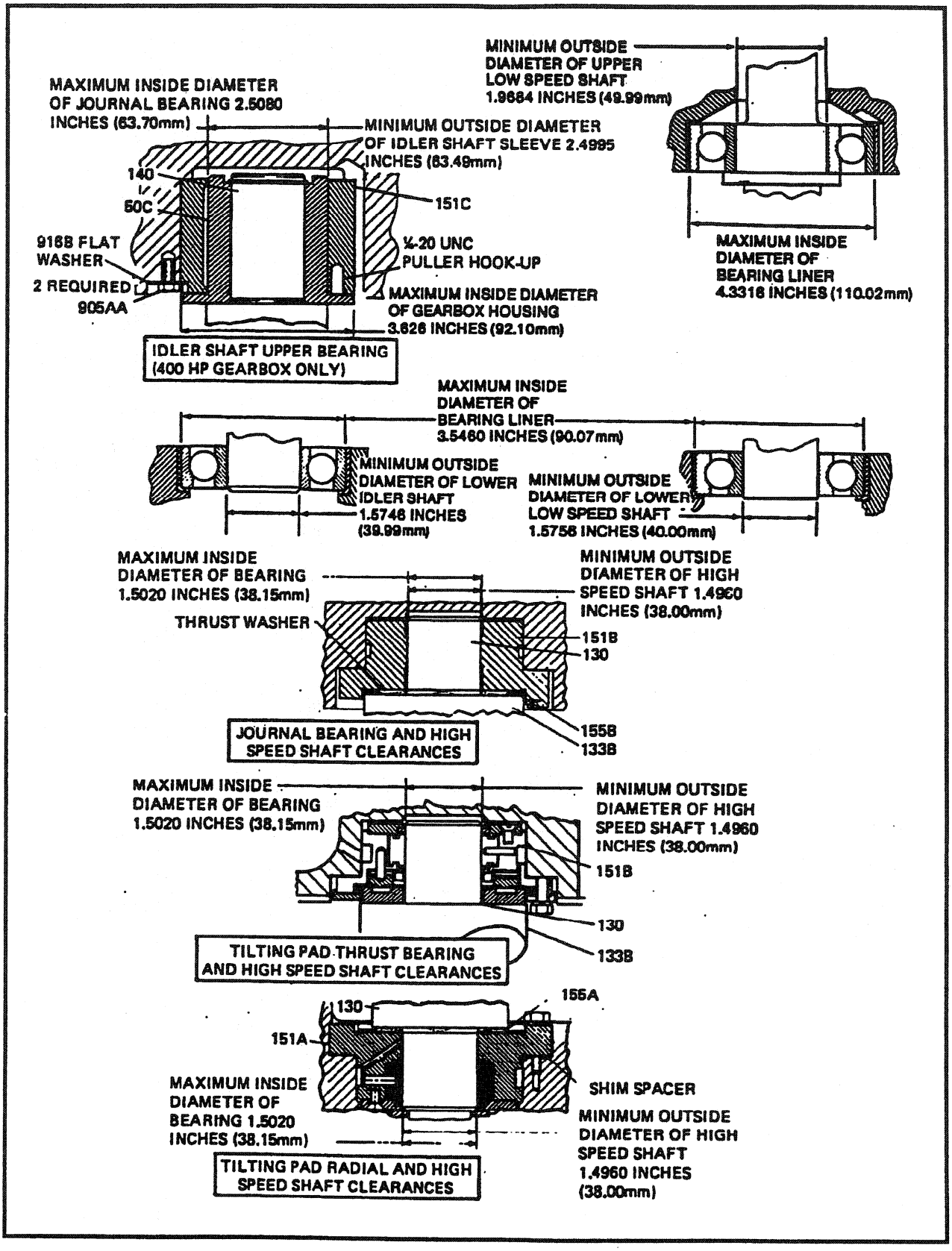


Figure 29. Bearing and Shaft Clearance

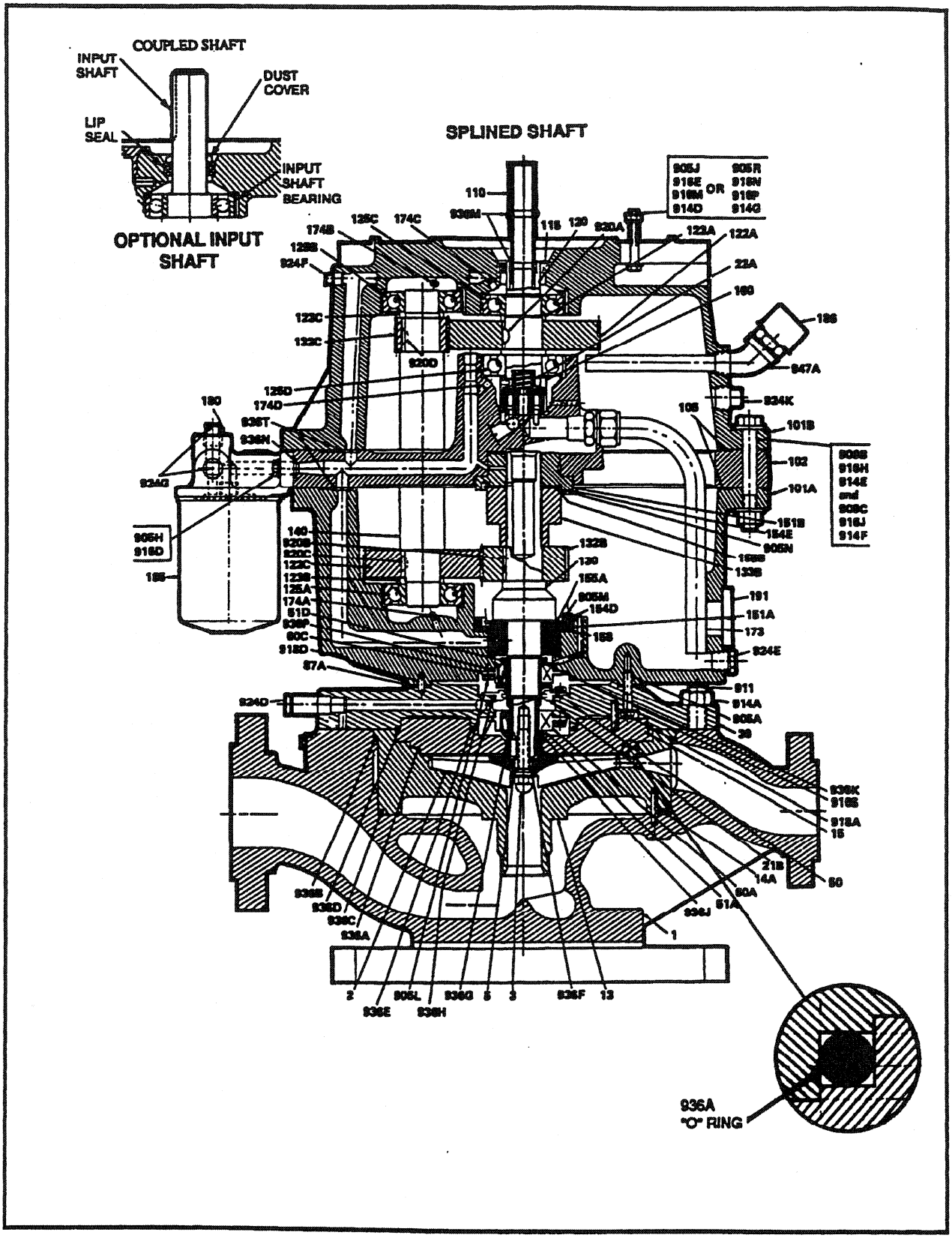
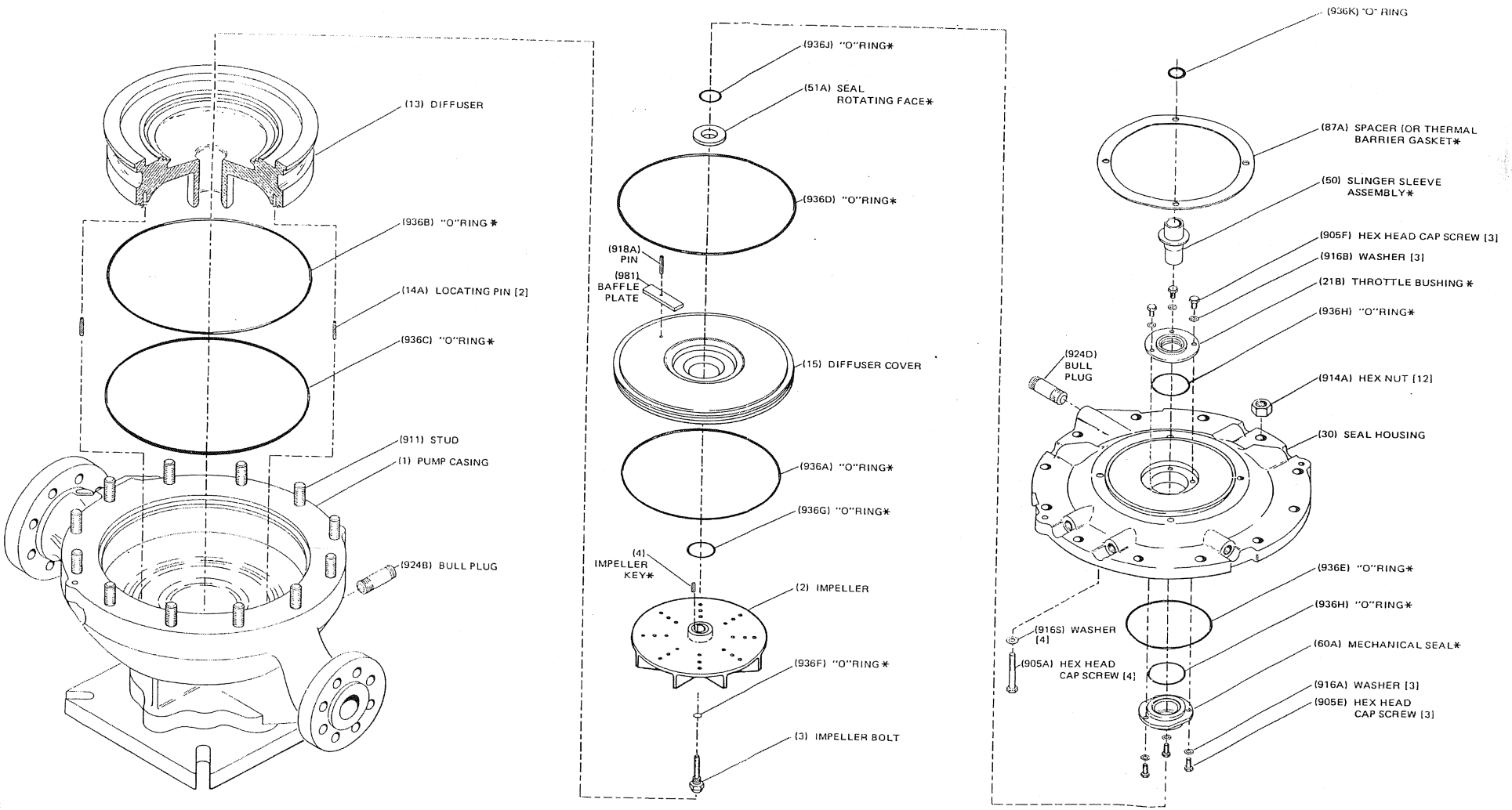


Figure 30. Cross Section

ITEM NO.	PART NAME	QTY	ITEM NO.	PART NAME	QTY
1	Casing	1	911	Stud	12
2	Impeller	1	914A	HexNut	12
3	Impeller Bolt	1	916B	Washer	3
4	Impeller Key	1*	916S	Washer	4
5	Impeller Tab Washer	1*	918A	Pin	1
		1	924B	Pipe Plug	1
		1	924D	Bull Plug	1
13	Diffuser	1	936A	"O" Ring Packing	1*
14A	Locating Pin	2	936B	"O" Ring Packing	1*
15	Diffuser Cover	1	936C	"O" Ring Packing	1*
21B	Throttle Bushing	1	936D	"O" Ring Packing	1*
30	Seal Housing	1	936E	"O" Ring Packing	1*
50	Slinger Sleeve Assembly	1	936F	"O" Ring Packing	1*
51A	Seal Rotating Face	1*	936G	"O" Ring Packing	1*
51C	Seal Mating Ring	1*	936H	"O" Ring Packing	1*
87A	Spacer (or Thermal Barrier Gasket) (Large)	1	936J	"O" Ring Packing	1*
			936K	"O" Ring Packing	1*
905A	Hex Head Cap Screw	3	981	Baffle Plate	1
905F	Hex Head Cap Screw	3			

