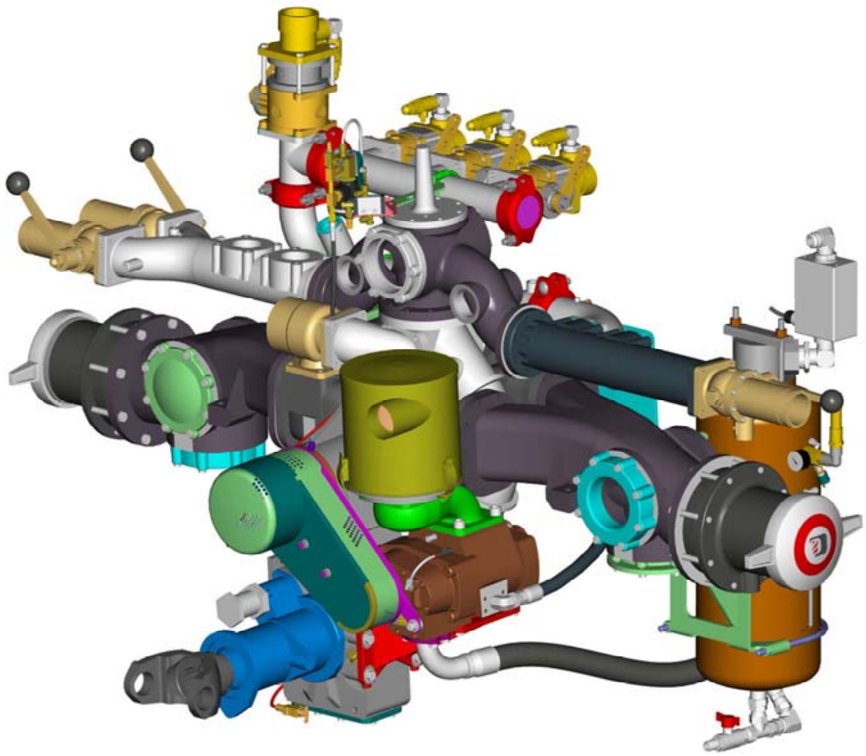
DARLEY AutoCAFS II
Compressed Air Foam System

OPERATION INSTRUCTIONS
LDMBC
AUTOCAFS COMMANDER CONTROL SYSTEM



Darley
WWW.DARLEY.COM

Corporate Office:

325 Spring Lake Drive
Itasca, Illinois 60143-2072
800-323-0244, Fax (708) 345-8993

CAFS Applications:

920 Kurth Rd.
Chippewa Falls, WI. 54729
800-527-0068, Fax (715) 726-2648

Pump Manufacturing:

1051 Palmer St.
Chippewa Falls, WI. 54729
800-634-7812, Fax (715) 726-2656

This manual is for DARLEY FIRE PUMP:
Model: **_LDMBC_** Pump Serial Number: ________

P/N 1200602
Date: 8/13/15

TABLE OF CONTENTS

INTRODUCTION

This manual provides information for the correct operation, use and maintenance of the Darley LDMBC AutoCAFS II compressed air foam system including the new AutoCAFS Commander Control. Please read and understand these instructions thoroughly before putting the system in service. Doing so will ensure optimal performance and long life of your compressed air foam system (CAFS) equipped apparatus.

The manual is divided into four sections plus an appendix. Each section details the operation, use and maintenance of the individual CAFS components that comprise the LDMBC compressed air foam system. The appendix includes supplementary information.

This is the safety alert symbol. It is used to alert you to potential physical injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

The words DANGER, WARNING, CAUTION, and NOTICE are used throughout this manual to highlight important information.

⚠ DANGER
Indicates a hazardous situation that, if not avoided, *will* result in death or serious injury.

⚠ WARNING
Indicates a hazardous situation that, if not avoided, *could* result in death or serious injury.

⚠ CAUTION
Indicates a hazardous situation that, if not avoided, *could* result in minor or moderate injury.

NOTICE
Indicates a situation that can cause damage to the engine, personal property, and/or the environment, or cause the equipment to operate improperly.

NOTE: *Indicates a procedure, practice, or condition that should be followed in order for the pump to function in the manner intended.*

General Safety Messages

⚠ WARNING

Sudden Movement Hazard: Always have the hose nozzle operators brace themselves when using compressed air foam system (CAFS) as if they were opening a nozzle on a high-pressure water line. The initial reaction force of opening the hose nozzle is much greater than the normal operating force. The force on the operator will drop off quickly, becoming much easier to handle than a typical water line. Be sure to:

1. Open and close the valves slowly.
2. Do not run with just air/water.
3. Shut off the air when the foam tank is empty.
4. Be prepared for high reactions; open the nozzle slowly.

Observe the following:

- Do not exceed system rated pressure, capacity, or speed.
- Follow local regulations on the use of hearing protection.
- Use only hoses with a pressure rating higher than the intended use.
- Remove all pressure from the hoses before disconnecting.
- Shut down and depressurize completely before attempting maintenance.

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⚠ WARNING

High-Pressure Hazard: Avoid skin contact with high-pressure air. High-pressure air can penetrate your skin and result in serious injury.

⚠ WARNING

Burn Hazard: Wait until the air compressor oil and components cool before touching them. The air compressor oil and components are very hot during operation. Do not touch during or immediately after use.

NOTICE

Avoid immediate restart of the air compressor after shutdown. Allow 1 minute minimum time period between air compressor shutdown and restart for system blow-down.

If maximum air compressor speed is exceeded, the air compressor is automatically disengaged. The air compressor will automatically re-engage if the engine speed is reduced to 900 rpm or lower and system blow-down is completed.

Do not over-speed the air compressor. Input RPM should not exceed that required to produce a rated air flow of 220 cfm at 150 psi maximum pressure.

Disengage the air compressor when service testing or performing UL test on the CAFS-equipped vehicle.

Description of Pump Type

The Type LDMBC pump is a high-speed, single-stage, UL-rated, centrifugal Fire Fighting Pump with an integral belt-driven rotary screw air compressor for compressed air foam generation.

The LDMBC is inherently compact, lightweight, and highly efficient, and it offers a wide range of pumping capabilities.

The LDMBC pump is midship mounted and powered via the chassis engine/transmission.

Operation and Maintenance of Type LDMBC Fire Pump

OPERATION OF PUMP

The pump gearshift consists of a sliding clutch gear splined to the transmission shaft. The sliding clutch gear can be moved forward to engage the pump clutch gear (PUMP position) or to the rear engaging the rear drive shaft (ROAD position). A neutral position is half-way between.

The sliding clutch gear is moved either by direct mechanical linkage from a shift lever or an air-powered cylinder controlled by a selector switch. The shift lever must be moved all the way and locked into either ROAD position to drive the truck, or PUMP position to power the pump.

The truck clutch must always be disengaged to stop the rotation of the truck transmission output shaft before shifting into either ROAD or PUMP gear to prevent clashing and damaging the gear teeth. With the manual shift lever, a butt tooth position of gears may be encountered, occasionally preventing engagement. If this occurs, move pump shift lever to neutral (half-way) position, engage truck clutch momentarily, and then disengage the truck clutch and try to shift the pump again.

The pump is always operated with the truck transmission in direct (high) gear, such as fourth on a 4-speed, or fifth on a 5-speed manual transmission, and D or 2.5 on an automatic transmission.

Review the following instruction sheet *"PUMP SHIFTING PROCEDURE"* for step-by-step shifting instructions.

NOTICE

Only run the pump dry momentarily and at low speeds.

Do not use this pump for hose testing.

Do not over-speed the air compressor. Input RPM should not exceed that required to produce a rated air flow of 220 cfm at 150 psi maximum pressure.

Disengage the air compressor when service testing or performing UL test on the CAFS-equipped vehicle.

PUMP GEAR CASE LUBRICATION

Maintain gear case oil level to a point between the two grooves on the oil level dipstick. When checking oil level, dipstick must be screwed all the way in for accurate readings.

Check the oil level every 25 hours or every three months. Change the oil every 50 hours or 6 months.

Service the pump transmission with SAE 80W/90, GL4/GL5 gear lubricant. Do not use grease.

NOTICE

Do not overfill the pump transmission. Overfilling may cause excessive gear case operating temperatures.

Darley

Darley
Pump Division
1051 Palmer St.
Chippewa Falls, WI 54729
715-726-2650

Technical Bulletin on Midship Mounted Fire Pump Drivelines

1202519

FEB, 25 2016

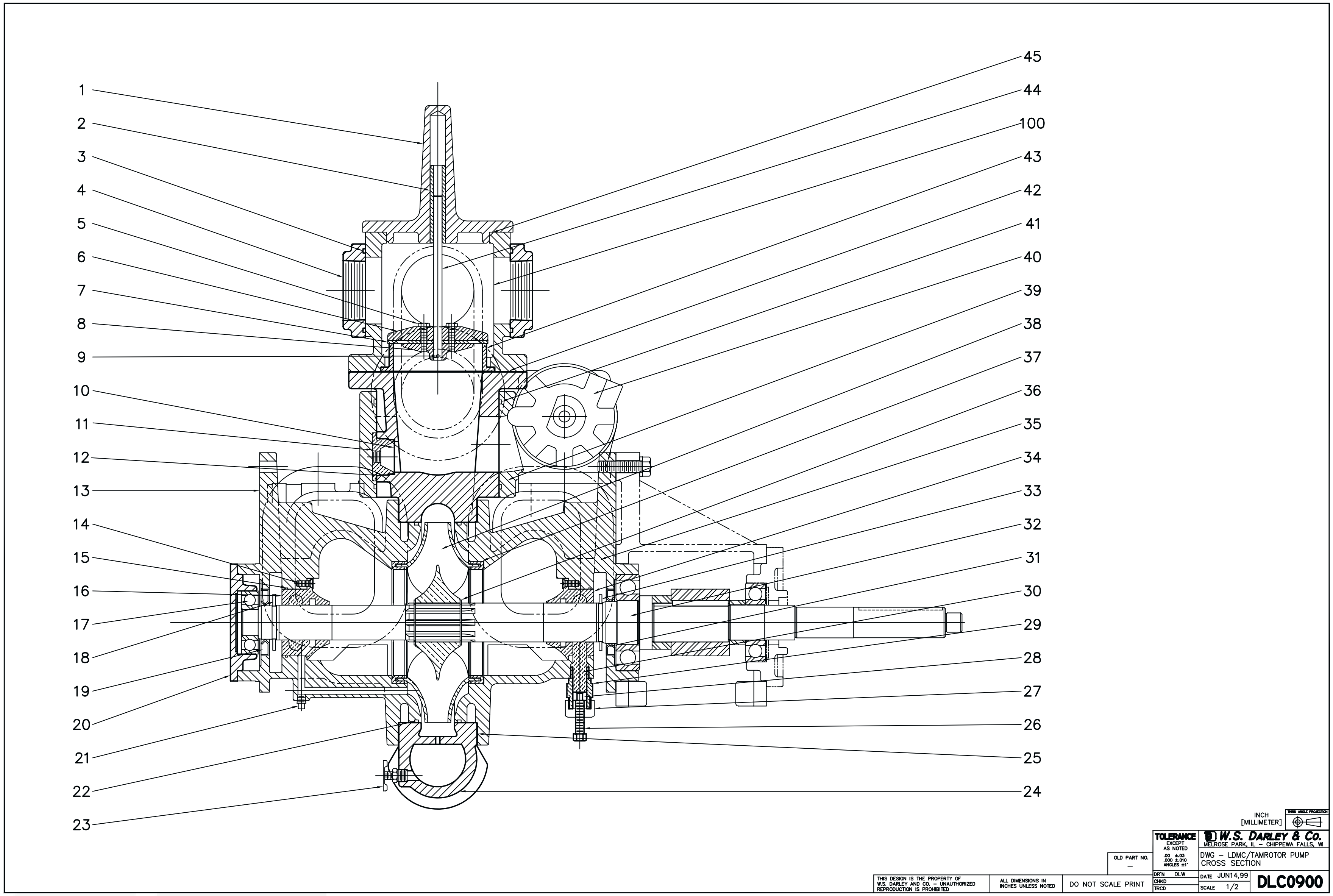
The driveline torque rating is 19,230 lb-ft (26,072 Nm) – exceeding this torque rating can result in a driveline failure.

Great care must be taken in the layout of pump drivelines. Interference and driveline vibration must be considered. An experienced installer with knowledge of driveline considerations, proper layout and recommended guidelines should be utilized as well as proper CAD systems for driveline layouts. Installation of the driveline should not occur until a proper analysis is performed by either a qualified driveline specialist or W.S. Darley. W.S. Darley utilizes, can distribute and can train qualified individuals to use the Allison Multiple Joint Driveline Analysis program.

W.S. Darley requires that midship driven pumps have at most 500 radians per second^2 torsional vibration, at most 1000 radians per second^2 inertial drive torsional vibration and at most 1000 radians per second^2 inertial coast torsional vibration, as calculated by the Allison Multiple Joint Driveline Analysis program, for a completed driveline installation. A completed driveline installation includes the entire multi-driveshaft assembly from the power source on apparatus transmission output flange to the input flange of the rear axle.

Failure to design and analyze a proper driveline layout could result in severe injury and damage to equipment, including but not limited to: the water pump, the water pump transmission, drive tubes, hanger bearings, u-joint crosses, gears, the rear differential, and the main truck transmission.

Questions can also be directed to our Customer Service Department at
800-634-7812 or 715-726-2650.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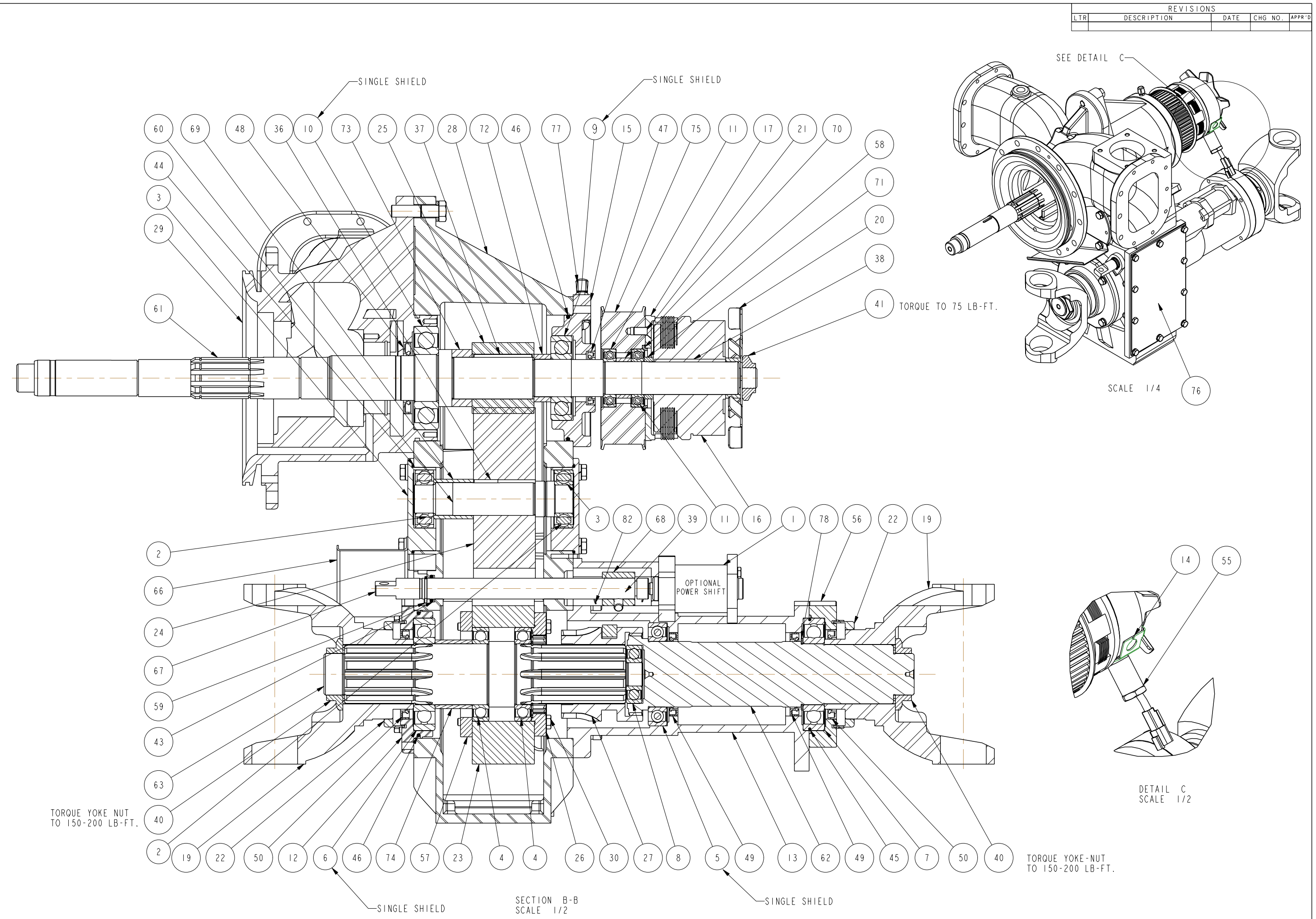
INCH
[MILLIMETER]
THIRD ANGLE PROJECTION
TOLERANCE
EXCEPT
AS NOTED
.00 ±.03
.000 ±.010
ANGLES ±1°
W.S. DARLEY & Co.
MELROSE PARK, IL – CHIPPEWA FALLS, WI
OLD PART NO.
–
DWG – LDMC/TAMROTOR PUMP
CROSS SECTION
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. – UNAUTHORIZED REPRODUCTION IS PROHIBITED
ALL DIMENSIONS IN INCHES UNLESS NOTED
DO NOT SCALE PRINT
DR'N DLW
CHKD
TRCD
DATE JUN14,99
SCALE 1/2
DLC0900

Rep No.	Description
1	Cover, Discharge Head, LDM
2	Bushing, Check Valve
3	O-Ring
4	Flange
5	Hex Head Capscrew
6	Plate, Check Valve, LDM
7	Seal, Check Valve, LDM
8	Diffuser, Check Valve
9	Pin, Drive Lok
10	Screen, Strainer
11	Strainer, Fitting
12	O-Ring
13	Outboard Head
14	Flathead Capscrew
15	O-Ring
16	Stuffing Box, LDM, Outboard
17	Ball Bearing
18	Slinger, Water, LDM
19	Oil Seal
20	Bearing Cap
21	Plug, Pipe
22	O-Ring
23	Draincock

Rep No.	Description
24	Pump Casing
25	Gasket
26	Component of Packing Nut Assembly
27	Component of Packing Nut Assembly
28	Component of Packing Nut Assembly
29	Packing Cylinder
30	Packing, Pellet
31	Oil Seal
32	Impeller Shaft
33	Slinger, Water
34	Stuffing Box, LDM/EM, Inboard
35	Suction Head, LDM
36	Retainer Ring
37	Seal Ring, LDM
38	Impeller, LDM, Mixed Flow
39	Relief Valve Elbow
40	Relief Valve
41	O-Ring
42	Gasket, Discharge Head, LDM
43	Seat, Check Valve, LDM
44	Stem, Check Valve, LDM
45	O-Ring
100	Discharge Head, LDM

NO.	DESCRIPTION	PART NO.	QTY.
1	AIR CYLINDER - 1.75 BORE	-	1
2	BEARING - 22206 PC-3	-	2
3	BEARING CAP, IDLER	-	2
4	BEARING-BALL, 113KSFF	-	2
5	BEARING-BALL, 114KSFCO	-	1
6	BEARING-BALL, 213SF	-	1
7	BEARING-BALL, 213SFF	-	1
8	BEARING-BALL, 305SFF	-	1
9	BEARING-BALL, 308SF	-	1
10	BEARING-BALL, 310SF	-	1
11	BEARING-BALL, 6007.2RSR	-	2
12	BRACKET - BEARING, FRONT, N	-	1
13	BRACKET - BEARING, REAR NO BRK	-	1
14	BRACKET - THERMOSTAT	-	1
15	CAP - BEARING, LDMC ENDURO12	-	1
16	CLUTCH - 12 VDC W/HARNESS	-	1
17	CUP - DRIVE, ELECTRIC CLUTCH	-	1
18	DIPSTICK - M22x2.5 THR'D	-	1
19	END YOKE	-	2
20	FAN - LDMBC ELECTRIC CLUTCH	-	1
21	FHSCS - .313-18 X 0.75, GR8	-	3
22	FLINGER - WATER	-	2
23	GEAR - DRIVE	-	1
24	GEAR - IDLER	-	1
25	GEAR - PINION	-	1
26	GEAR - PUMP CLUTCH	-	1
27	GEAR - SLIDING CLUTCH, N	-	1
28	GEARCASE - LDMH/LDMC, PUMP FWD	-	1
29	HEAD - SUCTION, LDM, MECH SEAL	-	1
30	HHCS - .313-18 X 3.75, GRF911	-	6
31	HHCS - .375-16 x 0.88, GR5	-	8
32	HHCS - .375-16 x 1.25, GR5	-	4
33	HHCS - .375-16 x 1.75, GR5	-	4
34	HHCS - .500-13 x 1.75, GR5	-	2
35	HHCS - .500-13 x 2.00, GR5	-	1
36	KEY - SQ., 0.25 x 1.00, GR2	-	1
37	KEY - SQ., 0.25 X 2.50 GR2	-	1
38	KEY - SQ., 0.25 X 3.00 GR2	-	1
39	LOCK BOLT - SHIFT BAR	-	1
40	LOCKNUT	-	2
41	NUT - FLANGE, 7/8-14	-	1
42	O-RING - 20MM x 25MM x 2.5MM	-	1
43	O-RING - 0.88 x 1.12 x 0.12	-	1
44	O-RING - 3.50 x 3.69 X 0.09	-	2
45	O-RING - 4.50 x 4.69 x 0.09	-	1
46	O-RING - 5.00 x 5.25 x 0.12	-	2
47	OIL SEAL - 1.563 ID X 2.250 OD	-	1
48	OIL SEAL - 1.875 ID X 3.005 OD	-	1
49	OIL SEAL - 2.750 ID X 3.505 OD	-	2
50	OIL SEAL - 2.938 ID X 3.756 OD	-	2
51	PELLET - OIL WICK	-	6
52	PIN - DOWEL, .250 X 0.62, GR8	-	2
53	PIN - DOWEL, .313 X 1.00, MIL-SPEC	-	2
54	PLUG - PIPE, 0.375, MAG SOC HD	-	1
55	POST - CLUTCH ANTI-ROTATION	-	1
56	REAR BEARING CAP, N	-	1
57	RETAINER - BEARING, N	-	1
58	RING - CLUTCH CUP PILOT	-	1
59	RING - RETAINER, 5160-87	-	1
60	SHAFT - IDLER GEAR, N	-	1
61	SHAFT - PUMP, LDMBC, MECH SEAL	-	1
62	SHAFT - TRANSMISSION	-	1
63	SHAFT - TRANSMISSION	-	1
64	SHCS - .375-16 x 1.00, GR8	-	5
65	SHCS - .375-16 x 1.25, GR8	-	7
66	SHIELD - WATER, KDM/LDM/N	-	1
67	SHIFT BAR - PSM	-	1
68	SHIFT YOKE	-	1
69	SPACER - 1.38 X 1.66 X 0.85	-	1
70	SPACER - 1.38 x 1.69 x 0.62	-	2
71	SPACER - 1.38 X 1.75 X 0.391	-	1
72	SPACER - 1.57 X 2.00 X 0.71	-	1
73	SPACER - 1.75 X 2.40 X 0.86	-	1
74	SPACER - 2.56 x 2.88 x 1.58	-	1
75	SPROCKET - GATES POLY CHAIN	-	1
76	TRANSMISSION COVER ASSEMBLY	-	1
77	VENT	-	1
78	WASHER - 2.56 x 3.00 x .09 STL	-	1
79	WASHER - LOCK, 0.375 ID	-	16
80	WASHER - LOCK, 0.500 ID	-	3
81	WASHER - LOCK, HC, 0.375 ID	-	9
82	WIRE - SAFETY	-	1



NOTE: DIPSTICK, OIL-WICK PELLET, AND FASTENERS SHOWN ON EXPLODED VIEW (SHEET 2)

NOTE: BEARINGS WITH SINGLE SHIELDS - SHIELDED SIDE GOES TOWARD OUTSIDE OF TRANSMISSION

MODEL NAME: TM00214 | MDL CREATED: 14-JULY-2003 | SHEET: 1/2 | D

REMOVE SHARP EDGES | INCH [MILLIMETER] | THIRD ANGLE PROJECTION | OLD PART NO. | TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1°

W.S. Darley & Co.
CHIPPEWA FALLS, WI - MELROSE PARK, IL

MATERIAL DESCRIPTION: - | MATERIAL NO. | PATTERN NO.

DWG - LDMBC TRANS, ELEC CLUTCH CROSS SECTION

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NO.	DESCRIPTION	PART NO.	QTY.
1	AIR CYLINDER - 1.75 BORE	-	1
2	BEARING - 22206 PC-3	-	2
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14	BRACKET - THERMOSTAT	-	1
15	CAP - BEARING, LDMC ENDURO12	-	1
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17	CUP - DRIVE, ELECTRIC CLUTCH	-	1
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19	END YOKE	-	2
20	FAN - LDMBC ELECTRIC CLUTCH	-	1
21	FHSCS - .313-18 X 0.75, GR8	-	3
22	FLINGER - WATER	-	2
23	GEAR - DRIVE	-	1
24	GEAR - IDLER	-	1
25	GEAR - PINION	-	1
26	GEAR - PUMP CLUTCH	-	1
27	GEAR - SLIDING CLUTCH, N	-	1
28	GEARCASE - LDMH/LDMC, PUMP FWD	-	1
29	HEAD - SUCTION, LDM, MECH SEAL	-	1
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38	KEY - SQ., 0.25 X 3.00 GR2	-	1
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67	SHIFT BAR - PSM	-	1
68	SHIFT YOKE	-	1
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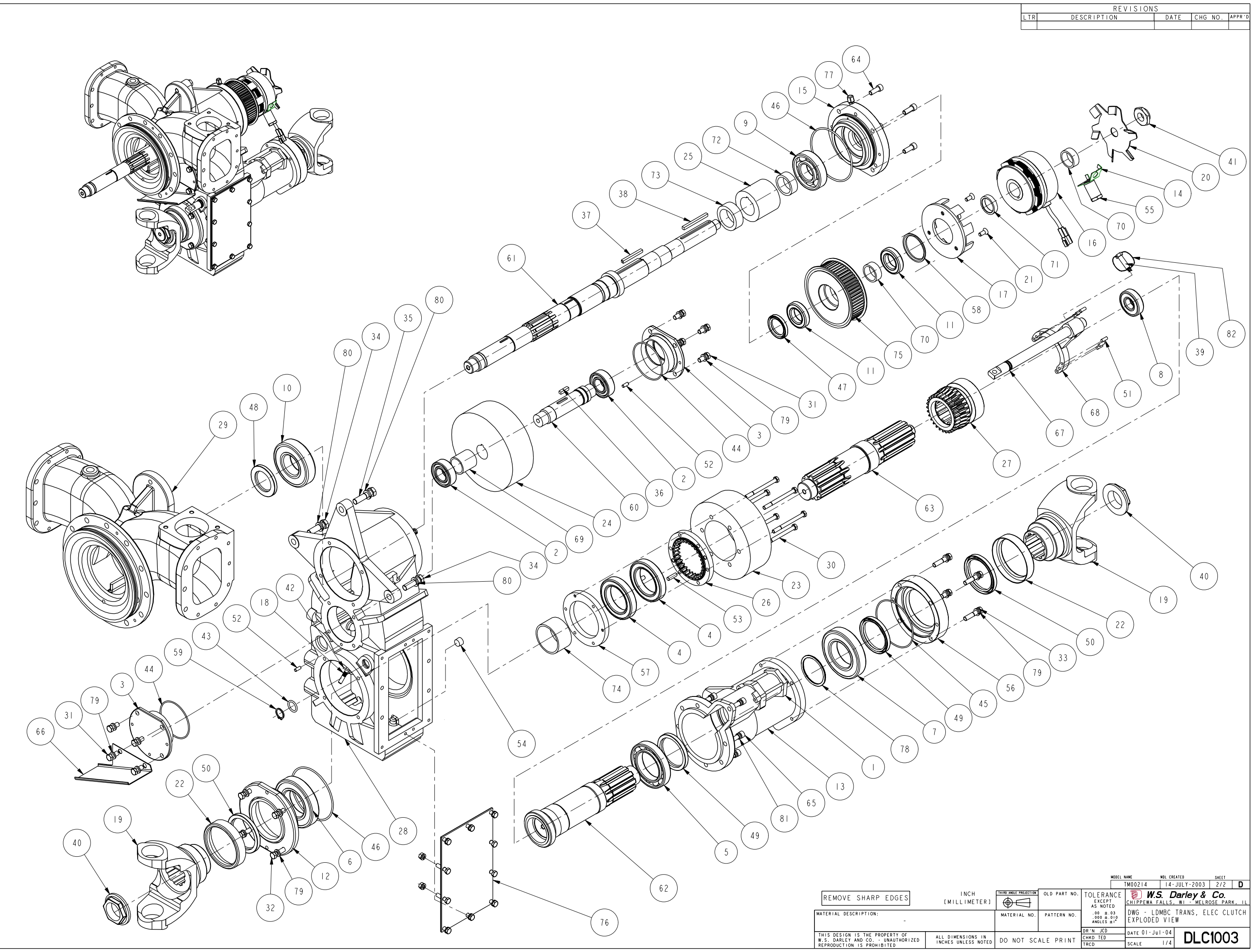

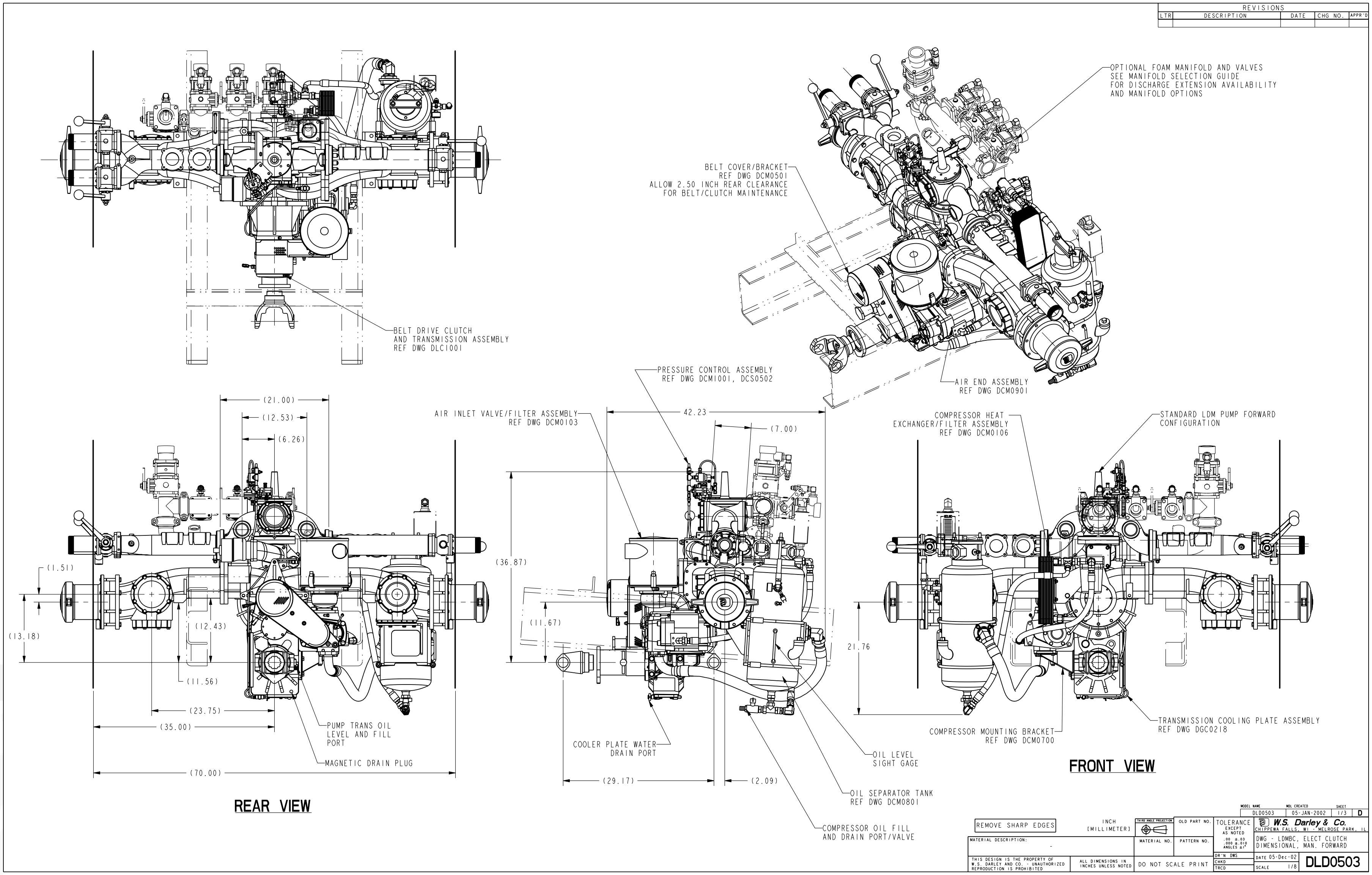

REVISIONS
LTR
DESCRIPTION
DATE
CHG NO.
APPR'D
OPTIONAL FOAM MANIFOLD AND VALVES
SEE MANIFOLD SELECTION GUIDE
FOR DISCHARGE EXTENSION AVAILABILITY
AND MANIFOLD OPTIONS
BELT COVER/BRACKET
REF DWG DCM0501
ALLOW 2.50 INCH REAR CLEARANCE
FOR BELT/CLUTCH MAINTENANCE
BELT DRIVE CLUTCH
AND TRANSMISSION ASSEMBLY
REF DWG DLC1001
PRESSURE CONTROL ASSEMBLY
REF DWG DCM1001, DCS0502
AIR END ASSEMBLY
REF DWG DCM0901
AIR INLET VALVE/FILTER ASSEMBLY
REF DWG DCM0103
COMPRESSOR HEAT
EXCHANGER/FILTER ASSEMBLY
REF DWG DCM0106
STANDARD LDM PUMP FORWARD
CONFIGURATION
(21.00)
(12.53)
(6.26)
42.23
(7.00)
(36.87)
(1.51)
(13.18)
(12.43)
(11.56)
(11.67)
21.76
(23.75)
(35.00)
(70.00)
(29.17)
(2.09)
PUMP TRANS OIL
LEVEL AND FILL
PORT
MAGNETIC DRAIN PLUG
COOLER PLATE WATER
DRAIN PORT
OIL LEVEL
SIGHT GAGE
OIL SEPARATOR TANK
REF DWG DCM0801
COMPRESSOR OIL FILL
AND DRAIN PORT/VALVE
COMPRESSOR MOUNTING BRACKET
REF DWG DCM0700
TRANSMISSION COOLING PLATE ASSEMBLY
REF DWG DGC0218
REAR VIEW
FRONT VIEW
MODEL NAME
MDL CREATED
SHEET
DLD0503
05-JAN-2002
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REMOVE SHARP EDGES
INCH
[MILLIMETER]
THIRD ANGLE PROJECTION
OLD PART NO.
TOLERANCE
EXCEPT
AS NOTED
.00 ±.03
.000 ±.010
ANGLES ±1°
W.S. Darley & Co.
CHIPPEWA FALLS, WI - MELROSE PARK, IL
MATERIAL DESCRIPTION:
MATERIAL NO.
PATTERN NO.
DWG - LDMBC, ELECT CLUTCH
DIMENSIONAL, MAN. FORWARD
THIS DESIGN IS THE PROPERTY OF
W.S. DARLEY AND CO. - UNAUTHORIZED
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INCHES UNLESS NOTED
DO NOT SCALE PRINT
DR'N DWS
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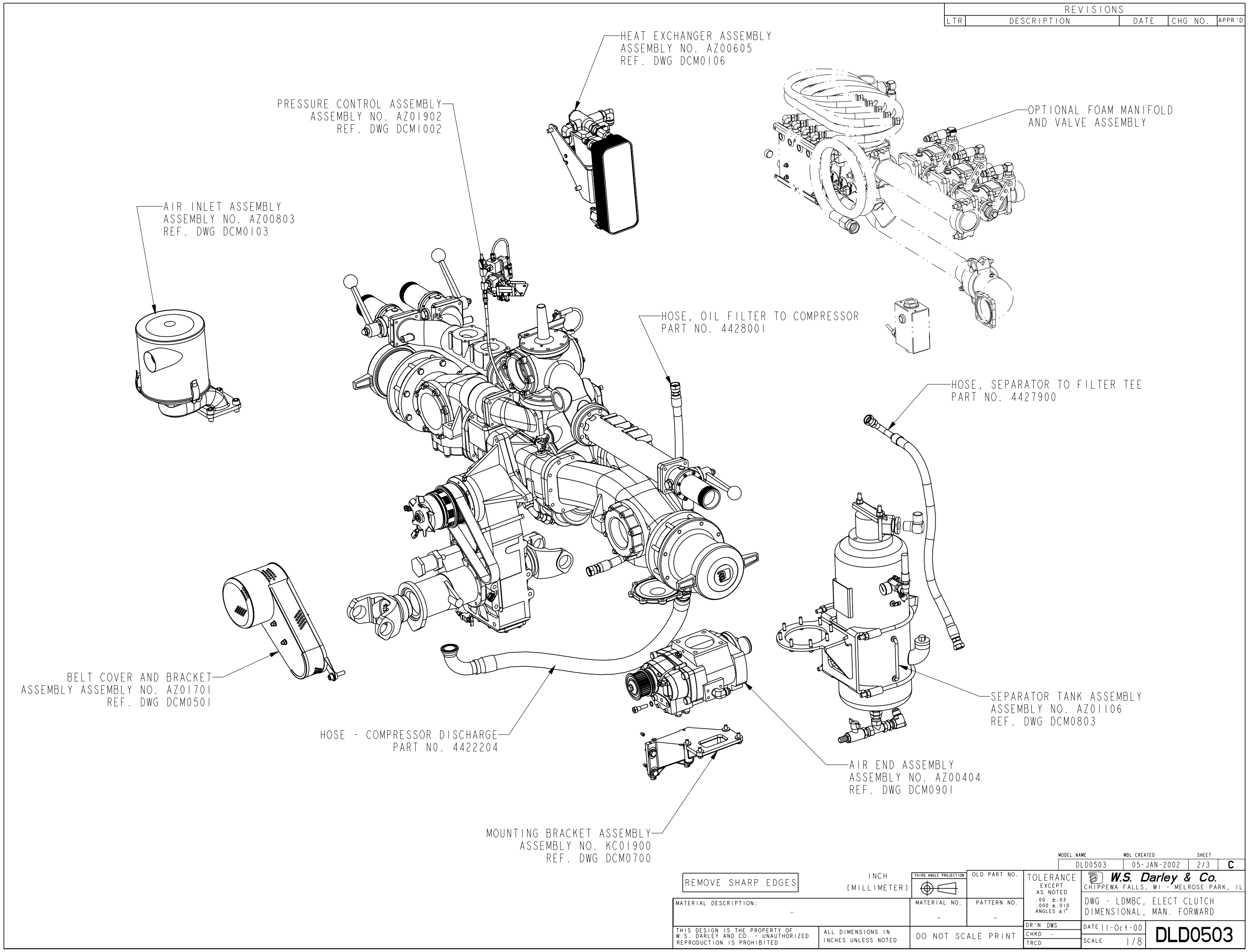
DATE 05-Dec-02
SCALE 1/8
DLD0503