*Recommended Spare Parts

Table 9. Parts List



* Recommended Spare Parts

Figure 31. Exploded View

ITEM NO.	PART NAME	QTY	ITEM NO.	PART NAME	QTY
23A	Lube Pump Spring	1	173	Tube (sump)	1
51D	Seal Rotating Face	1	174A	Lube Jet	1
60C	Mechanical Seal	1	174B	Lube Jet	1
98	Dust Cover (Coupled Shaft)	1	174C	Lube Jet	1
101A	Gearbox Housing (output)	1	174D	Lube Jet	1
101B	Gearbox Housing (input)	1	177	Valve	1
102	Bearing Plate	1	180	Filter Manifold	1
105	Housing Gasket	2	185	Oil Filter (Fram PH-41)	1*
110	Interconnecting Shaft	1	186	Fill and Vent Fitting	1
115	Shaft Seal	1*	191	Sight Glass	1
A120	Low Speed Shaft Assembly	1	193C	Pressure Guage	1
120	• Low Speed Shaft	1	905E	Hex Head Cap Screw	3
122A	• Spur Gear (Low Speed)	1	905H	Hex Head Cap Screw	2
123A	• Shaft Spacer (Low Speed)	1	905M	Hex Head Cap Screw	3
125C	• Ball Bearing	1*	905N	Hex Head Cap Screw	3
125D	• Ball Bearing	1*	909B	Bolt	7
A130	High Speed Shaft Assembly	1	909C	Bolt (Alignment)	2
130	• High Speed Shaft	1	914E	Hex Nut	7
132B	• Pinion Gear (High Speed)	1	914F	Hex Nut (Alignment)	2
133B	• Thrust Runner	1	916A	Washer	3
A140	Idler Shaft Assembly	1	916D	Washer	2
140	Idler Shaft	1	916H	Washer	14
122C	• Spur Gear (Idler)	1	916J	Washer (Alignment)	4
123B	• Shaft Spacer (Idler)	1	918D	Pin	1
123C	• Ball Bearing	1	920A	Key	1
125A	• Ball Bearing	1*	920B	Key	1
125B	• Pinion Gear	1*	920C	Key	1
132C	Journal Bearing or Tilting Pad Journal and Thrust Bearing Assembly (Lower)	1	920D	Key	1
151A	Journal Bearing or Tilting Pad Journal and Thrust Bearing Assembly (Upper)	1	920F	Key (For Coupled Shaft Only)	1
151B	Lock Washer (Lower)	3	924AA	Pipe Plug	1
154D	Lock Washer (Upper)	3	924E	Pipe Plug	1
154E	Thrust Washer (Lower)-Req. with Journal Bearing	1	924G	Pipe Plug	1
155A	Thrust Washer (Upper)-Req. with Journal Bearing	1	924H	Pipe Plug	1
155B	Shim Spacers	AR	924K	Pipe Plug	1
158	Lube Pump	1*	936K	"O" Ring Packing	1
160			936M	"O" Ring Packing	2*
			936N	"O" Ring Packing	2*
			936T	"O" Ring Packing	2*
			944A	Pipe Connecotor (Female)	1
			944B	Pipe Connector (Male)	1
			947A	Elbow	1
			951Y	Nipple	1

*Recommended Spare Parts

Table 10. Gearbox Parts List

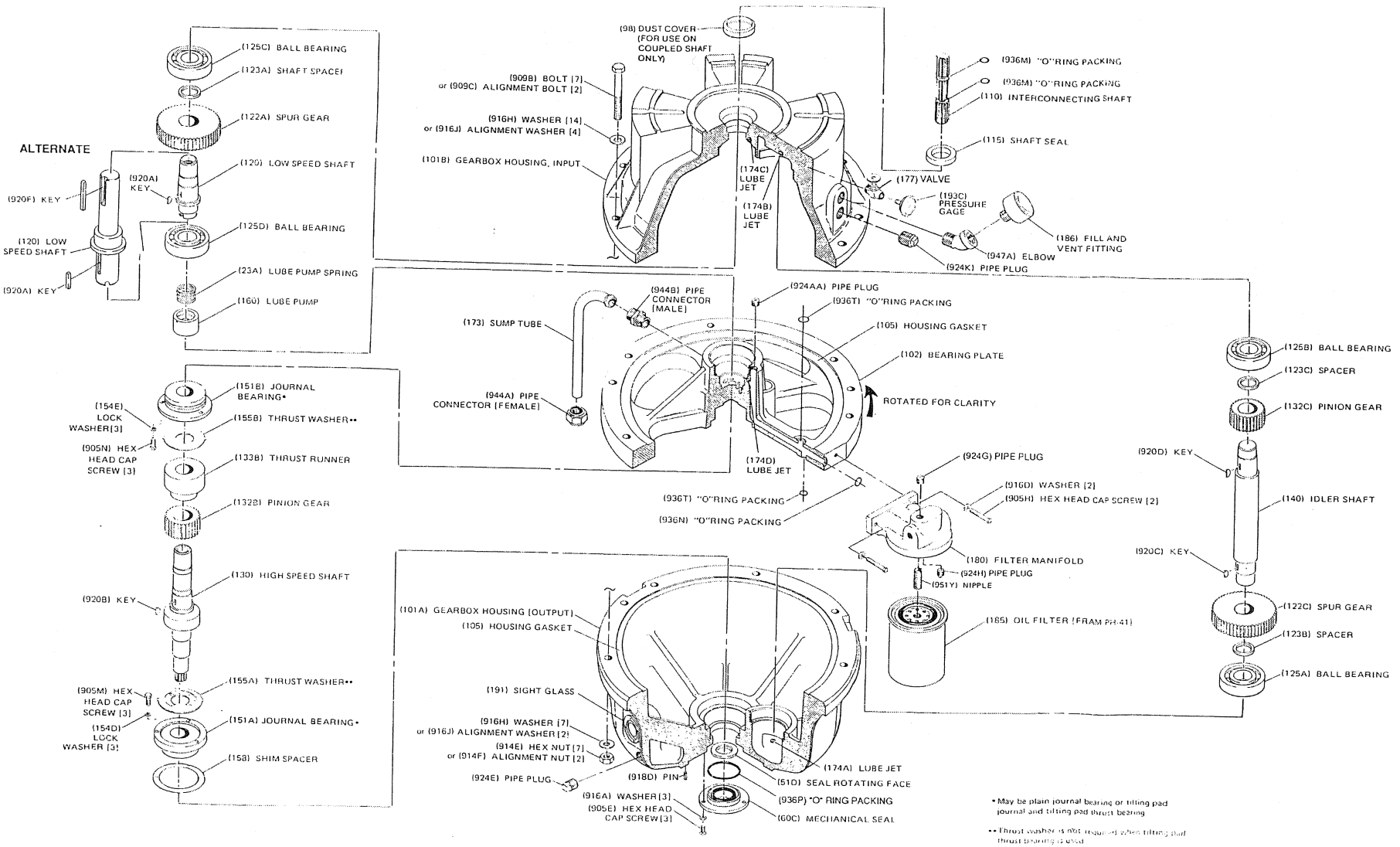


Figure 32. 200 HP Gearbox

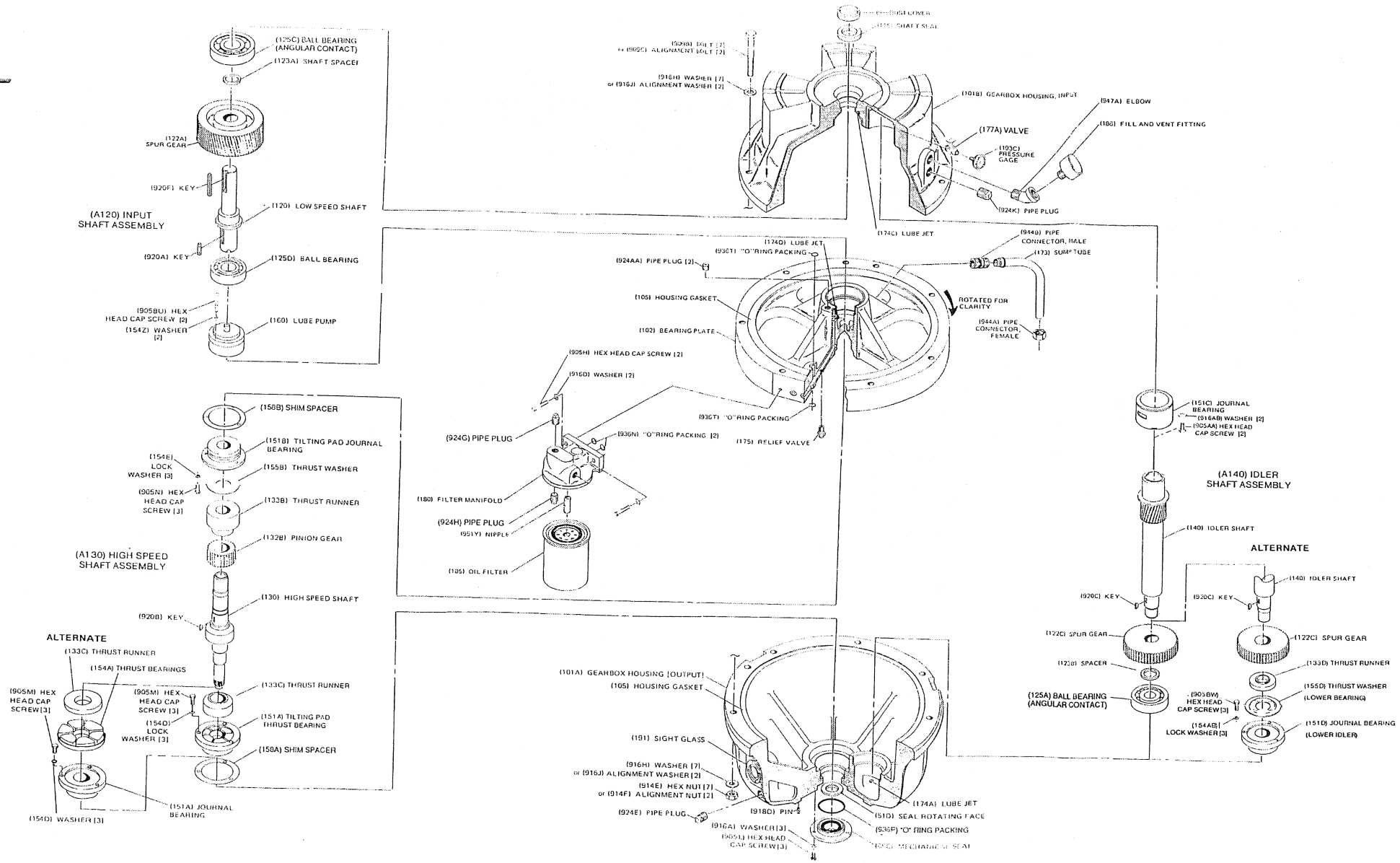


Figure 33. 400 HP Gearbox

ITEM NO.			DESCRIPTION
LOWER PROCESS SEAL	UPPER PROCESS SEAL	**GEARBOX SEAL	
60A	60B	60C	Mechanical Seal Assembly
61A	61B	61C	Retainer, Seal
62A*	62B*	62C*	Seal Face Washer
63A*	63B*	N/A	Seal Spring Backup Ring
64A*	64B*	64C*	Seal Retaining Ring
65A*	65B*	65C*	Seal Spring
68A*	68B*	N/A	Teflon Wedge
69A*	69B*	69C*	Secondary may be "U" Cup or "O" Ring

Seal Repair Kits are available and contain all parts marked with a single asterisk.

**CAUTION

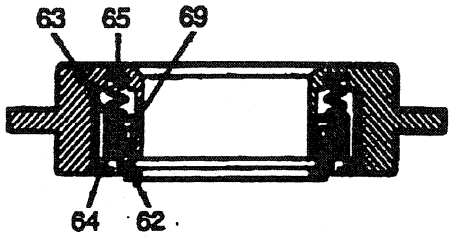
Item 60C to be used on gearbox only.

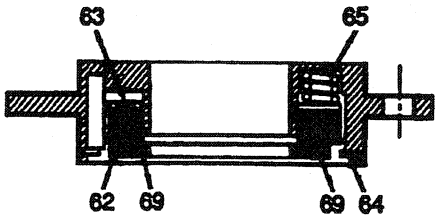
NOTE

To maximize seal performance, consult the parts list for correct seal configuration. For additional information, please contact your area representative or the Sundstrand factory direct.

NOTE

1-1/2" gas seal for upper tan[illegible] position on light hydrocarbon service only.





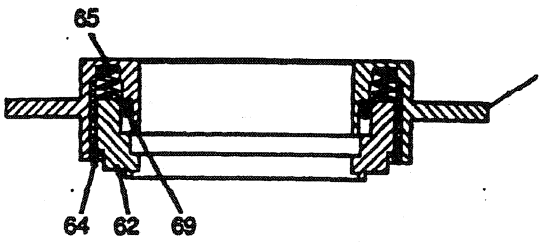
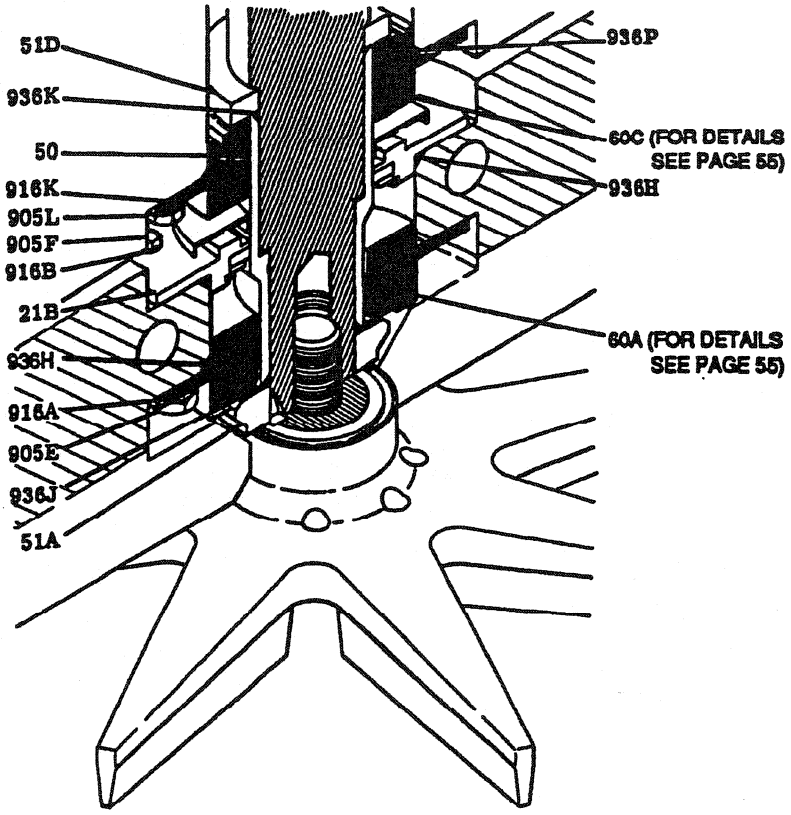


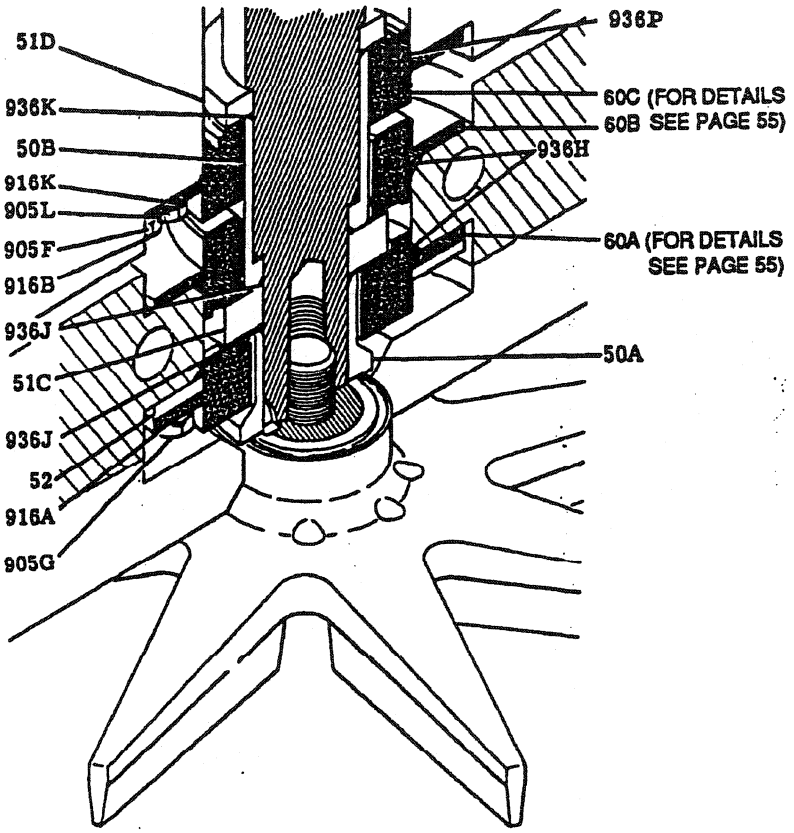
Figure 34. Mechanical Seals



ITEM NO.	PART NAME	QTY.	ITEM NO.	PART NAME	QTY.
21B	Upper Throttle Bushing	1	905L	Hex Head Cap Screw	3
50	Slinger Sleeve Assembly	1*	916A	Washer	3
51A	Seal Rotating Face	1*	916B	Washer	3
51D	Seal Rotation Face (Gearbox)	1*	916K	Washer	3
60A	Mechanical Seal (Lower)	1*	936H	"O" Ring Packing	2*
60C	Mechanical Seal (Gearbox)	1*	936J	"O" Ring Packing	1*
905E	Hex Head Cap Screw	3	936K	"O" Ring Packing	1*
905F	Hex Head Cap Screw	3	936P	"O" Ring Packing	1*

*Recommended Spare Parts

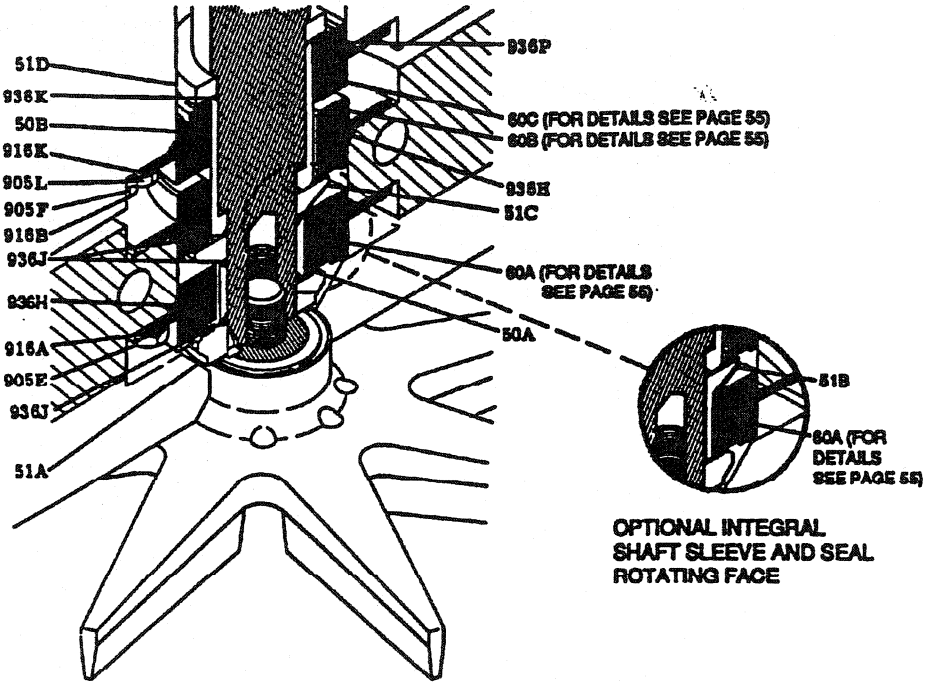
Figure 35. Single Seal Arrangement



ITEM NO.	PART NAME	QTY.	ITEM NO.	PART NAME	QTY.
50A	Shaft Sleeve (Lower)	1*	905G	Hex Head Cap Screw	3
50B	Shaft Sleeve (Upper)	1*	905L	Hex Head Cap Screw	3
51C	Seal Rotating Face	1*	916A	Washer	3
51D	Seal Rotating Face (Gearbox)	1*	916B	Washer	3
52	Seal Spacer	1	916K	Washer	3
60A	Mechanical Seal (Lower)	1*	936H	Washer	3
60B	Mechanical Seal (Upper)	1*	936J	"O" Ring Packing	2*
60C	Mechanical Seal (Gearbox)	1*	936K	"O" Ring Packing	2*
905F	Hex Head Cap Screw	3	936P	"O" Ring Packing	1*
				"O" Ring Packing	1*

*Recommended Spare Parts

Figure 36. Double Seal Arrangement



ITEM NO.	PART NAME	QTY.	ITEM NO.	PART NAME	QTY.
50A	Shaft Sleeve (Lower)	1*	905E	Hex Head Cap Screw	3
50B	Shaft Sleeve (Upper)	1*	905F	Hex Head Cap Screw	3
51A	Seal Rotating Face	1*	905L	Hex Head Cap Screw	3
51B	Seal Rotating Face (Optional)	1*	916A	Washer	3
51C	Seal Rotating Face	1*	916B	Washer	3
51D	Seal Rotating Face (Gearbox)	1*	916K	Washer	3
60A	Mechanical Seal (Lower)	1*	936H	"O" Ring Packing	2*
60B	Mechanical Seal (Upper)	1*	936J	"O" Ring Packing	3*
60B	Mechanical Seal (Gas Seal)	1*	936K	"O" Ring Packing	1*
60C	Mechanical Seal (Gearbox)	1*	936P	"O" Ring Packing	1*

*Recommended Spare Parts

Figure 37. Tandem Seal Arrangement

SUNDYNE COMPRESSOR RECOMMENDED SPARE PARTS

200 Hp Gearbox: 311

ITEM NO.	PART NAME	CLASS		
		1 QTY	2 QTY	3 QTY
3	Impeller Bolt	0	1	1
4	Impeller Key	1	1	1
87A	Barrier Gasket	1	2	2
60A	Mechanical Seal (Lower)	1	1	2
60B	Mechanical Seal (Upper)	†	1	2
	Seal Repair Kit (Lower)		†	†
	Seal Repair Kit (Upper)	†	†	†
50A	Shaft Sleeve (Lower)	0	1	1
50B	Shaft Sleeve (Upper)	0	1	1
51A	Rotating Face (Lower)	1	1	2
51C	Rotating Face (Upper)	1	1	2
	"O" Ring Repair Kit	1	2	2

400 Hp Gearbox: 331

ITEM NO.	PART NAME	CLASS		
		1 QTY	2 QTY	3 QTY
3	Impeller Bolt	0	1	1
87A	Barrier Gasket	1	2	2
60A	Mechanical Seal (Lower)	1	1	2
60B	Mechanical Seal (Upper)	1	1	2
	Seal Repair Kit (Lower)	†	†	†
	Seal Repair Kit (Upper)	†	†	†
50A	Shaft Sleeve (Lower)	0	1	1
50B	Shaft Sleeve (Upper)	0	1	1
51A	Rotating Face (Lower)	1	1	2
51C	Rotating Face (Upper)	1	1	2
	"O" Ring Repair Kit	1	2	2

† These are alternate items and may be purchased according to users preference.

NOTES

Class 1 Spares - Minimum recommended spare parts necessary to perform a start-up and inspection of a new unit.

Class 2 Spares - Minimum recommended spare parts necessary to cover 1-2 years nromal operation.

Class 3 Spares - Minimum recommended spare parts stock necessary for critical services or units which will be installed in remote locations.

TERMS: NET 30 DAYS

F.O.B. POINT: ARVADA, COLORADO

SUNDYNE GEARBOX RECOMMENDED SPARE PARTS

200 Hp Gearbox: 311

ITEM NO.	PART NAME	CLASS		
		1 QTY	2 QTY	3 QTY
60C	Gearbox Mechanical Seal	0	1	1
	Repair Kit for Gearbox Seal	0	†	†
51D	Gearbox Seal Rotating Face	0	1	1
185	Oil Filter	2	5	5
115	Input Shaft Seal	1	1	1
A130	High Speed Shaft Assembly	0	†	1
151A	Journal Bearing (Lower)	0	0	1
151B	Journal Bearing (Upper)	0	0	1
155A	Thrust Washer (Lower)	0	0	1
155B	Thrust Washer (Upper)	0	0	1*
105	Housing Gasket	1	2	2
936N	"O" Ring	2	4	4
936T	"O" Ring	2	4	4
125A	Bearing, Ball	0	1	1
125C	Bearing, Ball	0	1	1
125D	Bearing, Ball	0	1	1
125B	Bearing, Ball	0	1	1
0	Spline Lube	1	1	1
936M	"O" Ring	2	4	4

400 Hp Gearbox: 331

ITEM NO.	PART NAME	CLASS		
		1 QTY	2 QTY	3 QTY
60C	Gearbox Mechanical Seal	0	1	1
	Repair Kit for Gearbox Seal	0	†	†
51D	Gearbox Seal Rotating Face	0	1	1
185	Oil Filter	2	5	5
115	Input Shaft Seal	1	1	1
A130	High Speed Shaft Assembly	0	†	1
151A	Journal Bearing (Lower)	0	0	1
151B	Journal Bearing (Upper)	0	0	1
155A	Thrust Washer (Lower)	0	0	1
155B	Thrust Washer (Upper)	0	0	1*
105	Housing Gasket	1	2	2
936N	"O" Ring	2	4	4
936T	"O" Ring	2	4	4
151C	Journal Bearing, (Idler)	0	0	1
125C	Bearing, Ball	0	1	1
125D	Bearing, Ball	0	1	1
125A	Bearing, Ball	0	1	1

*Not applicable with use of Tilting Pad Thrust Bearings in upper position.
† These are alternate items and may be purchased according to users preference.

NOTES

Class 1 Spares - Minimum recommended spare parts necessary to perform a start-up and inspection of a new unit.

Class 2 Spares - Minimum recommended spare parts necessary to cover 1-2 years nromal operation.

Class 3 Spares - Minimum recommended spare parts stock necessary for critical services or units which will be installed in remote locations.

TERMS: NET 30 DAYS

CRITICAL STARTUP CHECK LIST

KNOW YOUR MACHINE:

Prior to servicing and startup of the Sundyne compressor, carefully review the specification sheet, outline drawing, performance curves, and the instruction manual. It is important you become familiar with the compressor configuration before starting and operating the compressor.

DRIVER INSTRUCTIONS:

Follow installation and starting instructions of the driver manufacturer.

GEARBOX SERVICING:

Fill gearbox within 1/4-inch from top of oil level sight glass with Type A automatic transmission fluid or light turbine hydraulic oil. Operate auxiliary lube pump to fill heat exchanger and filter. Add oil as necessary (approximately seven U.S. quarts) through fill-vent fitting until oil level stabilizes in sight glass.

ENVIRONMENTAL CONTROL SYSTEM:

Install seal environmental control system, if required, and overhead drain piping.

PRESSURIZE FLUID LOOP:

Pressurize double seal buffer fluid loop or external seal flush, if required, prior to admitting fluid into compressor casing.

CHECK DRIVER ROTATION:

Rotation must be in same direction as arrow stamped on compressor casing.

START COMPRESSOR:

Start compressor with suction valve completely open while throttling discharge valve, to bring compressor to design operating point.

HEAT EXCHANGER:

If gearbox heat exchanger is installed, adjust cooling flow to maintain gearbox sump temperature of 140° to 200°F. (60° to 93°C.).

CHECK:

Check headrise flow rate, and power consumption (182 HP max) against compressor specification sheet. Check that specific gravity, viscosity and NPSH are in accordance with the specification sheet. These conditions will significantly alter performance of the compressor.

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BALDOR • RELIANCE

Integral Horsepower
AC Induction Motors
ODP, WPI Enclosures
TENV, TEAO, TEFC Enclosure
Explosion Proof

Installation & Operating Manual

3/09

MN408

Table of Contents

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 carrying conductors and permanent magnet motors can result result in a serious health hazard to persons with cardiac pacemakers, metal implants, and hearing aids. To avoid risk, stay way 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 WPII 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 WPII (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: **Rm = kV + 1**

where: (Rm is minimum resistance to ground in Meg-Ohms and kV is rated nameplate voltage defined as Kilo-Volts.)

Example: For a 480VAC rated motor Rm =1.48 meg-ohms (use 5 MΩ).
For a 4160VAC rated motor Rm = 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 mils 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-regreasable 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 regreasable 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.