REVISIONS
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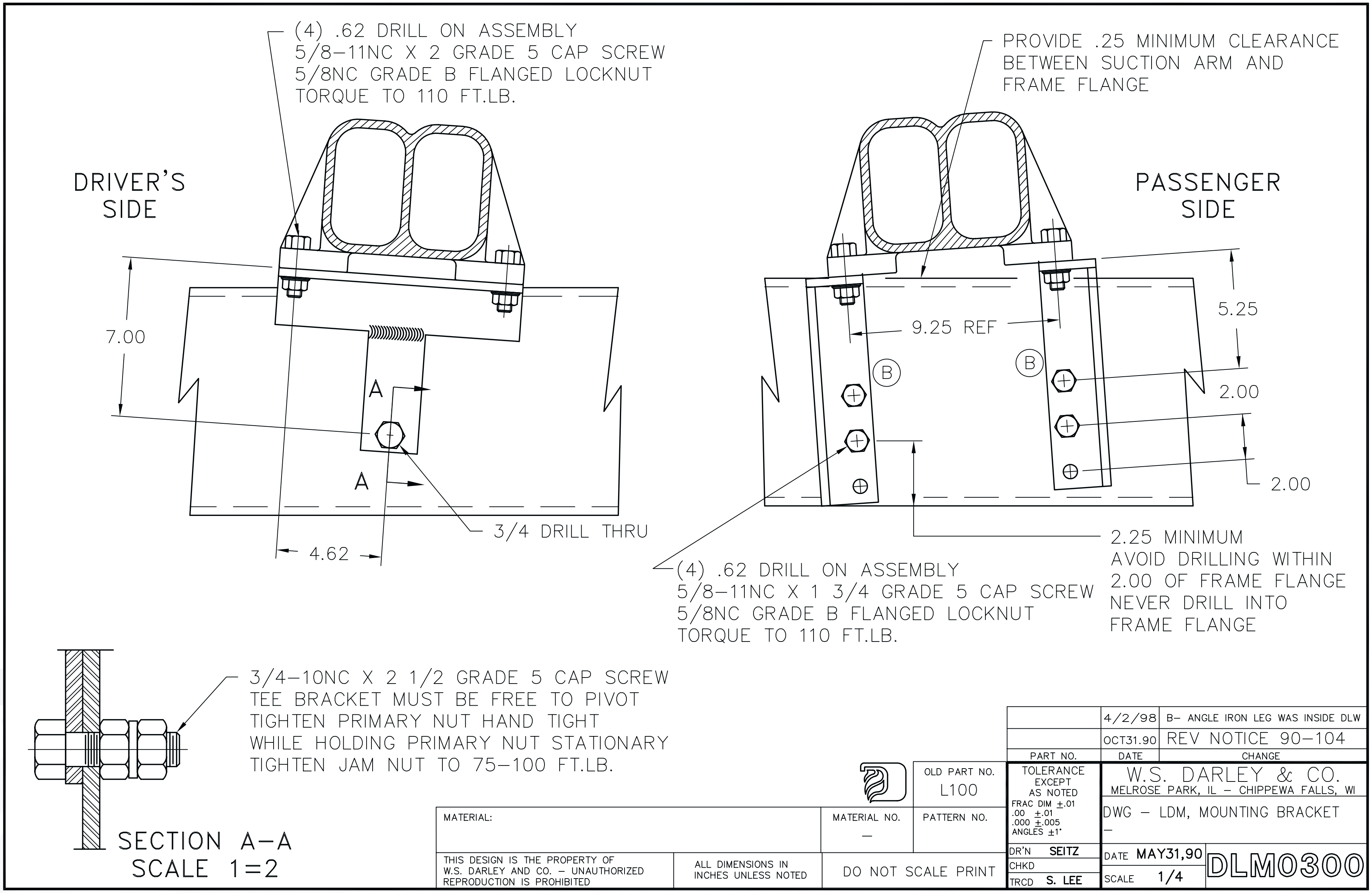
DESCRIPTION
DATE
CHG NO.
APPR'D
HEAT EXCHANGER ASSEMBLY
ASSEMBLY NO. AZ00605
REF. DWG DCM0106
PRESSURE CONTROL ASSEMBLY
ASSEMBLY NO. AZ01902
REF. DWG DCM1002
OPTIONAL FOAM MANIFOLD
AND VALVE ASSEMBLY
AIR INLET ASSEMBLY
ASSEMBLY NO. AZ00803
REF. DWG DCM0103
HOSE, OIL FILTER TO COMPRESSOR
PART NO. 4428001
HOSE, SEPARATOR TO FILTER TEE
PART NO. 4427900
BELT COVER AND BRACKET
ASSEMBLY ASSEMBLY NO. AZ01701
REF. DWG DCM0501
SEPARATOR TANK ASSEMBLY
ASSEMBLY NO. AZ01106
REF. DWG DCM0803
HOSE - COMPRESSOR DISCHARGE
PART NO. 4422204
AIR END ASSEMBLY
ASSEMBLY NO. AZ00404
REF. DWG DCM0901
MOUNTING BRACKET ASSEMBLY
ASSEMBLY NO. KC01900
REF. DWG DCM0700
MODEL NAME
MDL CREATED
SHEET
DLD0503
05-JAN-2002
2/3
C
REMOVE SHARP EDGES
INCH
[MILLIMETER]
THIRD ANGLE PROJECTION
OLD PART NO.
TOLERANCE
EXCEPT
AS NOTED
.00 ±.03
.000 ±.010
ANGLES ±1°
W.S. Darley & Co.
CHIPPEWA FALLS, WI - MELROSE PARK, IL
MATERIAL DESCRIPTION:
-
MATERIAL NO.
-
PATTERN NO.
-
DWG - LDMBC, ELECT CLUTCH
DIMENSIONAL, MAN. FORWARD
THIS DESIGN IS THE PROPERTY OF
W.S. DARLEY AND CO. - UNAUTHORIZED
REPRODUCTION IS PROHIBITED
ALL DIMENSIONS IN
INCHES UNLESS NOTED
DO NOT SCALE PRINT
DR'N DWS
CHKD -
TRCD
DATE 11-Oct-00
SCALE 1/8
DLD0503

Darley


(4) .62 DRILL ON ASSEMBLY
5/8-11NC X 2 GRADE 5 CAP SCREW
5/8NC GRADE B FLANGED LOCKNUT
TORQUE TO 110 FT.LB.
PROVIDE .25 MINIMUM CLEARANCE
BETWEEN SUCTION ARM AND
FRAME FLANGE
DRIVER'S SIDE
PASSENGER SIDE
7.00
A
A
4.62
3/4 DRILL THRU
9.25 REF
B
B
5.25
2.00
2.00
2.25 MINIMUM
AVOID DRILLING WITHIN
2.00 OF FRAME FLANGE
NEVER DRILL INTO
FRAME FLANGE
(4) .62 DRILL ON ASSEMBLY
5/8-11NC X 1 3/4 GRADE 5 CAP SCREW
5/8NC GRADE B FLANGED LOCKNUT
TORQUE TO 110 FT.LB.
3/4-10NC X 2 1/2 GRADE 5 CAP SCREW
TEE BRACKET MUST BE FREE TO PIVOT
TIGHTEN PRIMARY NUT HAND TIGHT
WHILE HOLDING PRIMARY NUT STATIONARY
TIGHTEN JAM NUT TO 75-100 FT.LB.
SECTION A-A
SCALE 1=2
4/2/98 B- ANGLE IRON LEG WAS INSIDE DLW
OCT31.90 REV NOTICE 90-104
PART NO.
DATE
CHANGE
OLD PART NO.
L100
TOLERANCE EXCEPT AS NOTED
FRAC DIM ±.01
.00 ±.01
.000 ±.005
ANGLES ±1°
W.S. DARLEY & CO.
MELROSE PARK, IL - CHIPPEWA FALLS, WI
DWG - LDM, MOUNTING BRACKET
MATERIAL:
MATERIAL NO.
PATTERN NO.
DR'N SEITZ
CHKD
TRCD S. LEE
DATE MAY31,90
SCALE 1/4
DLM0300
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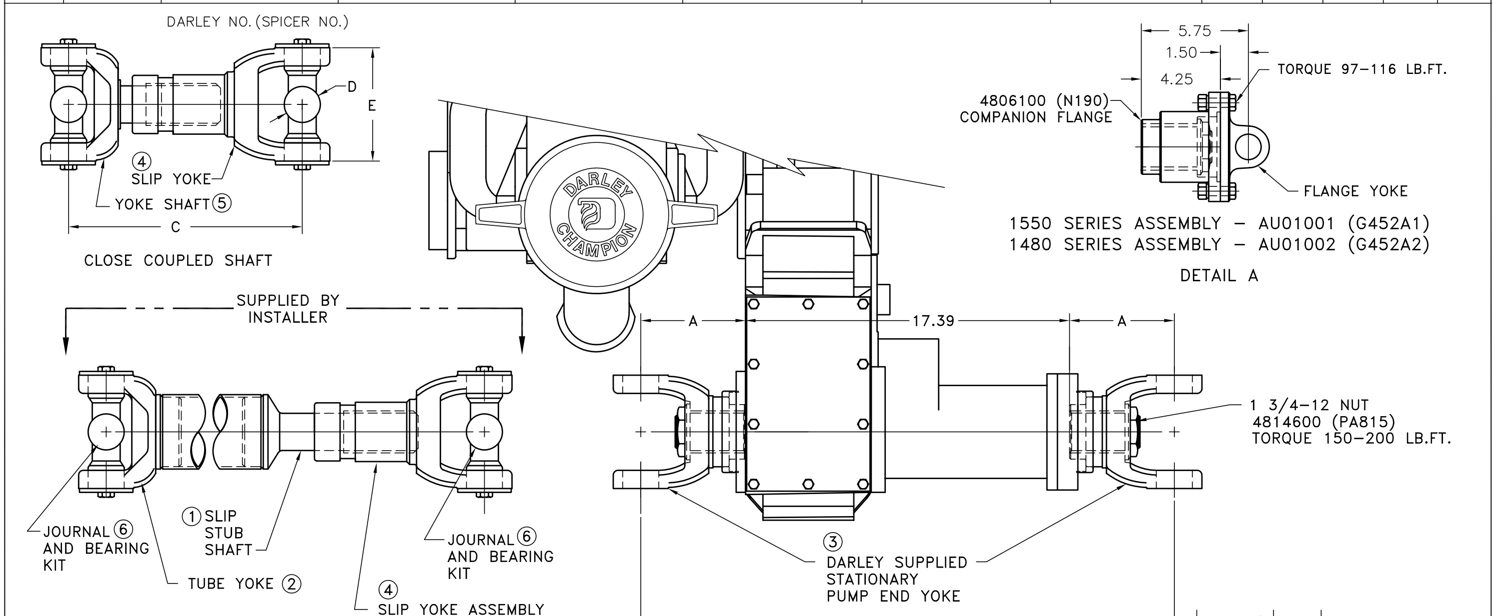
DO NOT SCALE PRINT

YOKE SERIES	TUBE SIZE	SLIP STUB SHAFT ①	TUBE YOKE ②	PUMP YOKE ③	SLIP YOKE ④	YOKE SHAFT ⑤ (FOR CLOSE COUPLE)	BEARING KIT ⑥	A	B	C CLOSE COUPLED	D	E
1550	3.00x.095W	PA671 (4-40-821)	PA678 (4-28-377X)	ASSEMBLY: AU01001 [G452A1] (REF. DETAIL A)	PA690 (4-3-1241KX)	PA695 (4-82-371)	PA620 (5-155X)	5.75	28.90	10.31	1.38	4.97
1550	3.50x.095W	PA672 (4-40-761)	PA679 (4-28-307)									
1610	3.50x.095W	PA673 (5-40-451)	4816900 (5-28-167)	4813310 Ⓚ	4814201 (5-3-108KX)	PA696 (5-82-871)	4809900 (5-279X)	6.12	29.64	11.25	1.88	5.31
1610	3.50x.134W	4814401 (5-40-1151)	4810800 (5-28-627)									
1710	4.00x.134W	PA675 (6-40-711)	4811700 (6-28-347)	4813410 Ⓚ	4813700 (6-3-2741KX)	4813800 (6-82-1251)	4810300 (5-280X)	5.63	28.66	11.42	1.94	6.09
1710	4.50x.134W	PA676 (6-40-631)	PA682 (6-28-407)									
1760	4.00x.134W	PA675 (6-40-711)	PA683 (6.3-28-17)	4813510 Ⓚ SEE NOTE 3. Ⓗ	PA693 (6.3-3-41KX)	PA698 (6.3-82-21-13)	4810600 (5-407X)	6.00	29.40	13.66	1.94	7.00
1760	4.50x.134W	PA676 (6-40-631)										
1810	4.50x.134W	PA677 (6.5-40-201)	PA684 (6.5-28-117)	4813610 Ⓚ	PA694 (6.5-3-1431KX)	PA699 (6.5-82-451-8)	PA633 (5-281X)	5.88	29.16	13.46	1.94	7.55



NOTES:
1] REFERENCE DIMENSION 'B' IS FOR ALL CHAMPION PUMPS WHICH USE THE 'N' STYLE GEAR BOX [EM-LDM-N-PSM]
2] 1810 SERIES JOINTS WILL NOT SWING UNDER CASING OF 'N' PUMP FORWARD OF GEAR CASE
3] 1760 SERIES JOINTS REQUIRE SPECIAL YOKE KIT KA00051 TO SWING UNDER CASING OF 'N' PUMP FORWARD OF GEAR CASE Ⓗ

PART NO.	DATE	CHANGE
2004-301 Ⓚ	04FEB05	UPDATED TO YOKE ASSY
Ⓙ	16JUL02	UPDATED TO NEW GEARCASE
Ⓗ	11FEB00	REVISION (2000-65)
	JUL11,94	REVISION (94-60)
	DEC15,92	REVISION (92-121)

TOLERANCE EXCEPT AS NOTED: FRAC DIM ±.01, .00 ±.01, .000 ±.005, ANGLES ±1°
W.S. DARLEY & CO. MELROSE PARK, IL - CHIPPEWA FALLS, WI
DRIVELINE DETAIL SPICER LOCKON YOKE
MATERIAL:
OLD PART NO. N188
DR'N SEITZ
CHKD
TRCD
DATE FEB22,91
SCALE 1/4
DNM0000
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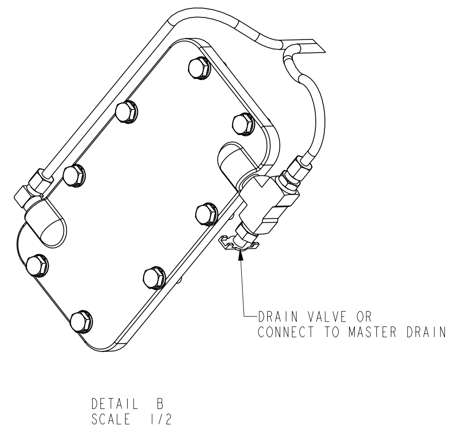
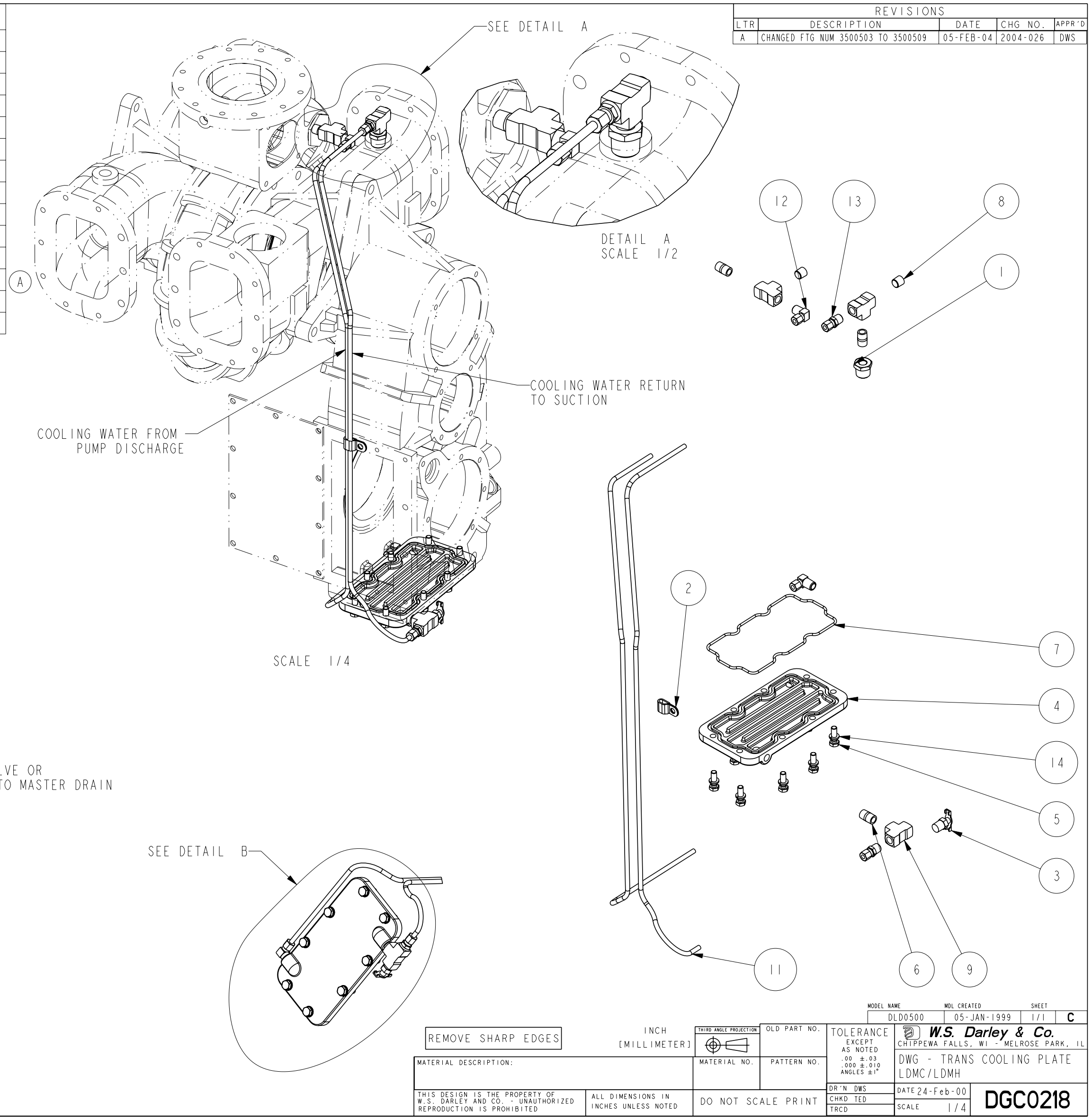
ALL DIMENSIONS IN INCHES UNLESS NOTED
DO NOT SCALE PRINT

NO.	DESCRIPTION	PART NO.	QTY.
1	BUSHING - PIPE, 1.00 x 0.50 BR	1080608	1
2	CLAMP - DBL .25 TUBE, STEEL	4403334	1
3	DRAINCOCK - 0.250 NPTM, 9KC BR	5203600	1
4	HEAT EXCHANGER - LDM TRANS	4218900	1
5	HHCS - .313-18 x 1.00, GR5	5400020	8
6	NIPPLE - PIPE, .25 CLOSE, BR	1081005	3
7	O-RING - 7.00 x 7.25 x .12	3601238_FRM	1
8	PLUG - PIPE, 1/4NPT, SOC HD	1080505	2
9	TEE - PIPE, .25 NPT	1080404	3
10	TUBE - TRANS COOLER, DISCHARGE	3520001	1
11	TUBE - TRANS COOLER, SUCTION	3520002	1
12	TUBE FITTING - EL, .25 x .25	3500509	2
13	TUBE FITTING - STR, .25 x .25	3500009	2
14	WASHER - LOCK, 0.313 ID	3603502	8





MECHANICAL SHAFT SEAL

This pump assembly incorporates high-quality mechanical shaft seal(s) separating the pump housing components from the atmosphere. Depending on the pump design, there may be one or two seals on each impeller shaft.

The seal size, design type, component materials, and housing configuration have been specifically designed for this pump application and rated operating parameters.

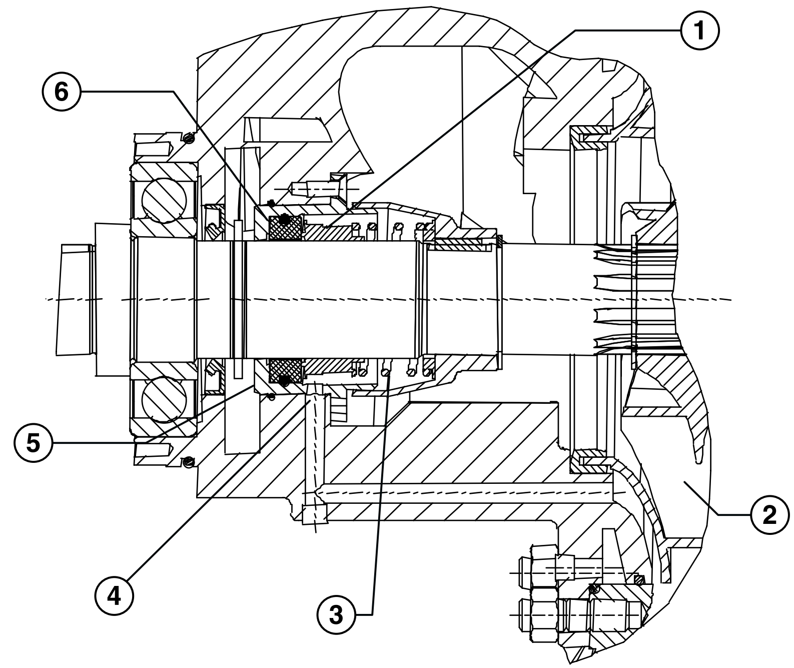
MECHANICAL SEAL BASICS

A mechanical seal is a device that houses two highly polished components (known as faces). One face rotates; the other is stationary. A secondary elastomer bellows seals the primary ring to the shaft. An O-ring or cup seal seals the mating ring in the housing. The polished seal faces of the primary and mating rings are pressed together by a spring mechanism to provide adequate force to effect a seal. The force acting between the seal faces increases in direct proportion to product pressure.

The elastomer bellows seal utilized in this pump has the following design features:

- In the mechanical drive of the primary seal ring, the drive band's notch design eliminates overstressing the elastomer sealing bellows.
- The bellows design provides automatic compensation for shaft end-play, run-out, and primary ring wear.
- Seal face contact pressure is controlled by a single, non-clogging coil spring. This coil spring has been custom-welded per Darley specifications to eliminate high-speed spring distortion.

The seal housing is designed and ported to provide optimal water flow and pressure, assuring proper cooling and flushing of the seal components.



1. Primary ring with bellows seal
2. Impeller
3. Seal coil spring
4. Water flush port
5. Seal housing
6. Mating ring with O-ring seal

OPERATION AND MAINTENANCE

When used within rated operating conditions of this pump, these seals will provide trouble-free service for extended periods.

Properly selected and applied mechanical shaft seals are leak-free and require no adjustment. Should the seal area develop a leak, investigate the cause as soon as possible. Seal failure and leakage may be the result of worn seal faces, leaking bellows, or damaged O-rings. These failures may be attributed to bearing failure, impeller blockage, impeller imbalance, seal housing contamination, operating beyond pump design rating, or dry running.

The mechanical shaft seal design relies on the sealed media (in this case, water) to cool and lubricate the sealing surfaces. Therefore, extended dry operation may cause overheating and scoring or damage to the sealing surfaces, resulting in excessive leakage or a much shortened seal life.

To maximize seal life, minimize operation at pump pressures higher than pump rating. While operating at pressures beyond rating will not immediately damage the seal, it will increase sealing surface wear rate.

NOTICE

Only run the pump dry except momentarily and at low speeds.

Do not use this pump for hose testing.

Never run the mechanical seal dry while the pump is not entrained with water for a period longer than 2 minutes. Failure to follow this recommendation will lead to premature wear and failure of the mechanical shaft seal.

Darley – Installation of Mechanical Face Seal with O-Ring

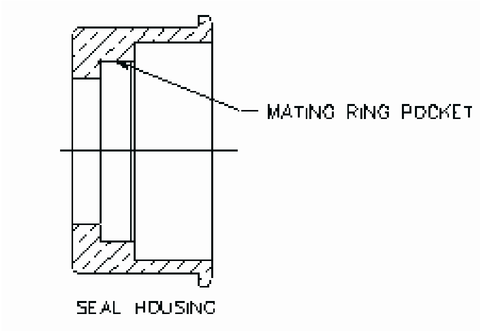
SPECIAL HANDLING

Study the engineering layout before installing the seal. This shaft seal is a precision product and should be handled and treated with care. Take special care to prevent scratches on the lapped faces of the primary and mating ring. Provide a clean work area where the assembly will take place. Clean hands prior to assembly.

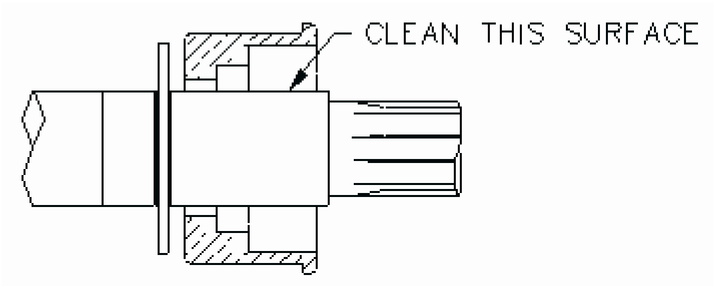
INSTRUCTION STEPS

INSTRUCTIONS FOR INSTALLING A MECHANICAL SHAFT SEAL

1. Inspect the mating ring pocket in the seal housing, ensuring it is clean, free of chips, and nick-free, to provide a proper sealing surface. Isopropyl alcohol may be used to clean the surface if required.

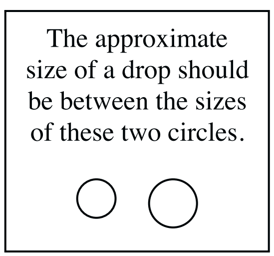


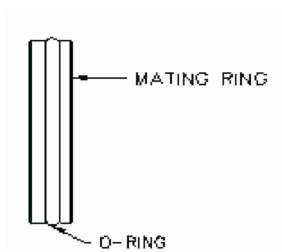
2. Inspect the pump shaft surface under the bellows, ensuring it is clean and nick-free to provide a proper sealing surface. Isopropyl alcohol may be used to clean the surface if required.

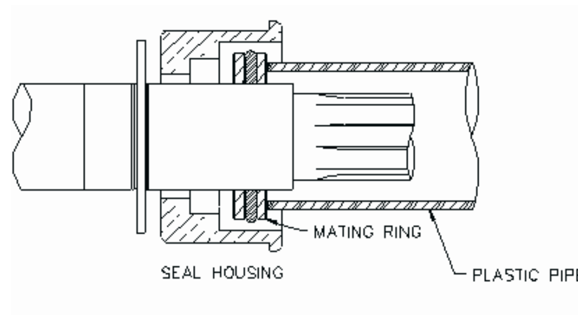


3. Lightly lubricate the O-ring on the mating ring with a single drop of P-80 water-soluble rubber lubricant (do not over-lubricate) and push it into the cavity using the recommended installation tool or other suitable plastic tube free of contaminants, firmly seating the mating ring square.

NOTE: *The polished face of the mating ring must face out and away from the pump's gear case. Try to not touch the polished sealing face with your fingers; the oils from your fingerprint can cause the seal to leak. Remove any P-80 from the sealing face after installation.*





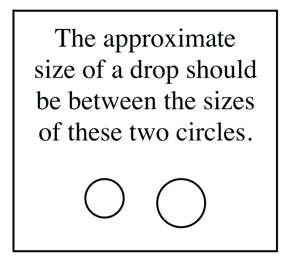


4. Clean the mating ring surface with isopropyl alcohol to remove any fingerprints and any other contaminants left on mating ring.

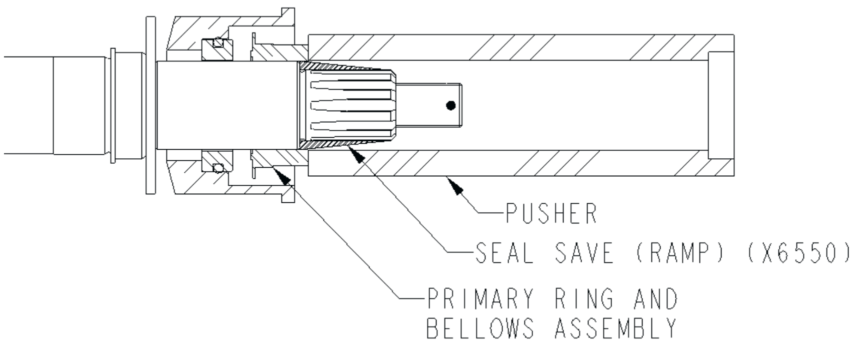
NOTE: *Steps 5–9 need to all be completed within 15 minutes or less.*

5. Apply a small drop of P-80 rubber lubricant or water-soluble lubricant (not soapy water) to the inside diameter of the bellows assembly, allowing it to be pushed easily into position.

6. Clean the polished sealing face of the primary ring with a clean lint-free rag with isopropyl alcohol to remove all fingerprints and other contaminants.



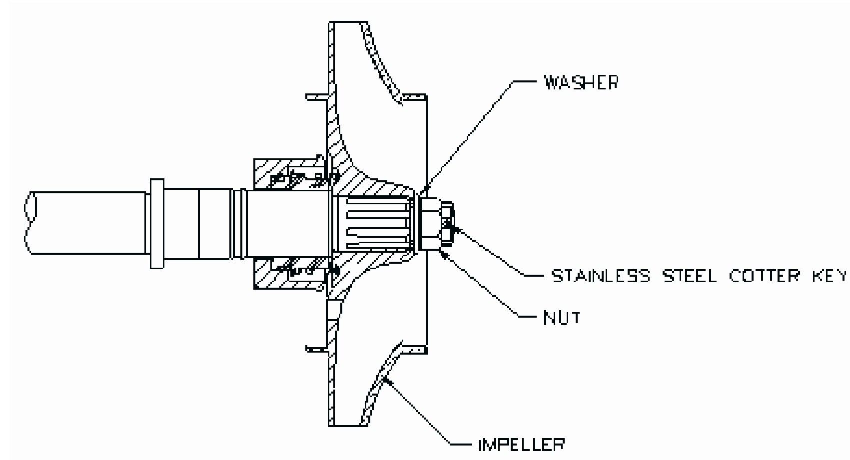
7. Slide a seal save, similar to X6550, over the shaft splines to ensure that the seal is not damaged during installation. Place the primary ring and lubricated bellows assembly (without the spring) on the shaft, using a proper pusher. Push the assembly into position so that the seal surfaces are in contact. Remove the seal save from the shaft.



8. Put the spring in place, seated tight against the spring retainer on the primary ring.

NOTE: *Some springs may be slightly tapered, so one end fits the seal better than the other. The end of the spring that best fits the seal should go toward the seal to ensure even spring pressure all the way around.*

9. Slide the impeller onto the impeller shaft, engage the spring into the groove of the impeller hub, and install the impeller washer, impeller nut, and stainless steel cotter key.



**Reference pump configuration for individual mechanical seal instructions.

**Reference pump assembly drawings and pump assembly tips for further assembly.

NOTE: *If the seal leaks slightly after assembly, it may be necessary to run the pump for approximately 30 minutes at 50-60 psi to rinse out excess lubricant and other contaminants.*
Once a mechanical seal has been installed, do not reuse it.

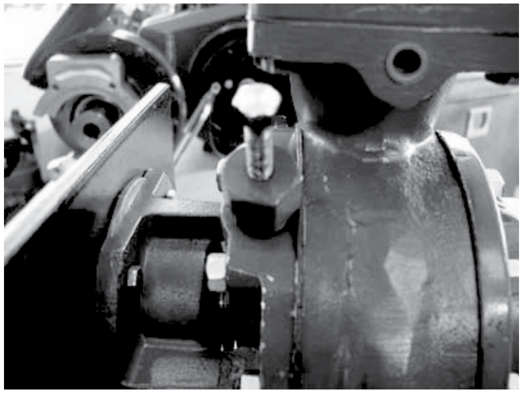
W.S. Darley & Co. – Darley Injection Type Stuffing Box Adjustment

NOTICE

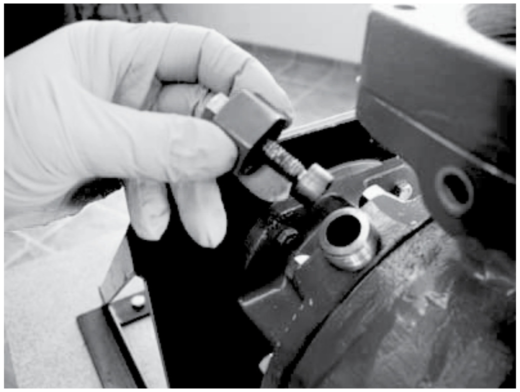
Always use Darley injection packing. Using the wrong packing material may cause catastrophic failure of the pump shaft sealing components.

Only use W.S. Darley & Co.'s plastallic injection packing material. It is made of a special composition of shredded fibers and a special bonding and lubricating compound.

It is important that the stuffing box is completely filled solid with packing and compressed firm during adjustment to prevent formation of voids and excessive leakage.

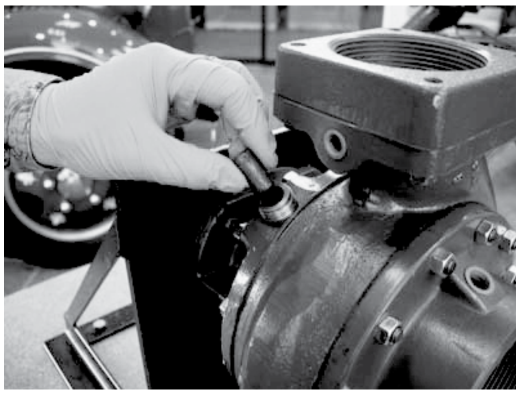


To pack the stuffing box when empty and assembled in the pump, remove the packing screw and nut assembly, and insert pellet form packing into the packing plunger guide. Replace the packing screw assembly and use a hand speed wrench to force the pellets into the gland. DO NOT USE A POWER TOOL! Repeat pellet additions while turning the impeller shaft by hand until resistance to turning is felt when the stuffing box is almost full. Continue turning the packing screw by hand using a standard 6 in. long, 9/16 in. end wrench until 4 lb of force is felt at the end of the wrench. This is equivalent to 2 ft-lb or 24 in.-lb torque. Continue turning until a few flakes of packing are extruded out the opening between the impeller shaft and the stuffing box hole. The gland is now ready for pressure testing or pumping.



Darley

After priming the pump with water, start the pump and raise the discharge pressure to 50 psi. Tighten the packing screw using a 6 in. long, 9/16 in. end wrench until 4 lb of force is felt at the end of the wrench (24 in-lb torque). Continue operating the pump at 50 psi for 5 minutes to dissipate packing pressure against the shaft and permit cooling water to flow between the shaft and stuffing box hole. Make sure that water actually does come through before operating pump at any higher pressure. The normal drip rate may vary between 5 and 60 drops per minute.



Operate the pump for 10 minutes at the highest normal operating pressure, flowing sufficient water to prevent overheating. Do not run the pump blocked tight. Lower discharge pressure to 50 psi and repeat the packing screw tightening procedure outlined above.

The pump may now be operated for any time period required within its rated capacity. However, the drip rate should be monitored more frequently during the first few hours and should be adjusted if necessary to achieve a stable flow rate. Several more adjustments may be required.

For a list of approximate quantity of packing pellets required by model (completely repacked), see below:

Model	Approximate # Packing Pellets
A	6
2BE	6
EM	15
H	8
JM	8
KD	10
KS	8
LD	15
LS	9
P	10
U2	5
U4	10

If further information is needed, call W.S. DARLEY & CO. at Chippewa Falls, WI at 800-634-7812 or 715-726-2650.

Summary of Things to Remember

1. Always shift the pump clutches with the engine clutch disengaged.
2. Do not clash clutch gears when shifting.
3. Close the booster valves, drain valves, cooling line, and third-stage discharge valve before attempting to prime the pump.
4. Always keep primer shut-off valve closed, except while priming.
5. Re-open and close primer valve to re-prime or eliminate trapped air from the suction line.
6. Always drive a midship-mounted, split-shaft pump with truck transmission in the gear recommended by the chassis manufacturer.
7. Never run the pump without water in it except momentarily while priming.
8. Accelerate and retard the speed of the engine gradually.
9. Watch the engine temperature, and start the cooling water at the first signs of overheating.
10. Keep good gaskets in the suction hoses, and handle the gaskets carefully to avoid damage to the coupling threads.
11. Air leakage into suction lines is the most frequent source of trouble when pumping from a suction lift (draft).
12. Always use a suction strainer when pumping from draft, and a hydrant strainer when pumping from a hydrant.
13. Foreign matter in impellers is a result of a failure to use adequate strainers and is a common source of trouble.
14. Drain the pump immediately after each run. This recommendation is especially critical in freezing conditions.
15. Do not run the pump long with the discharge completely shut off.
16. Do not close a “shut-off” nozzle when pumping with motor throttle wide open, unless relief valve or pressure regulator is set for the correct pressure.
17. Keep the pump gear case filled with oil to the level of the oil level plug/dipstick.
18. Check oil level in the pump transmission after every 25 hours of operation or 3 months, and changed it after every 50 hours of operation or 6 months.

19. In such equipped transmissions, once the oil is drained, remove the strainer screen oil sump fitting and thoroughly cleanse in a parts washer or with isopropyl alcohol, ensuring any debris is washed away.
20. If pump is equipped with a Darley plastallic (injection) packing shaft seal, check the drip rate frequently, and adjust according to the packing adjustment instruction, as required. The drip rate may vary between 5 and 60 drops per minute.
21. Work all suction and discharge valves often to ensure free and easy operation.

Pump Shifting Procedure

For trucks equipped with manual transmissions, the following shifting procedures should be followed for pump operation:

1. Set the parking brake.
2. Disengage the truck clutch to stop shaft rotation.
3. Move the pump shift lever to the PUMP position.
4. Move truck transmission shift lever to the neutral position.
5. Engage the truck clutch.
6. Prime the pump (see Priming instructions).
7. Disengage the truck clutch.
8. Move the truck transmission shift lever to direct drive position and lock in place with the safety latch.
9. Engage the truck clutch to begin pumping.

If the power pump shift is provided, the procedure is identical except the green indicator light (if provided) will come on at step #3 to show the pump gear has been engaged

To return to road operation:

1. Disengage the truck clutch to stop shaft rotation.
2. Move the truck transmission shift lever to the neutral position.
3. Move the pump shift lever to the ROAD position.

When the truck is equipped with an automatic transmission, there is the danger that if the operator forgets to move the pump shift lever to the PUMP position, and at the same time he or she places the transmission selector lever in high gear before leaving the cab, the engine will continue to run due to converter slip. Upon advancing the vernier throttle at the pump operator's panel, the engine could overcome the parking brake and accidentally move the truck. To prevent this possibility, the following shifting procedure should be followed for pump operation:

1. Set the parking brake.
2. Place the automatic transmission shift selector in neutral.
3. Move the pump shift lever to the PUMP position. The "Pump Engaged" light in the cab should now come on.
4. Prime the pump (see Priming Instructions).
5. Move the automatic transmission shift selector to the direct drive position (see Automatic Transmission Instructions).
6. Lock the automatic transmission shift selector in the direct drive position with the safety latch provided.
7. Check that the parking brake is fully engaged.
8. Depress the foot accelerator and observe that the speedometer registers mph. If the pump is not engaged, the speedometer will not indicate mph.
9. Listen for the pump shifting and the sound of the pump gears turning.

10. At the pump operator's position, observe that the green indicator light above the vernier throttle control is on. Do not operate the throttle unless the light is on.
11. Observe the discharge pressure gauge on the panel while advancing the vernier throttle, to ensure that it is indicating pressure. If the pump is not engaged, no pressure will show.
12. Remember, the vernier throttle has a quick-release emergency center button. Push it all the way in immediately, should the truck move.

To return to ROAD OPERATION:

1. Place the truck transmission selector lever in the reverse position to stop forward rotation of the transmission shaft.
2. Move the transmission selector to neutral, and at the same time, move the pump shift lever from PUMP to the ROAD position.

Operation of Pump Shift with Automatic Transmission

The pump gear shift consists of a sliding clutch gear splined to the transmission shaft. The sliding clutch gear can be moved forward to engage the pump clutch gear, or to the rear to engage the rear drive shaft connected to the truck drive axle.

The sliding clutch gear is moved either by direct mechanical linkage from a notched quadrant shift lever, or by an air power cylinder controlled by a selector valve. The shift lever or selector valve must be moved all the way and locked for either ROAD position to drive the truck or the PUMP position to pump.

MANUAL PUMP GEAR SHIFT PROCEDURE

With the truck parking brake set, the truck transmission shift selector must be in the neutral position to stop the rotation of the truck transmission output shaft before shifting into either the ROAD or PUMP gear to prevent clashing and damage to gear teeth. With a manual pump gear shift control, a butt tooth position of gears may be encountered, preventing engagement and the "Pump Engaged" light from coming on. If this occurs, move the transmission shift selector momentarily into any forward gear position with the engine idling, and then return to neutral. Wait approximately 5 seconds until the shaft stops turning. Moving the pump shift lever to the PUMP position again should complete the pump shift and turn on the "Pump Engaged" light. Repeat this procedure if a butt tooth condition is again encountered. Pump priming should be completed before shift to the PUMP position.