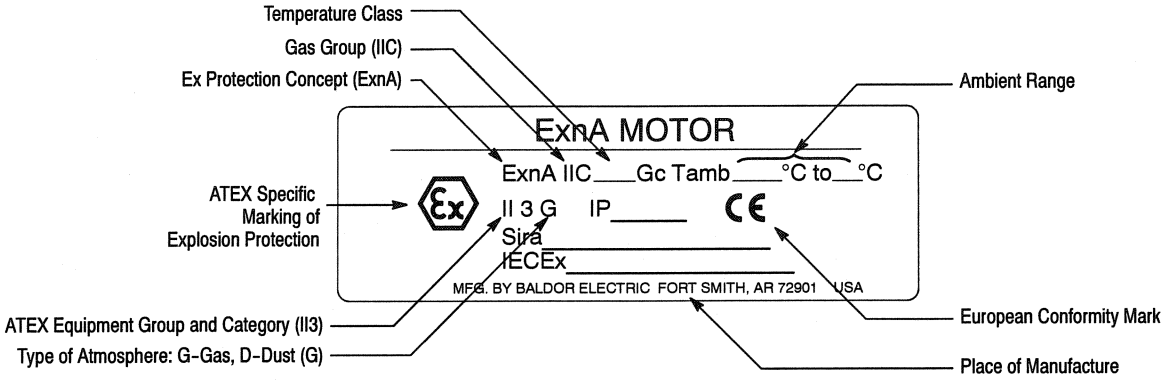
Removal From Storage

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. IECEx Certificates are available online at www.iecex.com

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.

EMC Compliance Statement for European Union

The motors described in this instruction manual are designed to comply 2004/108/EC . These motors are commercial in design and not intended for residential use.

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.

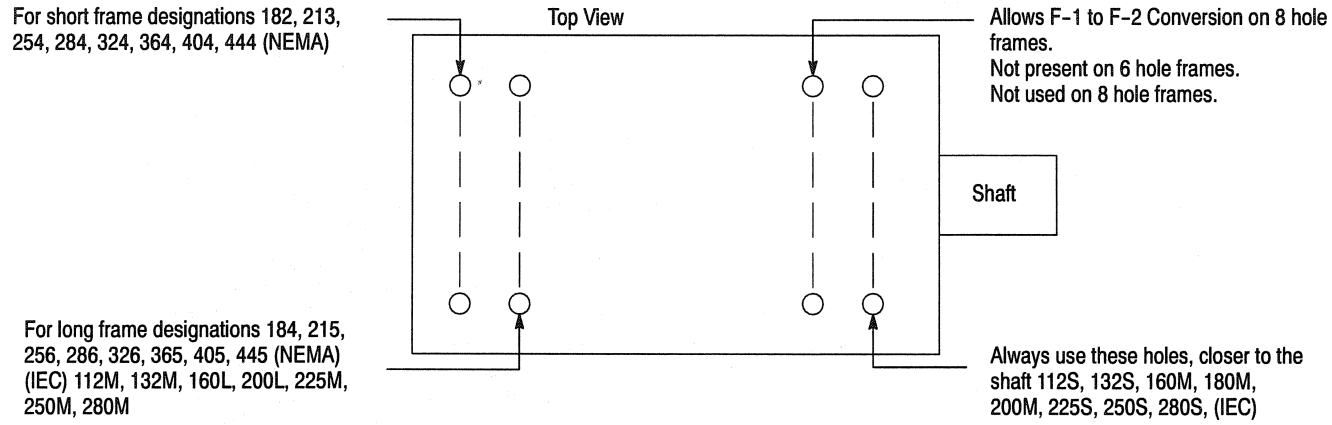
When installation is complete and accurate alignment of the motor and load is accomplished, the base should be grouted to the foundation to maintain this alignment.

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



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. Fully insulated and lugged terminations must be bolted and provided with lock washer to prevent rotation. 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 ±10% of rated voltage with rated frequency. (See motor name plate for ratings).
   OR
2. AC power is within ±5% of rated frequency with rated voltage.
   OR
3. A combined variation in voltage and frequency of ±10% (sum of absolute values) of rated values, provided the frequency variation does not exceed ±5% of rated frequency.

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

Figure 2-3 Accessory Connections

HEATERS H1 —∿∿— H2 H1 —∿∿— H2	One heater is installed in each end of motor. Leads for each heater are labeled H1 & H2. (Like numbers should be tied together).
THERMISTORS TD1 —∿∿— TD2	Three thermistors are installed in windings and tied in series. Leads are labeled TD1 & TD2.
WINDING RTDS RED RED WHITE	Winding RTDs are installed in windings (2) per phase. Each set of leads is labeled 1TD1, 1TD2, 1TD3, 2TD1, 2TD2, 2TD3 etc.
BEARING RTD RED RED WHITE	* 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

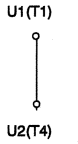
AC Motor Connection Diagram

IEC VERSUS NEMA LEAD MARKING

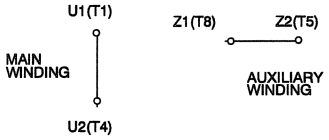
EXAMPLE COMPARISIONS OF IEC AND NEMA LEADING MARKINGS FOR COMMON CONNECTION TYPES ARE SHOWN BELOW.

SINGLE PHASE MOTORS

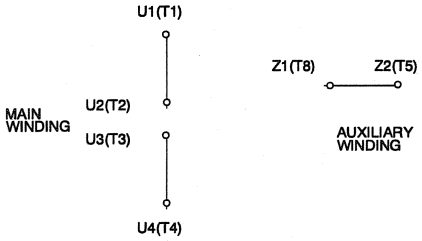
SINGLE VOLTAGE NON REVERSIBLE



SINGLE VOLTAGE REVERSIBLE



DUAL VOLTAGE REVERSIBLE



AC Motor Connection Diagram

THREE PHASE

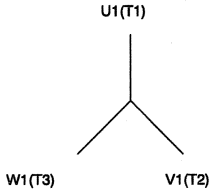
FOR SINGLE WINDING 3 PHASE MOTORS, LEAD MARKINGS CAN BE DIRECTLY TRANSLATED BETWEEN IEC AND NEMA DESIGNATIONS. FOR THESE MOTORS, THE LEAD MARKINGS ARE EQUIVALENT AS FOLLOWS:

U1=T1	U2=T4	U5=T7	U6=T10
V1=T2	V2=T5	V5=T8	V6=T11
W1=T3	W2=T6	W5=T9	W6=T12

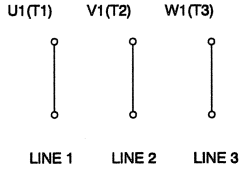
EXAMPLES OF COMMON CONNECTIONS ARE GIVEN BELOW.

THREE LEADS

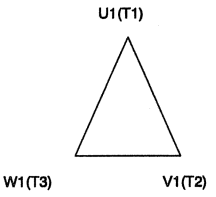
WYE CONNECT



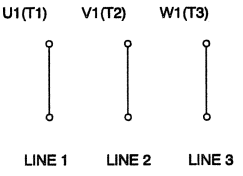
WIRING DIAGRAM



DELTA CONNECT



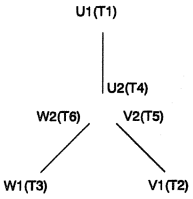
WIRING DIAGRAM



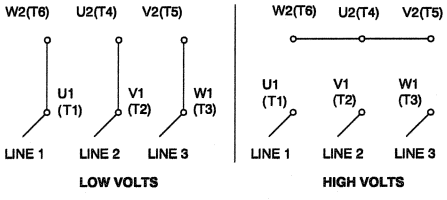
AC Motor Connection Diagram

SIX LEADS

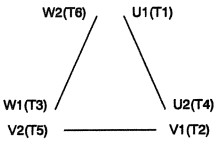
DELTA-WYE CONNECT



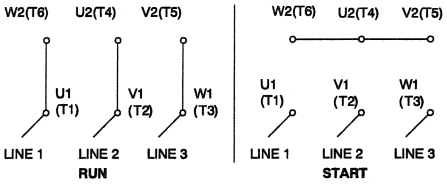
DUAL VOLTAGE-HIGH TO LOW VOLTAGE RATIO 1.73:1



WYE-DELTA CONNECT



WYE START-DELTA RUN SINGLE VOLTAGE

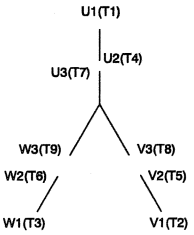


AC Motor Connection Diagram

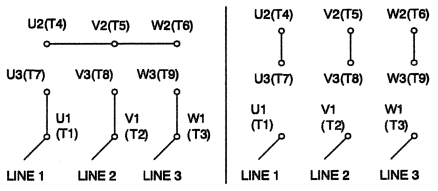
NINE LEADS

DUAL VOLTAGE-HIGH TO LOW VOLTAGE RATIO 2:1

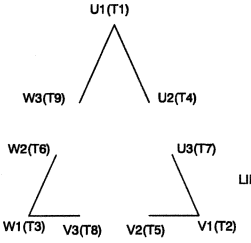
WYE CONNECT



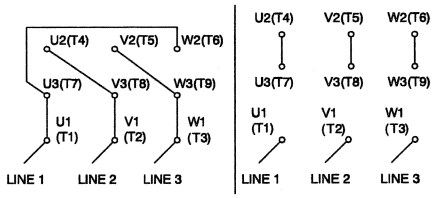
WIRING DIAGRAM



DELTA CONNECT



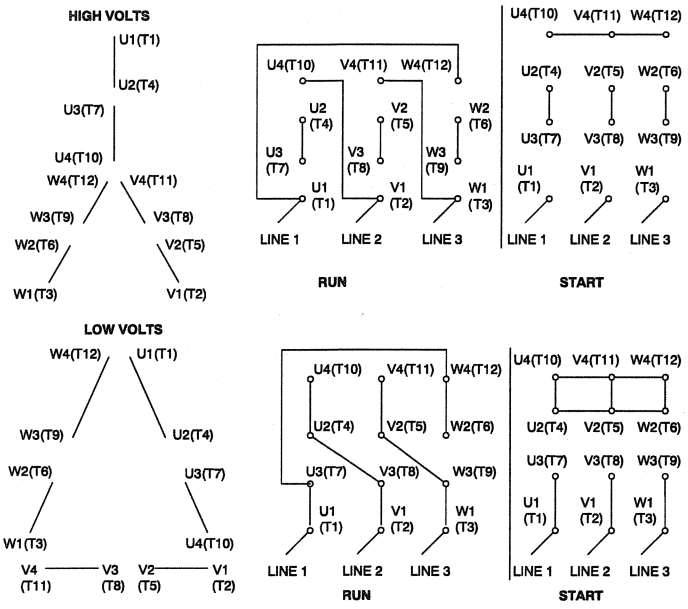
WIRING DIAGRAM



AC Motor Connection Diagram

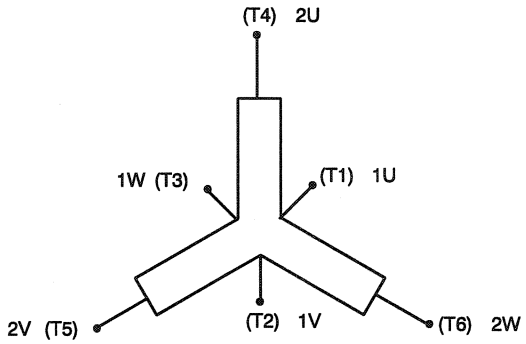
TWELVE LEADS

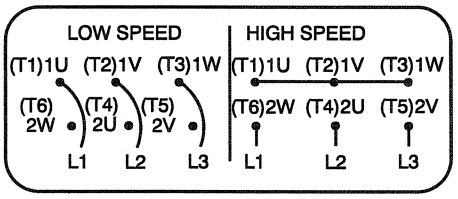
DUAL VOLTAGE WYE START - DELTA - RUN



AC Motor Connection Diagram

SINGLE WINDING MULTI-SPEEDS CONSTANT TORQUE

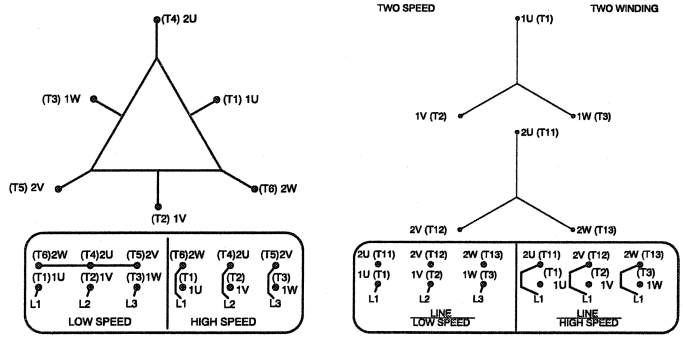




(N.P. 1634-DE)

AC Motor Connection Diagram

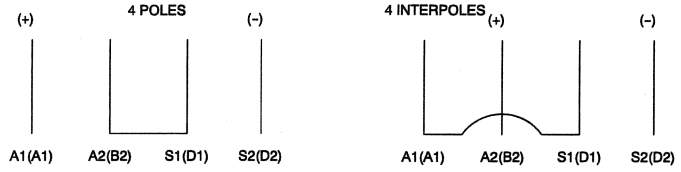
SINGLE WINDING MULTI-SPEEDS CONSTANT HP.



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

DC Motor Connection Diagram

WIRING DIAGRAM TYPE "T" MOTOR



COUNTERCLOCKWISE ROTATION CLOCKWISE ROTATION

ROTATION - FACING COMMUTATOR END

COMPARISON OF IEC AND NEMA LEAD MARKINGS
FOR DIRECT CURRENT MOTORS

A1--A1
A2--B2
S1--D1
S2--D2

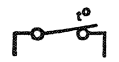
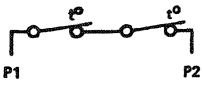
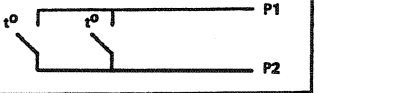
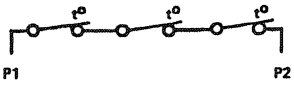
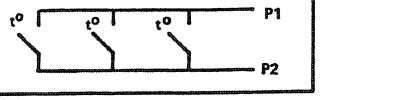
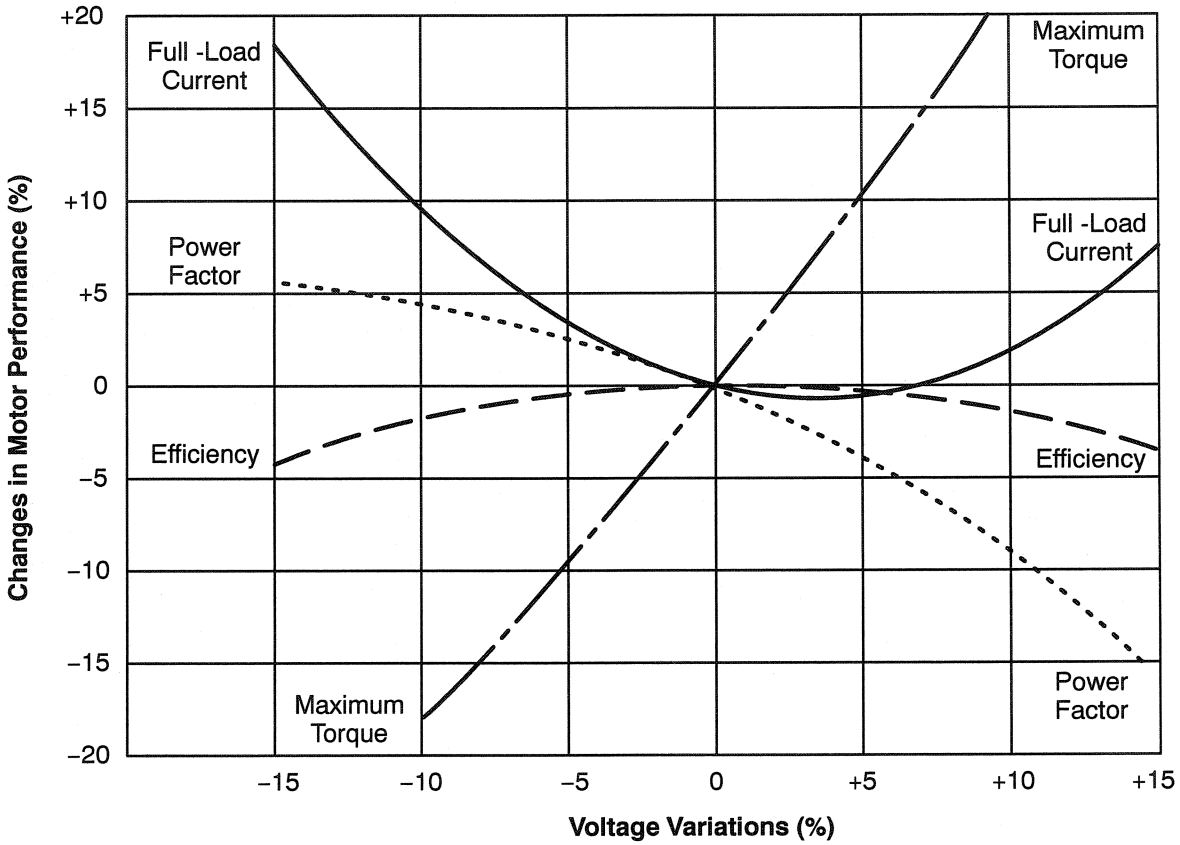
THERMOSTATS	
NORMALLY CLOSED	NORMALLY OPEN
FIGURE 1 	FIGURE 4 
FIGURE 2 	FIGURE 5 
FIGURE 3 	FIGURE 6 

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 though 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. Where intermediate circuitry is involved the circuit shall fall within the scope of a safety, controlling and regulating device as defined in article 1(2) of European Directive 94/9/EC, and shall be covered by an appropriate EC Type Examination Certificate.

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. Openings in connection boxes must be closed with suitably certified and dimensioned device.

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 flamepath, 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 (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 (315–355)	6328	4.70 (130)	9.2	30.0
5000 to 5800 (315–355)	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 in^3 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 $^3/_4$ filled.
	Insufficient grease in bearing.	Add grease until cavity is approximately $^3/_4$ filled.
	Dirt in bearing.	Clean bearing cavity and bearing. Repack with correct grease until cavity is approximately $^3/_4$ 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 are 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 $^3/_4$ 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
- Rykon Premium #2
- Chevron SRI #2
- Mobilith SHC-100
- Pennzoil Pennzlube EM-2
- Chevron Black Pearl
- Darmex 707
- Darmex 711
- 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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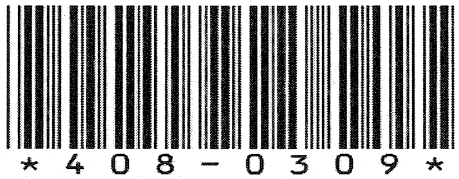

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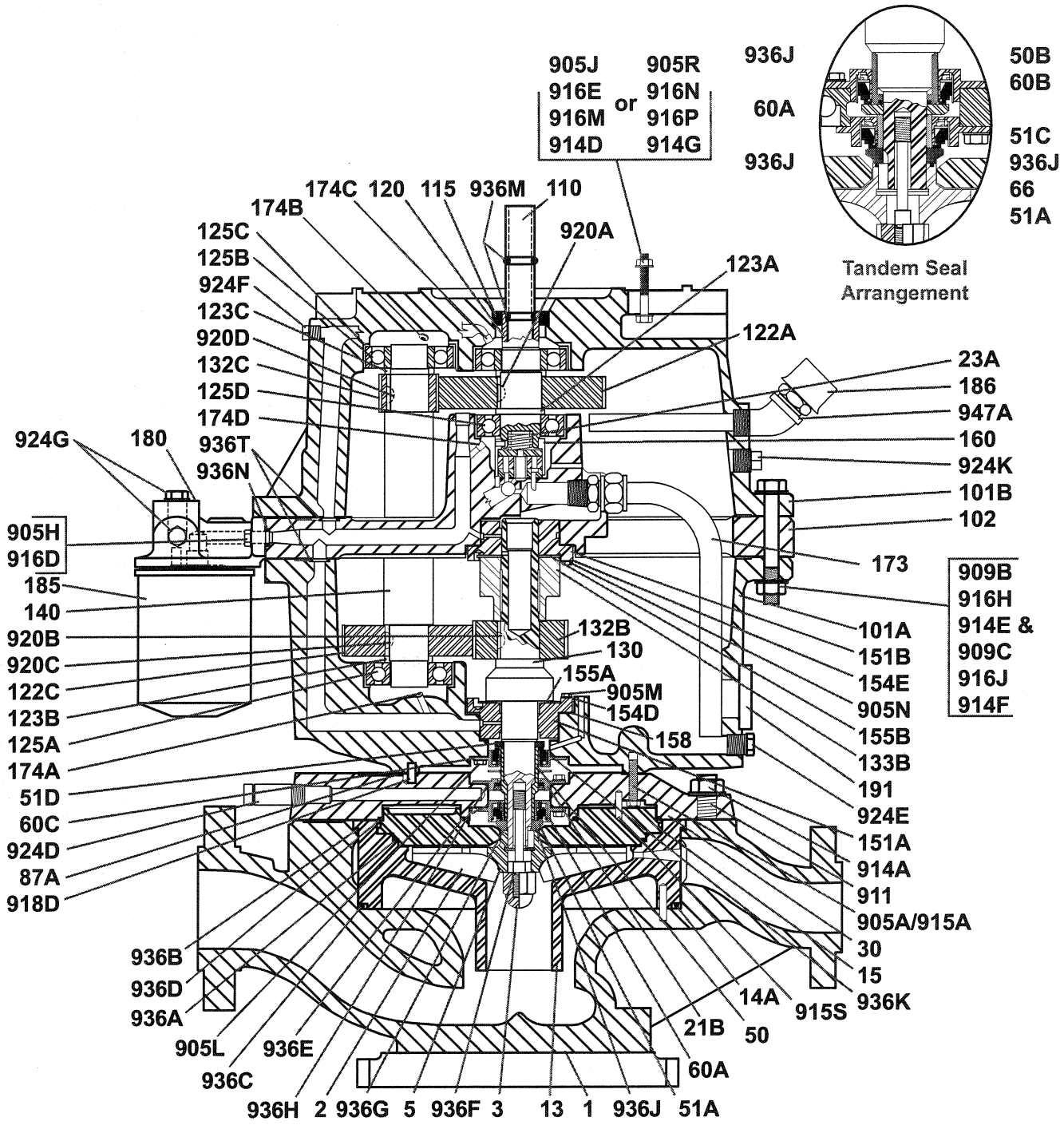
Sundyne LMC-311P

Compressor and Gearbox Cross Section
Seal Arrangement



Note:

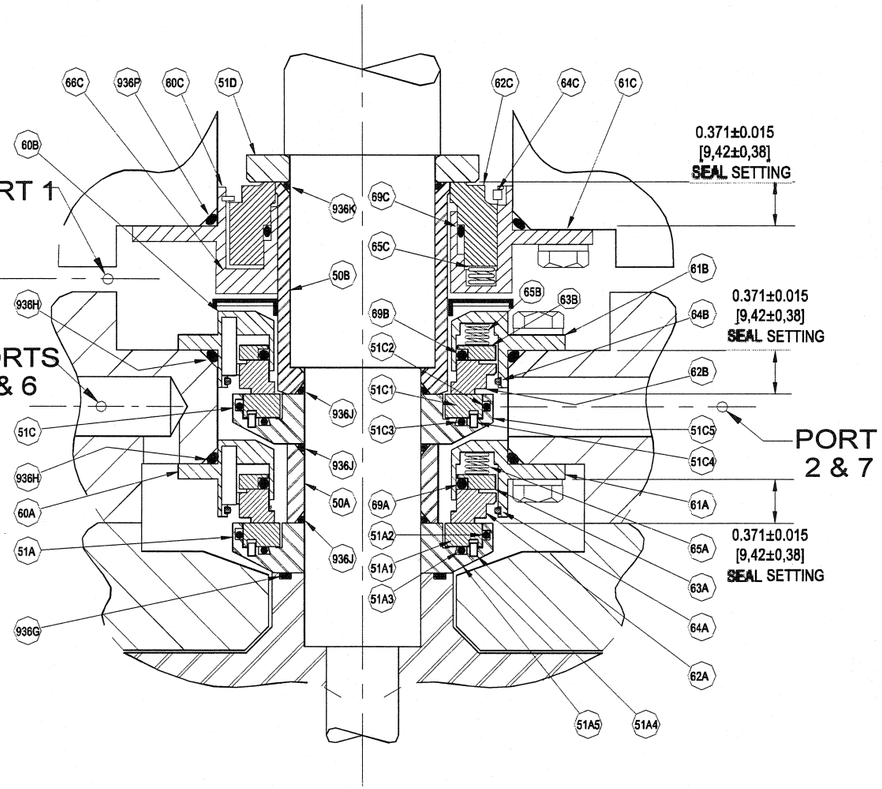
1. Item numbers listed above identify only part location and must be used with parts list for specific compressor.
2. A combination of options may be used in a specific unit. Refer to instruction manual.
3. A solid shaft and flexible coupling is used on some units instead of splined interconnecting shaft.

March 1, 2004

CUSTOMER
UOP Russell
Customer P.O. Number
4500747768
Sundyne Corporation Serial Number
C2754703-01

SEAL ARRANGEMENT DRAWING (SUNY-P007)
Flowserve GSS Tandem Mechanical Dry Gas seals for the LMC-311P
(Natural Split Tandem)

Sundyne COMPRESSORS
14845 West 64th Avenue, Arvada, Colorado, 80007, USA web: www.sundyne.com



PORT LOCATIONS	
Port 1	Open to Atmosphere
Port 2	Plugged
Port 5	Plugged
Port 6	Plugged
Port 7	Plugged

PARTS LIST

Item No.	Description	Material	Qty	Sundyne Part No.
50A	Shaft Sleeve (Lower)	17-4 SST	1	SL01AA12DD
50B	Shaft Sleeve (Upper)	17-4 SST	1	SL01AD02DD
51A	Lower Rotating Face	See Sub-Assembly Chart	1	RJ09AD29DDUC
51C	Upper Rotating Face	See Sub-Assembly Chart	1	RJ09AD29DDUC
60A	Lower Process Seal	See Sub-Assembly Chart	1	SE04AD22RZ1TA1A
60B	Upper Process Seal	See Sub-Assembly Chart	1	SE04AD29RZ1TA1A
51D/60C	Gearbox Seal	See Sub-Assembly Chart	1	SE04AA77UCSDRJ
936G	O-Ring	Fluorocarbon	1	14-054UC
936H	O-Ring	Fluorocarbon	2	14-055UC
936J	O-Ring	Fluorocarbon	3	14-009UC
936K	O-Ring	Fluorocarbon	1	14-053UC
936P	O-Ring	Fluorocarbon	1	14-055UC