AIR POWER PUMP GEAR SHIFT PROCEDURE

With the air power pump gear shift control, a butt tooth condition may also occur, preventing engagement and the "Pump Engaged" light from coming on. This problem can be easily overcome by momentarily placing the truck transmission in any forward gear position with the engine idling after the pump shift valve is placed in the PUMP position. Shaft rotation will complete the shift and turn on the green "Pump Engaged" light. The transmission shift should be returned to the neutral position after the "Pump Engaged" light comes on for the pump priming period.

The above procedure ensures that the pump shift is completed and the "Pump Engaged" light illuminates. An alternate procedure in case of a butt tooth condition is simply to wait until the transmission is placed into the pump drive gear position, when the shaft rotation will immediately permit the pump gears to mesh into full engagement.

The pump is usually operated with the truck transmission in direct (high) gear such as D or 2-5. Overdrive may be required with very low speed engines.

When the truck is equipped with an automatic transmission, there is the danger that should the operator forget to move the pump shift valve to the PUMP position, and at the same time place the transmission selector in high gear before leaving the cab, the engine will continue to run due to converter slip. If the operator advances the vernier throttle at the pump operator's panel, the engine could overcome the parking brake and cause the truck to move. To prevent this possibility, the following shifting procedure should be followed for the PUMP position:

1. Read and fully understand the pump Operator's Manual before proceeding.
2. Set the parking brake and idle the engine.
3. Place the automatic transmission shift selector in neutral.
4. Move the pump shift lever or valve to the PUMP position. The "Pump Engaged" green light in the cab should now illuminate. If not, momentarily place the truck transmission shift selector in a forward gear to complete the pump shift, then return to the neutral position. The green light will now illuminate.
5. Prime the pump.
6. Move the automatic transmission shift selector to the direct drive position. The "OK to Pump" green light in the cab should illuminate.
7. Lock the automatic transmission shift selector in direct drive.
8. Listen for the sound of the pump gears turning. The speedometer will show mph unless connected to the wheel.
9. At the pump operator's position, observe the green indicator warning light near the vernier throttle control.

⚠ WARNING

Do not open the throttle unless the green indicator light is ON.

10. Advance the throttle to provide a minimum of 900 rpm idle speed. Observe the discharge pressure gauge on the panel while advancing the vernier throttle to make sure it is indicating pressure. If the pump is not engaged or the pump is not primed, no pressure will show.

    The vernier throttle has a quick-release emergency red center button. Push it all the way in to return the engine to idle if necessary in an emergency situation.

To return to ROAD operation:

1. Throttle the engine back to idle.
2. Place the truck transmission selector lever in the neutral position. Wait approximately 5 seconds until the drive shaft stops rotating.
3. Move the pump shift lever or valve from the PUMP to the ROAD position. The "Pump Engaged" green indicator light should be off. A butt tooth condition may require momentary engagement of the transmission to complete the shift.

OPERATION OF PUMP SHIFT WITH MANUAL TRANSMISSION

The pump gear shift consists of a sliding clutch gear, splined to the transmission shaft, which can be moved forward to engage the pump clutch gear, or to the rear to engage the rear drive shaft connected to the truck drive axle. A neutral position is half-way between.

The sliding clutch gear is moved either by direct mechanical linkage from a notched quadrant shift lever, or by a vacuum or air power cylinder controlled by a selector switch. The shift lever must be moved all the way and locked for either the ROAD position to drive the truck or the PUMP position to power the pump.

The truck clutch must always be disengaged to stop the rotation of the truck transmission output shaft before shifting into either the ROAD or PUMP gear to prevent clashing and damage to gear teeth. With the manual shift lever, a butt tooth position of gears may be encountered occasionally, preventing engagement. If this occurs, move the pump shift lever to neutral (half-way) position, engage the truck clutch momentarily, and then disengage truck clutch and try the pump shift again.

The pump is always operated with the truck transmission in direct (high) gear, such as fourth on a 4-speed or fifth on a 5-speed transmission.

The following shifting procedure should be followed for PUMP operation:

1. Set the parking brake.
2. Disengage the truck clutch.
3. Move the pump shift lever (valve) to the PUMP position. The "PUMP ENGAGED" green light in the cab should now illuminate.
4. Move the truck transmission shift lever to the neutral position.
5. Engage the truck clutch.
6. Prime the pump (see Priming Instructions).
7. Disengage the truck clutch.
8. Move the truck transmission shift lever to the direct drive position and lock in place with the safety latch provided.
9. Slowly engage the truck clutch to begin pumping.

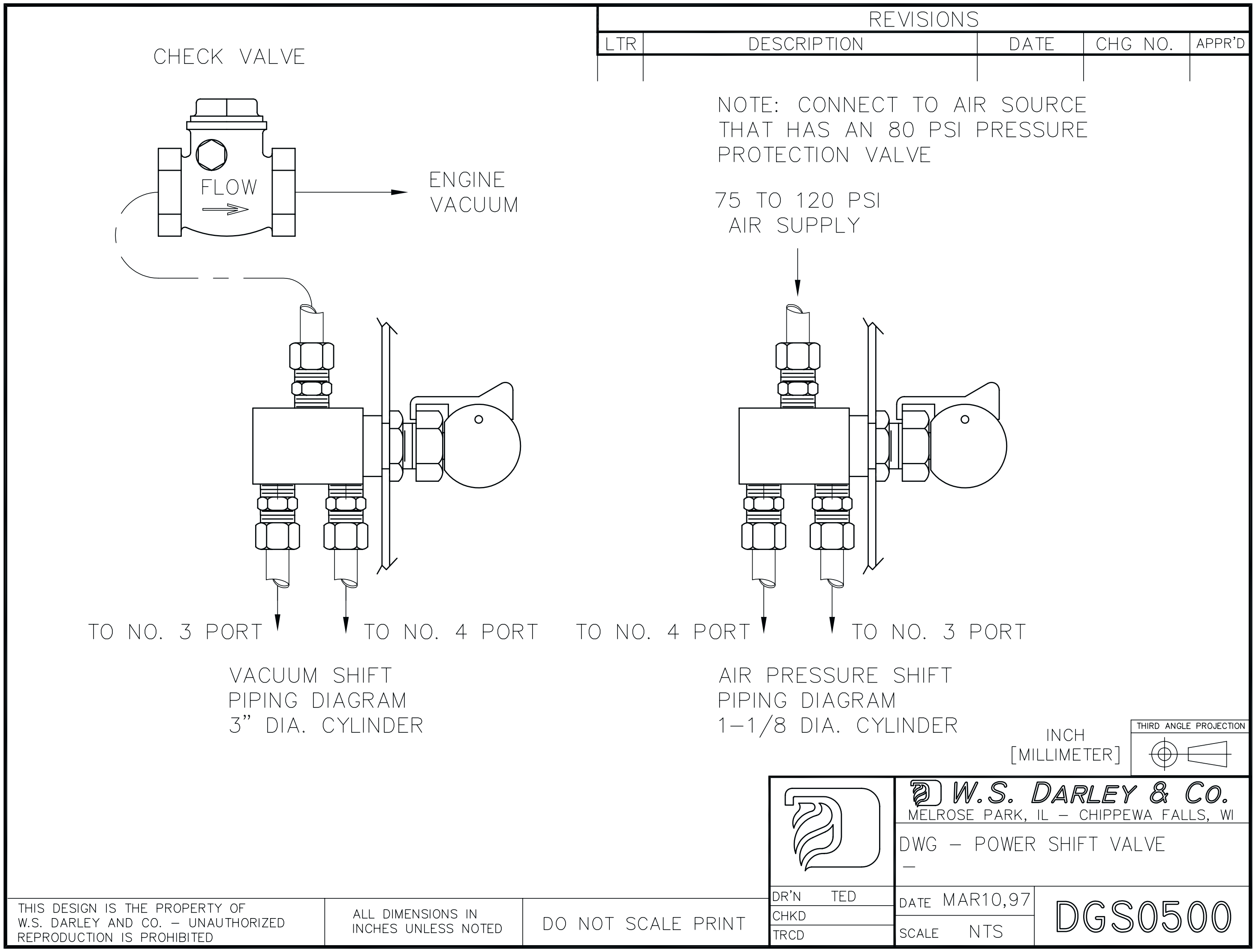
To return to ROAD operation:

1. Disengage the truck clutch to stop shaft rotation. Allow 10 seconds for the shaft to stop rotating.
2. Move the truck transmission shift lever to the neutral position.
3. Move the pump shift lever (valve) to the ROAD position.

⚠ CAUTION

Follow the procedures step by step as indicated.

IF FURTHER INFORMATION IS NEEDED, CALL W.S. DARLEY & CO. AT CHIPPEWA FALLS, WI AT 800-634-7812 or 715-726-2650.


REVISIONS
LTR
DESCRIPTION
DATE
CHG NO.
APPR'D
CHECK VALVE
FLOW
ENGINE VACUUM
NOTE: CONNECT TO AIR SOURCE THAT HAS AN 80 PSI PRESSURE PROTECTION VALVE
75 TO 120 PSI AIR SUPPLY
TO NO. 3 PORT
TO NO. 4 PORT
TO NO. 4 PORT
TO NO. 3 PORT
VACUUM SHIFT PIPING DIAGRAM 3" DIA. CYLINDER
AIR PRESSURE SHIFT PIPING DIAGRAM 1-1/8 DIA. CYLINDER
INCH [MILLIMETER]
THIRD ANGLE PROJECTION
W.S. DARLEY & Co.
MELROSE PARK, IL - CHIPPEWA FALLS, WI
DWG - POWER SHIFT VALVE
DR'N TED
CHKD
TRCD
DATE MAR10,97
SCALE NTS
DGS0500
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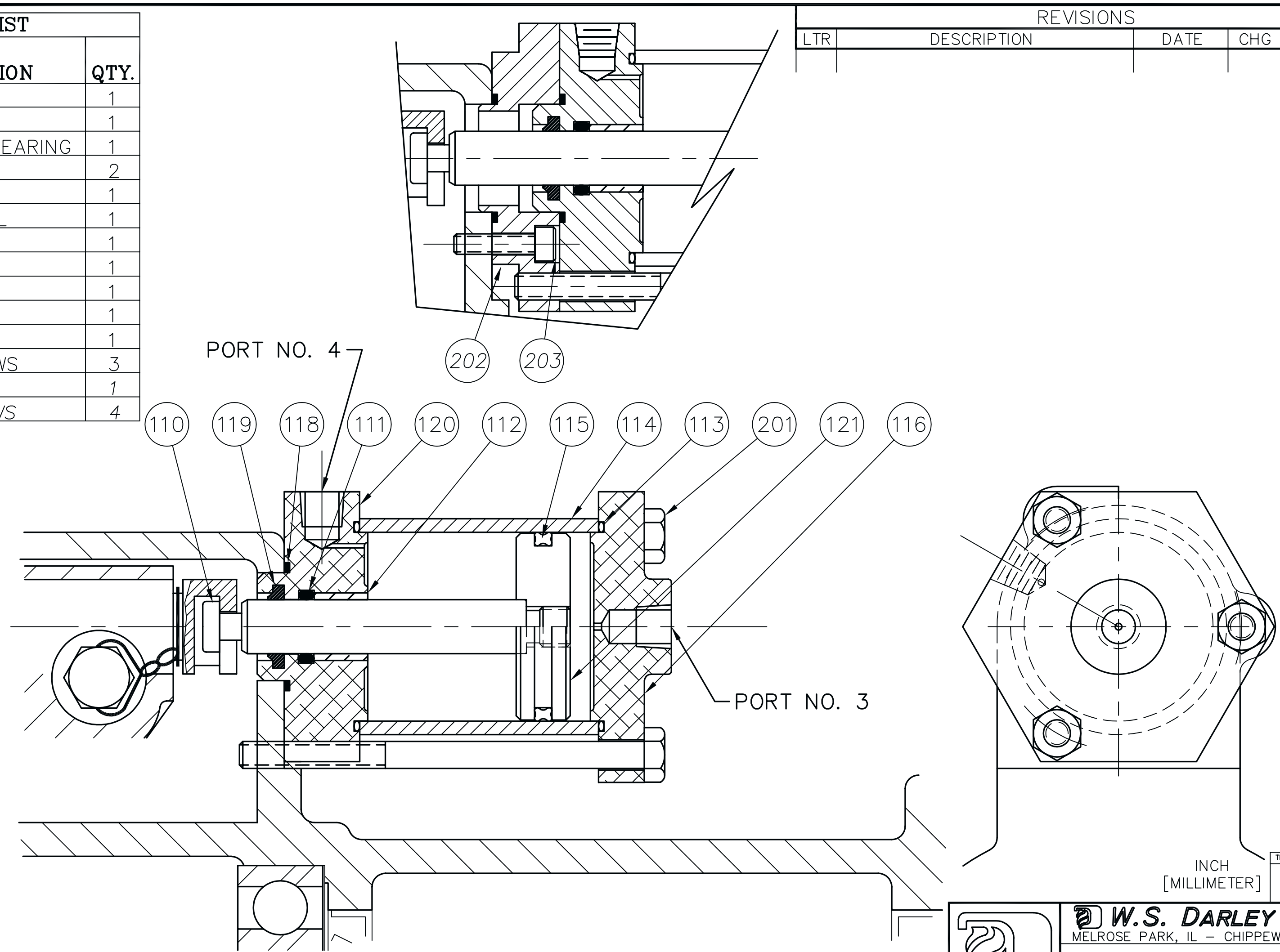
ALL DIMENSIONS IN INCHES UNLESS NOTED
DO NOT SCALE PRINT

PARTS LIST		
REP. NO.	DESCRIPTION	QTY.
110	PISTON ROD	1
111	ORING – ROD	1
112	OILITE SLEEVE BEARING	1
113	O'RING	2
114	CYLINDER	1
115	QUAD RING SEAL	1
116	CYLINDER END	1
118	O'RING	1
119	WIPER RING	1
120	CYLINDER HEAD	1
121	PISTON	1
201	CYLINDER SCREWS	3
202	*ADAPTER*	*1*
203	*ADAPTER SCREWS*	*4*

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D



INCH
[MILLIMETER]

THIRD ANGLE PROJECTION

REFERENCE SPEC AY00201 (G427A1)
& AY00202 (G427A2)

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ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

OLD PART NO. G2514

W.S. DARLEY & Co.
MELROSE PARK, IL – CHIPPEWA FALLS, WI

DWG – 1.75" AIR CYLINDER

DR'N DWS
CHKD
TRCD

DATE JUN02,93
SCALE 1/1

DGC070I

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⚠ WARNING

Do not use this pump for hose testing.

OPERATING THE ENGINE

After the pump has been primed, the engine speed should be increased gradually. Never jerk the throttle wide open. Likewise, the engine speed should be decreased gradually when shutting down.

Watch the pump pressure gauge and open the throttle only enough to give the desired pressure. The pressure may rise high enough to burst the discharge hose, when using small nozzles, if the engine is given full throttle (except pumps equipped with pressure regulators set for desired pressure).

Never run the engine at high speeds except when the pump is primed and ready to discharge water.

COOLING THE ENGINE

National Fire Protection Association (NFPA) 1901 requires that a supplementary heat exchanger cooling system be provided. On most models, this heat exchanger is an integral part of the pump, and the installation of two hoses from the engine cooling system to the pump is all that is required.

On some models an external heat exchanger must be used. In that case, two hoses from the engine cooling system and two lines from the pump will run to the heat exchanger.

The cooling line should not be opened until pressure develops in the pump, and the pump should never be operated under prolonged heavy loads without an adequate supply of cooling water flowing.

Coolant temperatures should never be allowed to exceed 200° F while pumping; 180° F is usually accepted as a safe operating temperature.

Always shut off the cooling line when finished pumping.

SUCTION STRAINERS

A large suction strainer, which will prevent the passage of a body larger than the pump impeller ports, must always be used on the free end of the suction line when pumping from draft.

The small hydrant strainer must always be inserted in the suction manifold of pump, when pumping from hydrants and at all other times except when maximum capacity is required from draft.

Failure to use a strainer at all times when pumping will cause serious trouble by clogging the pump, because even in water mains, foreign matter is invariably present and will be drawn into the pump by the high velocity of the water entering.

SUCTION LINE

The suction line of a fire pump can be the source of more operating difficulties than all the rest of the pump when working with a suction lift. Faults in the suction line that cause trouble in operation are as follows:

AIR LEAKS: A small amount of air, expanding in the vacuum of the suction line, displaces a considerable volume of water, which subtracts from the capacity that the pump is able to deliver and makes the priming difficult or causes pump to lose its prime. Therefore, it is absolutely essential to keep the suction line and the suction side of the pump casing air-tight at all time when drafting water.

Air leakage into the pump during operation is usually indicated by a rattling sound in the pump casing, miniature explosions in the stream issuing from the nozzle, or the loss of prime when operating at very low capacities.

The usual cause of leaky suction lines is carelessness in the handling of the suction hose. Bruising of the hose threads by bumping against hard surfaces or sand in the coupling often prevents tightening of the joints up against the gaskets. The hose gaskets are often defective and are sometimes lost without being noticed by the operator.

INSUFFICIENT SUBMERGENCE: The free end of the suction hose must be submerged to a sufficient depth to prevent the entrance of air that may be sucked down from the surface of the water when operating at large capacities.

Entrance of air into the suction lines in this manner is indicated by a small whirlpool or vortex on the surface of the water over the end of the hose.

A minimum submergence of 4 times the hose diameter to the upper holes in the suction strainer is recommended where the full capacity of the pump is required. Where sufficient submergence is not possible, a board or sheet of metal laid over the end of the suction line will keep air from entering.

SUCTION LINE ENTRANCE TOO CLOSE TO BOTTOM: If the end of the suction line is laid on the bottom of the source of the supply, a part of the suction opening will be shut off. If the bottom is soft, the hose will suck itself down into the earth, closing more of the opening and loosening sand and mud that will be carried into the pump.

The suction entrance should be suspended a foot or more above the bottom. If this action is not possible, the suction entrance should be laid on a board or piece of sheet metal. A rope tied to the suction strainer is a convenient means of holding it off the bottom.

OBSTRUCTION OF THE SUCTION STRAINER BY FOREIGN MATTER: The high velocity of water entering the suction line will carry loose, foreign bodies in against the strainer from a considerable distance. Therefore, all weeds and refuse should be removed from close proximity of the suction entrance.

SUCTION LINE TOO SMALL OR TOO LONG: The flow of water into the pump is opposed by the frictional resistance in the suction line. This friction loss must be added to the height of the pump above the water (static lift) to determine the “total lift” of the pump. When all of the vacuum in the pump (atmospheric pressure) is consumed in raising water through this total lift, then the limit of capacity has been reached. This capacity can be increased only by decreasing total lift. If the static lift cannot be reduced, then the friction loss must be reduced by using a shorter or larger suction hose.

The rated capacity of the pump is guaranteed for a static lift of 10 ft, with 20 ft of recommended suction hose at sea level. Increasing the capacity without reducing the static lift, or increasing the lift without sacrificing the capacity requires a larger suction hose.

An excessively long suction line is a handicap to any pump. Besides reducing capacity through the added friction loss, it retards priming and produces a detrimental effect known as “cavitation.” Cavitation means a separation of the water column in the pump suction, or void spaces, produced by the inertia of the heavy mass of water in the line resisting sudden change in the velocity when the pump starts to deliver or when discharge valves are opened or closed. This phenomenon reduces capacity further, and usually sets up a vibratory motion and “water hammer” as the water surges in and out of the void spaces.

When operating with a long suction line, the driving engine should be accelerated gradually, the discharge gates should be opened gradually, and the capacities of the pump should be held down to within the range of smooth performance.

AIR TRAP IN SUCTION LINE: If the suction line is laid so that part of it is higher than any other part that is nearer to the pump, as when hose is laid over a high bridge rail, an air trap is formed at the highest part of the hose from which the air cannot be sucked out by the primer. This trapped air is expanded and carried into the pump with the first rush of water, causing the pump to immediately lose its prime.

If suction line cannot be laid so that it slopes all the way from the pump to the water, the pump can still be primed easily by simply allowing the primer to continue to function until all the trapped air in the hose has been carried into the pump and picked up by the primer.

TESTING FOR AIR LEAKS

Tests for leakage should be made with the suction hose attached and capped, the discharge gate open, and all other openings closed tightly.

Run the electric priming pump with the primer shut-off valve open until maximum vacuum is shown on the gauge. The vacuum should hold for several minutes before satisfactory performance of the pump can be expected.

If excessive leakage of air occurs, the source of leaks can be located by shutting off the primer motor, with the vacuum at its highest point, and listening for the hiss of air.

In the absence of a vacuum gage, the vacuum in the pump may be judged by closing the suction opening with the flat of the hand or a rubber pad.

Water or air pressure may be applied to the pump casing to test for air leakage if more convenient. Do not pressurize with air beyond 10 psi.

SOURCE OF WATER SUPPLY

Water may be drafted from a pond, lake, stream, cistern, stocktank, or well. Whatever the source, the static lift must not exceed 20 ft from the center of the pump to the surface of the water, and a lift not exceeding 10 ft is recommended. The source of the supply should be reasonably clear and free from foreign matter. All water holes, which may be needed for fire protection, should be deepened if necessary and kept free from weeds and refuse. In many fire protection areas, cisterns or reservoirs are built and allowed to fill up with rainwater to be used in emergencies.

PUMPING IN COLD WEATHER

The first insurance against cold weather trouble is to keep the fire apparatus stored in heated quarters. All water must be eliminated from the pump casing and primer line between periods of operations.

When setting up for pumping, unnecessary delays should be avoided by having thoroughly trained pump operators. Be sure that the primer and booster lines are kept closed until ready for use. Have discharge lines ready so that the pump may be started as soon as it has become primed. Do not stop the flow of water through the pump until the pump is ready to drain and be returned to the station.

Engine coolant from the engine circulated through the heater jacket in the pump casing prevents all ordinary freezing troubles.

WHEN FINISHED PUMPING

Drain water out of the pump casing immediately. (The drain valve is located at the lowest point in the pump casing and is accessible from underneath the chassis.)

Don't forget to close all the drain cocks after all the water has been drained out. Otherwise, priming trouble will occur on the next run.

Shut off the cooling line to make the pump ready for priming again.

If the pump transmission is equipped with a transmission cooler, it must be drained also. If the master drain is located below the cooler outlets, it can be connected to the master drain. If not, two separate drains must be connected to the transmission cooler.

If the pump is equipped with an external heat exchanger, drain the heat exchanger using gravity and vacuum drain on all trucks as follows: Close all open lines and drain cocks. Open the cooler valve and open the air vent at the top or drain cock at the bottom of the heat exchanger, depending on model. With the pump air-tight, open the primer with the engine running for about 1 minute and then close the primer. Drain the pump of the water that was deposited when the heat exchanger and lines were being drained.

Pumps not often used for fire service should be inspected and run periodically to ensure that they will be in readiness for an emergency.

PUMPING SALTWATER

The pump should be flushed out with fresh water immediately after pumping saltwater to prevent excessive rusting (except pumps that are built of special material to resist the corrosive action of the brine.)

When measuring seawater with a Pitot gauge, capacities shown in *Table 1 on page 36* should be discounted approximately 1-1/2% to determine the correct capacity.

A centrifugal pump will show 2-1/2% higher pressure and require 2-1/2% more power when handling seawater than when handling fresh water if operated at the same speed and capacity.

TESTING OF EQUIPMENT FOR PRACTICE

Operators of fire apparatuses who are not thoroughly familiar with the apparatus operations become confused under the stress of emergency and neglect some little detail that may cause trouble or delay in getting the equipment into operation. Therefore, practice tests should be conducted repeatedly until operators are thoroughly trained. More than one person in the department should be a competent operator.

Practice should include pumping from low lifts and high lifts with short and long suction lines; with the suction line elevated to form an air trap; and from hydrants, at large and small capacities.

Note the effects of air leaks in the hose, insufficient submergence and restriction of the suction line. (The suction line can be restricted by placing a can or other strong closure around the suction strainer.)

NEVER BREAK OR RESTRICT SUCTION OR ALLOW AIR TO ENTER THE SUCTION LINE WHILE THE ENGINE IS OPERATING WITH THE THROTTLE OPEN. This will release the load and allow the engine to run away.

Do not allow personnel to hold a large nozzle while working at high pressures, as serious accidents may result if the hose breaks loose.

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MEASURING PUMP PERFORMANCE

Pump performance is measured by the quantity of water the pump can deliver per minute against a certain pressure called “Total Head” or “Net Pump Pressure,” as it is usually termed in fire pump testing.

The net pump pressure is the sum of the pump discharge pressure, as shown on the pressure gauge with which the pump is regularly equipped, and the total suction lift converted to equivalent pounds per square inch. If the pump is operating from a hydrant, the net pump pressure is the discharge pressure less the incoming pressure from the hydrant measured at the suction entrance of the pump.

Capacity of the fire pump is measured in gallons per minute. The usual method of measurement is to determine the pressure of the jet of water leaving a given size of nozzle by means of a Pitot gauge from which the capacity is computed mathematically.

A Pitot gauge consists of a small tube adapted to a point directly into the hose nozzle from the center of the issuing stream; the other end of the tube connects to an accurate pressure gauge.

The nozzle jet drives straight into the Pitot tube and converts the velocity of the jet to pressure, which is an accurate measure of velocity of the water as it leaves the nozzle. The tip of the Pitot tube should be one-half the diameter of the nozzle away from the nozzle tip while taking a reading. *Table 2 on page 41* shows nozzle capacities for various Pitot gauge readings.

If a Pitot gauge is not available, approximate pump capacities can be determined by referring to *Table 3 on page 44*.

ACCEPTANCE TESTS

Acceptance tests require continuous tests of 3 hours’ duration: 2 hours at 100% rated capacity and 150 psi net pump pressure; a half-hour at 70% capacity and 200 psi; a half-hour at 50% capacity and 250 psi; and a spurt test at 100% capacity and 165 psi.

Table 1 on page 36 shows recommended set-ups and gauge readings for rating tests.

To adjust the nozzle pressure for the correct capacity while maintaining the correct pump pressure, it is necessary to make simultaneous adjustments of the engine throttle and the discharge gate valve, partially closing the latter until just the right discharge resistance is built up.

ENGINES

An Underwriter fire pump imposes heavy loads on the engine that drives it, often absorbing all of the power the engine is capable of delivering at full throttle. Continuous pumping gives the engine no time to rest. Therefore, a new engine and pump unit must be thoroughly broken in before delivering prolonged maximum pump performance.

A minimum break-in period of 20 hours at light pumping loads is recommended, with occasional spurt tests and interruptions. Temperature and lubrication should be checked during this period.

Engine manufacturers’ power ratings usually show maximum performance of a selected, factory-adjusted engine, operating without the fan, generator, muffler or other accessories, and corrected for “ideal” conditions, such as sea level barometer (29.92 in. of mercury) 60° F and high humidity. Therefore, the actual power delivered by an average truck-mounted engine is considerably lower than the manufacturers’ rating, and allowances must be made in predicting pump performance.

EFFECTS OF ATMOSPHERIC CONDITIONS ON ENGINE AND PUMP PERFORMANCE

Each 1-in. drop in barometric pressure or each 1,000 ft of elevation of the pumping site reduces engine power approximately 3-1/2% for engines not equipped with a turbo charger.

Each 12° rise in temperature above 60° F of carburetor intake air reduces engine power approximately 1%. Lowering of humidity reduces power slightly.

Each 1-in. drop in barometric pressure or each 1,000 feet of elevation reduces the maximum possible static lift of a pump approximately 1 ft.

Temperature of the water supply affects the attainable suction lift of a pump. The effect is slight at low water temperatures but becomes increasingly detrimental as the temperature rises.

A 10° rise from 70° F subtracts about 1/2 ft from the maximum attainable suction lift, while an equal rise from 100° F will reduce the lift at least 1-1/2 ft.

Temperature is an important consideration when pumping from a test pit where the water is heated by recirculation.

DEFINITIONS

HEAD OF WATER: Vertical depth of water measured in feet or in pressure per unit or area. In hydraulics, head always represents pressure and it is expressed interchangeably in feet of water or pounds per square inch and sometimes in inches of depth of mercury.

STATIC HEAD: the pressure that is exerted by a stationary column of water of a given height or depth.

TOTAL HEAD OR TOTAL DYNAMIC HEAD: the maximum height above the source of supply to which the pump would elevate the water plus all the resistance to flow in the pipe or hose line.

DISCHARGE HEAD: the pressure measured at the discharge outlet of a pump.

SUCTION HEAD: the positive pressure measured at the suction entrance of a pump (when pumping from an elevated tank or hydrant).

VELOCITY HEAD: the equivalent pressure represented by fluid in motion as measured by means of a Pitot gauge.

STATIC LIFT: the vertical height of the center of the pump above the source of supply (when pumping from draft).

TOTAL SUCTION LIFT: the static lift plus the friction in the suction line plus entrance losses.

NET PUMP PRESSURE: the total dynamic head of the pump.

EFFECTIVE NOZZLE PRESSURE: the pump discharge pressure minus hose friction plus or minus the difference in elevation above or below the pump.

WATER HORSEPOWER: the theoretical power required to deliver a given quantity of water per minute against a given head.

BRAKE HORSEPOWER: actual power as delivered by a motor or engine to a driven machine.

PUMP EFFICIENCY: the quotient of the water horsepower divided by the brake horsepower required to produce it.

WATER HAMMER: a series of shock waves produced in a pipeline or pump by a sudden change in water velocity. A sudden change in flow velocity can result from the rapid closure of valves. A pressure wave is set up and travels back and forth in the water column at extremely high speed, producing rapid vibrations that may be violent and destructive if the water column is long.

THE MAXIMUM THEORETICAL LIFT of a pump is 34 ft, which is the pressure of the atmosphere at sea level. The maximum practical total lift at sea level is 20–25 ft (depending on the type and condition of the pump), and this decreases with drops in barometric pressure

OPERATING CHARACTERISTICS OF PUMPS

CENTRIFUGAL PUMPS: A centrifugal pump develops pressure by centrifugal force of the liquid rotating in the impeller wheel. The pressure developed depends upon the peripheral speed of the impeller (increasing as the square of the speed) and it remains fairly constant over a wide range of capacities up to the maximum output of the pump, if speed remains constant.

If the discharge outlet of a centrifugal pump is entirely shut off, with speed kept constant, there is a small rise in pressure, the water churns in the pump casing, and the power drops to a low value. If the discharge is opened wide, with little resistance to flow, the pressure drops while the capacity and power both increase to their maximum.

A centrifugal pump is an extremely simple mechanism mechanically, but it is complex hydraulically in that many factors enter into the design of the impeller and waterways, affecting the pump's efficiency.

DISPLACEMENT PUMPS: Rotary and piston pumps are termed "positive displacement" pumps because each revolution displaces or discharges (theoretically) an exact amount of liquid, regardless of the resistance. The capacity is, therefore, proportional to the number of revolutions of the pump per minute and independent of the discharge pressure except as it is reduced by "slip" (leakage past the pistons or rotors). For a given speed, the power is directly proportional to the head. If the discharge is completely shut off, the pressure, power, and torque climb indefinitely until the drive power is stalled or breakage occurs.

Slip is the greatest factor affecting efficiency of a displacement pump, and this factor is greatly influenced by the condition of and wears on the working parts.

CONVERSTION FACTORS

1 lb per square in.	=	2.31 ft of water
	=	2.04 inches of mercury
	=	27.7 inches of water
1 ft of water	=	0.43 lbs per square in.
1 in. of mercury	=	1.13 ft of water
	=	0.49 lbs per square in.
1 cu ft of water	=	62.4 lbs
		7.5 gal
1 gal of water	=	231 cubic in.
	=	0.13 cubic ft
	=	8.34 lbs
	=	3.8 liters
1 imperial gal	=	1.2 U.S. gals
atmospheric pressure (sea level)	=	14.8 lbs per square in
	=	29.9 in. of mercury
	=	34 ft of water

Table 1: National Fire Protection Assciation 1901 Test

Class A							
TEST No.	GPM	Recommended Nozzles	Min. Nozzle Press. PSI	Min. Disch. Press. PSI	Min. Net Pump Press. PSI	Disch. Lines	Suction Hose
250 GPM Fire Pump							
1	250	(1), 1 in.	72	143	150	(1), 50 ft	20 ft of 3 in.
2	175	(1), 7/8 in.	62	194	200		
3	125	(1), 3/4 in.	56	244	250		
4	250	(1), 1 in.	72	158	165		
350 GPM Fire Pump							
1	350	(1), 1-1/4 in.	58	144	150	(1), 50 ft	20 ft of 4 in.
2	245	(1), 1 in.	69	195	200		
3	175	(1), 1-7/8 in.	62	245	250		
4	350	(1), 1-1/4 in.	58	159	165		
500 GPM Fire Pump							
1	500	(1), 1-1/2 in.	57	143	150	(1), 50 ft	20 ft of 4 in.
2	350	(1), 1-1/4 in.	58	194	200		
3	250	(1), 1 in.	72	245	250		
4	500	(1), 1-1/2 in.	57	158	165		
750 GPM Fire Pump							
1	750	(1), 1-3/4 in. or (2), 1-1/4 in.	68 / 66	142	150	(2), 50 ft or (2), 100 ft Siamesed	20 ft of 4-1/2 in.
2	525	(1), 1-1/2 in.	62	193	200		
3	375	(1), 1-1/4 in.	66	244	250		
4	750	(1), 1-3/4 in. or (2), 1-1/4 in.	68 / 66	157	165		

Class A							
TEST No.	GPM	Recommended Nozzles	Min. Nozzle Press. PSI	Min. Disch. Press. PSI	Min. Net Pump Press. PSI	Disch. Lines	Suction Hose
1,000 GPM Fire Pump							
1	1,000	(1), 2 in. or (2), 1-1/2 in.	71 57	142	150	(2), 50 ft	
2	700	(1), 1-3/4 in. or (2), 1-1/4 in.	60 58	193	200	or	20 ft of 5 in.
3	500	(1), 1-1/2 in.	57	244	250	(3), 100 ft	
4	1,000	(1), 2 in. or (2), 1-1/2 in.	71 57	157	165	Siamesed	
1,250 GPM Fire Pump							
1	1,250	(1), 2-1/4 in. or (2), 1-1/2 in.	69 88	143	150	(3), 50 ft	
2	875	(1), 2 in. or (2), 1-3/8 in.	55 61	194	200	or	
3	625	(1), 1-1/2 in.	88	245	250	(3), 100 ft	20 ft of 6 in.
4	1,250	2-1/4 in. or (2), 1-1/2 in.	69 88	158	165	and (1), 50 ft Siamesed	

Class A							
TEST No.	GPM	Recommended Nozzles	Min. Nozzle Press. PSI	Min. Disch. Press. PSI	Min. Net Pump Press. PSI	Disch. Lines	Suction Hose
1,500 GPM Fire Pump							
1	1,500	(2), 1-3/4 in. or (3), 1-1/2 in.	68 57	142	150	(3), 50 ft	20 ft of 6 in. min. or (2) 20 ft of 6 in. max.
2	1,050	(1), 2 in. or (2), 1-1/2 in.	78 62	194	200	or	
3	750	(1), 1-3/4 in. or (2), 1-1/4 in.	68 66	245	250	(3), 100 ft and (1), 50 ft	
4	1,500	(2), 1-3/4 in. or (3), 1-1/2 in.	68 57	157	165	Siamesed	
1,750 GPM Fire Pump							
1	1,750	(2), 2 in. or (3), 1-1/2 in.	55 76	143	150	(4), 50 ft	(2) 20 ft of 6 in.
2	1,225	(2), 1-5/8 in. or (2), 1-1/2 in. or (3), 1-1/4 in.	61 84 79	194	200	or	
3	875	(1), 2 in. or (2), 1-3/8 in.	55 61	245	250	(4), 100 ft	
4	1,750	(2), 2 in. or (3), 1-1/2 in.	55 76	158	165		

Class A							
TEST No.	GPM	Recommended Nozzles	Min. Nozzle Press. PSI	Min. Disch. Press. PSI	Min. Net Pump Press. PSI	Disch. Lines	Suction Hose
2,000 GPM Fire Pump							
1	2,000	(2), 2 in. or (4), 1-1/2 in.	71 57	147	150	(4), 50 ft or (4), 100 ft	(2) 20 ft of 6 in.
2	1,400	(2), 1-3/4 in. or (3), 1-1/2 in.	60 49	199	200		
3	1,000	(1), 2 in. or (2), 1-1/2 in.	71 57	249	250		
4	1,750	(2), 2 in. or (4), 1-1/2 in.	71 57	163	165		
2,250 GPM Fire Pump							
1	2,250	(2), 2-1/4 in.	56	144	150	(2 groups) (3), 100 ft Siamesed	20 ft of 8 in.
2	1,575	(2), 1-3/4 in.	76	196	200		
3	1,125	(2), 1-1/2 in.	72	246	250		
4	2,250	(2), 2-1/4 in.	56	153	165		
2,500 GPM Fire Pump							
1	2,500	(2), 2-1/4 in.	69	144	150	(2 groups) (3), 100 ft Siamesed	20 ft of 8 in.
2	1,750	(2), 2 in.	55	195	200		
3	1,250	(2), 1-1/2 in.	88	246	250		
4	2,500	(2), 2-1/4 in.	69	159	165		

Class A							
TEST No.	GPM	Recommended Nozzles	Min. Nozzle Press. PSI	Min. Disch. Press. PSI	Min. Net Pump Press. PSI	Disch. Lines	Suction Hose
3,000 GPM Fire Pump							
						(2 groups)	
1	3,000	(2), 2-1/2 in.	65	146	150	(3), 100 ft	
2	2,100	(2), 2 in.	78	196	200	Siamesed	(2) 20 ft of 8 in.
3	1,500	(2), 1-3/4 in.	68	247	250		
4	3,000	(2), 2-1/2 in.	65	161	165		
3,000 GPM Industrial Fire Pump							
						(2 groups)	
1	3,000	(2), 2-1/2 in.	65	96	100	(3), 100 ft	(2) 20 ft of 8 in.
2	2,100	(2), 2 in.	78	146	150	Siamesed	
3	1,500	(2) 1-3/4 in.	68	197	200		
3,500 GPM Industrial Fire Pump							
		(2), 2-1/2 in.	45	95	100	(2 groups)	
1	3,500	and				(3), 100 ft	
		(1), 2-1/4 in.	44			Siamesed	(2) 20 ft of 8 in.
2	2,450	(2), 2-1/4 in.	67	146	150	and	
3	1,750	(2), 2 in.	55	197	200	(2) 50 ft	
						Siamesed	

Minimum discharge pressures listed above are for pumps operating with full 10 ft static suction lift. These pressures must be increased by 1 psi for each 2.3 ft less than 10 ft of lift.