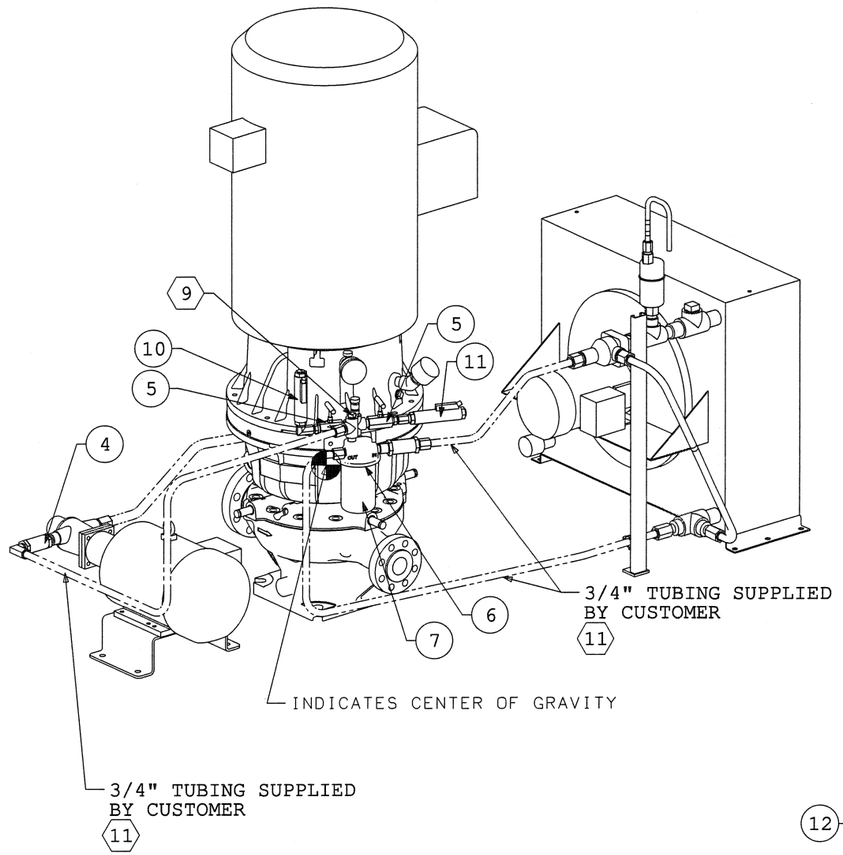
SUB-ASSEMBLY CHART

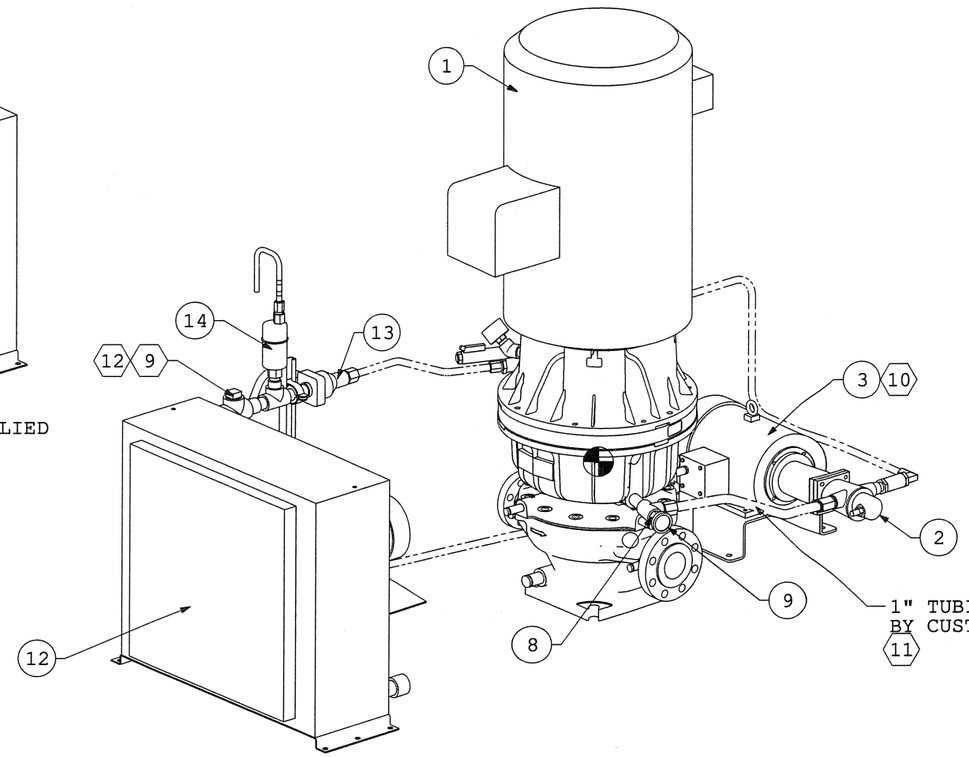
Parent Part	Item No.	Description	Qty	Material
Lower Process Seal Rot. Face 51A	51A-1	Insert	1	Silicon Carbide
	51A-2	O-Ring	1	Fluorocarbon
	51A-3	O-Ring	1	Fluorocarbon
	51A-4	Drive Pin	2	17-4PH SS
	51A-5	Seal Rotating Face Retainer	1	17-4PH SS
Upper Process Seal Rot. Face 51C	51C-1	Insert	1	Silicon Carbide
	51C-2	O-Ring	1	Fluorocarbon
	51C-3	O-Ring	1	Fluorocarbon
	51C-4	Drive Pin	2	17-4PH SS
	51C-5	Seal Rotating Face Retainer	1	17-4PH SS
Lower Process Seal 60A	62A	Seal Face Washer	1	Carbon, Metal Filled (RZ)
	69A	Seal Secondary TEC-Ring	1	PTFE (similar to TEFLON)
	63A	Seal Spring Backup Disc	1	316SS
	65A	Seal Spring	9	Hastelloy C
	64A	Seal Retaining Ring	1	304SS
	61A	Seal Retainer	1	316SS
Upper Process Seal 60B	62B	Seal Face Washer	1	Carbon, Metal Filled (RZ)
	69B	Seal Secondary TEC-Ring	1	PTFE (similar to TEFLON)
	63B	Seal Spring Backup Disc	1	316SS
	65B	Seal Spring	9	Hastelloy C
	64B	Seal Retaining Ring	1	304SS
	61B	Seal Retainer	1	316SS
Gearbox Seal 60C	62C	Seal Face Washer	1	Silicon Carbide
	69C	Seal Secondary O-Ring	1	Fluorocarbon
	66C	Anti-Rotation Pin	1	316SS
	65C	Seal Spring	9	316SS
	64C	Seal Retaining Ring	1	316SS
	61C	Seal Retainer	1	316SS
	51D	Gearbox Rotating Face	1	Tungsten Carbide

Dimensions are in Inches (mm)
All seals are 1-1/2" nominal size and pusher type

DWG NO.	SH	REV
KL14AD92	1	D

NO.	UNLESS OTHERWISE SPECIFIED OR APPLICABLE
1	ALL DIMENSIONS IN INCHES[mm].
2	SEE FLOW SCHEMATIC (SHEET #3)FOR CUSTOMER CONNECTIONS.
3	ACTUAL TUBE ROUTING MAY DIFFER FROM DRAWING AS DETERMINED BY ASSEMBLY TECHNICIAN OR ENGINEER
4	TEST LUBE SYSTEM PER PN 41.25-08
5	SEAL HOUSING PORT #1 IS PROCESS SEAL VENT & GEARBOX SEAL DRAIN. REMOVE SHIPPING PLUG BEFORE START-UP.
6	PORT #1 SHALL BE OPEN TO FLARE SYSTEM OR ATMOSPHERE. BACK PRESSURE NOT TO EXCEED 5 PSIG.
7	UNIT WEIGHTS: CASE 490 LBS / 222 KG GEARBOX 270 LBS / 122 KG MISC. 150 LBS / 68 KG DRIVER 860 LBS / 390 KG TOTAL APPROX. WEIGHT 1770 LBS / 803 KG
8	TOLERANCES: ALL PIPING CONN 1/4" ALL JUNCTION BOX CONDUIT CONN 1/2" ALL OTHER ELECT CONN 1" ALL ANCHOR BOLTS PER API REQUIREMENTS) 1/8" ALL OTHER DIMS 1/2"
9	LUBE PIPING, AND FILTER, MUST BE FULLY PRIMED BEFORE STARTING UNIT
10	LUBE OIL PRIMING PUMP MUST BE RUN FOR PRE-LUBRICATION OF BEARINGS. THE PERMISSIVE START PRESSURE SWITCH SHOULD REMAIN CONTINUOUSLY ACTUATED FOR A MINIMUM OF 30 SECONDS PRIOR TO STARTING MAIN DRIVER.
11	INTERCONNECTING TUBING TO BE PROVIDED & PLUMBED BY CUSTOMER PER SCHEMATIC SHOWN. TOTAL LENGTH OF TUBING & FITTINGS NOT TO EXCEED 20 FT. STAINLESS STEEL TUBE RECOMMENDED. DO NOT USE TEFLON TAPE ON THREADED CONNECTIONS.
12	THE LEVEL AT WHICH THE LUBE OIL IS AT THE HIGHEST POINT IN THE HEAT EXCHANGER MUST BE AT OR BELOW OIL FILTER MANIFOLD ON THE BEARING PLATE.
13	INSTALLCAPS FOR SHIPPING. WIRETIE FERULES AND NUTS TO FITTINGS.
14	FOLLOW FIELD ENGINEERING BULLETIN 40.2.70 FOR HIGHT PRESSURE STARTUP AT OR ABOVE 450 PSIG.
15	USED ISO GRADE 32 SYNTHETIC OIL.





REVISION	DESCRIPTION
'A'	EC87931 NOTED CUSTOMER CONNECTION "C" AS PLUGGED. CORRECTED CUSTOMER CONNECTION "T" FROM 1/2" NPT TO 1" NPT. 12/18/13 KM JB
'B'	EC87958 CORRECTED MOTOR CONECTION FROM 4" TO 3" 21/23/13 KM JB
'C'	EC96650 UPDATED PUMPCASE AND SEAL HOUSING MODELS AND REMOVED UNUSED PORT PLUGS. CHANGED FORCES AND MOMENTS DETAIL FROM LMV-311 TO LMC-311. MADE HEIGHT TO "N" & "M" REFERENCE. CORRECTED AMOUNT OF YTF075X09SEND8 FROM 160. UPDATED BOM LAYOUT TO CURRENT STANDARD. 12/9/16 KM JB
'D'	EC96829 CORRECTED DESCRIPTION OF "D" FROM "PUMP SEAL VENT 1/2"-600# R.F.". CORRECTED SIZE OF "E" FROM 3/4" NPT. 12/28/16 KM JB

XXXXXX COMPLETE BOM IDENTIFIED ON SHT 5

CUSTOMER CONNECTION IDENTIFIED ON SHEET 3

NOTE CALLOUT IDENTIFIED ON SHT 1

MAJOR COMPONENT BOM IDENTIFIED ON SHT 2

CUSTOMER	UOP RUSSELL
SERVICE	REGENERATION GAS
TAG NUMBER	C-141
MODEL	LMC-311P

MATERIAL	DWN: K. MILLER	5/30/13
	PROJ: J. BOENING	5/30/13
	MFG: UNIT ME	5/30/13

Sundyne
14845 WEST 64th AVENUE, ARVADA, COLORADO, 80007, U.S.A. www.sundyne.com

KIT,UOP RUSSELL,60X200MM GAS PLANT REGEN COMP.

SIZE		REV
D	KL14AD92	D

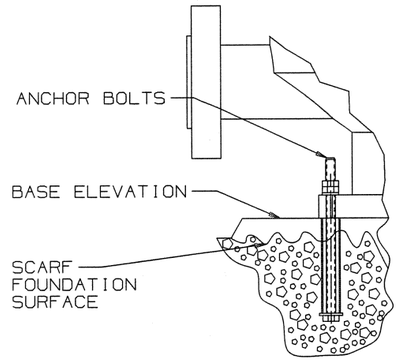
SCALE 1/8	WT:ACTL CALC	SHEET 1 OF 5

MODEL:LMC-311P

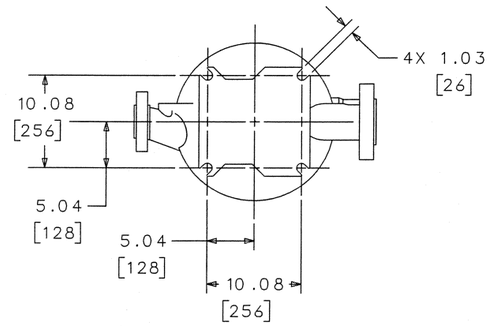
SIMILAR TO -

N/A -

ITEM #	QTY	SUNDYNE PART #	SIZE	MATERIAL	MFG NUM	NOTES:
1	1	MAIN DRIVER 28-861	75 HP	–	BALDOR A36-2576-1545	MAIN DRIVER,BALDOR,75 HP,365HPZ FRAME, 3PH/60HZ/460V,3550 RPM,1.15 S.F.,CL 1, GRP A/B/C/D,DIV 2,T3,TEFC-841XL
2	1	PUMP,LUBE 34-433	7 GPM @ 1200 RPM	CAST IRON CASE	VIKING #GG495M	PUMP,LUBE,7 GPM,1200RPM VIKING #GG495M (WITHOUT MOTOR)
3	1	MOTOR,AUX LUBE 28-711	2 HP	–	BALDOR M7041T	2HP,1.0 SF,1200RPM,3/60/230-460 VAC,CL 1, DIV 1,GRPS C/D,184TC FRAME,XP,C FACE FOOT MOUNTED
4	2	VALVE, CHECK 24-232	–	316 SST	CIRCLE SEAL 259T1-6PP	VALVE,CHECK,3/4"FNPT,CIRCLE SEAL, 316 SST,0.5-1.0 PSI CRACKING PRESSURE
5	2	VALVE, BLOCK & BLEED 24-502	1/2" NPT	316 SST	NOSHOK MODEL #604MFS-HL1	VALVE,BLOCK & BLEED,316/316L SST,HARD METAL SEATS, 10,000 MAWP,(690 BAR)
6	1	MANIFOLD MA01AA86	1/2" NPT	ALUMINUM	SUNDYNE MA01AA86	GEARBOX MANIFOLD FOR USE WITH 22-362 FILTER ELEMENTS
7	1	FILTER, ELEMENT 22-362	3 MICRON	–	SUNDYNE 22-362	FILTER ELEMENT,SINGLE SPIN-ON,3 MICRON, ISO EXTENDED CODE,8 PSID(.55 BAR) INT. RELIEF VALVE,NITRILE (BUNA-N) GASKET
8	1	THERMOWELL 41-147	–	316 SST	CALLIES & ASSOC.	THERMOWELL,1"NPTX1/2"NPT,2-1/2"U, .26I,.500,1"NPT PROCESS 1/2" NPT TO GAUGE
9	1	GAUGE,TEMP. GA02AA03	2-3/8" DIAL	SST	SUNDYNE GA02AA03	TEMP GAUGE, DUAL SCALE 0°-250°F/ -20°-120°C,SST, /2" NPT,2-3/8" DIAL
10	1	SWITCH, PRESSURE PSS 93-011	1/2" NPT	316 SST PROCESS	SOR 6AG-EG2-S1-C2A-TT	PRESSURE SWITCH,DPDT,12 PSI INCR,VITON O-RING & DIAP,5 AMPS @ 125/250VAC,XP HERMETICALLY SEALED,CL 1,GRP B/C/D,CL 2, GRP E/F/G,DIV 1/2,UL &CSA LISTED
11	1	SWITCH, PRESSURE PSLL 93-011	1/2" NPT	316 SST PROCESS	SOR 6AG-EG2-S1-C2A-TT	PRESSURE SWITCH,DPDT,10 PSI DECR,VITON O-RING & DIAP,5 AMPS @ 125/250VAC,XP HERMETICALLY SEALED,CL 1,GRP B/C/D,CL 2, GRP E/F/G,DIV 1/2,UL &CSA LISTED
12	1	HEAT EXCHANGER 38-678	–	–	YOUNG OCH-174	AIR COOLED,2 PASS,STEEL TUBES, 3/60/230-460 VAC,3/4 HP XP MOTOR,1140 RPM, CL 1,DIV 1,GRPS C/D
13	1	VALVE, THERMOSTATIC 71-138	1" NPT	316 SST	AMOT 1CMRT12002	THERMOSTATIC VALVE,1" NPT,SET AT 120°, STANDARD ELEMENT,VITON SEAL,NI PLATED ELEMENT,SST BODY
14	1	VENT, AIR & GAS 25-032	3/4" X 1/2" NPT	SST	ARMSTRONG 11-AV	VENT,AIR & GAS,FLOAT TYPE,ARMSTRONG #11-AV,316 SST,3/4" NPT IN,1/2" NPT OUT, Ø.075 ORIFICE,400 PSI @ 100°F



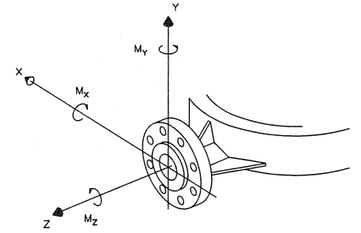
ANCHOR BOLT DETAIL



ANCHOR BOLT DETAIL

COMPRESSOR MODELS LMC/BMC-311,331,341

MAXIMUM ALLOWABLE FORCES AND MOMENTS ON FLANGES OF SUNDYNE UNITS



Units:
Forces = LBf
Moments = FT-LBf

FLANGES	Fx	Fy	Fz	Mx	My	Mz
Suction 3"	335	835	667	1670	835	835
Discharge 2"	335	835	667	1670	835	835

Units:
Forces = Newton
Moments = Newton Meter

FLANGES	Fx	Fy	Fz	Mx	My	Mz
Suction 3"	1490	3714	2967	2264	1132	1132
Discharge 2"	1490	3714	2967	2264	1132	1132

MAIN COMPONENT LIST

CUSTOMER	UOP RUSSELL
SERVICE	REGENERATION GAS
TAG NUMBER	C-141
MODEL	LMC-311P

KIT,UOP RUSSELL,60X200MM GAS PLANT REGEN COMP.

SIZE D | KL14AD92 | REV D

SCALE 1/8 | WT:ACTL CALC | SHEET 2 OF 5

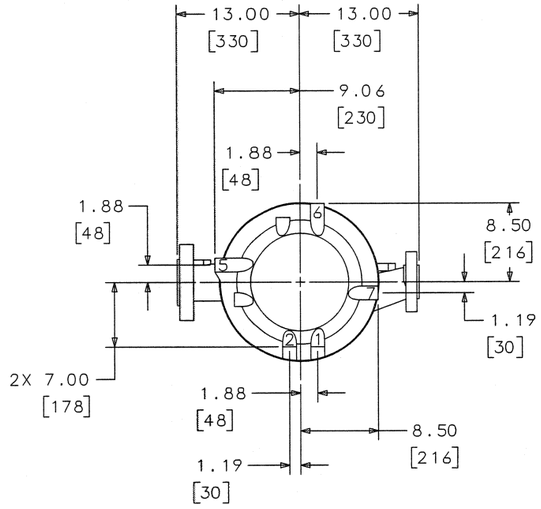
MODEL:LMC-311P

CUSTOMER CONNECTIONS

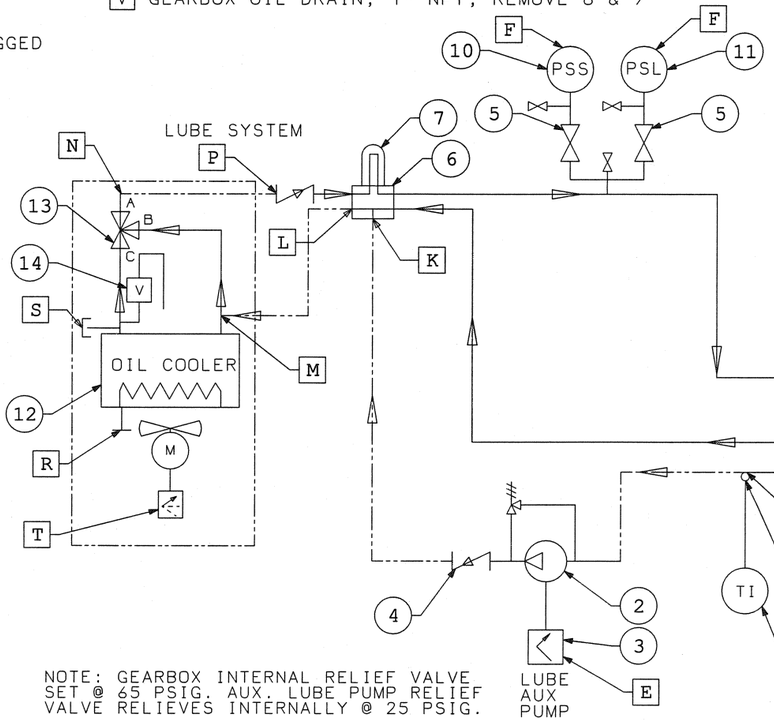
- [A] PROCESS INLET 3"–600# R.F.
- [B] PROCESS OUTLET 2"–600# R.F.
- [C] CASE DRAIN 1" NPT, PLUGGED
- [D] MAIN DRIVE MOTOR, 3" NPT
- [E] AUX. LUBE MOTOR,JBOX 3/4" NPT CONNECTION
- [F] PRESSURE SWITCH, 1/2" NPT CONDUIT
- [G] SUCTION TAP, 1/2" NPT, PLUGGED
- [H] PORT 1 VENT, 1/2" NPT, OPEN TO ATMOSPHERE OR FLARE
- [J] DISCHARGE TAP, 1/2" NPT, PLUGGED
- [K] LUBE FILL ON FILTER MANIFOLD, 1/2" NPT, PLUGGED

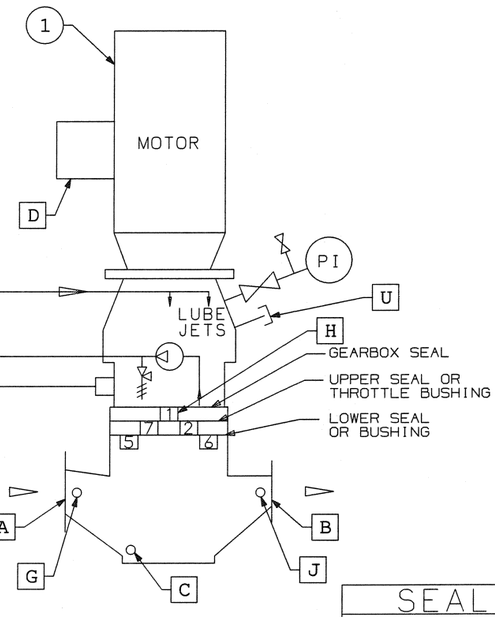
CUSTOMER CONNECTIONS

- [L] FILTER MANIFOLD OUTLET TO HEAT EXCHANGER INLET, 3/4" TUBE
- [M] HEAT EXCHANGER INLET FROM FILTER MANIFOLD, 3/4" TUBE
- [N] HEAT EXCHANGER OUTLET TO FILTER, 3/4" TUBE
- [P] FILTER INLET FROM HEAT EXCHANGER, 3/4" TUBE
- [R] HEAT EXCHANGER DRAIN, 1–1/4" NPT, CAPPED
- [S] LUBE FILL ON HEAT EXCHANGER, 1–1/4" NPT, PLUGGED
- [T] HEAT EXCHANGER MOTOR, 1" NPT CONDUIT
- [U] GEARBOX OIL FILL, 3/4" NPT
- [V] GEARBOX OIL DRAIN, 1" NPT, REMOVE 8 & 9



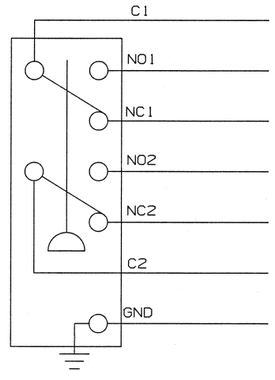
TOP VIEW





PSS, PERMISSIVE START PRESSURE SWITCH SET AT 12 PSI INCR. ITEM 10

PSLL, LOW LUBE PRESS. SHUTDOWN PRESSURE SWITCH SET AT 10 PSI DECR. ITEM 11



DPDT SWITCH SCHEMATIC

NOTE: GEARBOX INTERNAL RELIEF VALVE SET @ 65 PSIG. AUX. LUBE PUMP RELIEF VALVE RELIEVES INTERNALLY @ 25 PSIG.

SEAL PORT DATA	
PORT 1	SEAL DRAIN, 1/2" NPT
PORT 2	PLUGGED, 1/2" NPT
PORT 5	PLUGGED, 1/2" NPT
PORT 6	PLUGGED, 1/2" NPT
PORT 7	PLUGGED, 1/2" NPT

COMPONENT AND FLOW SCHEMATIC

CUSTOMER	UOP RUSSELL
SERVICE	REGENERATION GAS
TAG NUMBER	C–141
MODEL	LMC–311P

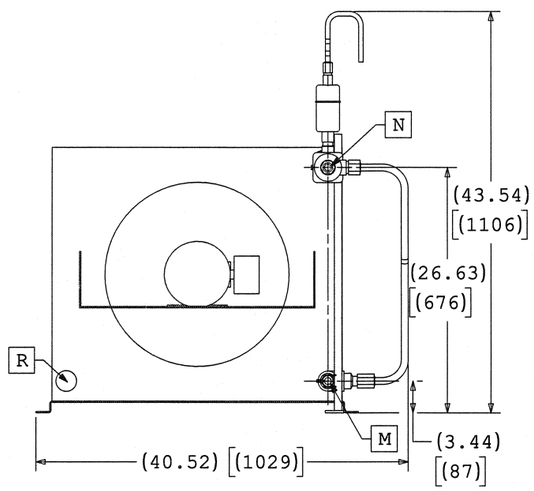
FLOW & COMPONENT SCHEMATIC

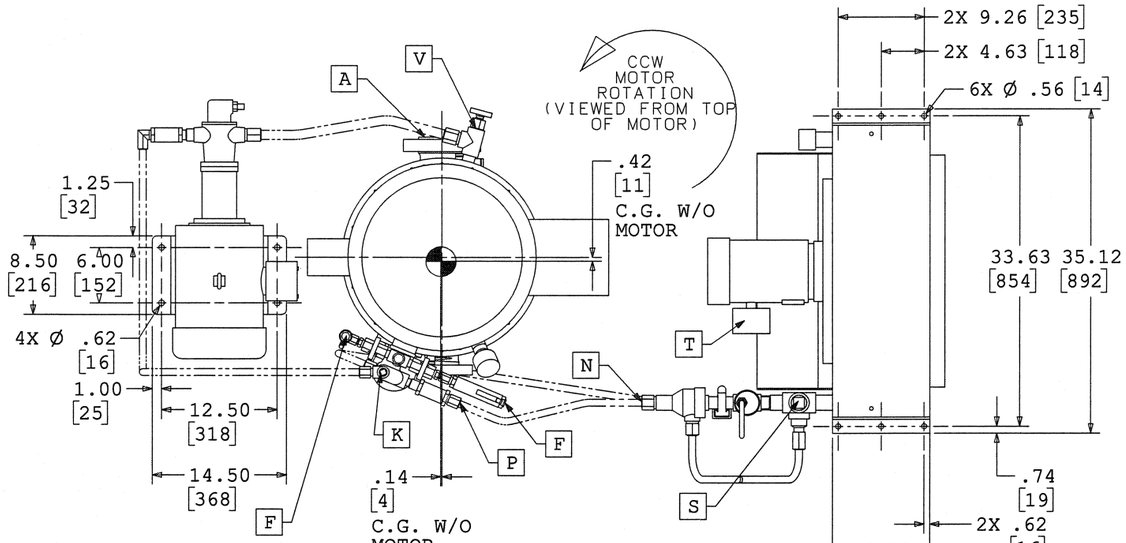
KIT,UOP RUSSELL,60X200MM GAS PLANT REGEN COMP.