Table 2: Discharge from Smooth Bore Nozzle
Pressures measured by Pitot gauge

Nozzle Pressure (psi)	1/4 in.	3/8 in.	1/2 in.	5/8 in.	3/4 in.	7/8 in.	1 in.	1-1/8 in.	1-1/4 in.	1-3/8 in.	1-1/2 in.	1-5/8 in.	1-3/4 in.	2 in.	2-1/4 in.	2-1/2 in.
	GALLONS PER MINUTE DELIVERED															
5	4	9	16	26	37	50	66	84	103	125	149	175	203	266	337	415
6	4	10	18	28	41	55	72	92	113	137	163	192	223	292	369	455
7	4	11	19	30	44	59	78	99	122	148	176	207	241	315	399	491
8	5	11	21	32	47	64	84	106	131	158	188	222	257	336	427	525
9	5	12	22	34	50	67	89	112	139	168	200	235	273	357	452	557
10	6	13	23	36	53	71	93	118	146	177	211	248	288	376	477	587
12	6	15	25	40	58	78	102	130	160	194	231	271	315	412	522	643
14	7	15	27	43	63	84	110	140	173	210	249	293	340	445	564	695
16	7	16	29	46	67	90	118	150	185	224	267	313	364	475	603	743
18	7	17	31	49	71	95	125	159	196	237	283	332	386	504	640	788
20	8	18	33	51	75	101	132	167	206	250	298	350	407	532	674	830
22	8	19	34	54	79	105	139	175	216	263	313	367	427	557	707	871
24	8	20	36	56	82	110	145	183	226	275	327	384	446	582	739	909
26	9	21	37	59	85	115	151	191	235	286	340	400	464	606	769	947
28	9	21	39	61	89	119	157	198	244	297	353	415	481	629	799	982
30	10	22	40	63	92	123	162	205	253	307	365	429	498	651	826	1017
32	10	23	41	65	95	127	167	212	261	317	377	443	514	673	854	1050
34	11	23	43	67	98	131	172	218	269	327	389	457	530	693	880	1082
36	11	24	44	69	100	135	177	224	277	336	400	470	546	713	905	1114
38	11	25	45	71	103	138	182	231	285	345	411	483	561	733	930	1144

Nozzle Pressure (psi)	1/4 in.	3/8 in.	1/2 in.	5/8 in.	3/4 in.	7/8 in.	1 in.	1-1/8 in.	1-1/4 in.	1-3/8 in.	1-1/2 in.	1-5/8 in.	1-3/4 in.	2 in.	2-1/4 in.	2-1/2 in.
	GALLONS PER MINUTE DELIVERED															
40	11	26	46	73	106	142	187	237	292	354	422	496	575	752	954	1174
42	11	26	47	74	109	146	192	243	299	363	432	508	589	770	978	1203
44	12	27	49	76	111	149	196	248	306	372	442	520	603	788	1000	1231
46	12	28	50	78	114	152	200	254	313	380	452	531	617	806	1021	1259
48	12	28	51	80	116	156	205	259	320	388	462	543	630	824	1043	1286
50	13	29	52	81	118	159	209	265	326	693	472	554	643	841	1065	1313
52	13	29	53	83	121	162	213	270	333	404	481	565	656	857	1087	1339
54	13	30	54	84	123	165	217	275	339	412	490	576	668	873	1108	1364
56	13	30	56	86	125	168	221	280	345	419	499	586	680	889	1129	1389
58	13	31	56	87	128	171	225	285	351	426	508	596	692	905	1149	1414
60	14	31	57	89	130	174	229	290	357	434	517	607	704	920	1165	1437
62	14	32	58	90	132	177	233	295	363	441	525	617	716	936	1187	1462
64	14	32	59	92	134	180	237	299	369	448	533	627	727	951	1206	1485
66	14	33	60	93	136	182	240	304	375	455	542	636	738	965	1224	1508
68	14	33	60	95	138	185	244	308	381	462	550	646	750	980	1242	1531
70	15	34	61	96	140	188	247	313	386	469	558	655	761	994	1260	1553
72	15	34	62	97	142	191	251	318	391	475	566	665	771	1008	1278	1575
74	15	35	63	99	144	193	254	322	397	482	574	674	782	1023	1296	1597
76	15	35	64	100	146	196	258	326	402	488	582	683	792	1036	1313	1618
78	15	36	65	101	148	198	261	330	407	494	589	692	803	1050	1330	1639
80	16	36	66	103	150	201	264	335	413	500	596	700	813	1,063	1,347	1,660
82	16	37	66	104	152	204	268	339	418	507	604	709	823	1,076	1,364	1,681
84	16	37	67	105	154	206	271	343	423	513	611	718	833	1,089	1,380	1,701
86	16	37	68	107	155	208	274	347	428	519	618	726	843	1,102	1,396	1,721
88	16	38	69	108	157	211	277	351	433	525	626	735	853	1,115	1,412	1,741

Nozzle Pressure (psi)	1/4 in.	3/8 in.	1/2 in.	5/8 in.	3/4 in.	7/8 in.	1 in.	1-1/8 in.	1-1/4 in.	1-3/8 in.	1-1/2 in.	1-5/8 in.	1-3/4 in.	2 in.	2-1/4 in.	2-1/2 in.
	GALLONS PER MINUTE DELIVERED															
90	17	39	70	109	159	213	280	355	438	531	633	743	862	1,128	1,429	1,761
92	17	39	70	110	161	215	283	359	443	537	640	751	872	1,140	1,445	1,780
94	17	39	71	111	162	218	286	363	447	543	647	759	881	1,152	1,460	1,800
96	17	40	72	113	164	220	289	367	452	549	654	767	890	1,164	1,476	1,819
98	17	40	73	114	166	223	292	370	456	554	660	775	900	1,176	1,491	1,828
100	18	41	73	115	168	225	295	375	461	560	667	783	909	1,189	1,506	1,856
105	18	42	75	118	172	230	303	383	473	574	683	803	932	1,218	1,542	1,902
110	19	43	77	121	176	236	310	392	484	588	699	822	954	1,247	1,579	1,947
115	19	43	79	123	180	241	317	401	495	600	715	840	975	1,275	1,615	1,991
120	19	44	80	126	183	246	324	410	505	613	730	858	996	1,303	1,649	2,033
125	20	45	82	129	187	251	331	418	516	626	745	876	1,016	1,329	1,683	2,075
130	20	46	84	131	191	256	337	427	526	638	760	893	1,036	1,356	1,717	2,116
135	21	47	85	134	195	262	343	435	536	650	775	910	1,056	1,382	1,750	2,157
140	21	48	87	136	198	266	350	443	546	662	789	927	1,076	1,407	1,780	2,196
145	21	49	88	139	202	271	356	450	556	674	803	944	1,095	1,432	1,812	2,235
150	22	50	90	141	205	275	362	458	565	686	817	960	1,114	1,456	1,843	2,273

Table 3: Approximate Discharge Flow from Different Nozzles at the End of 50 ft of Average, 2-1/2 in. Rubber-Lined Fire Hose, for Various Pump Pressures with Discharge Valve Wide Open

Pump Pressure (lb)	Size of nozzle (in.) and gallons per minute						
	3/4	7/8	1	1-1/8	1-1/4	1-3/8	1-1/2
30	90	119	153	187	217	250	282
40	103	137	177	216	253	290	327
50	115	153	198	242	284	325	367
60	126	168	216	265	311	357	402
70	136	182	234	287	337	385	435
80	145	194	250	308	361	414	465
90	154	206	265	325	383	437	492
100	162	217	280	343	405	462	520
110	171	228	295	360	425	485	549
120	179	239	307	377	444	510	572
130	186	249	318	392	462	530	596
140	193	258	330	407	480	549	618
150	200	267	341	421	497	567	
175	215	288	374	455	538		
200	230	309	395	486			
225	243	328	420				
250	257	345					

This table is offered as an aide in testing pump performance where facilities for accurate measurement of capacity are not available. The capacities given above are conservative and will not vary more than 5% from actual capacities with any of the standard hose that might be used.

Table 4: Pump or Hydrant Pressure Required to Give Effective Nozzle Pressure through Various Lengths of Rubber-Lined Hose

Size of Hose (in.)		1	1-1/2			2		2-1/2					3	
Size of Nozzle (in.)		1/4	3/8	1/2	5/8	5/8	3/4	3/4	7/8	1	1-1/4	1-1/2	1-1/4	1-1/2
Nozzle Press. (psi)	Length of Hose (feet)	PUMP OR HYDRANT PRESSURE – PSI												
40	100	45	43	48	60	42	50	44	46	51	64	88	51	62
	200	49	46	56	79	43	60	47	52	60	86	130	59	78
	400	58	51	73	118	46	79	53	62	79	129	212	75	110
	600	67	57	89	158	50	99	59	74	97	172		92	143
	800	76	62	106	196	53	119	65	85	116	215		108	176
	1,000	85	68	122	235	56	138	72	96	134	258		124	208
	1,500	108	72	142		64	187	87	118	181			165	
	2,000	130	96	204		72	226	103	151	227			205	
60	100	67	64	72	89	63	73	65	69	75	95	132	76	92
	200	74	68	84	117	65	86	70	78	89	126	196	88	115
	400	87	76	107	173	69	112	79	94	116	188		111	161
	600	101	85	131	231	74	138	88	111	143	250		135	208
	800	114	93	153		79	164	98	127	170			158	
	1,000	127	101	178		83	190	107	143	197			182	
	1,500	161	122	237		95	155	130	184	264				
	2,000	195	142			106		153	225					
80	100	88	85	96	117	83	99	87	92	99	126	175	101	103
	200	97	91	112	154	86	117	93	103	115	167		116	154
	400	115	102	143	228	92	154	105	125	148	249		147	
	600	132	112	175		98	191	117	147	181		178		
	800	150	123	206		104	228	129	167	214			209	

Size of Hose (in.)		1	1-1/2			2		2-1/2					3	
Size of Nozzle (in.)		1/4	3/8	1/2	5/8	5/8	3/4	3/4	7/8	1	1-1/4	1-1/2	1-1/4	1-1/2
Nozzle Press. (psi)	Length of Hose (feet)	PUMP OR HYDRANT PRESSURE – PSI												
	1,000	167	134	238		110		141	191	247				
	2,000	254	188			140		201						
100	100	111	107	120	146	104	123	108	115	125	157		126	152
	200	122	113	139	192	108	145	116	128	150	209		146	190
	400	143	127	177	284	115	190	130	154	200			184	
	600	165	140	217		123	235	145	180	250			223	
	800	186	154	256		131		159	206					
	1,000	208	167			138		174	232					
	1,500	262	200			157		211						
	2,000		234			175		253						

Table 5: Reach of Fire Streams

Size of Nozzle	1/4 in.	3/8 in.	1/2 in.	5/8 in.	3/4 in.	7/8 in.	1 in.	1-1/4 in.	1-1/2 in.
NOZZLE PRESSURE	**EFFECTIVE VERTICAL REACH – FT**								
40	30	35	40	50	59	62	64	65	69
60	35	40	45	60	74	77	79	84	87
80	38	42	48	65	81	85	89	94	96
100	40	44	50	68	84	89	94	100	102
NOZZLE PRESSURE	**MAXIMUM VERTICAL REACH – FT**								
40	60	65	70	75	78	79	80	80	80
60	70	75	85	95	105	106	108	110	110

Size of Nozzle	1/4 in.	3/8 in.	1/2 in.	5/8 in.	3/4 in.	7/8 in.	1 in.	1-1/4 in.	1-1/2 in.
80	78	83	95	105	117	125	132	140	140
100	80	88	100	110	122	135	145	155	155
NOZZLE PRESSURE	**EFFECTIVE HORIZONTAL REACH – FT**								
40	20	25	30	40	44	50	55	62	66
60	25	32	37	50	54	61	67	75	80
80	28	35	40	57	62	70	76	84	88
100	30	37	42	60	66	76	84	93	95
NOZZLE PRESSURE	**MAXIMUM HORIZONTAL REACH – FT**								
40	65	80	90	100	108	120	125	138	140
60	80	95	95	120	127	142	156	176	183
80	90	105	105	135	143	160	175	201	210
100	95	110	110	140	153	180	205	215	223

Table 6: Friction Loss in Fire Hose
Loss in psi per 100 ft of Hose

SIZE HOSE	LINEN HOSE	BEST RUBBER-LINED HOSE									
GPM	1-1/2 in.	2 in.	2-1/2 in.	3/4 in.	1 in.	1-1/2 in.	2 in.	2-1/2 in.	3 in.	3-1/2 in.	(2) 2-1/2 in.
10	1.0			13.5	3.5	0.5	0.1				
15	2.2			29.0	7.2	1.0	0.3				
20	3.6			50.0	12.3	1.7	0.4				
25	5.5			75.0	18.5	2.6	0.6				
30	8.0	1.9		105.0	26.0	3.6	0.9				
40	13.0	3.2		180.0	44.0	6.1	1.5				
50	20.0	4.9	1.6		67.0	9.3	2.3				
60	28.0	7.0	2.2		96.0	13.5	3.3				
70	37.0	9.0	3.1		131.0	17.0	4.3				
80	47.0	11.5	3.8		171.0	23.0	5.6				
90	59.0	14.5	5.0		217.0	29.0	7.0				
100	72.0	17.5	5.9		268.0	33.0	8.4				
120		25.0	8.3		386.0	47.0	11.7				
140		34.0	11.0			62.0	16.0	5.2	2.0	0.9	1.4
160		43.0	14.0			78.0	20.0	6.6	2.6	1.2	1.9
180		53.0	17.7			97.0	25.0	8.3	3.2	1.5	2.3
200		63.0	21.5			121.0	30.6	10.1	3.9	1.8	2.8
220						146.0		12.0	4.6	2.1	3.3
240						173.0		14.1	5.4	2.5	3.9
260						204.0		16.4	6.3	2.9	4.5
280						237.0		18.7	7.2	3.3	5.2
300						272.0		21.2	8.2	3.7	5.9
320								23.8	9.3	4.2	6.6

SIZE HOSE	LINEN HOSE	BEST RUBBER-LINED HOSE									
GPM	1-1/2 in.	2 in.	2-1/2 in.	3/4 in.	1 in.	1-1/2 in.	2 in.	2-1/2 in.	3 in.	3-1/2 in.	(2) 2-1/2 in.
340								26.9	10.5	4.7	7.4
360								30.0	11.5	5.2	8.3
380								33.0	12.8	5.8	9.2
400								36.2	14.1	6.3	10.1
425								40.8	15.7	7.0	11.3
450								45.2	17.5	7.9	12.5
475								50.0	19.3	8.7	13.8
500								55.0	21.2	9.5	15.2
525									23.2	10.5	16.6
550									25.2	11.4	18.1
575									27.5	12.4	19.6
600									29.9	13.4	21.2
650									34.5	15.5	24.8
700									39.5	17.7	28.3
750									45.0	20.1	32.2
800									50.5	22.7	36.2
850									56.5	25.4	40.7
900									63.0	28.2	45.2
1000									76.5	34.3	55.0

Losses in rough-walled, rubber hose may be 50% higher than values given above.

Table 7: Friction Loss in 15-year-old Steel Pipe

Loss in psi per 100 ft of Pipe

PIPE SIZE / GPM	1/8 in.	1/4 in.	3/8 in.	1/2 in.	3/4 in.	1 in.	1-1/4 in.	1-1/2 in.	2 in.	2-1/2 in.	3 in.	4 in.	6 in.	8 in.
1	52.0	12.0	2.8	0.9										
2		45.0	10.0	3.2	4.0									
5			55.0	18.0	4.5	1.4	0.4							
10				64.0	16.0	5.0	1.3	0.6						
15				135.0	34.0	11.0	2.7	1.3	0.5					
20					59.0	18.0	4.7	2.2	0.8					
25					89.0	27.0	7.1	3.4	1.2					
30					125.0	39.0	10.0	4.7	1.7	0.6				
35						51.0	13.0	6.3	2.2	0.7				
40						66.0	17.0	8.0	2.9	0.9				
45						82.0	21.0	10.0	3.6	1.2				
50						99.0	26.0	12.0	4.3	1.4	0.6			
60						140.0	38.0	17.0	6.1	2.0	0.8			
70							49.0	23.0	8.0	2.7	1.1			
80							63.0	29.0	10.0	3.4	1.5			
90							78.0	36.0	13.0	4.3	1.8			
100							96.0	44.0	15.0	5.1	2.2	0.5		
125							144.0	66.0	24.0	7.8	3.3	0.8		
150								93.0	33.0	11.0	4.6	1.1		
175								125.0	44.0	15.0	6.1	1.5		
200									56.0	19.0	7.8	1.9		
250									84.0	28.0	12.0	2.9		
300									114.0	40.0	16.0	4.0	0.6	

PIPE SIZE	1/8 in.	1/4 in.	3/8 in.	1/2 in.	3/4 in.	1 in.	1-1/4 in.	1-1/2 in.	2 in.	2-1/2 in.	3 in.	4 in.	6 in.	8 in.
GPM														
350										53.0	22.0	5.4	0.8	
400										68.0	28.0	6.9	1.0	
450										84.0	35.0	8.6	1.2	
500										102.0	42.0	10.0	1.4	0.4
600											60.0	15.0	2.1	0.6
800												25.0	3.5	1.0
1,000												37.0	5.2	1.3
1,500													11.0	2.7
2,000													19.0	4.7
2,500													29.0	7.1
3,000														10.0

Table 8: Resistance of Fittings
Equivalent Lengths of Straight Pipe – Feet

PIPE SIZE (in.)	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2	3	4	5	6	8
Gate Valve	0.4	0.6	0.8	1.1	1.4	1.8	2.2	2.8	4.1	5.3	6.7	9.4
Global Valve	3.0	4.5	6.0	8.5	10.5	14.0	17.0	22.0	32.0	42.0	53.0	75.0
Angle Valve	1.4	2.0	2.7	3.8	4.8	6.3	7.9	10.5	14.5	18.5	23.0	33.0
Std. Elbow	1.1	1.5	2.0	2.8	3.5	4.7	5.8	7.5	11.0	14.0	18.0	24.0
45 Elbow	0.6	0.8	1.0	1.4	1.6	2.1	2.5	3.1	4.2	5.2	6.3	8.5
Long Sweep El Str Run Tee	0.5	0.8	1.0	1.4	1.7	2.3	2.8	3.7	5.3	7.0	9.0	12.5
Std. Tee Thru Side Outlet	2.1	2.9	3.9	5.5	6.9	9.1	11.6	14.8	21.0	27.0	34.0	49.0
Sudden Enlarg or contraction	1.8	2.5	3.2	4.2	5.0	6.5	7.5	9.5	13.0	16.0	19.0	25.0

PIPE SIZE (in.)	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2	3	4	5	6	8
Entrance to Pipe	1.0	1.3	1.6	2.2	2.6	3.3	3.9	4.9	6.5	8.2	10.0	13.0

Table 9: To Convert Pounds per Square Inch to Ft Elevation of Water
2.308 ft head = 1.0 psi
1 ft head = 0.433 psi

Feet	5	10	15	20	25	30	35	40	45	50	60	70	80	90
Pounds	2.2	4.3	6.5	8.7	11	13	15	17	20	22	26	30	35	39
Feet	**100**	**120**	**130**	**140**	**150**	**160**	**170**	**180**	**190**	**200**	**220**	**240**	**260**	**280**
Pounds	**43**	**52**	**56**	**61**	**65**	**69**	**74**	**78**	**82**	**87**	**95**	**104**	**113**	**121**
Feet	300	320	340	360	380	400	425	450	475	500	525	550	600	700
Pounds	130	139	147	156	165	173	184	195	206	217	227	238	260	303

Table 10: American National Fire Hose Connection Screw Thread – NH

Size of Hose (in.)	3/4	1	1-1/2	2-1/2	3	3-1/2	4	4-1/2	5	6	8
Threads per inch	8	8	9	7.5	6	6	4	4	4	4	4
Thread Designation	0.75-8 NH	1-8 NH	1.5-9 NH	2.5-7.5 NH	3-6 NH	3.5-6 NH	4-4 NH	4.5-4 NH	5-4 NH	6-4 NH	8-4NH
Max. OD Male	1.375	1.375	1.99	3.0686	3.6239	4.2439	5.0109	5.7609	6.26	7.025	9.05

Underwriters Nozzle Tip Thread: 2.1875 OD -12 threads per in.

Ref. National Fire Protection Association (NFPA) 1963

IF FURTHER INFORMATION IS NEEDED, CALL W.S. DARLEY & CO. AT CHIPPEWA FALLS, WI AT 800-634-7812 or 715-726-2650

OPERATING INSTRUCTIONS – ELECTRIC PRIMING PUMP

The Darley electric primer will develop up to 25 in. Hg in an air-tight pumping system.

The primer is activated by a combination spring return on-off valve and electric switch. Pulling the valve out opens the valve and closes the electrical circuit to start the motor.

Before the pump can be primed, booster line valves, drain valves, cooling line valve, and all other openings into the pump must be closed and absolutely air-tight. The discharge side of the pump is sealed by a check valve. Therefore, the main discharge valves need not be closed.

When operating from draft, suction hose connections must be tight and free of air leaks. Make certain the suction hose strainer is properly submerged and free of foreign material.

The main pump drive should remain disengaged until priming is complete to prevent possible damage to impeller seal rings by running "dry."

Pull the primer shut-off valve all the way out to start priming and hold open until water discharges from the primer pump exhaust port. Push the valve all the way in to shut off the primer motor and seal tight.

NOTICE

For Priming Up to 10 ft of Lift: *If water does not discharge from the primer exhaust within about 30 seconds (45 seconds with two 20 ft lengths of hose), stop the primer pump, check for air leaks, and make sure primer pump is receiving lubricant from its reservoir, if one is present. Maximum primer operation time is 90 seconds every 5 minutes. Do not exceed 90 seconds of primer operation.*

NOTICE

For Priming 10 ft of Lift and Higher: *If water does not discharge from the primer exhaust within 90 seconds, stop the primer pump, check for air leaks, and make sure primer pump is receiving lubricant from its reservoir, if one is present. Do not exceed 90 seconds of primer operation.*

NOTICE

The primer pump and motor will begin to generate heat as soon as operation begins. Extended run times (up to 90 seconds) and repeating priming cycles consecutively or within short time periods may lead to premature failure of the primer pump assembly. Such failures include but are not limited to overheating of the motor, seizure of the rotor, and cracking of primer vanes. To avoid this, after your first priming attempt, thoroughly inspect the pump system for air leaks, check that the primer is receiving lubricant from its reservoir if such is present, and resolve the issue before attempting re-prime.

Engage "Pump" shift to start pumping water.

When pumping from hydrants, the primer is not needed and must be kept closed.

It may be necessary to use the primer momentarily when pumping from a booster tank when the suction head is insufficient to force all the air out of the pump.

LUBRICATING SYSTEM – ELECTRIC PRIMING PUMPS WITH FLUID RESERVOIR

The electric motor rotary van primer pump creates a high vacuum by continuous lubrication of rotor and vanes. Therefore the primer lubricant supply tanks (4 quarts) should be kept full at all times. Recommended primer system lubricant is Darley PRIME GREEN. PRIME GREEN is an environmentally safe, non-toxic, biodegradable lubricant. Its use assures proper primer vane lubricant while minimizing environmental effects.

After the main pump is drained, run the primer motor to drain primer lines and re-lubricate the primer pump.

The vent hold on the lubricant tank cap should be kept open at all times to prevent siphoning lubricant from the tank after pump is stopped. Do not increase the size of the hole.

Locate the lubricant tank where it may be conveniently inspected and filled.

Should water appear in the lubricant supply tank, the primer valve is leaking.

Check and replace valve plug seal O-ring if necessary.

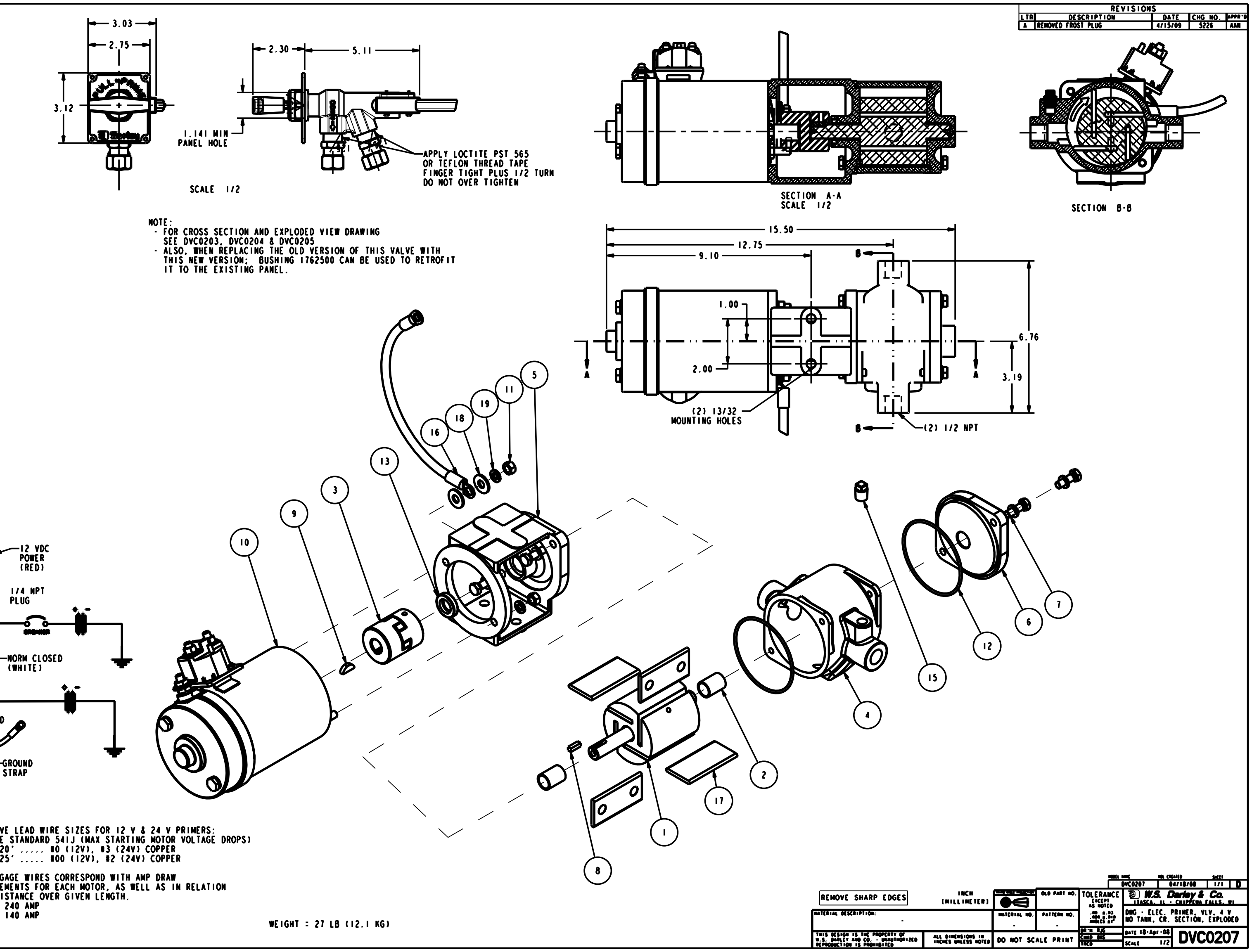
ELECTRIC PRIMING PUMPS WITHOUT FLUID RESERVOIR

The fluidless electric-motor rotary-vane primer pump creates a high vacuum by using a special material for the vanes and an initial factory-applied lubricant film. This film must be present in order for the primer to operate properly and to provide maximum life for the primer components.

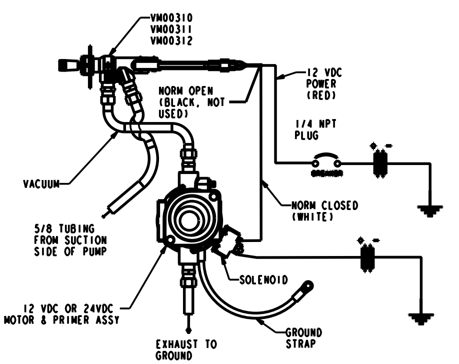
This film will not wash away completely if the pump is used to pump water. If the priming pump is disassembled for any reason, all internal surfaces of the housing and end caps must be coated completely with Dow Corning #111 Silicone valve lubricant prior to operating the primer. If after several years, a degradation of performance is noticed, performance may be restored by re-applying the film in this manner.

After the main pump is drained, run the primer motor to drain primer lines.

NO.	DESCRIPTION	PART NO.	QTY.
1	ASSEMBLY - PRIMER, ROTOR	4420105	1
2	BEARING - OILITE, 0.626 ID	1760023	2
3	COUPLING - #44093	2404500	1
4	CYLINDER - VACUUM PUMP	1020800	1
5	HEAD - CYLINDER INBOARD	2808904	1
6	HEAD - CYLINDER, OUTBOARD	2808800	1
7	HHCS - .313-18 x 1.00, SST	5400610	4
8	KEY - SQ., 0.19 X 0.62 GR2	3602425	1
9	KEY - WOODRUFF, 606	3602200	1
10	MOTOR - PRIMER, 12V	4223400	1
11	NUT - HEX, .313-15, SST	5403024	2
12	O-RING - 3.50 x 3.69 x 0.09	3601101	2
13	OIL SEAL - 0.625 ID X 1.128 OD	3600505	1
15	PLUG - PIPE, 0.250, BR SQ HD	1080504	1
16	STRAP - GROUND, 12V PRIMER	2600516	1
17	VANE - ROTOR, ELEC PRIMER	4407601	4
18	WASHER - FLAT, 5/16, STEEL	3603802	2
19	WASHER - LOCK, 0.313 ID	3603502	6



NOTE:
- FOR CROSS SECTION AND EXPLODED VIEW DRAWING SEE DVC0203, DVC0204 & DVC0205
- ALSO, WHEN REPLACING THE OLD VERSION OF THIS VALVE WITH THIS NEW VERSION; BUSHING 1762500 CAN BE USED TO RETROFIT IT TO THE EXISTING PANEL.



NOTE:

MOUNT WITH EXHAUST OUTLET DOWN

CONNECT 4 GA COPPER GROUND STRAP TO CLEAN, PAINT FREE GROUNDING SURFACE

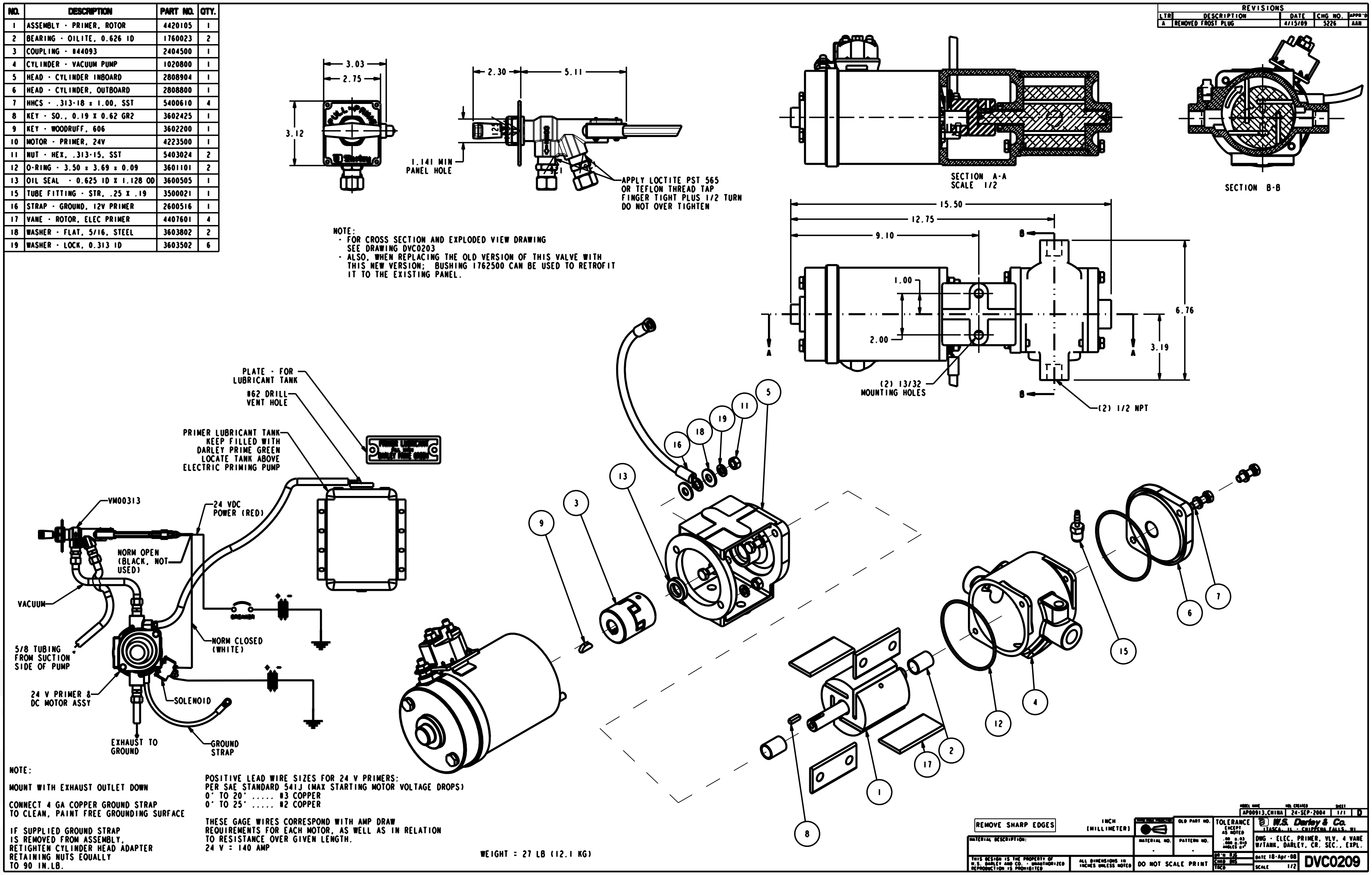
IF SUPPLIED GROUND STRAP IS REMOVED FROM ASSEMBLY, RETIGHTEN CYLINDER HEAD ADAPTER RETAINING NUTS EQUALLY TO 90 IN.LB.

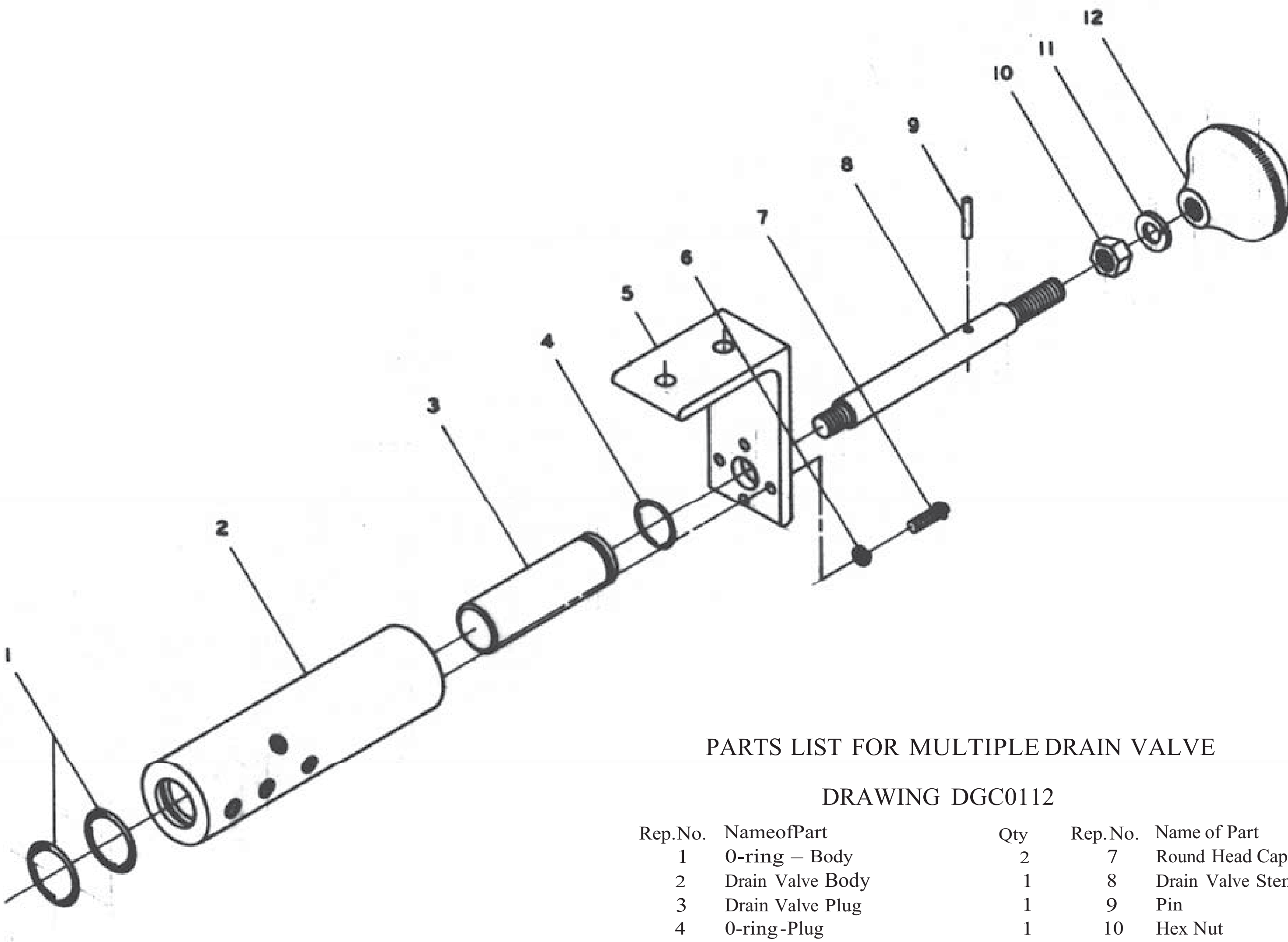
POSITIVE LEAD WIRE SIZES FOR 12 V & 24 V PRIMERS:
PER SAE STANDARD 541J (MAX STARTING MOTOR VOLTAGE DROPS)
0' TO 20' ..... #0 (12V), #3 (24V) COPPER
0' TO 25' ..... #00 (12V), #2 (24V) COPPER

THESE GAGE WIRES CORRESPOND WITH AMP DRAW REQUIREMENTS FOR EACH MOTOR, AS WELL AS IN RELATION TO RESISTANCE OVER GIVEN LENGTH.
12 V = 240 AMP
24 V = 140 AMP

WEIGHT = 27 LB (12.1 KG)

NO.	DESCRIPTION	PART NO.	QTY.
1	ASSEMBLY - PRIMER, ROTOR	4420105	1
2	BEARING - OILITE, 0.626 ID	1760023	2
3	COUPLING - #44093	2404500	1
4	CYLINDER - VACUUM PUMP	1020800	1
5	HEAD - CYLINDER INBOARD	2808904	1
6	HEAD - CYLINDER, OUTBOARD	2808800	1
7	HHCS - .313-18 x 1.00, SST	5400610	4
8	KEY - SQ., 0.19 X 0.62 GR2	3602425	1
9	KEY - WOODRUFF, 606	3602200	1
10	MOTOR - PRIMER, 24V	4223500	1
11	NUT - HEX, .313-15, SST	5403024	2
12	O-RING - 3.50 x 3.69 x 0.09	3601101	2
13	OIL SEAL - 0.625 ID X 1.128 OD	3600505	1
15	TUBE FITTING - STR, .25 X .19	3500021	1
16	STRAP - GROUND, 12V PRIMER	2600516	1
17	VANE - ROTOR, ELEC PRIMER	4407601	4
18	WASHER - FLAT, 5/16, STEEL	3603802	2
19	WASHER - LOCK, 0.313 ID	3603502	6





PARTS LIST FOR MULTIPLE DRAIN VALVE

DRAWING DGC0112

Rep.No.	NameofPart	Qty	Rep.No.	Name of Part	Qty
1	0-ring – Body	2	7	Round Head Cap Screw	4
2	Drain Valve Body	1	8	Drain Valve Stem	1
3	Drain Valve Plug	1	9	Pin	1
4	0-ring-Plug	1	10	Hex Nut	1
5	Drain Valve Mounting Bracket	1	11	Lock Washer	1
6	Lock Washer	4	12	Knob	1

NO.	DESCRIPTION	PART NO.	QTY.	
1	BEARING - OILITE, 0.500 ID	1760024	1	
2	BODY - MULTI DRAIN VALVE	5329401	1	(B)
3	BRACKET - MULTI DRAIN VALVE	4031300	1	
4	CAP - MULTI DRAIN VALVE	5323802	1	
5	DECAL - DRAIN VALVE	1963200	1	
6	GREASE ZERK - .25-28	4403200	1	
7	HANDWHEEL	3001800	1	
8	HHCS - .250-20 x 0.88, 18-8	5400658	2	(D)
9	O-RING - 0.38 x 0.50 x 0.06	3601000	1	
10	O-RING - 1.62 x 2.00 x 0.19	3601305	1	
11	RHMS - NO.10-24 x 0.50, SST	5402046	3	
12	RING - RETAINER, 68011	3600435	1	
13	SEAL - MULTI DRAIN VALVE	3802602	1	
14	SSS - 1/4-20 x 0.38, SST	5402603	1	
15	STEM - MULTIPLE DRAIN VALVE	5241302	1	
16	WASHER - .52 X 1.12 X .12	3603319	1	
17	NUT - JAM, .500-20, 18-8 SST	5403219	1	(C)
18	NUT - HEX, .250-20, 18-8 SST	5403027	2	(E)

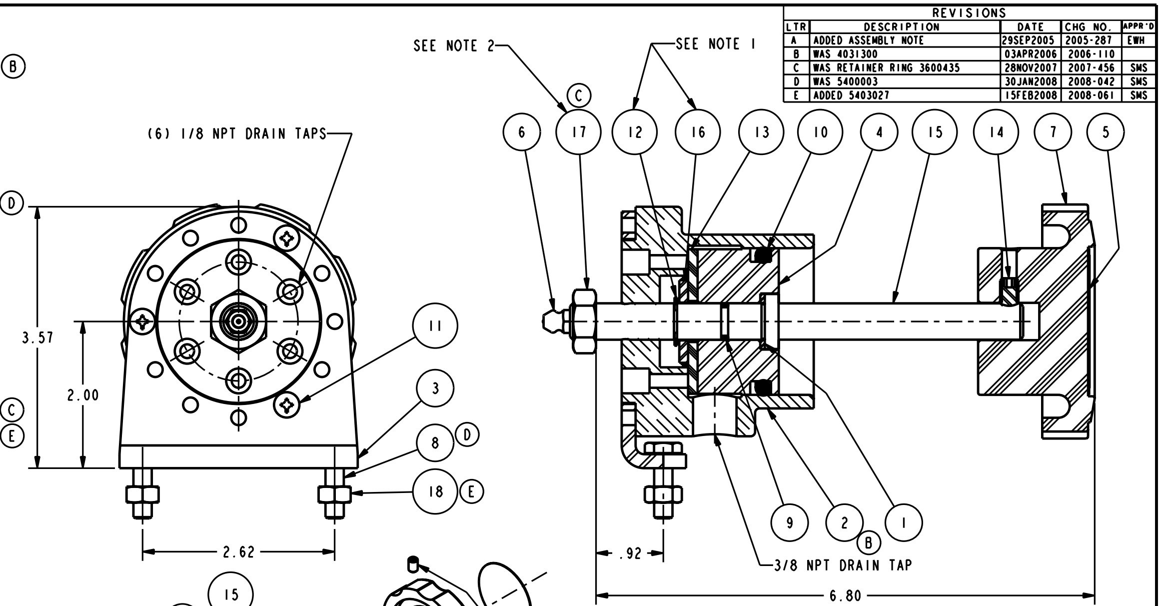
(A) NOTE:

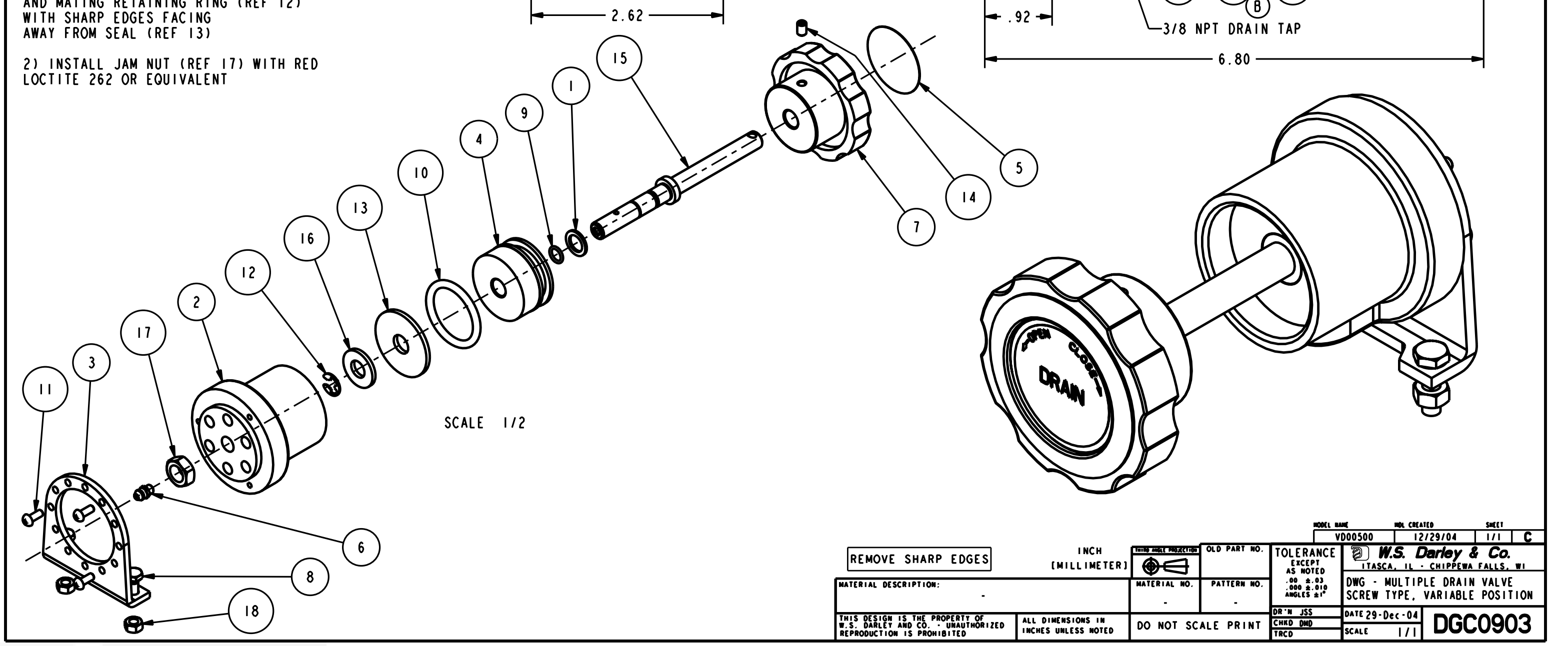
1) ASSEMBLE WASHER (REF 16) AND MATING RETAINING RING (REF 12) WITH SHARP EDGES FACING AWAY FROM SEAL (REF 13)

2) INSTALL JAM NUT (REF 17) WITH RED LOCTITE 262 OR EQUIVALENT

REVISIONS

LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
A	ADDED ASSEMBLY NOTE	29SEP2005	2005-287	EWH
B	WAS 4031300	03APR2006	2006-110	
C	WAS RETAINER RING 3600435	28NOV2007	2007-456	SMS
D	WAS 5400003	30JAN2008	2008-042	SMS
E	ADDED 5403027	15FEB2008	2008-061	SMS





REMOVE SHARP EDGES

INCH (MILLIMETER)

MODEL NAME: VD00500	MDL CREATED: 12/29/04	SHEET: 1/1 C
OLD PART NO.	TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1°	W.S. Darley & Co. ITASCA, IL - CHIPPEWA FALLS, WI
MATERIAL DESCRIPTION: -	MATERIAL NO. -	PATTERN NO. -
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED	ALL DIMENSIONS IN INCHES UNLESS NOTED	DO NOT SCALE PRINT
DR'N JSS / CHKD DMD / TRCD	DWG - MULTIPLE DRAIN VALVE SCREW TYPE, VARIABLE POSITION	DATE 29-Dec-04 / SCALE 1/1 / DGC0903

W.S. DARLEY & CO.

OPERATING INSTRUCTIONS - ELECTRIC PRIMING PUMP

PUSH BUTTON ELECTRIC ACTUATED VALVE

The Darley electric primer will develop up to 25 in. Hg. in an air tight pumping system.

The Primer is activated by a push button, 0.8 second cycle time, electric-actuated valve. This valve has three wires: ground (black), +12 or +24 VDC constant power (red), and +12 or +24 VDC energizing power (white). The valve has two internal micro-switches that cut the power to the valve when it is either fully closed or fully open. The push button is a simple SPST switch, that bypasses the red (constant power) wire with the white wire and energizes the valve to the open position when it is pushed; and cuts power to the white wire and resumes power to the red wire, closing the valve when it is released. When the button is pushed, the circuit for the primer motor is also completed, priming will begin instantaneously, and likewise when the button is released, the primer motor will shut off instantaneously.

Before the pump can be primed, booster line valves, drain valves, cooling line valve, and all other openings into the pump must be closed and absolutely air tight. The discharge side of the pump is sealed by a check valve; therefore the main discharge valves need not be closed.

When operating from draft, suction hose connections must be tight and free of air leaks.

Make certain the suction hose strainer is properly submerged and free of foreign material.

The main pump drive should remain disengaged until priming is complete to prevent possible damage to impeller seal rings by running “dry”.

Push the primer/valve activation button, located on your control panel, and hold until water discharges from primer pump exhaust port.

If water does not discharge from primer exhaust within about 30 seconds (45 seconds with 2-20’ lengths) stop primer pump, check for air leaks and make sure primer pump is receiving lubricant from its reservoir.

NOTE: Do not run the primer for more than one minute; it will burn up the motor, if prime is not reached within one minute, repeat the steps above.

Engage “Pump” shift to start pumping water.

When pumping from hydrants, the primer is not needed and must be kept closed.

It may be necessary to use the primer momentarily when pumping from a booster tank when the suction head is insufficient to force all the air out of the pump.

LUBRICATING SYSTEM - ELECTRIC PRIMING PUMPS WITH FLUID RESERVOIR

The electric motor rotary van primer pump creates a high vacuum by continuous lubrication of rotor and vanes. Therefore the primer lubricant supply tanks (4 quarts) should be kept full at all times. Recommended primer system lubricant is Darley PRIME GREEN. PRIME GREEN is an environmentally safe, non-toxic, biodegradable lubricant. Its use assures proper primer vane lubricant while minimizing environmental effects.

After the main pump is drained, run the primer motor to drain primer lines and re-lubricate the primer pump.

The vent hole on the lubricant tank cap should be kept open at all times to prevent siphoning lubricant from the tank after the pump is stopped. Do not increase the size of the hole.

Locate the lubricant tank where it may be conveniently inspected and filled.

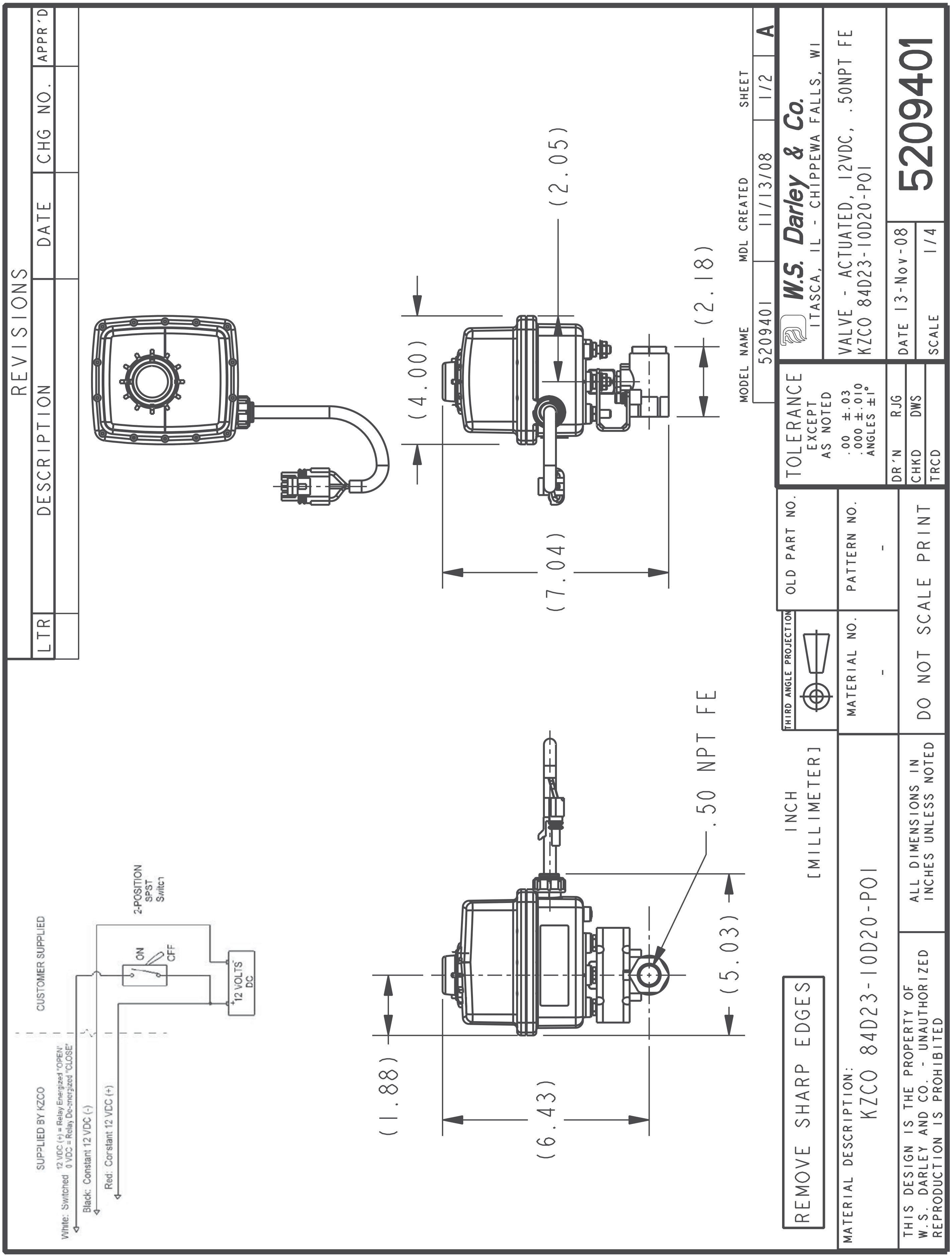
Should water appear in the lubricant supply tank, the primer valve is leaking. Check and replace valve plug seal o-ring if necessary.

ELECTRIC PRIMING PUMPS WITHOUT FLUID RESERVOIR

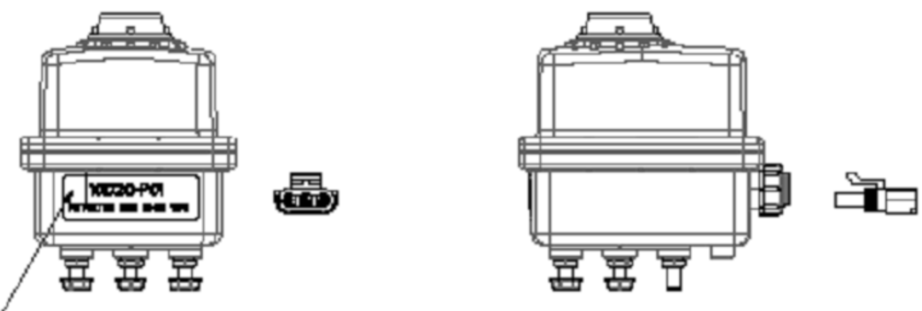
The fluidless electric-motor rotary-vane primer pump creates a high vacuum by using a special material for the vanes and an initial factory applied lubricant film. This film must be present in order for the primer to operate properly and to provide maximum life for the primer components.

This film will not wash away completely if the pump is used to pump water. If the priming pump is disassembled for any reason, all internal surfaces of the housing and end caps must be coated completely with Dow Corning #111 Silicone valve lubricant prior to operating the primer. If after several years, a degradation of performance is noticed, performance may be restored by re-applying the film in this manner.

After the main pump is drained, run the primer motor to drain primer lines.


REVISIONS
LTR
DESCRIPTION
DATE
CHG NO.
APPR'D
(2.05)
(2.18)
(4.00)
(7.04)
.50 NPT FE
(5.03)
(1.88)
(6.43)
SUPPLIED BY KZCO
White: Switched 12 VDC (+) = Relay Energized "OPEN"
0 VDC = Relay De-energized "CLOSE"
Black: Constant 12 VDC (-)
Red: Constant 12 VDC (+)
CUSTOMER SUPPLIED
2-POSITION SPST Switch
ON
OFF
12 VOLTS DC
REMOVE SHARP EDGES
INCH [MILLIMETER]
MATERIAL DESCRIPTION:
KZCO 84D23-10D20-P01
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED
ALL DIMENSIONS IN INCHES UNLESS NOTED
DO NOT SCALE PRINT
THIRD ANGLE PROJECTION
MATERIAL NO.
-
PATTERN NO.
-
OLD PART NO.
TOLERANCE EXCEPT AS NOTED
.00 ±.03
.000 ±.010
ANGLES ±1°
DR'N RJG
CHKD DWS
TRCD
MODEL NAME 5209401
MDL CREATED 11/13/08
SHEET 1/2
A
W.S. Darley & Co.
ITASCA, IL - CHIPPEWA FALLS, WI
VALVE - ACTUATED, 12VDC, .50NPT FE
KZCO 84D23-10D20-P01
DATE 13-Nov-08
SCALE 1/4
5209401

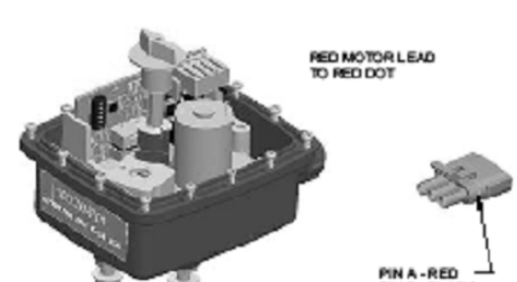
REV	REVISED BY	DATE	BY
-.2+		7/15/2008 9:41:57 AM	bgotschall



ACTUATOR LABEL
MAS90 / LABEL DESCRIPTION
"ACTUATOR, EH3 12 / 24 VDC"

INPUT/OUTPUT
POWER = 12/24 VDC
1 - BLACK - POWER (-) NEGATIVE
2 - RED - POWER (+) POSITIVE
3 - WHITE - SIGNAL 1 (+) POSITIVE TO OPEN
4 - ****

DIP SX 4 'ON'



RED MOTOR LEAD
TO RED DOT

PIN A - RED
PIN B - BLACK
PIN C - WHITE

SCALE .500

PROGRAM NOTE:

MAS90 SET DATA
CONTROL INPUT = 1
FEEDBACK = 0
OPERATION = 0
MOTOR = M2
SPEED CT = 0.8
ZEROSET = 135
RANGE TOLERANCE = 1
ROTATION = CC092
ACTUATOR RANGE = 0.00-0.00
DESIGN VOLTAGE = E
DIP SX = 3
LABEL = KZCO
OPTIONS = 0
PLUG TYPE = P
TEST PLUG =

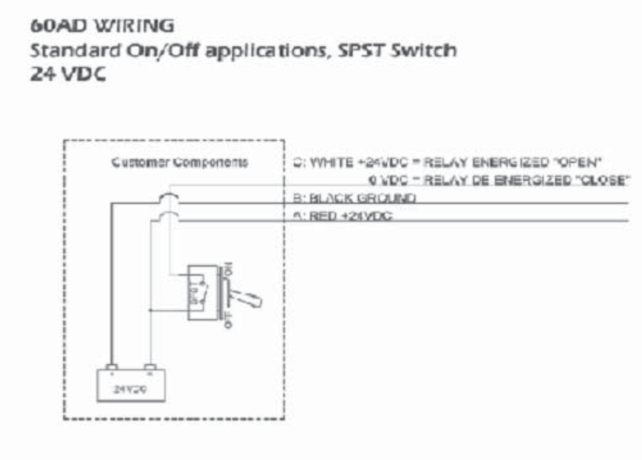
ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL
21	1	EH-502	LABEL, EH ACTUATOR, 2.5" X 1", THERMAL TRANSFER, WHITE	NO_MATERIAL
20	1	800018	HARNESS, 69A,3ST, WP3T,22.5"	
19	1	EH3-115-Y	FLAG, YELLOW	POLYPROPYLENE_TALC_20
18	1	399-0029	PCB ASSY, EH3 L1 SOLID STATE 12 VDC	
17	1	100401	GEAR MOTOR, M2 18 RPMMOLON	NO_MATERIAL
16	3	QX-222	NUT, HEX HEAD, SERRATED FLANGE, .250-20 UNC-2B	STAINLESS_STEEL_TYPE_303
15	4	EH3-135	STUD, 1/4-20 X 1/2 MTG	STAINLESS_STEEL_TYPE_303
14	1	EH-104	RETAINER, PUSH-ON 5/16" SHAFT	STAINLESS_STEEL_TYPE_18-8
13	1	499-0100	CAM ASSY, EXTD LOBE FOR EH2/5 E-OPT	
12	1	EH-502	LABEL, EH ACTUATOR, 2.5" X 1", THERMAL TRANSFER, WHITE	NO_MATERIAL
11	1	EH-130	O-RING, DOME	SILICONE_RED_55_DUROMETER
10	1	EH3-114	DOME, CLEAR	POLYCARBONATE,
9	14	EHPT-1103	SCREW, PAN, PHILLIPS, HIGH-LOW, 5-20 X .562	STAINLESS_STEEL_TYPE_410
8	1	EH3-1001-N	LID, CASE, EH3, DOME	NYLON_DPC_6N33-L_BLACK
7	4	EH3-139	SCREW, 8-32 X 1.25 PPHMS SS	STAINLESS_STEEL_TYPE_18-8
6	1	EH-157	SCREW, 8-18 x 3/8" TSB PPH SS	STAINLESS_STEEL_TYPE_18-8
5	1	EH3-1030	O-RING, EH3, CASE I.D., #120	SILICONE_RED_55_DUROMETER
4	1	EH-139	O-RING, #006, PRESSURE TEST PORT	FLUOROCARBON_BLACK_75_DUROMETER
3	1	EHPT-140	O-RING, #112, MOTOR SHAFT, VITON	FLUOROCARBON_BLACK_75_DUROMETER
2	1	EH3-1003-N	LOWER CASE - EH3 INTERNAL MTG	NYLON_DPC_6N33-L_BLACK
1	1	498-0002	CASE KIT, EH3 IM DOME NYLON M2 MTR	

STANDARD TOLERANCES
ALL DIMENSIONS IN INCHES [mm]

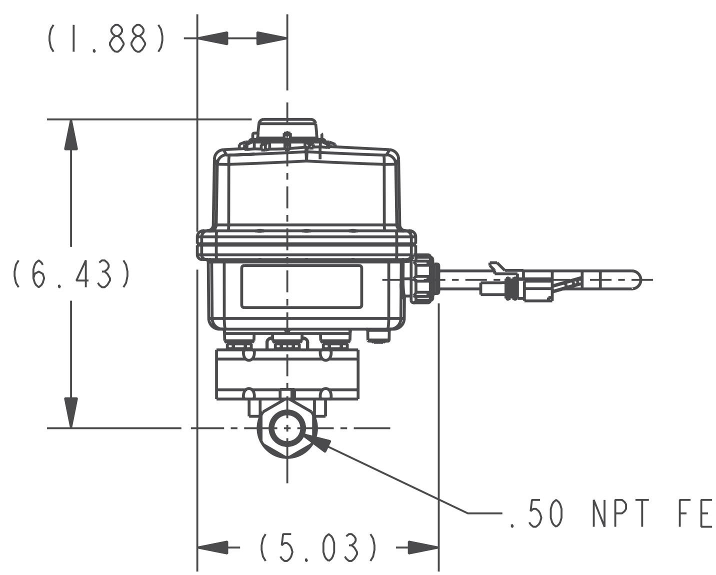
DATE	2008-05-29
DESIGNED	L. ERDKAMP
DRAWN	W. FEDDE
APPROVED	A. KOTTAS
SCALE	.500
SIZE	B
MATERIAL	

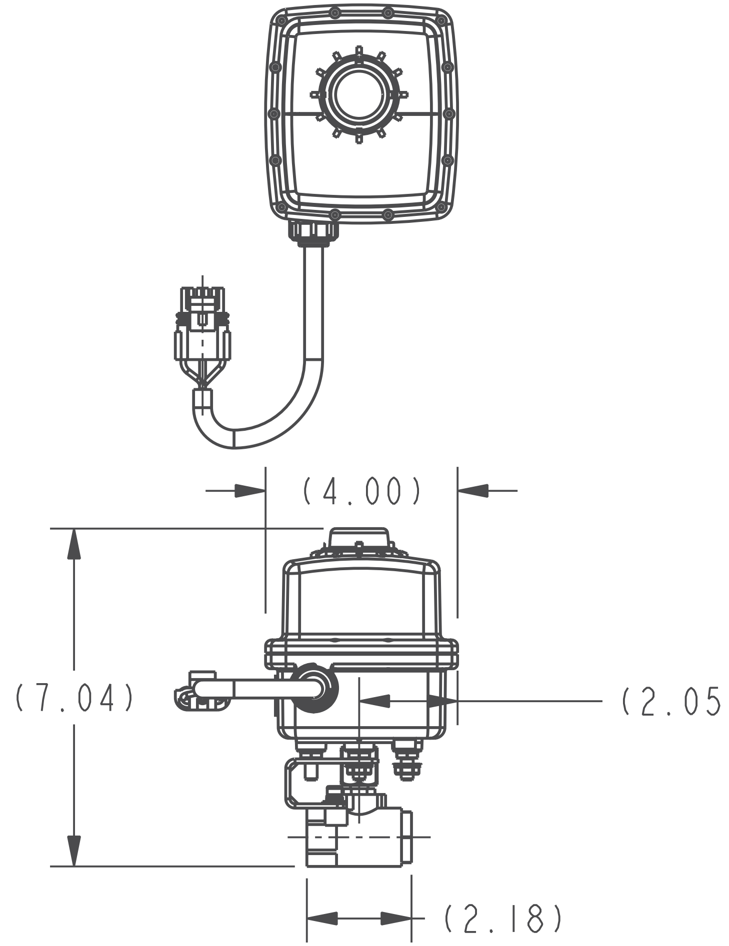
KZCO Inc.

TITLE	ACTUATOR, EH3, SOLID STATE
REF.	
PART NO.	10020-P01
REVISION	-.2+
DRAWING NO.	10020-P01
SHEET	1 of 1



REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D





MODEL NAME	MDL CREATED	SHEET	
5209402	11/13/08	1/3	A

REMOVE SHARP EDGES

INCH [MILLIMETER]

THIRD ANGLE PROJECTION

OLD PART NO.

TOLERANCE EXCEPT AS NOTED
.00 ±.03
.000 ±.010
ANGLES ±1°

W.S. Darley & Co.
ITASCA, IL - CHIPPEWA FALLS, WI

MATERIAL DESCRIPTION:
KZCO 84D23-60AD-M

MATERIAL NO. -

PATTERN NO. -

VALVE - ACTUATED, 24VDC, .50NPT FE
KZCO 84D23-60AD-M

DR'N RJG
CHKD DWS
TRCD

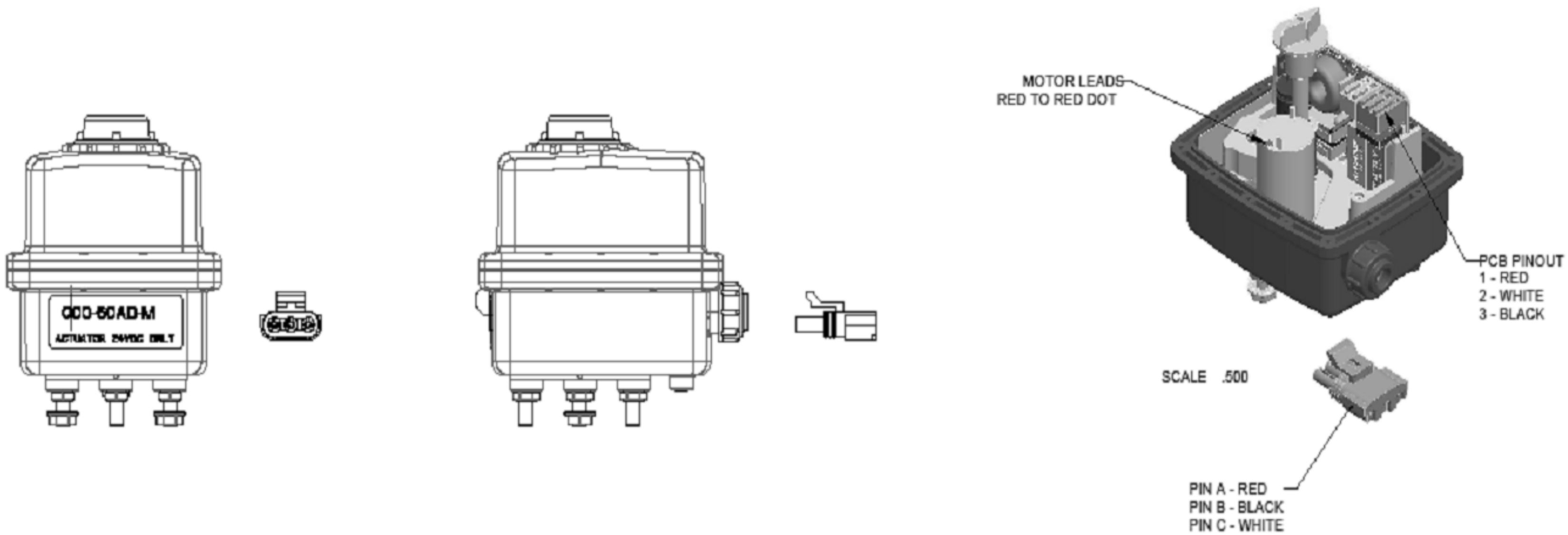
DATE 13-Nov-08
SCALE 1/4

5209402

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

REV/VER	REVISION ECO	REVISION/VERSION DATE	REVISION/VERSION BY
*** .1		3/28/2008 1:49:38 PM	wfedde



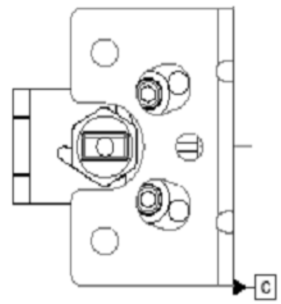
MAS90 SET DATA
CONTROL INPUT = 1
FEEDBACK = 0
OPERATION = 0
MOTOR = M
SPEED CT = 0.8
ZEROSET = 135
RANGE TOLERANCE = 1
ROTATION = CC091
ACTUATOR RANGE = 0.00/0.00
DESIGN VOLTAGE = D
DIP SX =
LABEL = KZCO
OPTIONS = 0
PLUG TYPE =
TEST PLUG =

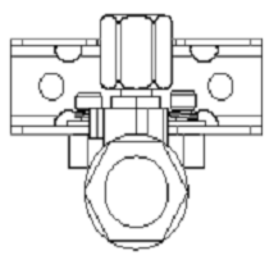
DET	QTY	PART NUMBER	DESCRIPTION	MATERIAL
8	1	EH-502	LABEL, EH ACTUATOR, 2.5" X 1", THERMAL TRANSFER, WHITE	NO_MATERIAL
7	2	QX-222	NUT, HEX HEAD, SERRATED FLANGE, .250-20 UNC-2B	STAINLESS_STEEL,TYPE_303
6	4	EH3-135	STUD, 1/4-20 X 1/2 MTG	STAINLESS_STEEL,TYPE_303
5	1	800018	HARNESS, 60A,3ST, WP3T,22.5"	
4	1	EH3-115-Y	FLAG, YELLOW	POLYPROPYLENE_TALC_20
3	1	800488	PCB ASSY, EH3 24VDC 60AD/60DF	
2	1	EH3-110	GEAR MOTOR, EH3 SERIES M1 18 RPM @ 12VDC	
1	1	498-0005	CASE KIT, EH3 IM DOME NYLON M1 & N1 MTR	

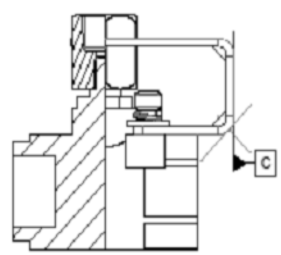
-STANDARD TOLERANCES-
-ALL DIMENSIONS IN INCHES [mm]-
.Xx ±.1 .XXx ±.01 .XXXx ±.005 XX°±1°
TOTAL RUNOUT: .005 FIM
CORNER BREAK: .001/.010
SURFACE FINISH: 125μIN
DENSITY: .047 LBM/CU IN
MASS: .562 LBM
SURF AREA: 163.793 SQ IN
VOLUME: 12.043 CU IN

DATE: 2007-04-16	KZCO inc. 23860 KZ PARKWAY GREENWOOD, NE 68366 USA PHONE: +1.402.944.2767 FAX: +1.402.944.2402
DESIGNED: L. ERDKAMP	
DRAWN: W. FEDDE	TITLE: ACTUATOR, EH3, .8S @24VDC
APPROVED: A. KOTTAS	REF:
SCALE: .500 SIZE: B	PART NO: 000-60AD-M REV/VER: *** .1
MATERIAL:	DRAWING NO: 000-60AD-M SHEET: 1 OF 1

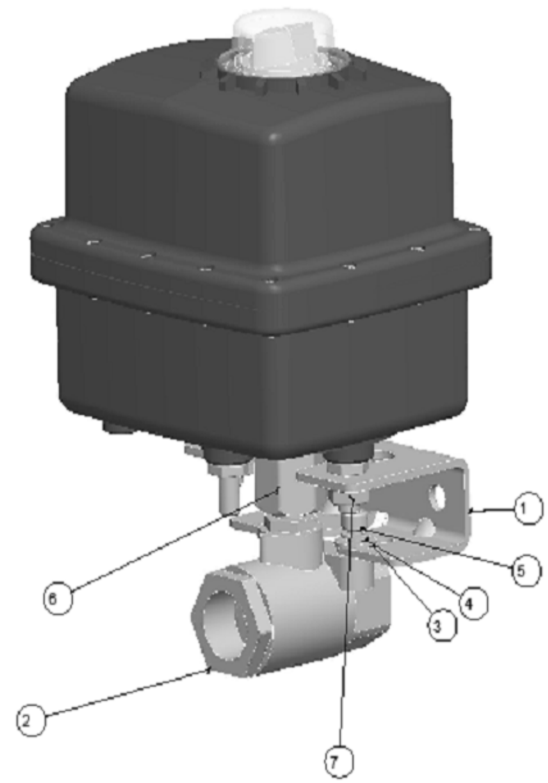
REVIVER	REVISION ECO	REVISION/VERSION DATE	REVISION/VERSION BY
-.6+		8/12/2008 9:18:50 AM	bgotschall







SECTION A-A



ACTUATOR SHOWN IS REPRESENTITVE USED
ONLY TO SHOW PROPER ORIENTATION TO VALVE.

DET	QTY	PART NUMBER	DESCRIPTION	MATERIAL
7	3	QX-222	NUT, HEX HEAD, SERRATED FLANGE, .250-20 UNC-2B	STAINLESS_STEEL,TYPE_303
6	1	EH-145	COUPLER, 1/4" ~ 1/2" APOLLO	STAINLESS_STEEL_TYPE_316
5	2	EH-158	SCREW, #10-24 X 3/8" SS SOCKET HEAD	STAINLESS_STEEL,TYPE_303_OR_316
4	2	EHPT-109	WASHER, LOCK, .197 ID X .334 OD X .047 T	STAINLESS_STEEL_TYPE_316
3	2	EHPT-150	WASHER, FLAT, #10 18-8 SS	STAINLESS_STEEL_TYPE_316
2	1	EH3-84D	VALVE, 1/2" 2-WAY APOLLO 70-103-01 BRONZE BALL VALVE	BRONZE
1	1	EH3-174	BRACKET, MOUNTING EH3 SERIES	STAINLESS_STEEL_TYPE_304

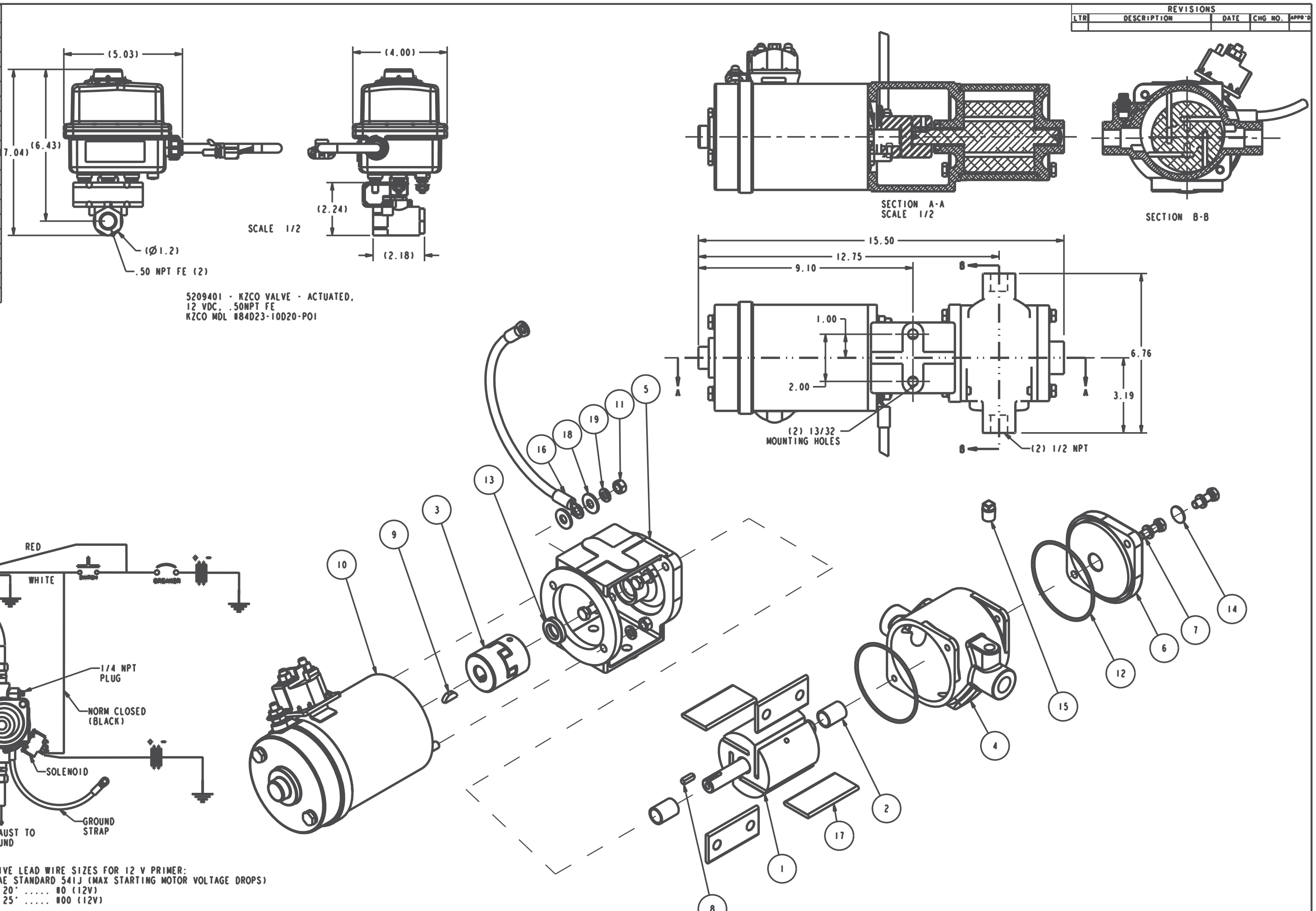
-STANDARD TOLERANCES-
-ALL DIMENSIONS IN INCHES [mm]-
.X±.1 .XX±.01 .XXX±.005 .XX°±1°
TOTAL RUNOUT: .005 RIM
CORNER BREAK: .001/.010
SURFACE FINISH: 125μIN
DENSITY: .250 LBM/CU IN
MASS: 3.134 LBM
SURF AREA: 142.873 SQ IN
VOLUME: 12.142 CU IN

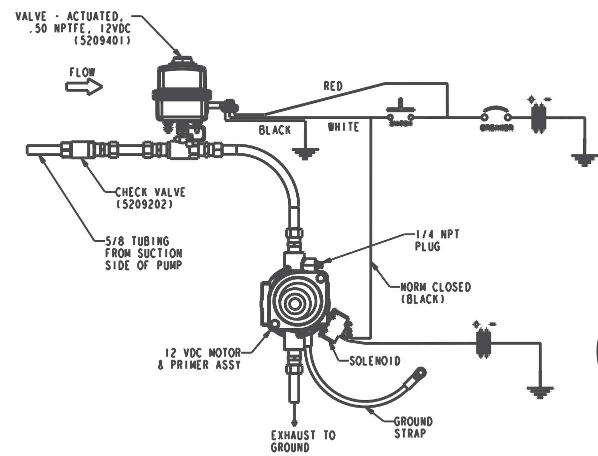
DATE: 2007-06-08
DESIGNED: L. ERDKAMP
DRAWN: C. HOWARD
APPROVED: L.ERDKAMP
SCALE: .750 SIZE: B
MATERIAL: AS NOTED

KZCO inc.
23800 KZ PARKWAY
GREENWOOD, NE 68366 USA
PHONE: +1.402.944.2767
FAX: +1.402.944.2402

TITLE: VALVE KIT, EH3 OFFSET MTG 1/2" 2-PC BRZ
REF:
PART NO: 84D23
DRAWING NO: 84D23
REVIVER: -.6+
SHEET: 1 OF 1

NO.	DESCRIPTION	PART NO.	QTY.
1	ASSEMBLY - PRIMER, ROTOR	4420105	1
2	BEARING - OILITE, 0.626 ID	1760023	2
3	COUPLING - #44093	2404500	1
4	CYLINDER - VACUUM PUMP	1020800	1
5	HEAD - CYLINDER INBOARD	2808904	1
6	HEAD - CYLINDER, OUTBOARD	2808800	1
7	HHCS - .313-18 x 1.00, SST	5400610	4
8	KEY - SQ., 0.19 X 0.62 GR2	3602425	1
9	KEY - WOODRUFF, 606	3602200	1
10	MOTOR - PRIMER, 12V	4223400	1
11	NUT - HEX, .313-15, SST	5403024	2
12	O-RING - 3.50 x 3.69 x 0.09	3601101	2
13	OIL SEAL - 0.625 ID X 1.128 OD	3600505	1
14	PLUG - 0.75", FREEZE	4402500	1
15	PLUG - PIPE, 0.250, BR SQ HD	1080504	1
16	STRAP - GROUND, 12V PRIMER	2600516	1
17	VANE - ROTOR, ELEC PRIMER	4407601	4
18	WASHER - FLAT, 5/16, STEEL	3603802	2
19	WASHER - LOCK, 0.313 ID	3603502	6





NOTE:

MOUNT WITH EXHAUST OUTLET DOWN

CONNECT 4 GA COPPER GROUND STRAP
TO CLEAN, PAINT FREE GROUNDING SURFACE

IF SUPPLIED GROUND STRAP
IS REMOVED FROM ASSEMBLY,
RETIGHTEN CYLINDER HEAD ADAPTER
RETAINING NUTS EQUALLY
TO 90 IN.LB.