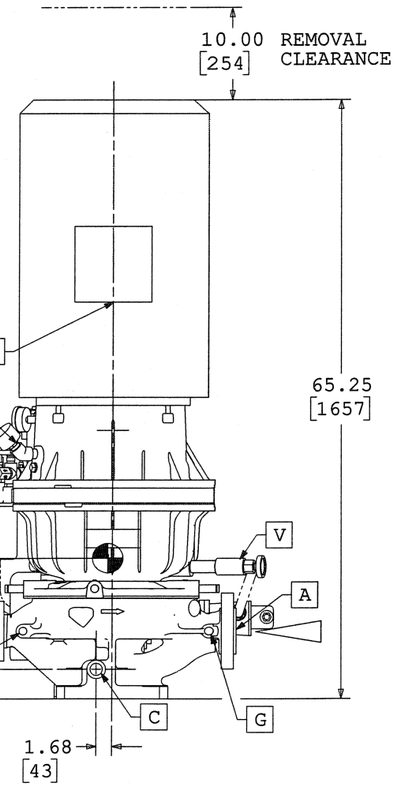
SIZE D | KL14AD92 | REV D

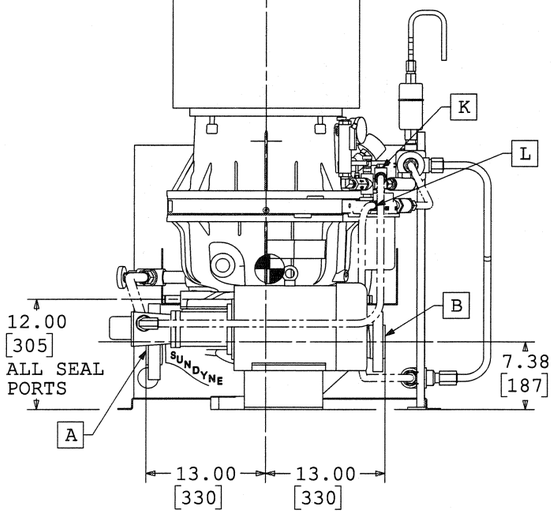
SCALE 1/8 | WT:ACTL | CALC | SHEET 3 OF 5

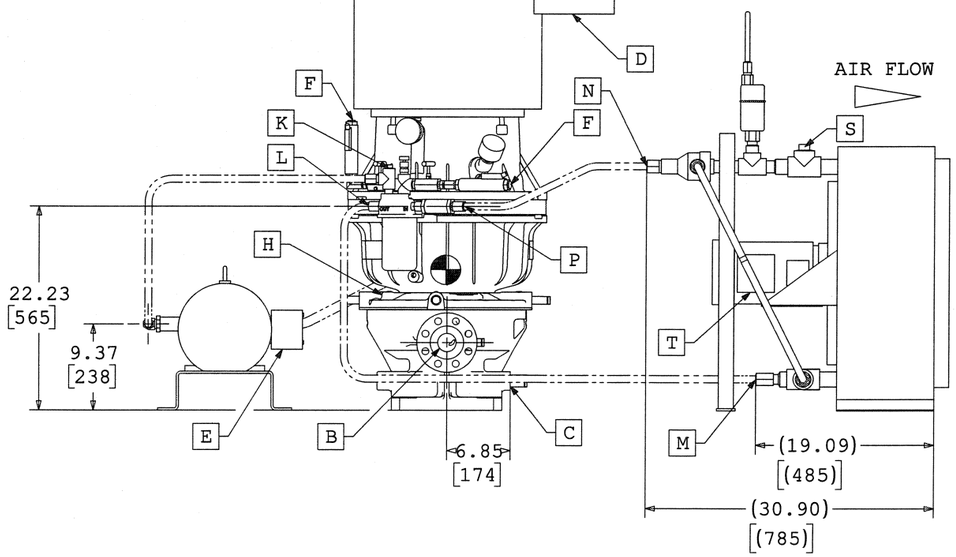
MODEL:LMC-311P











CUSTOMER	UOP RUSSELL
SERVICE	REGENERATION GAS
TAG NUMBER	C-141
MODEL	LMC-311P

KIT,UOP RUSSELL,60X200MM
GAS PLANT REGEN COMP.

SIZE D | KL14AD92 | REV D

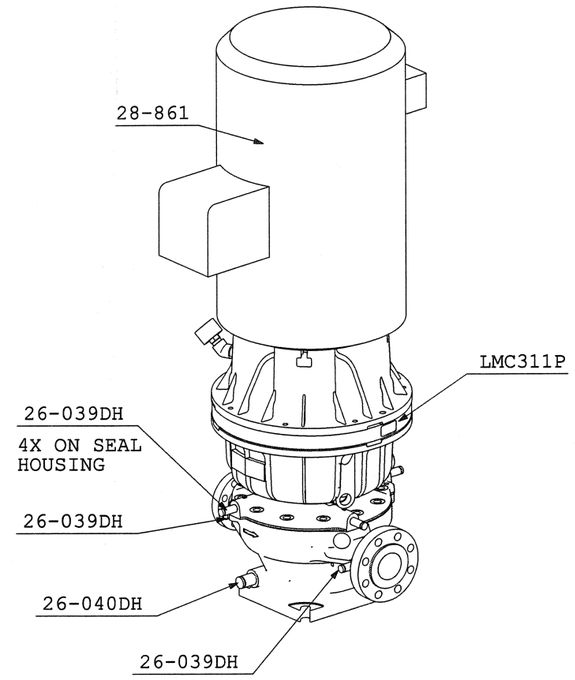
SCALE 1/8 | WT:ACTL CALC | SHEET 4 OF 5

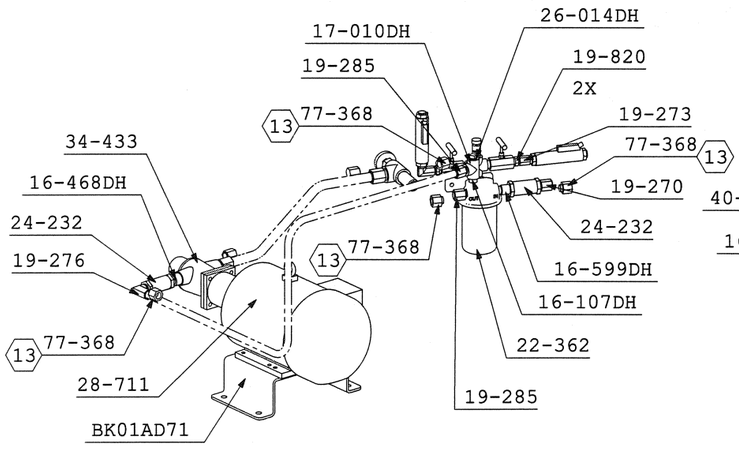
MODEL:LMC-311P

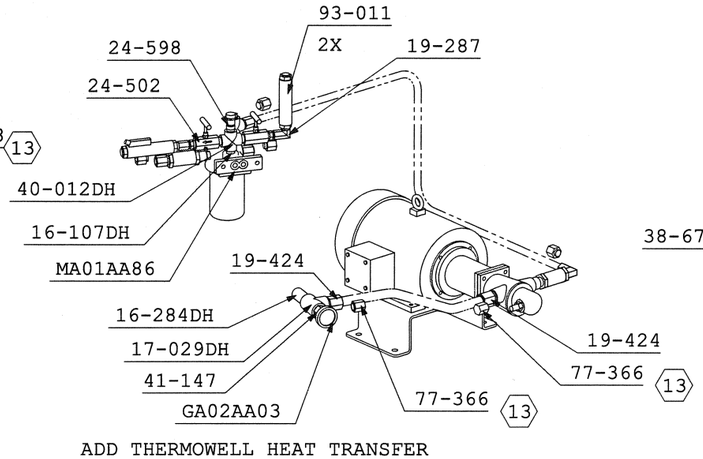
SIMILAR TO -

N/A -

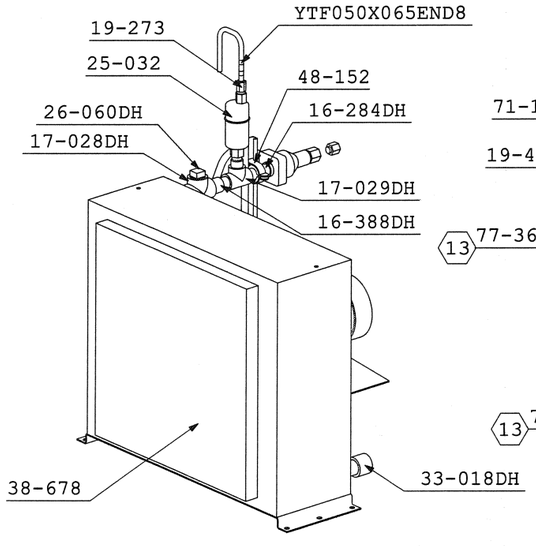
37	IN	YTF075X095END8	20	01/01/1990	TUBING,3/4",.095 WALL,SST
15	IN	YTF050X065END8	20	01/01/1990	TUBING,1/2",.065 WALL,316L NACE
1	EA	MA01AA86	20	01/01/1990	MANIFOLD,200 HP GBOX,FILTER,USE W/HEAT EXCH & PRESS PORT
1	REF	LMC311P	20	01/01/1990	LMC311P
1	EA	GA02AA03	20	01/01/1990	GAUGE,TEMP,2-3/4" DIAL,0-250F/-20-120C,1/2" BACK CONN,REOTEMP
1	EA	BK01AD71	20	01/01/1990	BRACKET, AUX LUBE PUMP
2	EA	93-011	20	01/01/1990	SWITCH,PRESS,SOR,7-30PSI
6	EA	77-368	20	01/01/1990	PLUG,SWAGELOK,3/4"T,SST
2	EA	77-366	20	01/01/1990	PLUG,SWAGELOK,1" TUBE FITTING
1	EA	71-138	20	01/01/1990	VALVE,THERMOSTATIC,AMOT,1"NPT
1	EA	59-038	20	01/01/1990	STRUT,SOLID,13/16,SST,12",W/ FOOT
1	EA	48-152	20	01/01/1990	CLAMP,1" PIPE,SST W/ WELD STUD
1	EA	48-147	20	01/01/1990	CLAMP,3/4" TUBE,316 SST
1	EA	41-147	20	01/01/1990	TWELL,1"NPTX1/2" NPT,2.5U,0.26ID,0.50D
1	EA	40-012DH	20	01/01/1990	CROSS,STD,1/2"NPT,2000#
1	EA	38-678	20	01/01/1990	HEAT X,AIR,YOUNG,OCH-174 W/ MTR
1	EA	34-433	20	01/01/1990	PUMP,10gpm@1800rpm/7gpm@1200rpm
1	EA	33-018DH	20	01/01/1990	PIPE,CAP,1-1/4"NPT,3000#
1	REF	28-861	20	01/01/1990	BALDOR 365HPZ MOTOR
1	EA	28-711	20	01/01/1990	MOTOR,2HP, 3/60/230-460 VAC, 1200 RPM
1	EA	26-060DH	20	01/01/1990	PLUG,PIPE,SQH,1-1/4" NPT
1	REF	26-040DH	20	01/01/1990	PLUG,BULL,1" NPT X 2.5" LG
6	REF	26-039DH	20	01/01/1990	PLUG,BULL,1/2" NPT X 2.5" LG
1	EA	26-014DH	20	01/01/1990	PLUG,PIPE,SQH,1/2" NPT
1	EA	25-032	20	01/01/1990	VENT,AIR & GAS, ARMSTRONG #11-AV
1	EA	24-598	20	01/01/1990	VALVE,BLEED,1/2" NPT,316SST
2	EA	24-502	20	01/01/1990	VALVE,BLOCK&BLEED,1/2"NPT(M-F)
2	EA	24-232	20	01/01/1990	VALVE,CHECK,3/4"NPT,SST,DOMESTIC
2	EA	22-362	20	01/01/1990	FILTER,ELEMENT,SINGLE,SUNDGARD,STANDARD GBOX
2	EA	19-820	20	01/01/1990	ADPT,M,1/2"Tx1/2"NPT
2	EA	19-464	20	01/01/1990	CONN,M,3/4"Tx1"NPT,SST
2	EA	19-452	20	01/01/1990	CONN,F,3/4"Tx3/4"NPT,SST
2	EA	19-424	20	01/01/1990	CONN,M,1"Tx1"NPT,SST
1	EA	19-287	20	01/01/1990	ELBOW,M,1/2"Tx1/2"NPT,SST
2	EA	19-285	20	01/01/1990	CONN,M,3/4"Tx1/2"NPT,SST
1	EA	19-276	20	01/01/1990	ELBOW,M,3/4"Tx3/4"NPT,SST
2	EA	19-273	20	01/01/1990	CONN,M,1/2"Tx1/2"NPT,SST
1	EA	19-270	20	01/01/1990	CONN,M,3/4"Tx3/4"NPT,SST
2	EA	17-029DH	20	01/01/1990	TEE,STD,1"NPT,2000#
2	EA	17-028DH	20	01/01/1990	TEE,STD,1-1/4"NPT,2000#
1	EA	17-010DH	20	01/01/1990	TEE,STD,1/2"NPT,2000#
1	EA	16-599DH	20	01/01/1990	NIPPLE,SWG 3/4"NPTx1/2"NPTx2.5"LG,SCH 80
2	EA	16-538DH	20	01/01/1990	NIPPLE,SWG 1-1/4"NPTx3/4"NPTx3"LG,SCH 80
2	EA	16-468DH	20	01/01/1990	NIPPLE,SWG 1"NPTx3/4"NPTx2.5"LG,SCH 80
1	EA	16-388DH	20	01/01/1990	NIPPLE,SWG 1-1/4"NPTx1"NPTx4"LG,SCH 80
2	EA	16-284DH	20	01/01/1990	NIPPLE,PIPE 1"NPTx1"NPTx4"LG,SCH 80
2	EA	16-107DH	20	01/01/1990	NIPPLE,PIPE 1/2"NPTx1/2"NPTx1.5"LG,SCH 80
KL14AD92_RC	QTY	UM	PART NUM	20	01/01/1990 DESCRIPTION

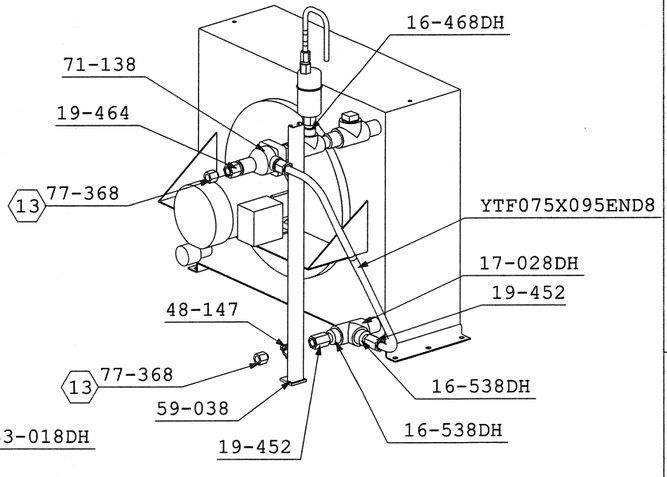






ADD THERMOWELL HEAT TRANSFER PASTE TO TEMP GAUGE PROBE BEFORE INSTALLING





CUSTOMER	UOP RUSSELL
SERVICE	REGENERATION GAS
TAG NUMBER	C-141
MODEL	LMC-311P

KIT,UOP RUSSELL,60X200MM GAS PLANT REGEN COMP.

SIZE D | KL14AD92 | REV D

SCALE 1/8 | WT:ACTL CALC | SHEET 5 OF 5

SIMILAR TO -

N/A -

MODEL:LMC-311P