POSITIVE LEAD WIRE SIZES FOR 12 V PRIMER:
PER SAE STANDARD 541J (MAX STARTING MOTOR VOLTAGE DROPS)
0' TO 20' ..... #0 (12V)
0' TO 25' ..... #00 (12V)

THESE GAGE WIRES CORRESPOND WITH AMP DRAW
REQUIREMENTS FOR EACH MOTOR, AS WELL AS IN RELATION
TO RESISTANCE OVER GIVEN LENGTH.
12 V = 240 AMP

WEIGHT = 27 LB (12.1 KG)

REMOVE SHARP EDGES

INCH [MILLIMETER]

MATERIAL DESCRIPTION:

THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED

ALL DIMENSIONS IN INCHES UNLESS NOTED

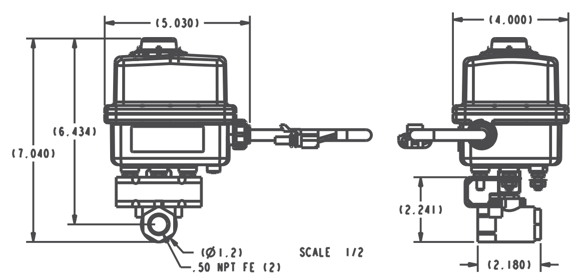
DO NOT SCALE PRINT

W.S. Darley & Co.
ITASCA, IL - CHIPPEWA FALLS, WI

DWG - ELEC. PRIMER, VLV, 4 V
NO TANK, CR. SECTION, EXPLODED

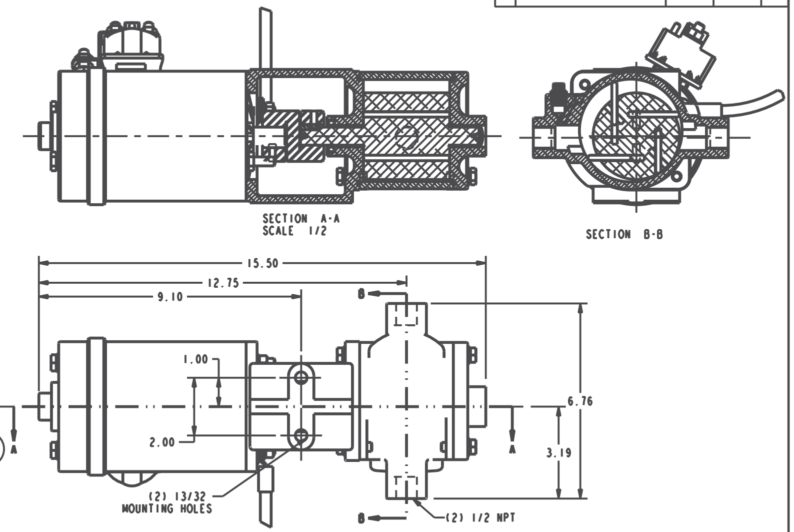
DATE 18-Apr-08
SCALE 1/2
DVC0210

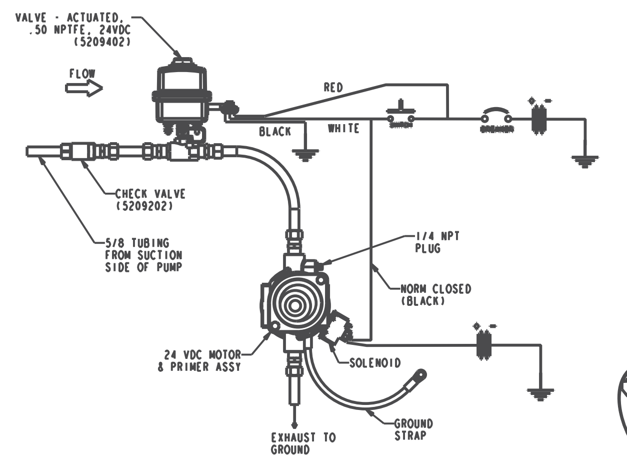
NO.	DESCRIPTION	PART NO.	QTY.
1	ASSEMBLY - PRIMER, ROTOR	4420105	1
2	BEARING - OILITE, 0.626 ID	1760023	2
3	COUPLING - #44093	2404500	1
4	CYLINDER - VACUUM PUMP	1020800	1
5	HEAD - CYLINDER INBOARD	2808904	1
6	HEAD - CYLINDER, OUTBOARD	2808800	1
7	HHCS - .313-18 x 1.00, SST	5400610	4
8	KEY - SQ., 0.19 X 0.62 GR2	3602425	1
9	KEY - WOODRUFF, 606	3602200	1
10	MOTOR - PRIMER, 24V	4223500	1
11	NUT - HEX, .313-15, SST	5403024	2
12	O-RING - 3.50 x 3.69 x 0.09	3601101	2
13	OIL SEAL - 0.625 ID X 1.128 OD	3600505	1
14	PLUG - 0.75", FREEZE	4402500	1
15	PLUG - PIPE, 0.250, BR SQ HD	1080504	1
16	STRAP - GROUND, 12V PRIMER	2600516	1
17	VANE - ROTOR, ELEC PRIMER	4407601	4
18	WASHER - FLAT, 5/16, STEEL	3603802	2
19	WASHER - LOCK, 0.313 ID	3603502	6

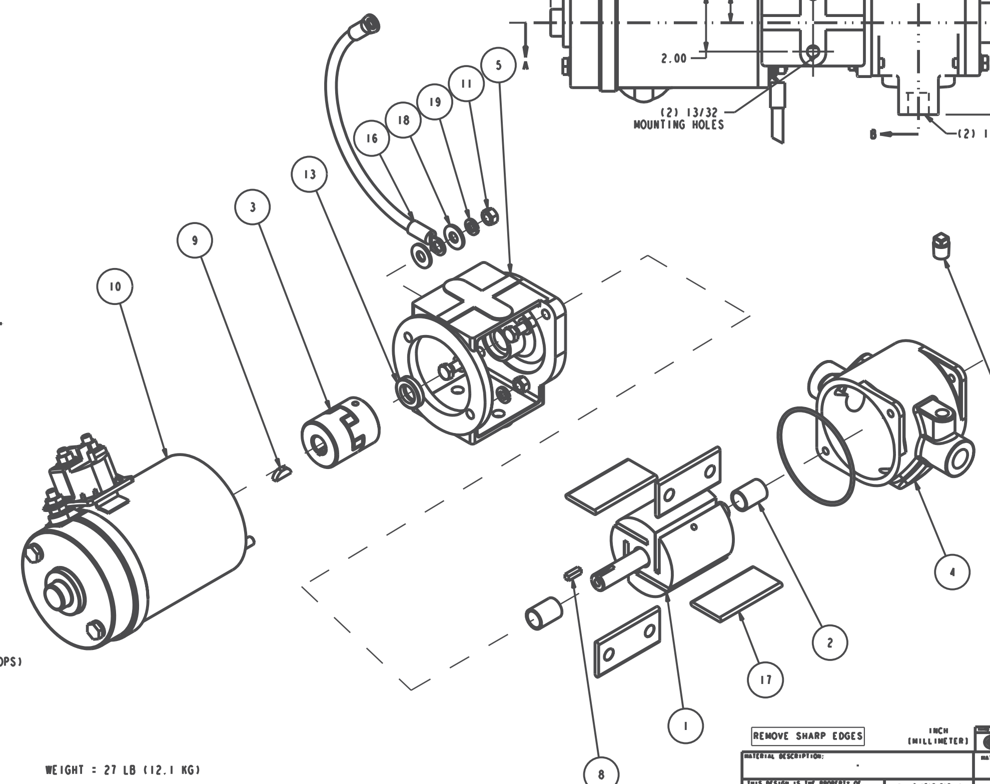


5209402 - KZCO VALVE - ACTUATED, 24 VDC, .50NPT FE
KZCO MDL #84D23-60AD-M

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D







NOTE:

MOUNT WITH EXHAUST OUTLET DOWN

CONNECT 4 GA COPPER GROUND STRAP TO CLEAN, PAINT FREE GROUNDING SURFACE

IF SUPPLIED GROUND STRAP IS REMOVED FROM ASSEMBLY, RETIGHTEN CYLINDER HEAD ADAPTER RETAINING NUTS EQUALLY TO 90 IN.LB.

POSITIVE LEAD WIRE SIZES FOR 24 V PRIMER:
PER SAE STANDARD 541J (MAX STARTING MOTOR VOLTAGE DROPS)
0' TO 20' ..... #3 COPPER (24V)
0' TO 25' ..... #2 COPPER (24V)

THESE GAGE WIRES CORRESPOND WITH AMP DRAW REQUIREMENTS FOR EACH MOTOR, AS WELL AS IN RELATION TO RESISTANCE OVER GIVEN LENGTH.
24 V = 140 AMP

WEIGHT = 27 LB (12.1 KG)

REMOVE SHARP EDGES

INCH [MILLIMETER]

MATERIAL DESCRIPTION:

THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

W.S. Darley & Co.
ITASCA, IL - CHIPPEWA FALLS, WI

DWG - ELEC. PRIMER, VLV, 4 V NO TANK, CR. SEC., EXPL., 24VDC

DATE 18-Apr-08 SCALE 1/2

DVC0211

BALL VALVE QUARTER TURN – SELF-LOCKING

The Darley Ball Valve is a quarter turn, all bronze valve designed for the fire service.

The ball is precision machined stainless steel for long, trouble-free service. It is easily serviced in the field.

The lever is self-locking and easily adjusted, even under extreme high pressure.

TO DISASSEMBLE AND REPAIR THE BALL VALVE

See illustration DGC0100

TOOLS REQUIRED

- 3/16 in. Allen wrench
- 1-1/8 in. wrench
- 3/4 in. and 1 in. wrench
- Vise Grips or Pliers

1. Remove cap nut (20) and adjusting nut (16).
2. Lever assembly (11) pulls straight up. Watch for 2 cam balls (12).
3. Unbolt and remove clutch ring (9), clutch sleeve (8), valve stem (7), spring (14), and valve stem washer (15). Check clutch ring (9) and sleeve (8) for scoring or excessive wear. Check O-ring (26). Replace if necessary.
4. Remove nipple (2). Check quad ring (25). Replace if necessary.
5. Unscrew ball guide screw (6). Check O-ring (23). Replace if necessary.
6. Remove valve ball (3). Check for scratches, corrosion and wear. Replace if necessary.
7. Remove seal assembly (4). Check condition of rubber seat. Replace seat assembly if necessary.

REASSEMBLY OF BALL VALVE

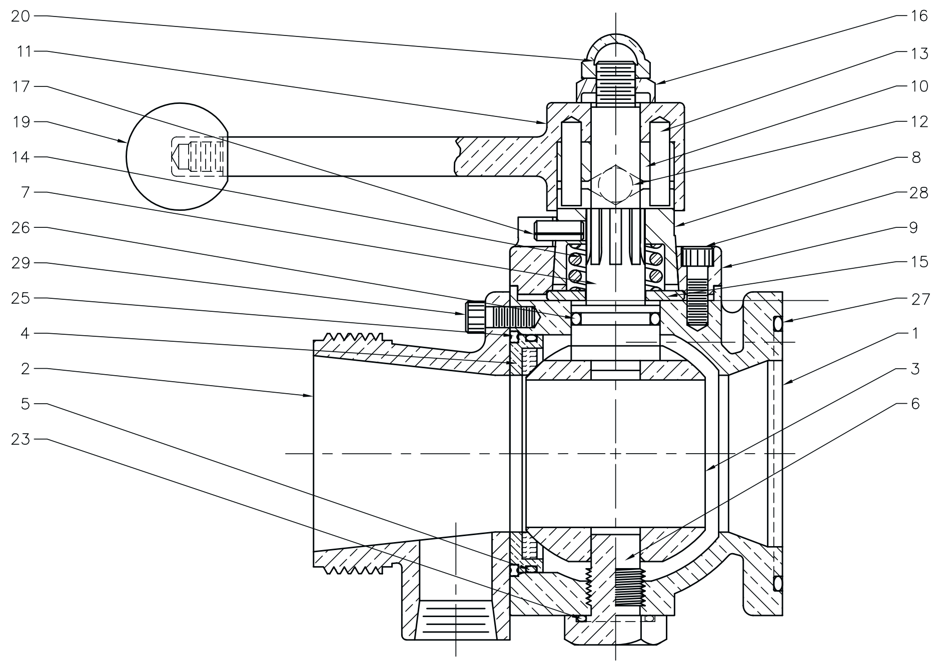
See illustration DGC0100

1. Position ball (3) in body so ball guide screw (6) engages bottom of ball as it is screwed into position.
2. Put valve stem (7) into position. Make certain stem engages slot on top of ball.
3. Slip washer (15), spring (14), and clutch sleeve (8) over the stem. Place clutch ring (9) over the sleeve and secure with the four (4) 1/4 in. NC x 5/8 in. socket head cap screws.
4. Set the two cam balls (12) into the V grooves in the clutch sleeve (8) and drop lever assembly over them. Tighten the adjusting nut (16) so that approximately 1/8 in. play is left at the end of a 6 in. lever. Over tightening this nut will make the clutch lock inoperative. Lock the adjusting nut (16) with the cap nut (20). Re-check this adjustment after the valve is placed in service.
5. Place the seat assembly (4), the seat O-ring (5), and the quad ring (25) into position.
6. Secure the nipple (2) to the valve body with eight (8) 1/4 in. NC x 5/8 in. socket head cap screws.

IF FURTHER INFORMATION IS NEEDED, CALL W.S. DARLEY & CO. AT CHIPPEWA FALLS, WI AT 800-634-7812 or 715-726-2650

LETTER	CHANGE NO.	DATE
(A)	96–53	5/15/96

REP NO.	NAME OF PART	QTY.
1	DISCHARGE VALVE BODY	1
2	VALVE NIPPLE	1
3	VALVE BALL	1
4	VALVE SEAT	1
5	O'RING	1
6	BALL GUIDE SCREW	1
7	VALVE STEM	1
8	CLUTCH SLEEVE	1
9	CLUTCH RING	1
10	LEVER CAM	1
11	FRONT MOUNT LEVER	1
12	CAM BALL	2
13	VALVE PIN	2
14	VALVE SPRING	1
15	VALVE STEM WASHER	1
16	ADJUSTING NUT	1
17	SPRING PIN–STL (A)	1
19	CONTROL LEVER BALL	1
20	CAP NUT	1
23	O'RING	1
25	QUAD RING	1
26	O'RING	1
27	O'RING	1
28	SOCKET HEAD CAP SCREW	4
29	SOCKET HEAD CAP SCREW	8



INCH
[MILLIMETER]

THIRD ANGLE PROJECTION

TOLERANCE EXCEPT AS NOTED	W.S. DARLEY & Co. MELROSE PARK, IL – CHIPPEWA FALLS, WI
.00 ±.03 .000 ±.010 ANGLES ±1°	DWG – BALL VALVE ASSEMBLY CROSS SECTION
DR'N JCM	DATE NOV12,65
CHKD	SCALE 1/1
TRCDLMH 5/96	DGC0100

OLD PART NO. G1200

THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. – UNAUTHORIZED REPRODUCTION IS PROHIBITED

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

REMOTE CONTROL SUCTION RELIEF VALVE

See drawing DGC0115

The suction relief valve bypasses water from the pump suction extension to the ground at a set pressure, preventing excessive rise of supply pressure when relay hose lines are shut off.

Turning pressure-setting hand wheel (14) clockwise raises the relief pressure, and counterclockwise lowers it.

The self-cleaning fine mesh strainer will prevent the entry of solids, which could cause the relief valve to malfunction. Open the strainer flush valve to remove small accumulations. Accomplish this action by turning the strainer flush valve knob (6) counterclockwise 2 to 3 full turns. Strainer-trapped debris will be flushed to the ground. The pump supply pressure should be 50-100 psi when performing this procedure.

TO SET SUCTION RELIEF VALVE

1. Connect a discharge line from an auxiliary pump to the pump suction containing the suction relief valve. The auxiliary pump must be able to supply a pressure greater than the desired pressure setting of the suction relief valve.
2. Close all other discharge and suction valves.
3. Increase the auxiliary pump engine throttle setting until pressure gauge indicates the pressure that the suction relief valve is open.
4. If the suction relief valve opens to bypass excessive pressure, slowly turn the hand wheel (14) clockwise until the valve closes.
5. If the suction relief valve does not open, turn the hand wheel (14) counterclockwise until the valve opens and begins bypassing water. Continue to turn the hand wheel (14) counterclockwise 2 more complete turns. Now slowly turn the hand wheel clockwise until the valve closes and stops bypassing water.

The suction relief valve will now prevent damage to the pump from a pressure surge (water hammer), which is the result of the rapid closing or opening of the relay line valves.

Should a higher or lower relief pressure be desired, repeat the above procedure.

NOTICE

With all the discharge valves closed, the water in auxiliary pump casing will heat up rapidly. Avoid damage by allowing a very low flow of water to discharge when pump is running.

REMOTE CONTROL SUCTION RELIEF VALVE

See drawing DGC0115

MAINTENANCE

Open the relief valve strainer flush valve (6) during every operation at 50 – 100 psi supply pressure to protect against foreign material blocking the screen.

The relief valve, pilot unit, and strainer assemblies should be taken apart for inspection and cleaning at least annually, or as often as found necessary to ensure trouble-free performance.

To disassemble the pilot head, first turn the hand wheel (14) counterclockwise to remove the spring compression.

Remove the four 1/4 in. screws holding the regulator spring housing (18). Lift out the diaphragm (23) and the pilot valve (51) assembly. Clean and make certain 3/32 in. diameter orifice hole is free of obstruction.

When reassembling the pilot head, turn the hand wheel (14) a few times clockwise to compress the spring before tightening the four screws holding the spring housing. This action will properly center the valve seat and the diaphragm.

The valve piston (40) and the spring (44) chamber should be inspected and cleaned. Replace the diaphragm and the O-rings if damaged or deteriorated.

Apply a thin coating of waterproof grease lubricant to the spring housing counterbore that guides the pilot valve (51) and ball (52), to the end of the tension screw (17), and between the piston (40) and the center post.

The self-cleaning strainer (63) can be removed for inspection or replacement by alternately turning the valve knob (6) and stop nut (7) counterclockwise until the stem is free for removal. To avoid discharging water through the opening created by the stem (62) removal, the pump should be completely shut down before the stem (62) is removed. Inspect and clean the screen (63) if required. Check the quad ring (64) for damage or deterioration. Reverse the procedure to reassemble the valve. Use care when initially inserting the screen into the body to avoid damaging the quad ring (64) or the valve seat.

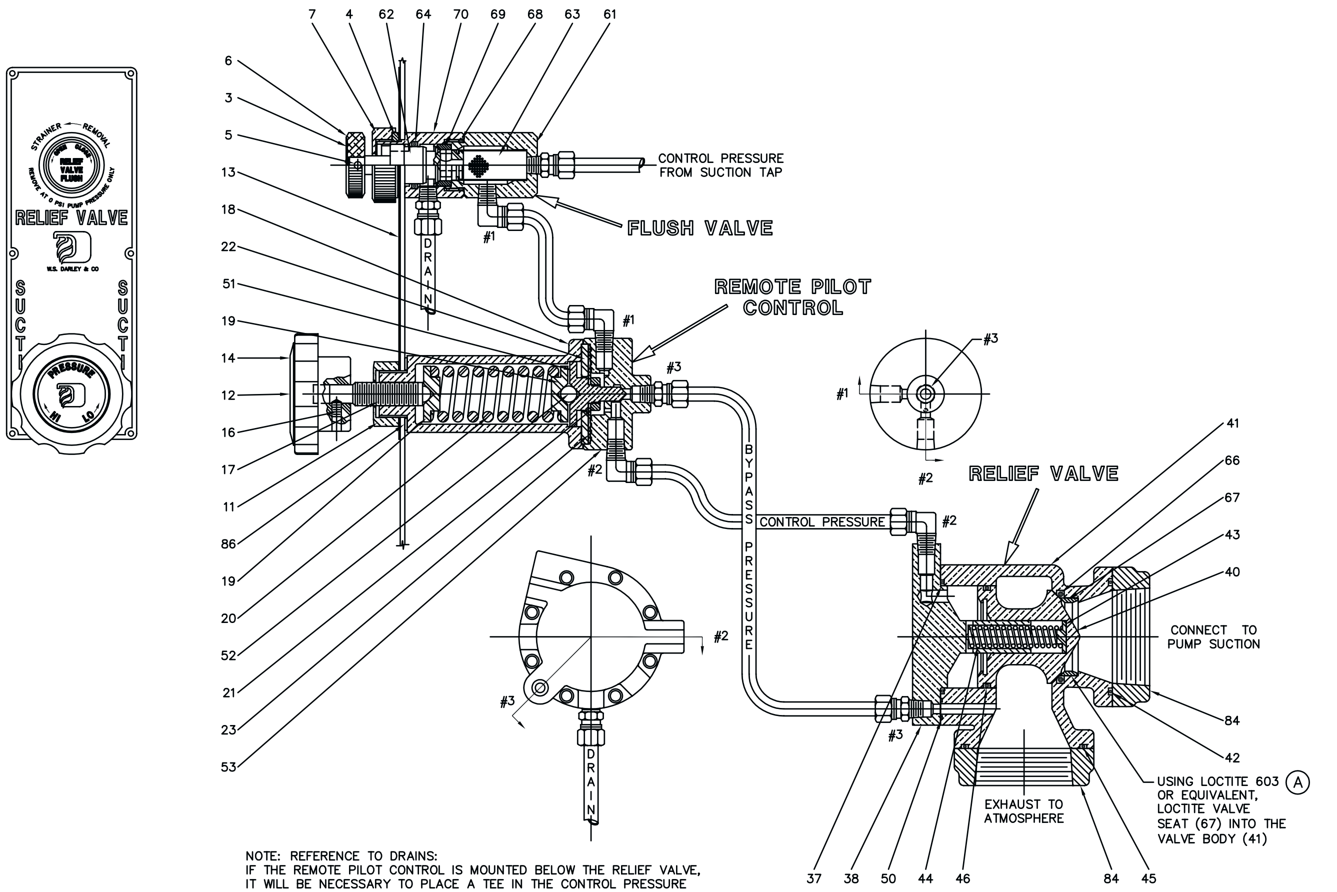
To replace the flush valve seat (69), remove the stem/screen assembly. Disconnect the tubing lines attached to (61) the body half, unscrew (61) the body half from (70) the body half. Replace (69) the valve seat. Reverse the procedure to reassemble the valve.

SUCTION RELIEF VALVE PARTS LIST DRAWING DGC0115

Rep No.	Description	Rep No.	Description
3	Decal – RV Flush	41	Relief Valve Body
4	Panel Nut	42	O-Ring Flange
5	Socket Set Screw	43	Spring Centering Plug
6	Flush Valve Knob	44	Spring
7	Stop Nut	45	O-Ring Body Flange
11	Panel Valve Nut	46	O-Ring Piston
12	Decal – Pressure Hi-Lo	50	O-Ring, Bleed Port
13	Trim Plate	51	Pilot Valve
14	Hand Wheel	52	Ball
16	Socket Set Screw	53	Pilot Valve Body
17	Spring Tension Screw	61	Body Half, Flush Valve
18	Spring Housing	62	Stem
19	Spring Retainer	63	Screen
20	Regulator Spring	64	Quad Ring
21	Pilot Valve Nut	66	O-Ring Valve Seat
22	Housing Pilot Ring	67	Valve Seat Ring
23	Diaphragm	68	O-Ring Flush Valve Body
37	O-Ring, Relief Valve Head	69	Flush Valve Seat
38	Relief Valve Head	70	Body Half, Flush Valve
40	Relief Valve Piston	84	Flange
		86	Lock Washer Internal

IF FURTHER INFORMATION IS NEEDED, CALL W.S. DARLEY & CO. AT CHIPPEWA FALLS, WI AT 800-634-7812 or 715-726-2650

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
A	ADDED LOCTITING NOTE	4NOV2002	2002–175	TED



NOTE: REFERENCE TO DRAINS:
IF THE REMOTE PILOT CONTROL IS MOUNTED BELOW THE RELIEF VALVE, IT WILL BE NECESSARY TO PLACE A TEE IN THE CONTROL PRESSURE LINE AND BYPASS PRESSURE LINE, AT THE LOWEST POINT, TO PROVIDE DRAINING. SUCH A DRAIN, IF INSTALLED, SHOULD NOT BE CONNECTED TOGETHER WITH THE RELIEF VALVE DRAIN. CONNECT DRAIN LINES TO SEPARATE INLET TAPS OF MULTIPLE DRAIN VALVE. DRAINS MUST BE CLOSED DURING OPERATION.

	OLD PART NO. G2453	TOLERANCE EXCEPT AS NOTED FRAC DIM ±.01 .00 ±.01 .000 ±.005 ANGLES ±1°	W.S. DARLEY & CO. MELROSE PARK, IL – CHIPPEWA FALLS, WI	
MATERIAL DESCRIPTION: –	MATERIAL NO. –	PATTERN NO. –	DWG – SUCTION RELIEF VALVE –	
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. – UNAUTHORIZED REPRODUCTION IS PROHIBITED	ALL DIMENSIONS IN INCHES UNLESS NOTED	DO NOT SCALE PRINT	DR'N S. LEE / CHKD / TRCD	DATE DEC17,91 / SCALE 1/2 / DGC0115

REMOTE CONTROL PRESSURE RELIEF VALVE WITH MECHANICAL SHUTOFF

See drawing DGC0141

The relief valve bypasses water from the pump discharge manifold to the suction chamber at a set pump pressure, preventing excessive rise of discharge pressure when hose lines are shut off.

Turning pressure-setting hand wheel (14) clockwise raises the relief pressure, and counterclockwise lowers it.

The self-cleaning fine mesh strainer will prevent the entry of solids that could cause the relief valve to malfunction. Open the strainer flush valve to remove small accumulations. Accomplish this action by turning the strainer flush valve knob (6) counterclockwise 2 to 3 full turns. Strainer-trapped debris will be flushed to the ground. Pump supply pressure should be 50–100 psi when performing this procedure.

TO SET RELIEF VALVE

1. Turn four-way valve OFF.
2. Open at least one discharge valve and increase the engine throttle setting until the pressure gauge indicates the pressure at which the relief valve is to open.
3. Turn the four-way valve ON.
4. If the gauge reading drops below the pressure set in step 2, turn the hand wheel (14) clockwise until the pressure returns to set point.
5. If the gauge reading does not drop, turn the hand wheel (14) counterclockwise until pressure drops 5 to 10 psi below the set point. Then slowly turn the hand wheel clockwise until the pressure returns to the pressure set in step 2.

The relief valve will now prevent the discharge pressure from rising above that for which it is set, and requires no further attention.

Should a higher or lower relief pressure be desired, repeat above procedure.

NOTICE

Avoid water in the auxiliary pump casing heating up rapidly with all discharge valves closed. Allow a very small stream of water to discharge when the pump is running to avoid possible damage.

REMOTE CONTROL PRESSURE RELIEF VALVE WITH MECHANICAL SHUTOFF

See maintenance drawing DGC0141

Open the relief valve strainer flush valve (6) during every operation at 50–100 psi supply pressure to ensure foreign material is not blocking the screen.

The 3/32 in. diameter metering orifice and diaphragm chamber at (21) may be back-flushed if necessary while the pump is delivering water by opening the pilot head drain and placing the valve handle (9) midway between the ON and OFF position.

The relief valve, pilot unit, and strainer assemblies should be taken apart for inspection and cleaning at least annually, or as often as found necessary to ensure trouble-free performance.

To disassemble the pilot head, first turn the hand wheel (14) counterclockwise to remove spring compression.

Remove the four 1/4 in. screws holding the regulator spring housing (18). Lift out the diaphragm (23) and pilot valve (51) assembly. Clean and make certain the 3/32 in. diameter orifice hole is free of obstruction.

When reassembling the pilot head, turn the hand wheel (14) a few times clockwise to compress the spring before tightening the 4 screws holding the spring housing. This action will properly center the valve seat and diaphragm.

The valve piston (40) and spring (44) chamber should be inspected and cleaned. Replace the diaphragm and O-rings if damaged or deteriorated.

Apply a thin coating of waterproof grease lubricant to the spring housing counterbore that guides the pilot valve (51) and ball (52), to the end of the tension screw (17), and the between the piston (40) and center post.

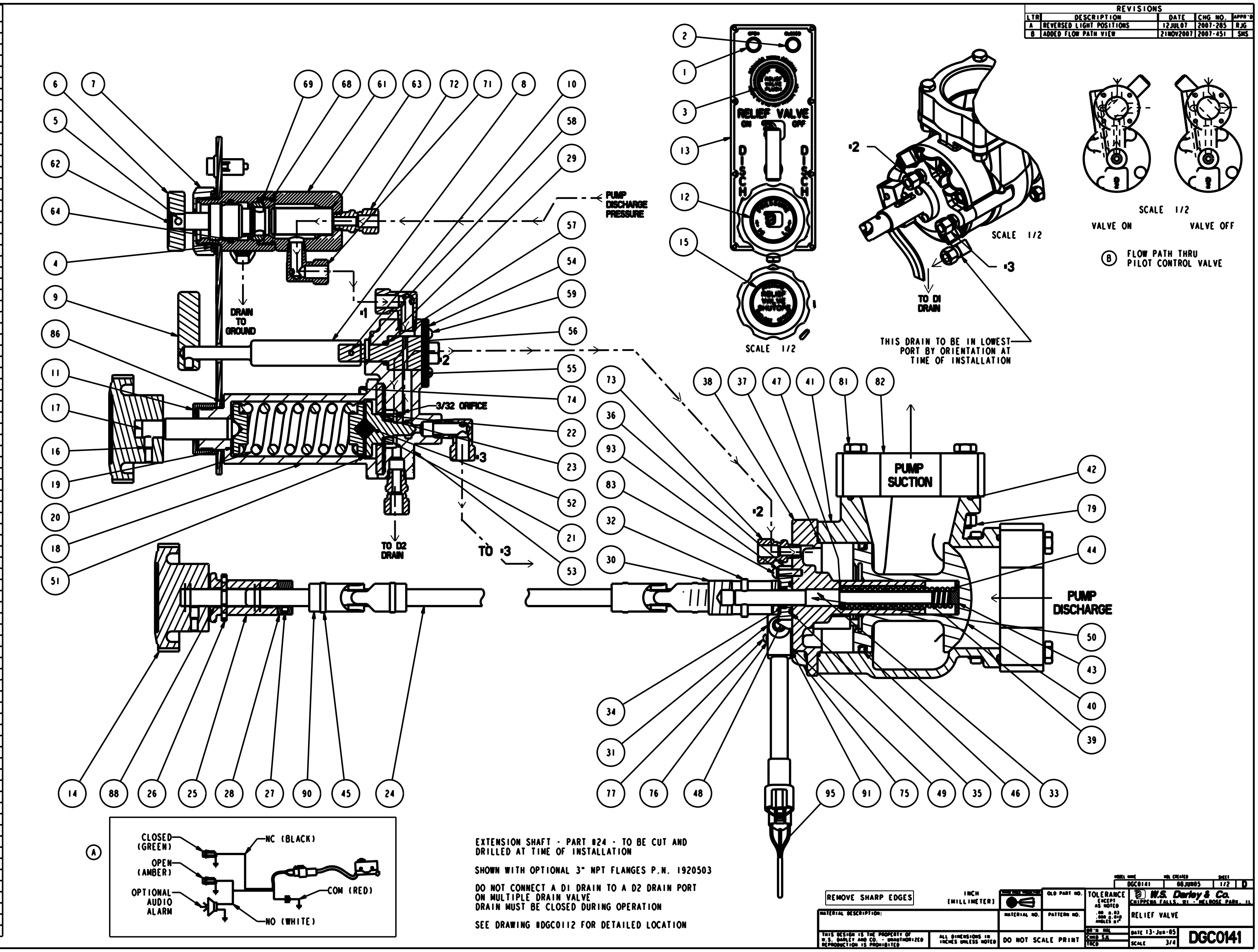
The self-cleaning strainer (63) can be removed for inspection or replacement by alternately turning the valve knob (6) and stop nut (7) counterclockwise until the stem is free for removal. To avoid discharging the water through the opening created by the stem (62) removal, the pump should be completely shut down before the stem (62) is removed. Inspect and clean the screen (63) if required. Check the quad ring (64) for damage or deterioration. Reverse the procedure to reassemble the valve. Use care when initially inserting the screen into the body to avoid damaging the quad ring (64) or valve seat.

To replace the flush valve seat (69), remove the stem/screen assembly, disconnect the tubing lines attached to (61) body half and unscrew (61) body half from (70) body half. Replace (69) the valve seat. Reverse the procedure to reassemble the valve.

All Darley relief valves can be provided with a micro switch and either one or two pilot lights to indicate when the valve is open or closed.

IF FURTHER INFORMATION IS NEEDED, CALL W.S.DARLEY & CO. AT CHIPPEWA FALLS, WI AT 800-634-7812 or 715-726-2650

NO.	DESCRIPTION	PART NO.	QTY.
1	LIGHT - AMBER, 24V	-	1
2	LIGHT - GREEN, 24V	-	1
3	DECAL - FLUSH SCREEN	-	1
4	NUT - PANEL, FLUSH VALVE	-	1
5	SSS - NO.10-32 x 0.38, GR5	-	1
6	KNOB - FLUSH VALVE	-	1
7	NUT - PANEL, 1.38-12	-	1
8	COUPLING - RELEIF VALVE STEM	-	1
9	LEVER - R.V. ON/OFF	-	1
10	PIN - DRIVE LOK, 0.125 X 0.750	-	1
11	NUT - PANEL VALVE, 1.250-12	-	1
12	DECAL - PRESSURE, HI/LO	-	1
13	PLATE - TRIM, REMOTE HEAD	-	1
14	HANDWHEEL	-	2
15	DECAL - PRESSURE RELIEF VALVE	-	1
16	SSS - 1/4-20 x 0.38, SST	-	3
17	SCREW - SPRING TENSION	-	1
18	HOUSING - PILOT VALVE	-	1
19	RETAINER - SPRING	-	2
20	SPRING - PRESSURE REGULATOR	-	1
21	NUT - PILOT VALVE	-	1
22	RING - HOUSING PILOT	-	1
23	DIAPHRAM - PIOLET HEAD	-	1
24	SHAFT - R.V. EXTENSION, 24"	-	1
25	BUSHING - RETAINER, PANEL	-	1
26	NUT - .750, CONDUIT	-	1
27	SSS - NO.10-24 x 0.19, GR5	-	1
28	COLLAR - SHAFT, 1/2" BORE	-	1
29	SSS - .313 x 0.31, GR5	-	1
30	COUPLING - RELIEF VALVE STEM	-	1
31	MICROSWITCH - OMRON	-	1
32	PIN - SPRING, 0.19 X 1.12	-	1
33	O-RING - 0.38 x 0.50 x 0.06	-	2
34	O-RING - 0.44 x 0.62 x 0.09	-	1
35	O-RING - 0.75 x 0.94 x 0.09	-	1
36	PLATE - SEAL, VALVE STEM	-	1
37	O-RING - 3.25 x 3.38 x 0.06	-	1
38	HEAD - RELIEF VALVE, REMOTE, 3"	-	1
39	STEM - RELIEF VALVE, 3"	-	1
40	PISTON - RELIEF VALVE, 3"	-	1
41	BODY - RELIEF VALVE, 3"	-	1
42	O-RING - 3.50 x 3.69 x 0.09	-	2
43	CENTER PLUG - PISTON SPRING	-	1
44	SPRING - PISTON	-	1
45	PIN - SPRING, 0.16 X 0.88	-	4
46	QUAD RING - 2.88 x 3.25 x 0.19	-	1
47	WASHER - 0.39 x 0.61 x .06 BR	-	1
48	STEM - RELIEF VALVE SWITCH	-	1
49	SHIM - SWITCH SPACER, 0.0125	-	1
50	PLUG - PIPE, 0.125, SST SOC HD	-	1
51	PIN - PILOT VALVE	-	1
52	BALL - CAM, 0.44"	-	1
53	HEAD - PILOT CONTROL	-	1
54	COVER - ON/OFF VALVE	-	1
55	O-RING - 1.12 x 1.25 x 0.06	-	1
56	PLUG - VALVE	-	1
57	O-RING - 0.50 x 0.69 x 0.09	-	1
58	PIN - SPRING, 0.12 X 0.62, SST	-	1
59	RHMS - NO.8-32 X 0.50, BR	-	4
61	BODY - FLUSH VALVE, COMPLETE	-	1
62	STEM - FLUSH VALVE	-	1
63	STRAINER - SCREEN	-	1
64	QUAD RING - 1.00 x 1.25 x 0.12	-	1
68	O-RING - 1.19 x 1.38 x 0.09	-	1
69	SEAT - FLUSH VALVE	-	1
71	TUBE FITTING - EL, .38 x .25	-	5
72	TUBE FITTING - STR, .38 cf x .25 MPTH	-	4
73	TUBE FITTING - STR, .38 cf x .12 MPTH	-	1
74	SHCS - .250-20 X 0.88, SST	-	4
75	SHCS - .313-18 x 0.75, GR8	-	8
76	WASHER - LOCK, NO.6 ID, SST	-	2
77	RHMS - NO.6-32 X1.00, BR	-	2
79	NUT - HEX, .375-16, GR2	-	8
81	HHCS - .375-16 x 2.25, GR5	-	8
82	FLANGE - ADAPTER, 3 NPT	-	2
83	RHMS - NO.10-24 X 0.75, GR5	-	3
86	WASHER - INT. TOOTH, 1.250 ID	-	1
88	BEARING - NYLINER, 0.50 ID	-	2
90	JOINT - UNIVERSAL, .500"	-	2
91	SHIM - SWITCH SPACER, 0.025	-	1
93	WASHER - LOCK, NO.10 ID, SST	-	3
95	CONNECTOR - DUETCH DT 06-3S	-	1



NO.	DESCRIPTION	PART NO.	QTY.
1	LIGHT - AMBER, 24V	-	1
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8	COUPLING - RELEIF VALVE STEM	-	1
9	LEVER - R.V. ON/OFF	-	1
10	PIN - DRIVE LOK, 0.125 X 0.750	-	1
11	NUT - PANEL VALVE, 1.250-12	-	1
12	DECAL - PRESSURE, HI/LO	-	1
13	PLATE - TRIM, REMOTE HEAD	-	1
14	HANDWHEEL	-	2
15	DECAL - PRESSURE RELIEF VALVE	-	1
16	SSS - 1/4-20 x 0.38, SST	-	3
17	SCREW - SPRING TENSION	-	1
18	HOUSING - PILOT VALVE	-	1
19	RETAINER - SPRING	-	2
20	SPRING - PRESSURE REGULATOR	-	1
21	NUT - PILOT VALVE	-	1
22	RING - HOUSING PILOT	-	1
23	DIAPHRAM - PIOLET HEAD	-	1
24	SHAFT - R.V. EXTENSION, 24"	-	1
25	BUSHING - RETAINER, PANEL	-	1
26	NUT - .750, CONDUIT	-	1
27	SSS - NO.10-24 x 0.19, GR5	-	1
28	COLLAR - SHAFT, 1/2" BORE	-	1
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32	PIN - SPRING, 0.19 X 1.12	-	1
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45	PIN - SPRING, 0.16 X 0.88	-	4
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47	WASHER - 0.39 x 0.61 x .06 BR	-	1
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49	SHIM - SWITCH SPACER, 0.0125	-	1
50	PLUG - PIPE, 0.125, SST SOC HD	-	1
51	PIN - PILOT VALVE	-	1
52	BALL - CAM, 0.44"	-	1
53	HEAD - PILOT CONTROL	-	1
54	COVER - ON/OFF VALVE	-	1
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56	PLUG - VALVE	-	1
57	O-RING - 0.50 x 0.69 x 0.09	-	1
58	PIN - SPRING, 0.12 X 0.62, SST	-	1
59	RHMS - NO.8-32 X 0.50, BR	-	4
61	BODY - FLUSH VALVE, COMPLETE	-	1
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86	WASHER - INT. TOOTH, 1.250 ID	-	1
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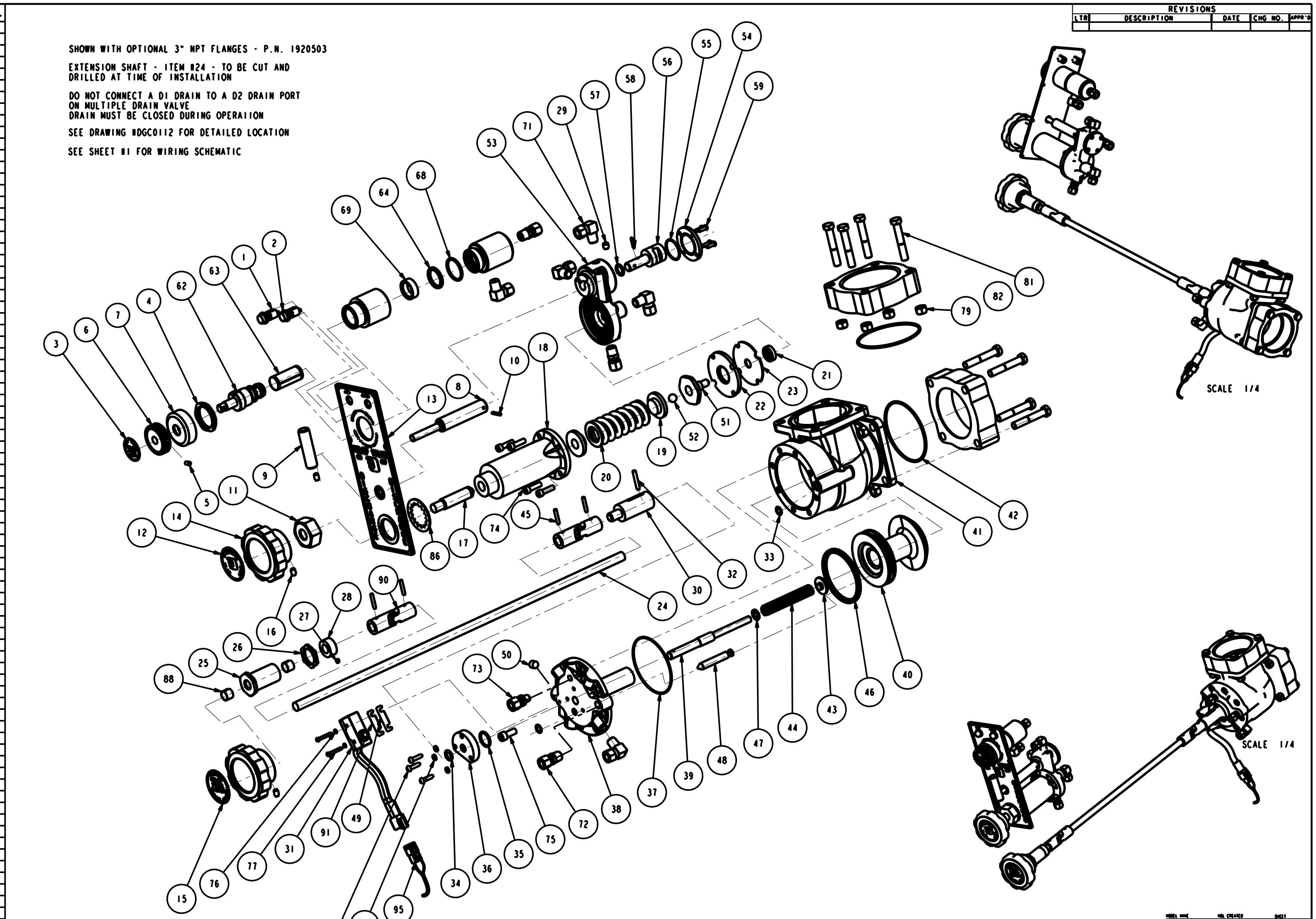
90	JOINT - UNIVERSAL, .500"	-	2
91	SHIM - SWITCH SPACER, 0.025	-	1
93	WASHER - LOCK, NO.10 ID, SST	-	3
95	CONNECTOR - DUETCH DT 06-3S	-	1

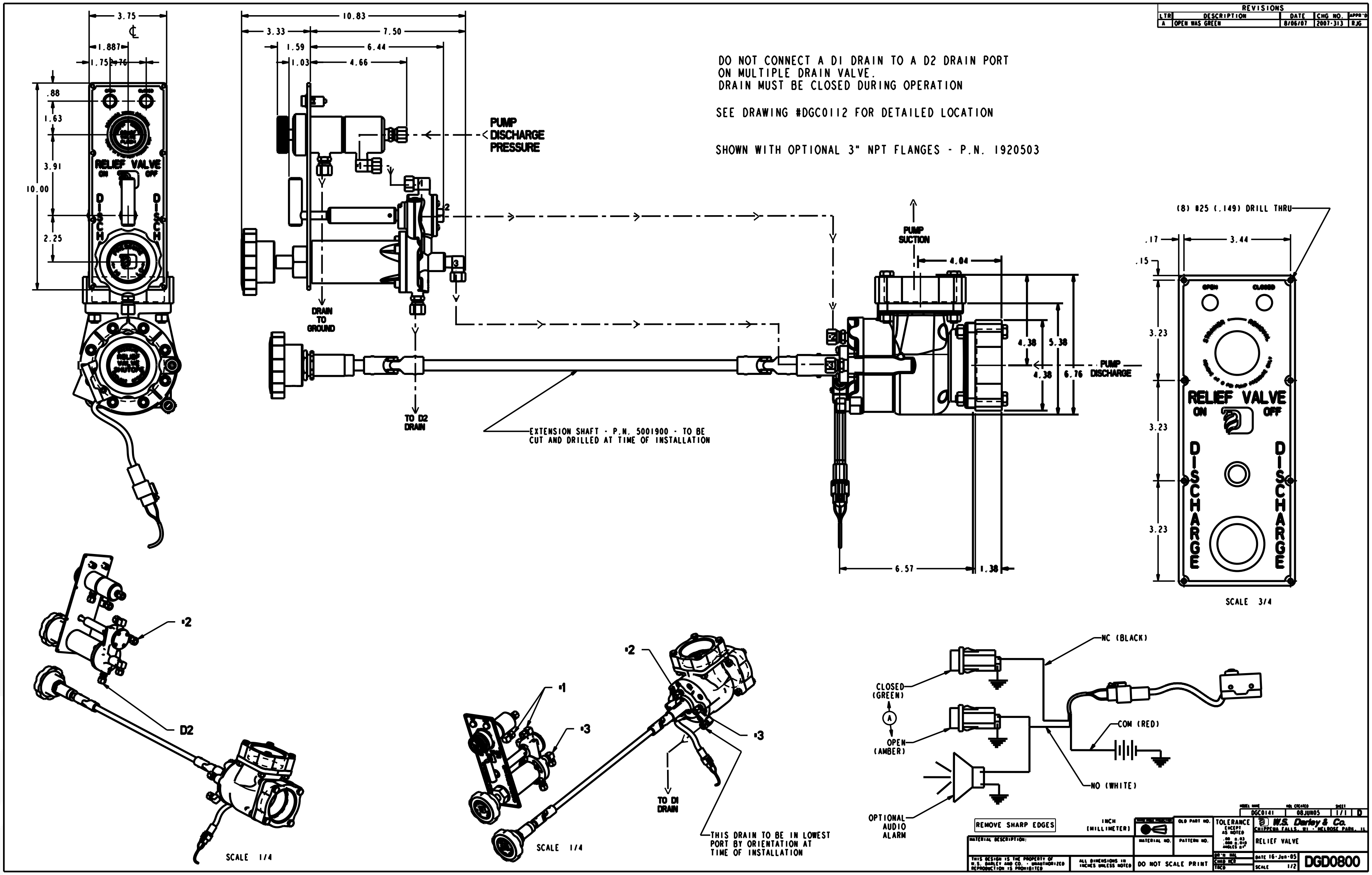


REMOVE SHARP EDGES | INCH (MILLIMETER) | OLD PART NO. | TOLERANCE EXCEPT AS NOTED | W.S. Darley & Co. CHIPPEWA FALLS, WI - MELROSE PARK, IL

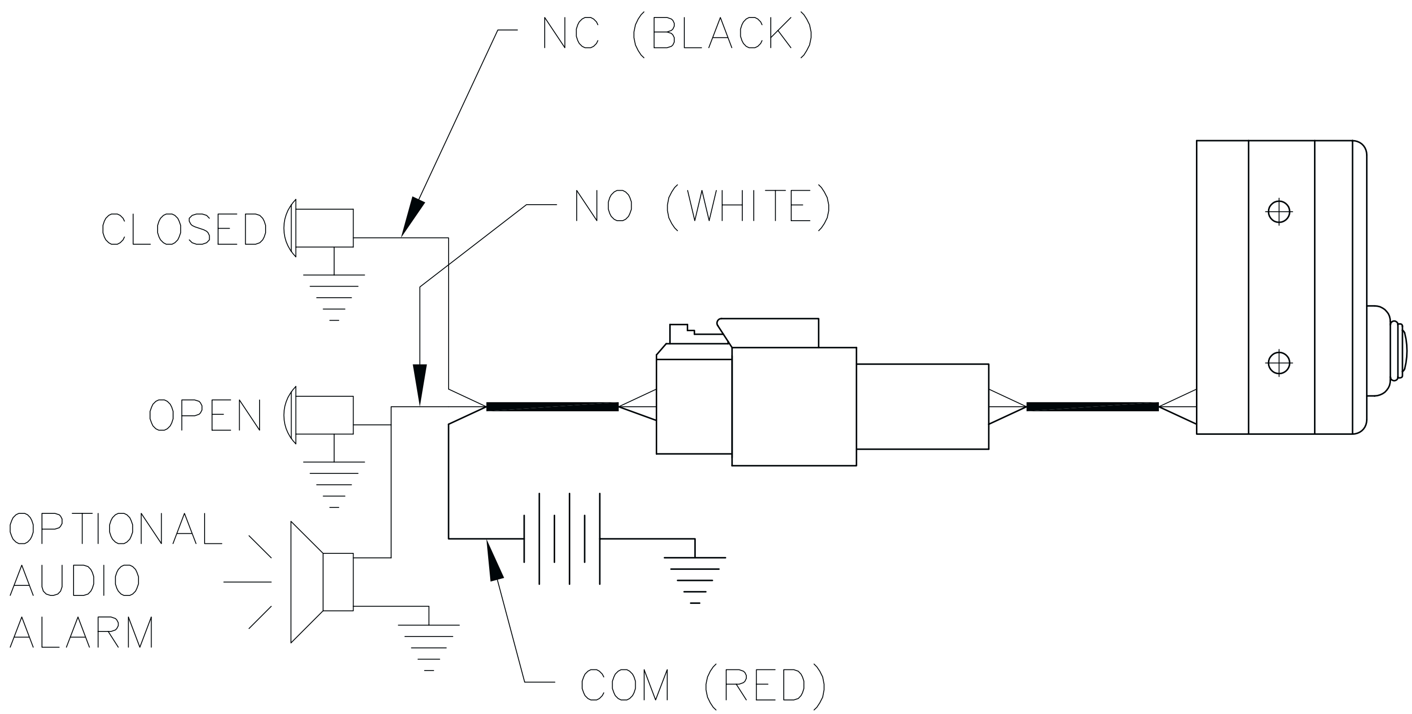
DGC0141 | 08JUN05 | 2/2 | D

MATERIAL DESCRIPTION: | MATERIAL NO. | PATTERN NO. | RELIEF VALVE

THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED | ALL DIMENSIONS IN INCHES UNLESS NOTED | DO NOT SCALE PRINT | DR'N MAL | CHKD SJL | TRCD | DATE 15-Jun-05 | SCALE 3/4 | DGC0141


REVISIONS
LTR DESCRIPTION DATE CHG NO. APPR'D
A OPEN WAS GREEN 8/06/07 2007-313 RJG
DO NOT CONNECT A D1 DRAIN TO A D2 DRAIN PORT
ON MULTIPLE DRAIN VALVE.
DRAIN MUST BE CLOSED DURING OPERATION
SEE DRAWING #DGC0112 FOR DETAILED LOCATION
SHOWN WITH OPTIONAL 3" NPT FLANGES - P.N. 1920503
3.75
1.887
1.75
.76
.88
1.63
3.91
10.00
2.25
RELIEF VALVE
ON
OFF
DISCH
10.83
3.33
7.50
1.59
6.44
1.03
4.66
PUMP
DISCHARGE
PRESSURE
DRAIN
TO
GROUND
TO D2
DRAIN
EXTENSION SHAFT - P.N. 5001900 - TO BE
CUT AND DRILLED AT TIME OF INSTALLATION
PUMP
SUCTION
4.04
4.38
5.38
4.38
6.76
PUMP
DISCHARGE
6.57
1.38
(8) #25 (.149) DRILL THRU
.17
3.44
.15
3.23
3.23
3.23
OPEN
CLOSED
RELIEF VALVE
ON
OFF
DISCHARGE
DISCHARGE
SCALE 3/4
#2
D2
SCALE 1/4
#2
#1
#3
#3
TO D1
DRAIN
SCALE 1/4
THIS DRAIN TO BE IN LOWEST
PORT BY ORIENTATION AT
TIME OF INSTALLATION
NC (BLACK)
CLOSED
(GREEN)
A
OPEN
(AMBER)
COM (RED)
NO (WHITE)
OPTIONAL
AUDIO
ALARM
DGC0141
08JUN05
1/1
D
REMOVE SHARP EDGES
INCH
(MILLIMETER)
OLD PART NO.
TOLERANCE
EXCEPT
AS NOTED
W.S. Darley & Co.
CHIPPEWA FALLS, WI · MELROSE PARK, IL
MATERIAL DESCRIPTION:
MATERIAL NO.
PATTERN NO.
RELIEF VALVE
THIS DESIGN IS THE PROPERTY OF
W.S. DARLEY AND CO. - UNAUTHORIZED
REPRODUCTION IS PROHIBITED
ALL DIMENSIONS IN
INCHES UNLESS NOTED
DO NOT SCALE PRINT
DATE 16-Jun-05
SCALE 1/2
DGD0800

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D



REMOVE SHARP EDGES

INCH
[MILLIMETER]

THIRD ANGLE PROJECTION

OLD PART NO. —

TOLERANCE EXCEPT AS NOTED
.00 ±.03
.000 ±.010
ANGLES ±1°

W.S. DARLEY & Co.
MELROSE PARK, IL – CHIPPEWA FALLS, WI

MATERIAL DESCRIPTION: —

MATERIAL NO. —

PATTERN NO. —

DWG – RELIEF VALVE
WIRING SCHEMATIC, NEW

DR'N JSS
CHKD CKE
TRCD

DATE 6/20/02
SCALE 1/1

DGS1601

THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. – UNAUTHORIZED REPRODUCTION IS PROHIBITED

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

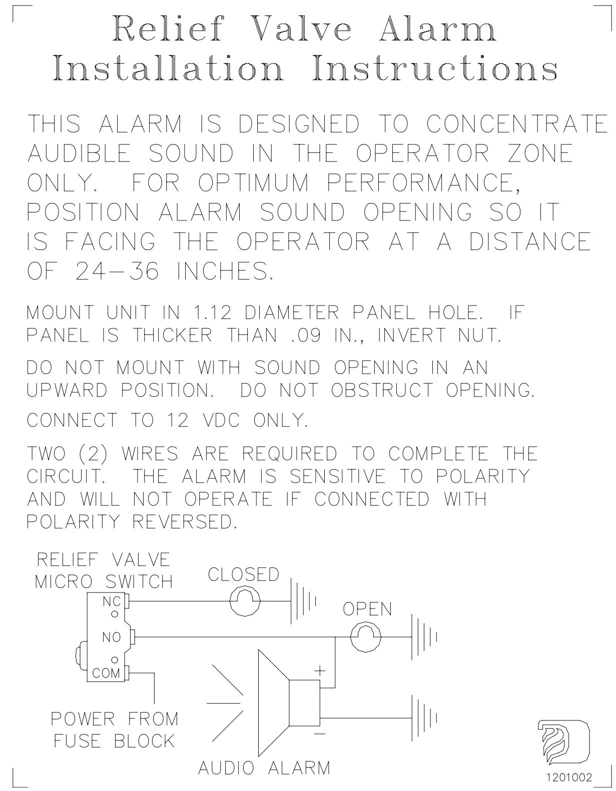
Relief Valve Alarm Installation Instructions

This alarm is designed to concentrate audible sound in the operator zone only. For optimum performance, position the alarm sound opening so it is facing the operator at a distance of 24 – 36 in.

Mount the unit in 1.12 diameter panel hole. If the panel is thicker than 0.09 in., invert the nut.

Do not mount with the sound opening in an upward position. Do not obstruct the opening.

Connect to 12 VDC only.
Two wires are required to complete the circuit. The alarm is sensitive to polarity and will not operate if connected with polarity reversed.



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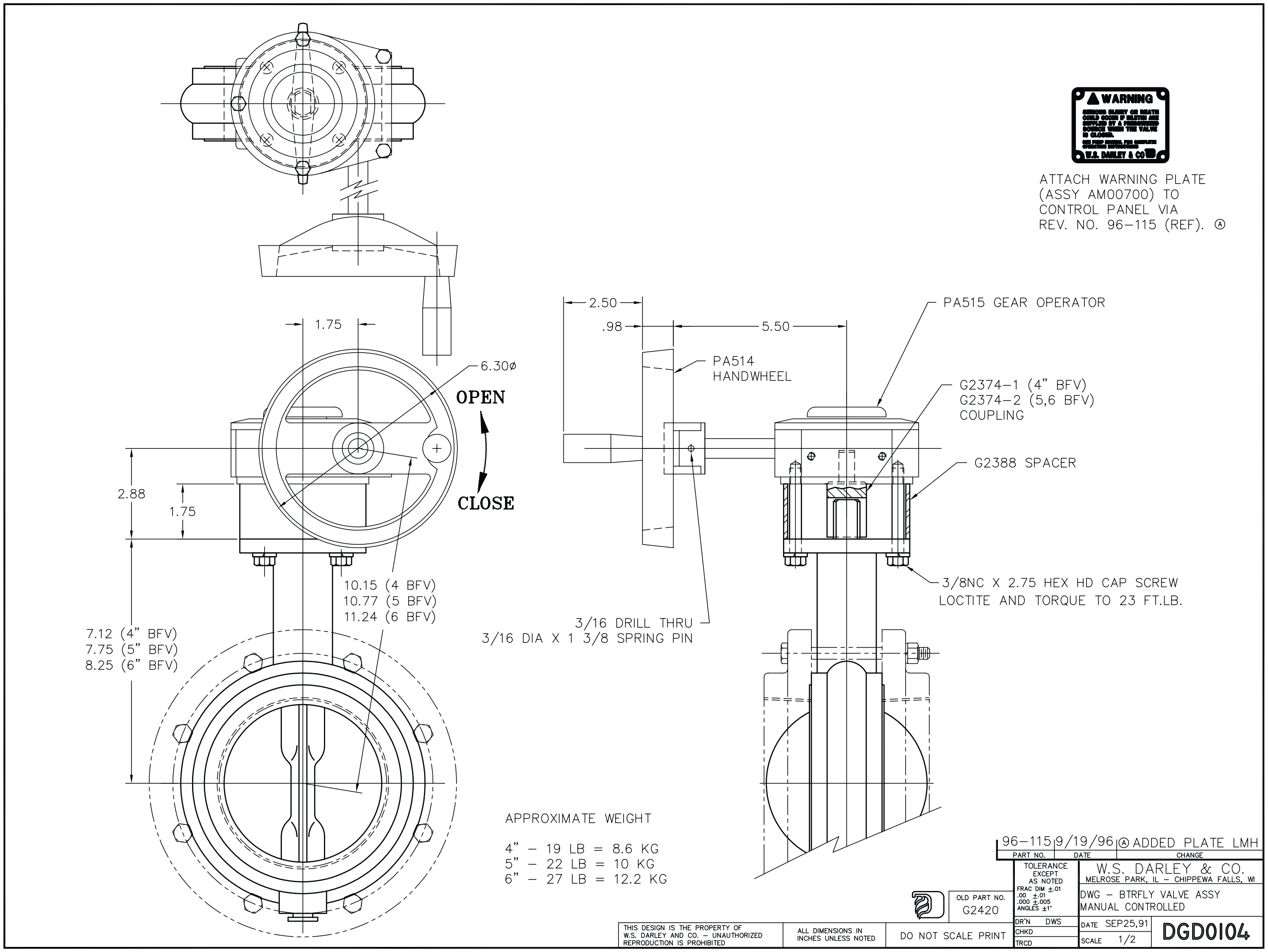
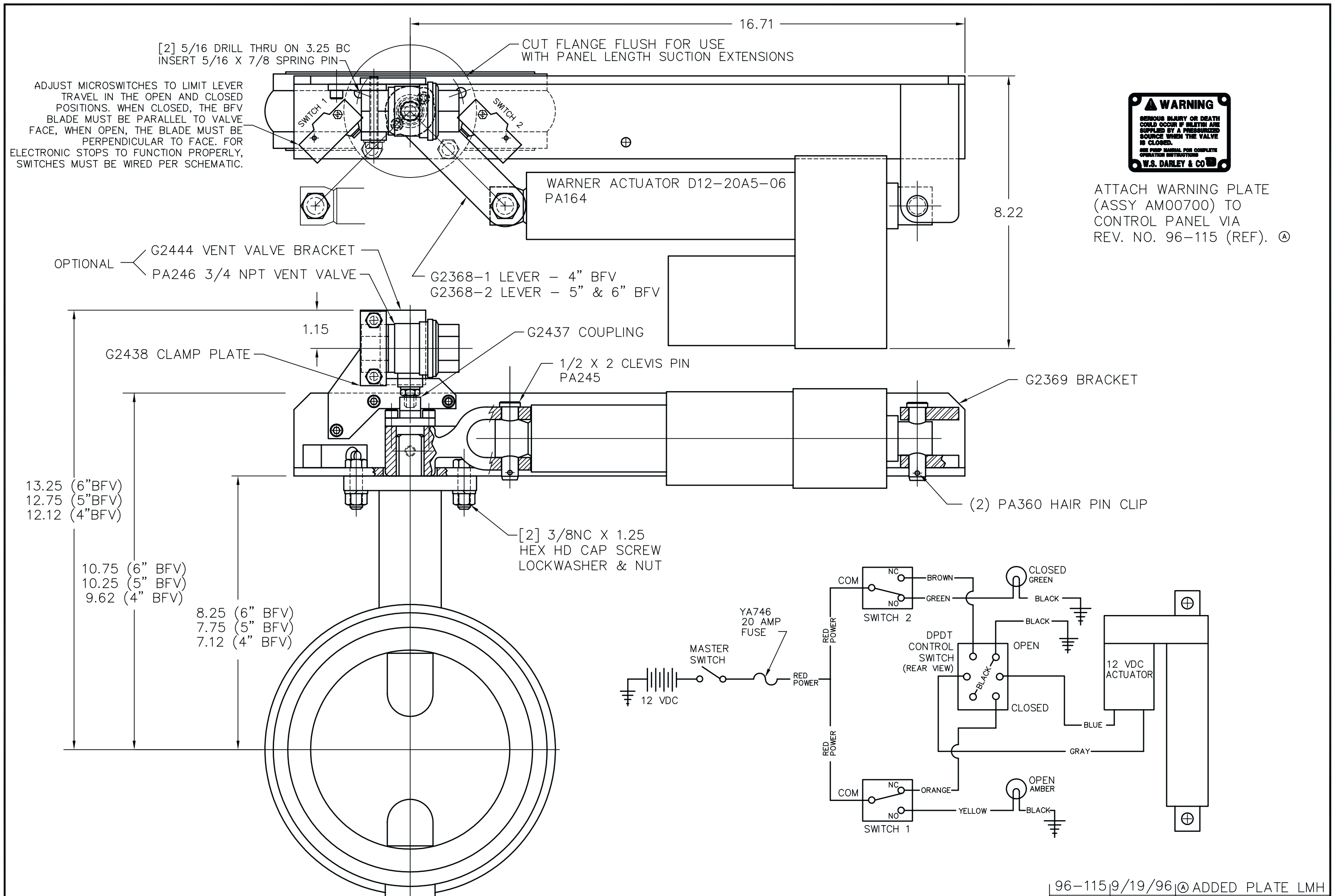


ATTACH WARNING PLATE
(ASSY AM00700) TO
CONTROL PANEL VIA
REV. NO. 96-115 (REF). Ⓐ
1.75
6.30ø
OPEN
CLOSE
2.88
1.75
10.15 (4 BFV)
10.77 (5 BFV)
11.24 (6 BFV)
7.12 (4" BFV)
7.75 (5" BFV)
8.25 (6" BFV)
2.50
.98
5.50
PA514
HANDWHEEL
PA515 GEAR OPERATOR
G2374-1 (4" BFV)
G2374-2 (5,6 BFV)
COUPLING
G2388 SPACER
3/8NC X 2.75 HEX HD CAP SCREW
LOCTITE AND TORQUE TO 23 FT.LB.
3/16 DRILL THRU
3/16 DIA X 1 3/8 SPRING PIN
APPROXIMATE WEIGHT
4" - 19 LB = 8.6 KG
5" - 22 LB = 10 KG
6" - 27 LB = 12.2 KG
96-115 9/19/96 Ⓐ ADDED PLATE LMH
PART NO. DATE CHANGE
TOLERANCE EXCEPT AS NOTED
W.S. DARLEY & CO.
MELROSE PARK, IL - CHIPPEWA FALLS, WI
OLD PART NO. G2420
DWG - BTRFLY VALVE ASSY
MANUAL CONTROLLED
DR'N DWS
CHKD
TRCD
DATE SEP25,91
SCALE 1/2
DGD0104
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED
ALL DIMENSIONS IN INCHES UNLESS NOTED
DO NOT SCALE PRINT



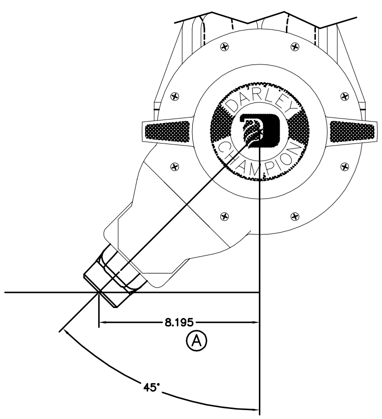
96-115	9/19/96	Ⓐ ADDED PLATE LMH		
PART NO.	DATE	CHANGE		
OLD PART NO. G2370	TOLERANCE EXCEPT AS NOTED FRAC DIM ±.01 .00 ±.01 .000 ±.005 ANGLES ±1°	W.S. DARLEY & CO. MELROSE PARK, IL - CHIPPEWA FALLS, WI		
MATERIAL:	MATERIAL NO. —	PATTERN NO.	DWG - BUTTERFLY VALVE ASSEMBLY ELECTRIC ACTUATED	
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED	ALL DIMENSIONS IN INCHES UNLESS NOTED	DO NOT SCALE PRINT	DR'N SEITZ CHKD TRCD	DATE NOV20,91 SCALE 1/2 DGD0101

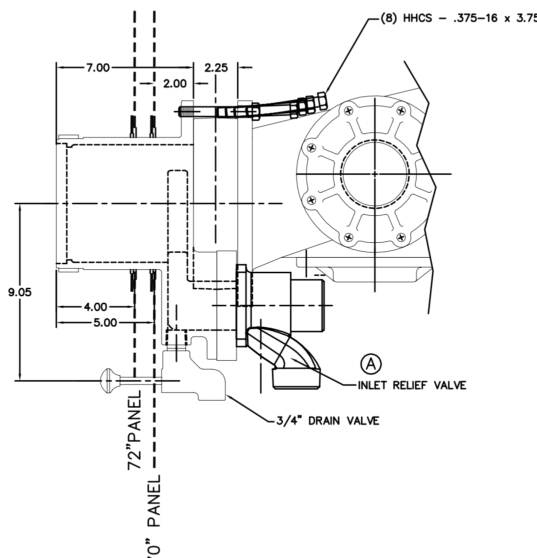
INLET RELIEF VALVE INFORMATION: (A)

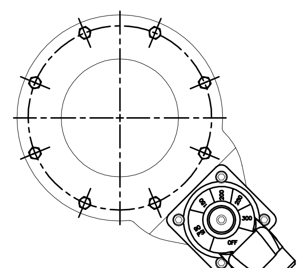
ACTUAL PRESSURE RANGE IS 90PSI – 300PSI
THERE MAY BE SOME DIMINISH IN FLOW AT HIGHER PRESSURE SETTINGS. (SETTINGS BELOW 200 PSI RECOMMENDED FOR MOST APPLICATIONS).
RELIEF VALVE IS FACTORY SET AT 125 PSI AND
WHEN PRESET AT 125 PSI, THE PRESSURE RELIEF VALVE SHALL NOT ALLOW A PRESSURE RISE GREATER THAN 60 PSI AT THE DEVICE INLET WHILE FLOWING A MINIMUM OF 150 GPM.
THIS VALVE IS NFPA 2009 1901 COMPLIANT PER SECTION 16.6.6.3

ADJUSTMENT INSTRUCTIONS (IF REQUIRED): (A)

ADJUST CENTER HEX COUNTERSUNK HEX HEAD PRESSURE ADJUSTING BOLT WITH A 1/4" ALLEN WRENCH, 9/16" OR 14 MM SOCKET.
TO SET AT THE DESIRED RELIEF PRESSURE, ADJUST THE ADJUSTING BOLT HEAD SO THE TOP OF THE BOLT HEAD IS EVEN WITH THE DESIRED PRESSURE.







(A)

NOTE:
SUCTION NIPPLE WILL BE ROTATED 45° OFF CENTER WHEN MOUNTED.

TYPICAL SUCTION EXTENSION CONFIGURATION FOR EM, LDM, N, & S PUMP

EXTENSION AND NIPPLE ARE THE SAME FOR 70 & 72" ASSEMBLIES WITH AND WITHOUT BUTTERFLY VALVES.
IF BFV IS NOT REQUIRED, THEN KC00300 ASSY W/2.25 THICK SPACER IS USED.
USE 1962503 STAINLESS STEEL PANEL TRIM RING

PART NO.	DATE	CHANGE
A – #8512	07/18/12	UPDATED DRAWING TO REFLECT USE OF TFT SUCTION RELIEF VALVE 8.20 WAS 5.22, UPDATED INFO AND ADJUSTMENT SECTION

MATERIAL:		PATTERN NO.
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. – UNAUTHORIZED REPRODUCTION IS PROHIBITED	ALL DIMENSIONS IN INCHES UNLESS NOTED	DO NOT SCALE PRINT

TOLERANCE EXCEPT AS NOTED
FRAC DIM ±.01
.00 ±.01
.000 ±.005
ANGLES ±1°

W.S. DARLEY & CO.
MELROSE PARK, IL – CHIPPEWA FALLS, WI

INSTR – INLET RV ADJUSTMENT
–

DR'N	CKE	DATE	03FEB,00
CHKD	SJL	SCALE	1/4
TRCD			

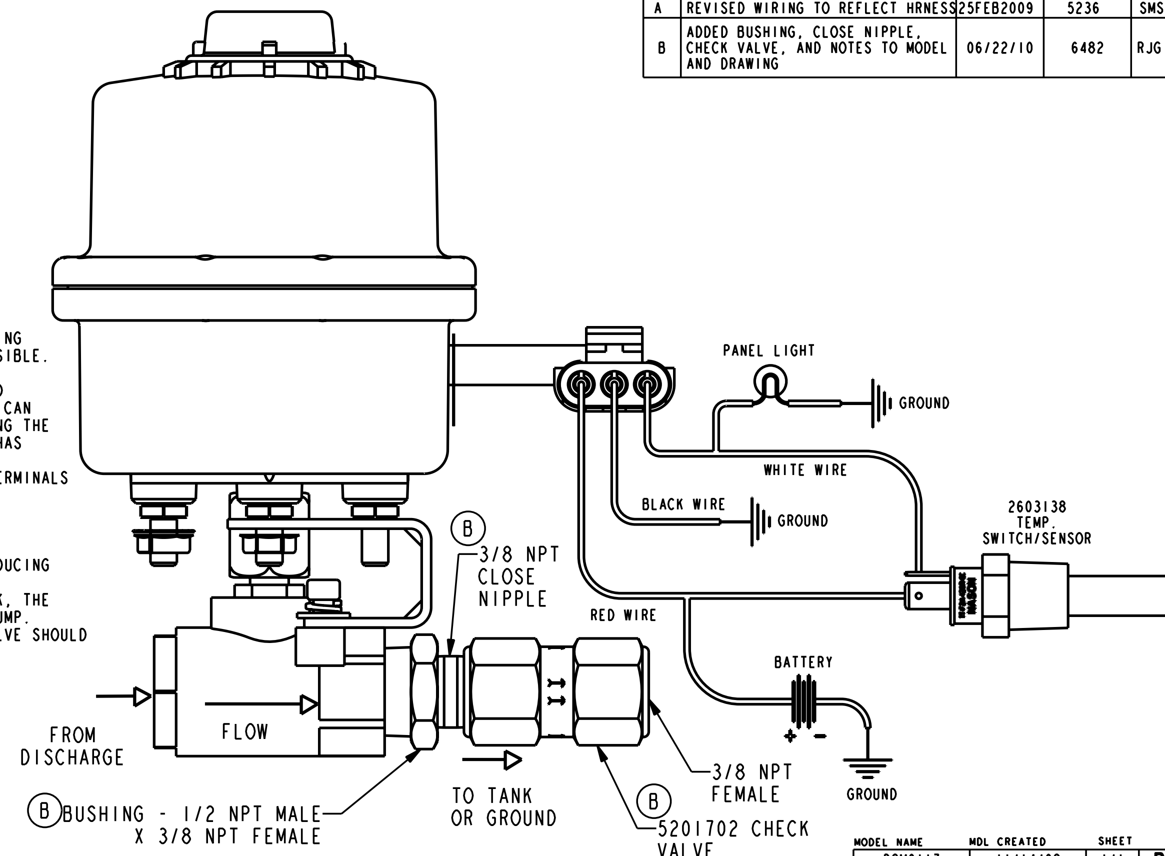
1200572

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
A	REVISED WIRING TO REFLECT HRNESS	25FEB2009	5236	SMS
B	ADDED BUSHING, CLOSE NIPPLE, CHECK VALVE, AND NOTES TO MODEL AND DRAWING	06/22/10	6482	RJG

INSTALLATION INSTRUCTIONS:

1) INSTALL TEMPERATURE SWITCH ON SUCTION SIDE OF PUMP, AS NEAR TO IMPELLER AS POSSIBLE, PREFERABLY BETWEEN THE IMPELLER AND THE RELIEF VALVE.
2) INSTALL THE ACTUATOR VALVE ON THE DISCHARGE SIDE OF THE PUMP. ITS LOCATION IS NOT CRITICAL.* IT CAN BE MOUNTED DIRECTLY TO THE PUMP OR POSITIONED REMOTELY AND CONNECTED WITH A 3/8 OD MINIMUM LINE.
3) VALVE DOES NOT NEED TO BE MOUNTED VERTICALLY AS SHOWN.
4) *PLUMB THE VALVE OUTLET TO TANK , IF DESIRED, USING 3/8 OD MINIMUM LINE. KEEP ALL LINES AS SHORT AS POSSIBLE.
5) ATTACH ONE LEAD OF VALVE TO THE TERMINAL ON THE TEMPERATURE SWITCH. ATTACH THE OTHER LEAD TO A FUSED VOLATAGE SOURCE. IF DESIRED, THE TEMPERATURE SWITCH CAN ALSO BE USED TO CONTROL A LIGHT ON THE PANEL NOTIFYING THE OPERATOR THAT OVERHEATING IS OCCURRING AND THE UNIT HAS BEEN ACTIVATED.
6) TO TEST THE VALVE: WITH PUMP RUNNING, JUMP THE TERMINALS ON THE TEMPERATURE SWITCH. IF THE VALVE DOES NOT DISCHARGE, IT MAY BE INSTALLED BACKWARDS OR WIRING CONNECTIONS MAY BE INCORRECT.

* CONNECTION TO TANK MAY CAUSE TANK TO OVERHEAT, REDUCING THE EFFECTIVENESS OF THIS DEVICE.
TO PREVENT FREEZING DAMAGE, WHEN CONNECTING TO TANK, THE VALVE SHOULD BE MOUNTED ON THE TANK, BUT ABOVE THE PUMP.
IF THE VALVE IS TO DISCHARGE TO ATMOSPHERE, THE VALVE SHOULD BE MOUNTED ON, OR AS CLOSE TO THE PUMP AS POSSIBLE.



MODEL NAME	MDL CREATED	SHEET	
DGM0117	11/14/08	1/1	B

REMOVE SHARP EDGES

INCH [MILLIMETER]

THIRD ANGLE PROJECTION

OLD PART NO.

TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1°

W.S. Darley & Co. ITASCA, IL - CHIPPEWA FALLS, WI

MATERIAL DESCRIPTION: -

MATERIAL NO. -

PATTERN NO. -

DWG - THERMAL RELIEF SYSTEM KZCO VALVE, 2603138 TEMP. SENSOR

THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED

ALL DIMENSIONS IN INCHES UNLESS NOTED

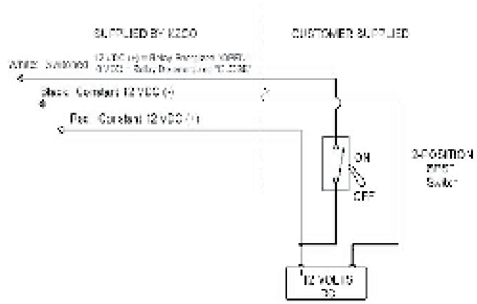
DO NOT SCALE PRINT

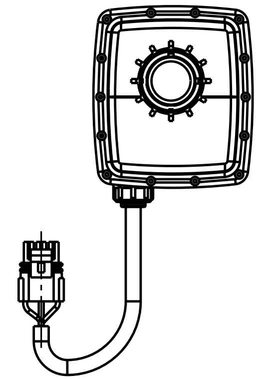
DR'N RJG
CHKD DWS
TRCD

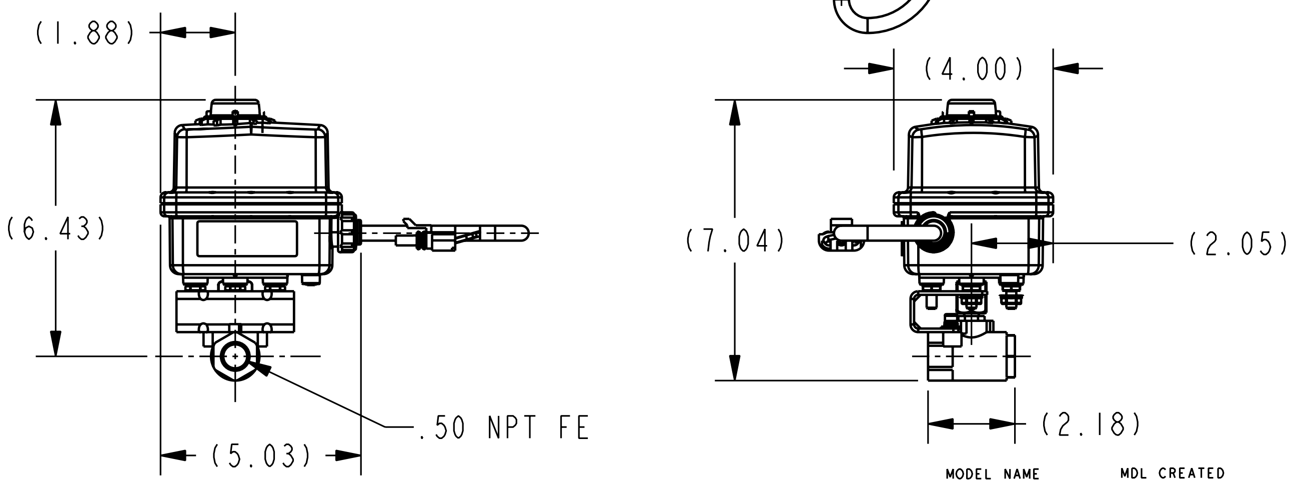
DATE 14-Nov-08
SCALE 1/1

DGM0117

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D







MODEL NAME	MDL CREATED	SHEET	
5209401	11/13/08	1/2	A

REMOVE SHARP EDGES

INCH [MILLIMETER]

THIRD ANGLE PROJECTION

OLD PART NO.

TOLERANCE EXCEPT AS NOTED
.00 ±.03
.000 ±.010
ANGLES ±1°

W.S. Darley & Co.
ITASCA, IL - CHIPPEWA FALLS, WI

VALVE - ACTUATED, 12VDC, .50NPT FE
KZCO 84D23-10D20-P01

MATERIAL DESCRIPTION:
KZCO 84D23-10D20-P01

MATERIAL NO. -

PATTERN NO. -

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ALL DIMENSIONS IN INCHES UNLESS NOTED

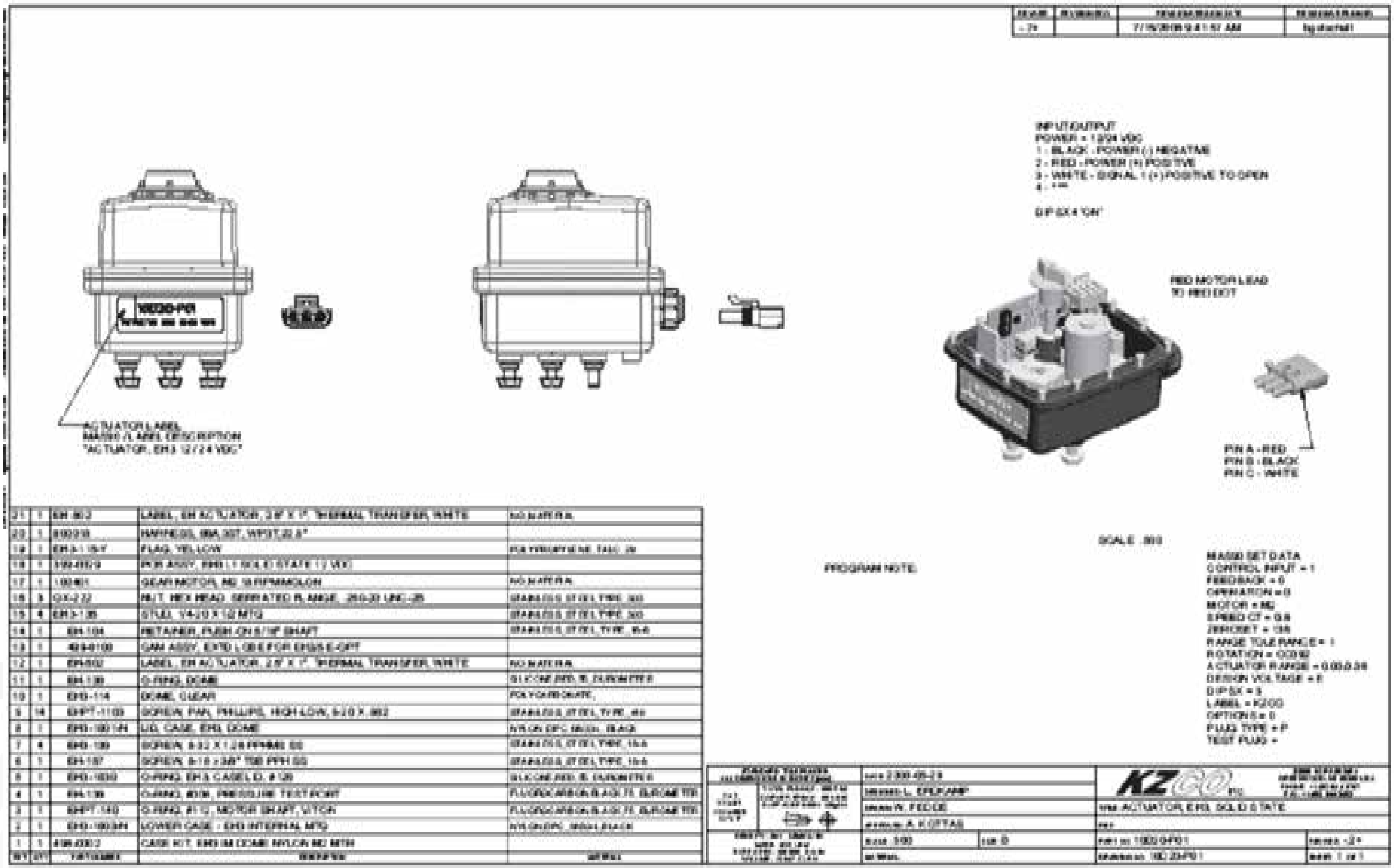
DO NOT SCALE PRINT

DR'N	RJG
CHKD	DWS
TRCD	

DATE 13-Nov-08
SCALE 1/4

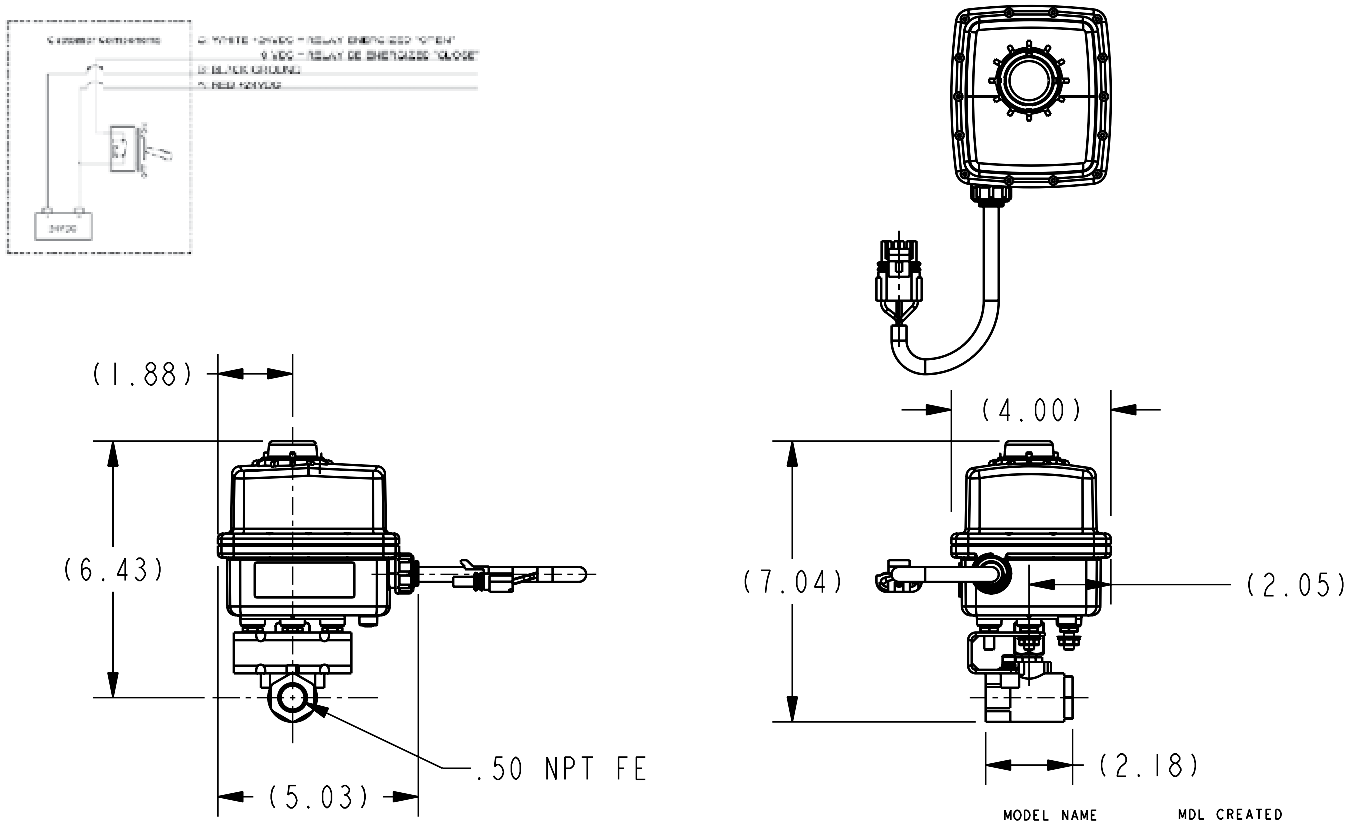
5209401

PUMP ASSEMBLY



60AD WIRING
Standard On/Off applications, SPST Switch
24 VDC

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D



MODEL NAME	MDL CREATED	SHEET	
5209402	11/13/08	1/3	A

REMOVE SHARP EDGES

INCH [MILLIMETER]

THIRD ANGLE PROJECTION

OLD PART NO.

TOLERANCE EXCEPT AS NOTED
.00 ±.03
.000 ±.010
ANGLES ±1°

W.S. Darley & Co.
ITASCA, IL - CHIPPEWA FALLS, WI

VALVE - ACTUATED, 24VDC, .50NPT FE
KZCO 84D23-60AD-M

MATERIAL DESCRIPTION:
KZCO 84D23-60AD-M

MATERIAL NO. -

PATTERN NO. -

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ALL DIMENSIONS IN INCHES UNLESS NOTED

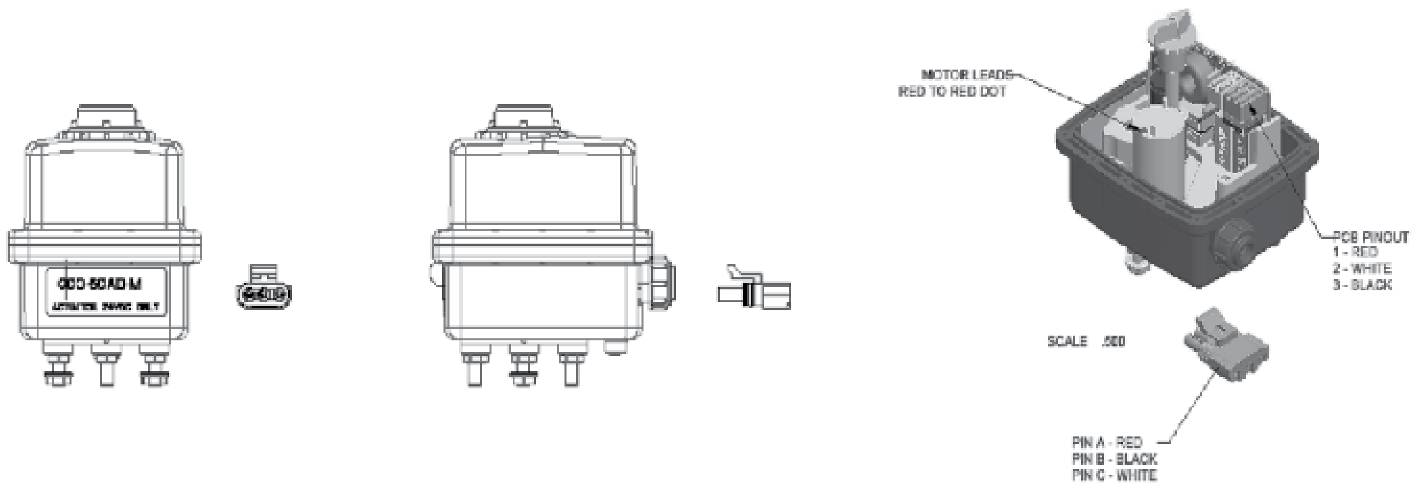
DO NOT SCALE PRINT

DR'N	RJG
CHKD	DWS
TRCD	

DATE 13-Nov-08
SCALE 1/4

5209402

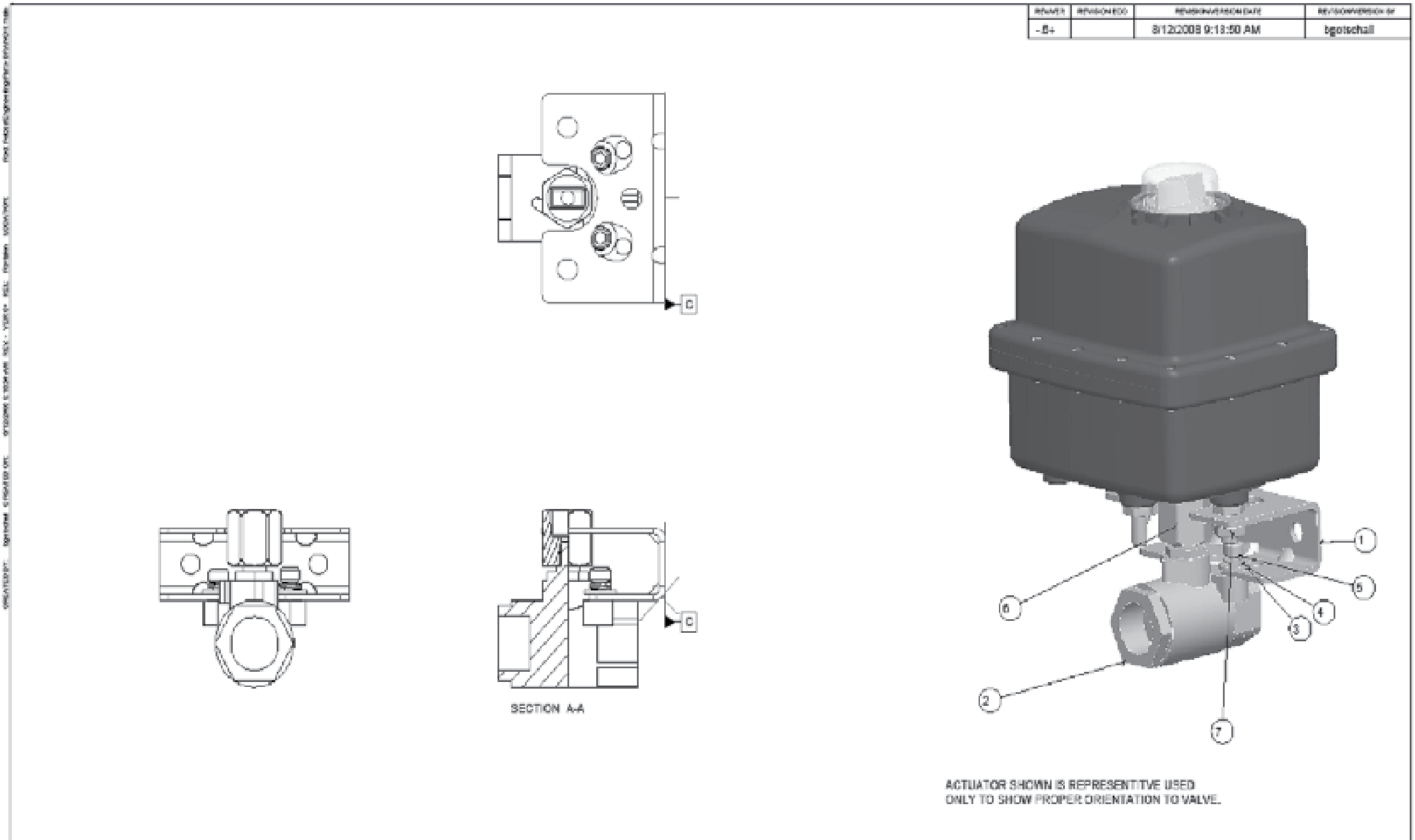
REV/VER	REVISION ECO	REVISION/VERSION DATE	REVISION/VERSION BY
.1		3/28/2008 1:49:38 PM	wfedde



MAS90 SET DATA
CONTROL INPUT = 1
FEEDBACK = 0
OPERATION = 0
MOTOR = M
SPEED CT = 0.0
ZEROSET = 126
RANGE TOLERANCE = 1
ROTATION = CC091
ACTUATOR RANGE = 0.00/0.00
DESIGN VOLTAGE = D
DIP SX =
LABEL = KZCO
OPTIONS = 0
PLUG TYPE =
TEST PLUG =

DET	QTY	PART NUMBER	DESCRIPTION	MATERIAL
8	1	EH-502	LABEL, EH ACTUATOR, 2.5" X 1", THERMAL TRANSFER, WHITE	NO_MATERIAL
7	2	QX-522	NUT, HEX HEAD, SERRATED FLANGE, .250-20 UNC-2B	STAINLESS_STEEL,TYPE_303
6	4	EH3-135	STUD, 1/4-20 X 1/2 MTG	STAINLESS_STEEL,TYPE_303
5	1	800018	HARNESS, 60A,3ST, WP3T,22.5"	
4	1	EH3-115-Y	FLAG, YELLOW	POLYPROPYLENE_TALC_20
3	1	800458	PCB ASSY, EH3 24VDC 60AD/60DF	
2	1	EH3-110	GEAR MOTOR, EH3 SERIES M1 12 RPM @ 12VDC	
1	1	490-0005	CASE KIT, EH3 M/DOME NYLON M1 & N1 MTR	

STANDARD TOLERANCES - ALL DIMENSIONS IN INCHES (mm)	DATE: 2007-04-16	KZCO inc.	
	DESIGNED: L. ERDKAMP		
	DRAWN: W. FEDDE	TITLE: ACTUATOR, EH3, .65 @24VDC	
	APPROVED: A. KOTTAS	REF:	
	SCALE: .500 SIZE: B	PART NO: 000-60AD-M	REV/VER: .1
	MATERIAL:	DRAWING NO: 000-60AD-M	SHEET: 1 OF 1



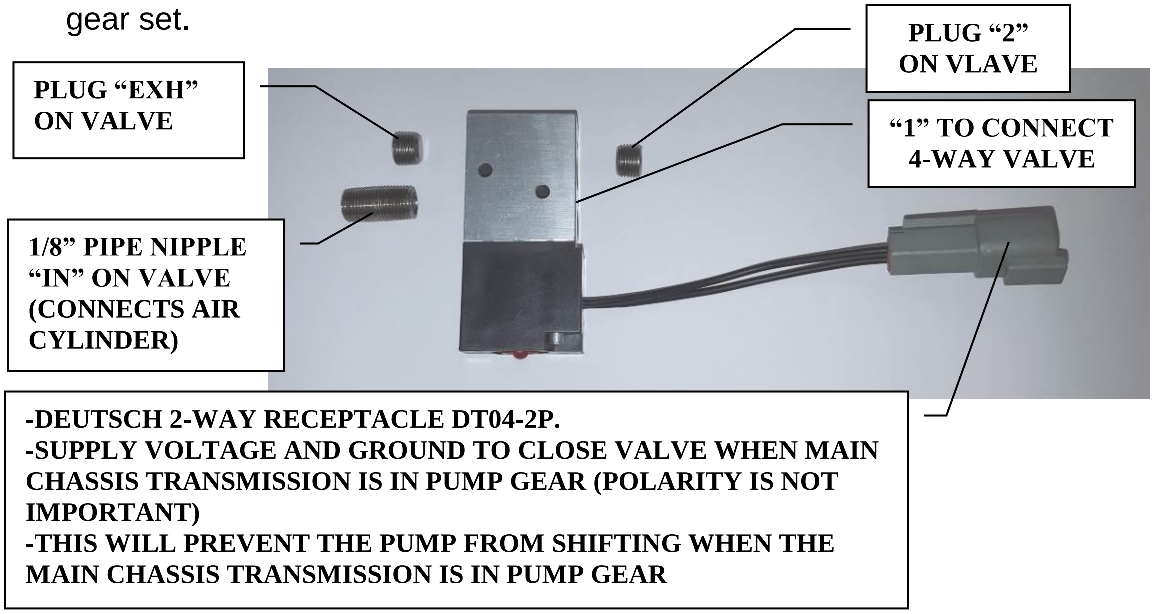
DET	QTY	PART NUMBER	DESCRIPTION	MATERIAL
7	3	[illegible]	NUT, HEX HEAD, SERRATED FLANGE, .250-20 UNC-2B	STAINLESS_STEEL_TYPE_303
6	1	[illegible]	COUPLER, 1/4" – 1/2" APOLLO	STAINLESS_STEEL_TYPE_316
5	2	EH-158	SCREW, #10-24 X 3/8" SS SOCKET HEAD	STAINLESS_STEEL_TYPE_303_OR_316
4	2	EHPT-109	WASHER, LOCK, .197 ID X .304 OD X .047 T	STAINLESS_STEEL_TYPE_316
3	2	EHPT-110	WASHER, FLAT, #10 18-8 SS	STAINLESS_STEEL_TYPE_316
2	1	[illegible]	VALVE, 1/2" 3-WAY APOLLO 70-103-01 BRONZE BALL VALVE	BRONZE
1	1	EH3-174	BRACKET, MOUNTING EH3 SERIES	STAINLESS_STEEL_TYPE_304

-STANDARD TOLERANCES- ALL DIMENSIONS IN INCHES [mm]. [illegible]	DATE: 2007-08-06	KZCO inc. [illegible]
	DESIGNED: L. ERDKAMP	
	DRAWN: C. HOWARD	TITLE: VALVE KIT, EH3 OFFSET MTG 1/2" 2-PC BRZ
	APPROVED: L.ERDKAMP	REF:
[illegible]	SCALE: .750 / SIZE: B	PART NO: 04D23 / REVIEWER: -B+
	MATERIAL: AS NOTED	DRAWING NO: 04D23 / SHEET: 1 OF 1

Darley

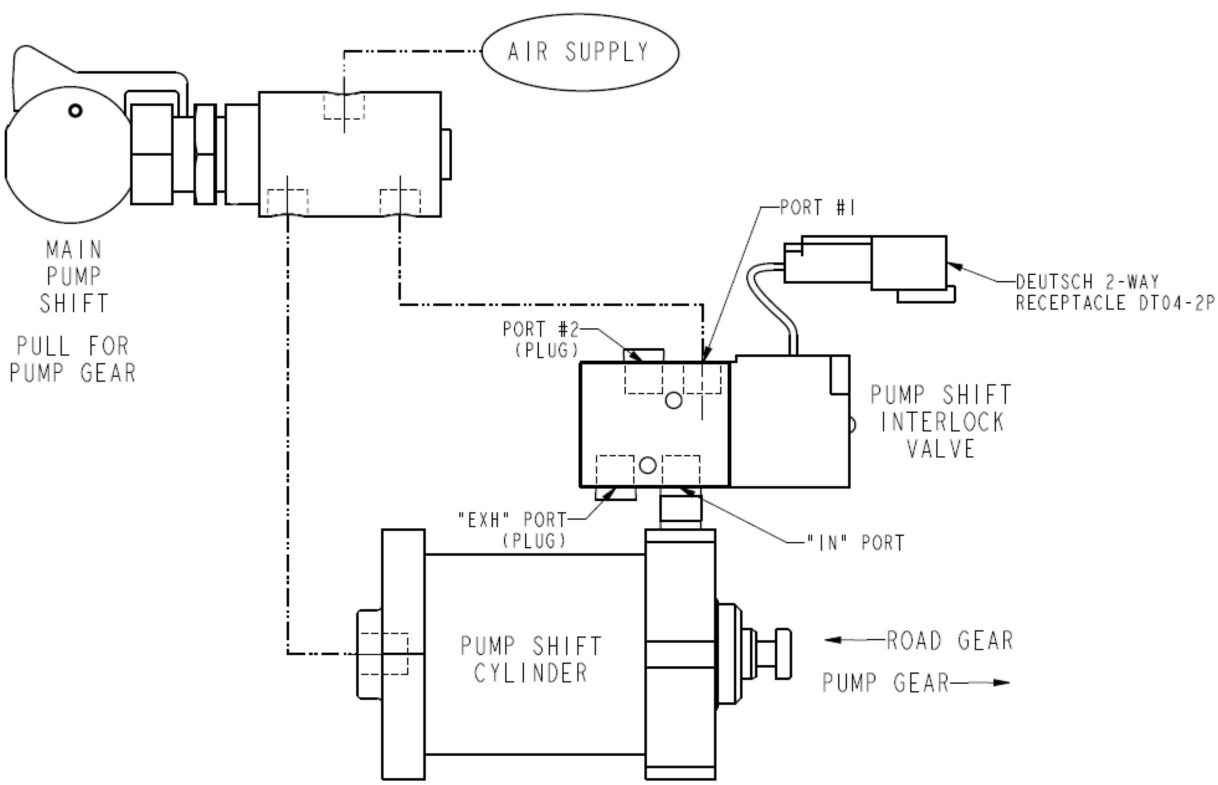
SHIFT SAFETY INTERLOCK
SCHEMATIC
MID-SHIP GEAR CASE

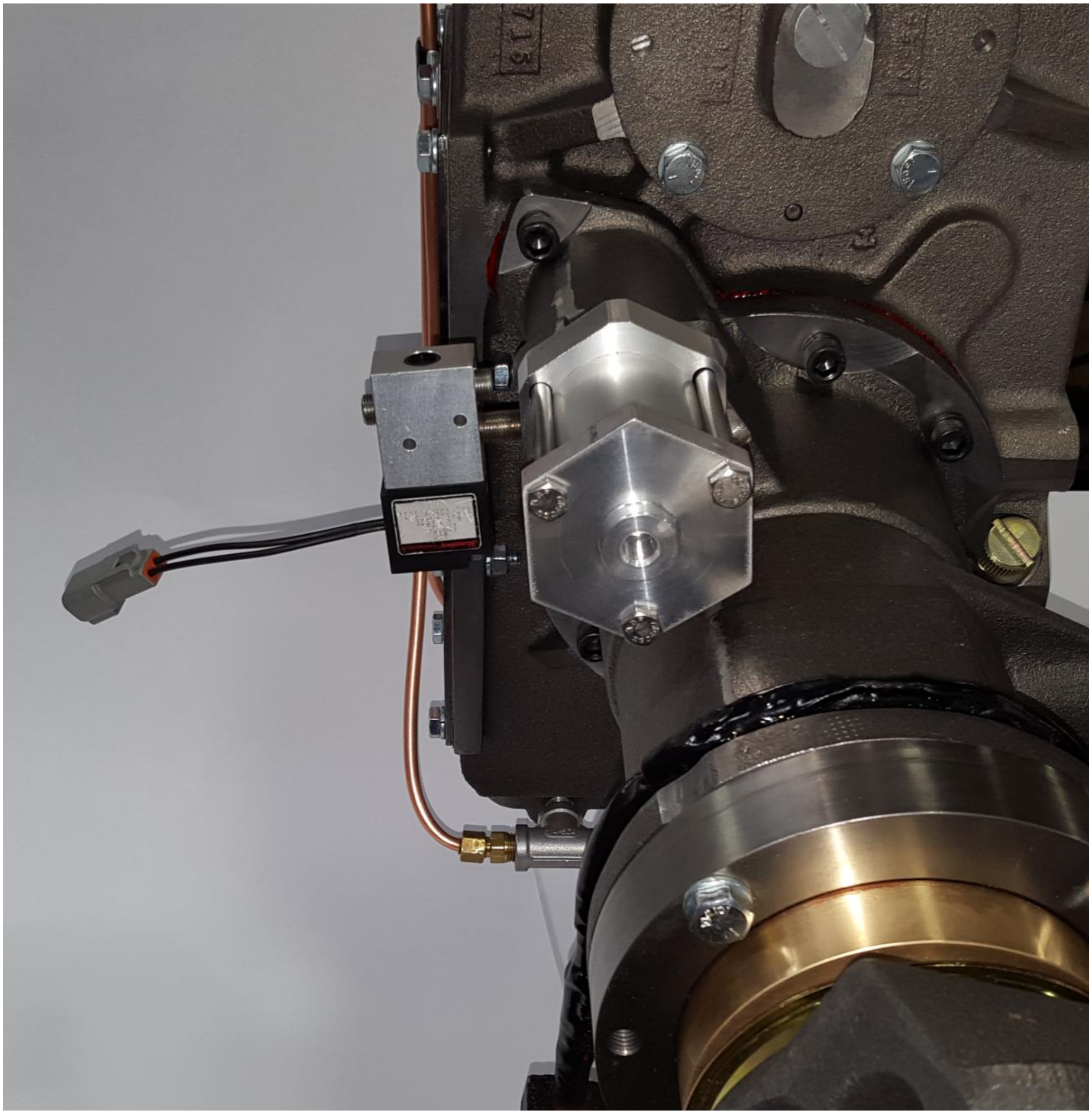
The safety interlock prevents the main pump shift from actuating while the automatic truck transmission is in drive gear. This eliminates clashing and possible damage of the pump gear set.



Assembly Notes:

1) Use Loctite 565 PST or equivalent pipe sealant on tapered pipe joints. (DO NOT USE TEFLON TAPE)
2) DO NOT over tighten fittings, doing so may damage thread.





Description – Air Compressor System

A Gardner-Denver Tamrotor rotary screw air compressor provides compressed air for the Darley LDMBC AutoCAFS II Compressed Air Foam System.

Rotary screw air compressors are widely used in industrial, transportation and construction applications where compactness, high efficiency, smooth operation, and reliability are paramount.

The compressor air end is driven via the fire pump impeller shaft through a high-performance, Gates Poly Chain drive belt. Compressor engagement is controlled by an electric multi-plate clutch system (1) providing hot shift capability. The air end and drive system components are rated to provide up to 220 cfm airflow at 125 psi.

Referring to *Figure 1 on page 80* and *Figure 2 on page 81*, the compressor system operates as follows: Air is drawn in through the filtered inlet-modulating valve (2) that also functions as a non-return valve during shutdown. From the inlet valve, air enters the air end (3) where pressurization occurs. Cooling and lubricating oil is continuously injected into the rotor housing through the hydraulic supply line (5). The pressurized air/oil mixture discharged from the air end flows through a hydraulic hose (4) into the oil receiver/separator tank (7) where oil is removed from the pressurized air.

Oil removal is a two-step process. Most of the oil is removed by the centrifugal effect of the cyclone in the lower part of the receiver (7). The remaining oil is removed by two coalescing elements located in the upper region of the separator tank (7). The oil removed by the separator elements is then returned to the air end via the oil return line (13). An orifice in this return line restricts air circulation back to the air end. Clean air is then discharged through the valve port (10).

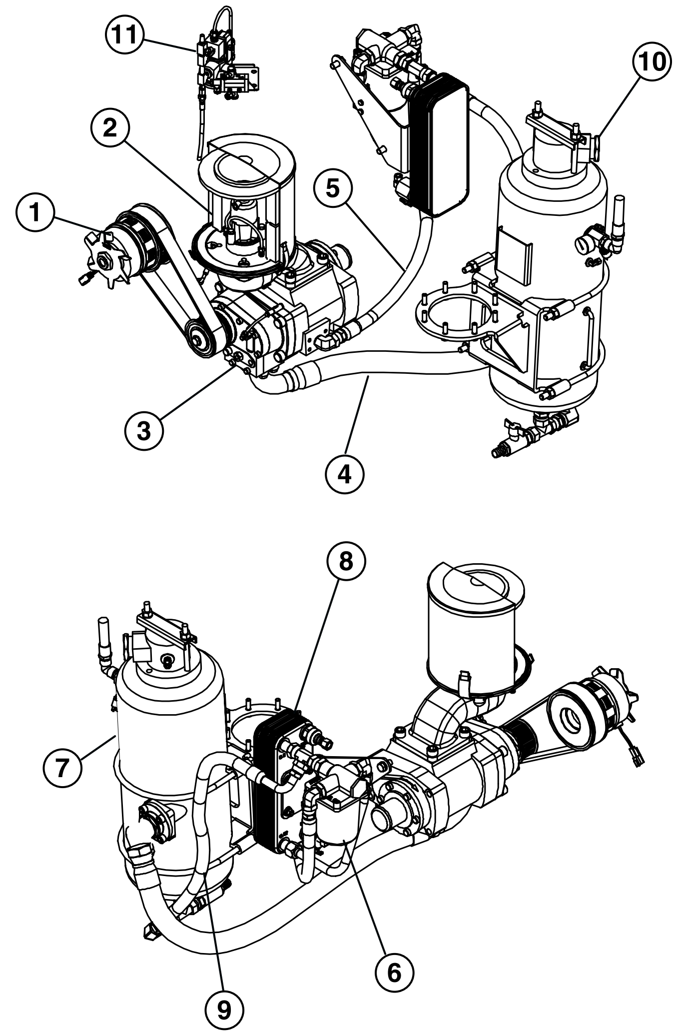


Figure 1

From the oil separator tank (7), hot oil flow through the hose connection (9) is led through the oil cooler (8) to cool down the screw unit. The oil circuit includes a thermostat (15) in the filter head that bypasses the cooler when the oil is cold.

Oil circulation is forced and is maintained by the pressure difference between the receiver and the screw unit. To keep oil in circulation under all operating conditions, the discharge port (10) includes a minimum pressure check valve (12). This valve prevents the receiver pressure from dropping below 45 psi, thus assuring continuous oil flow through the system.

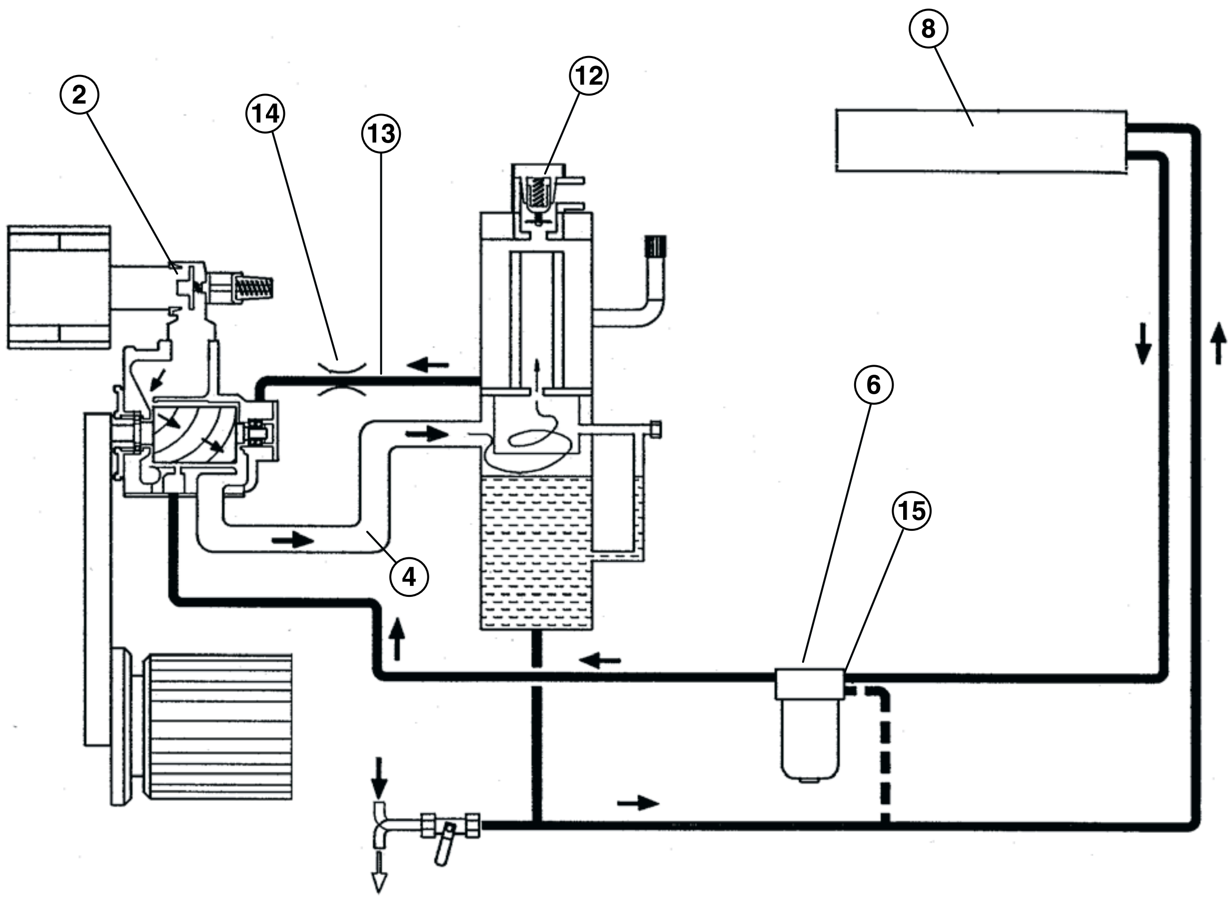
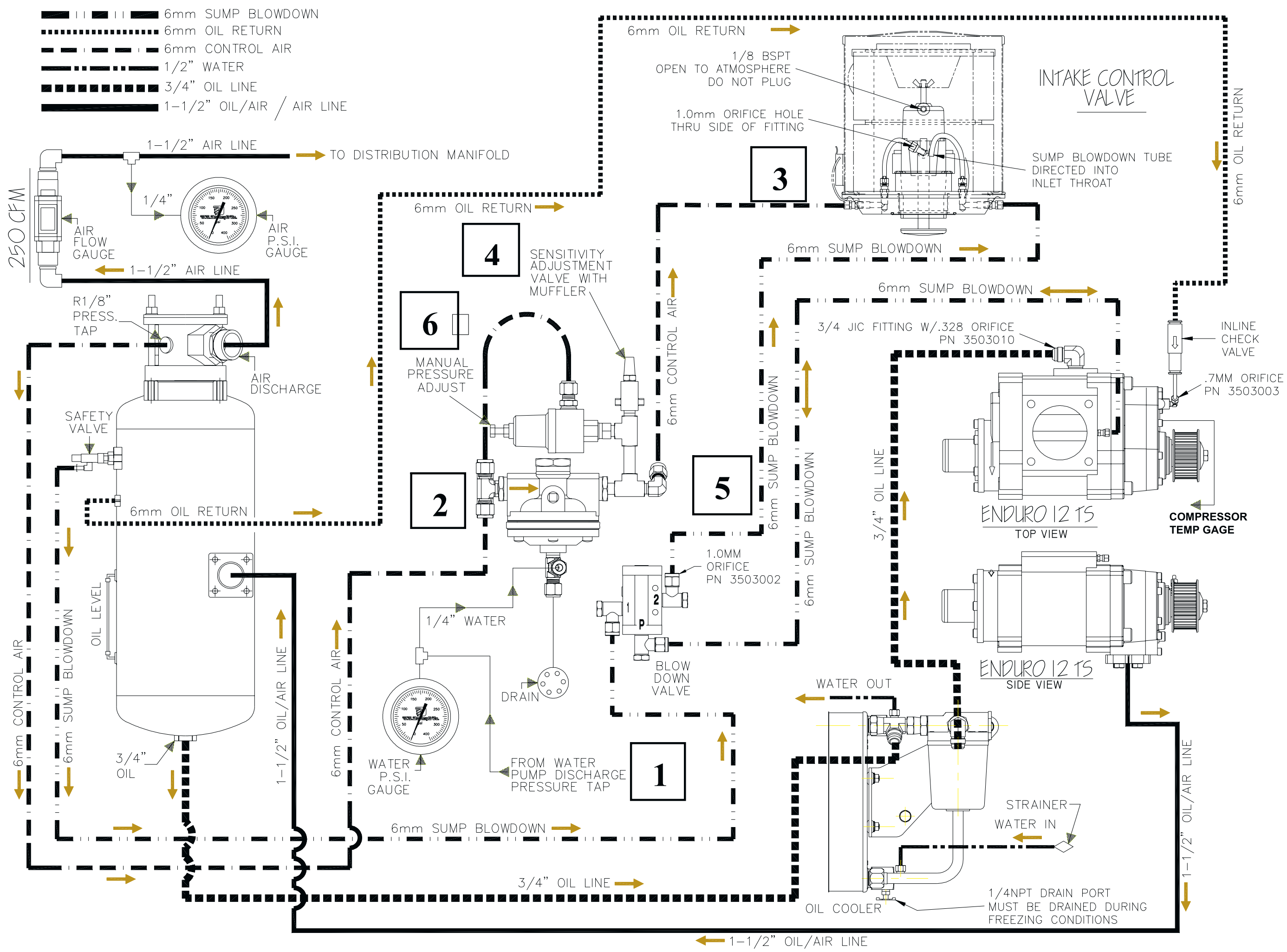


Figure 2

AutoCAFS II pressure balance valve assembly (11) includes a pressure-balancing system and a system blow-down valve.

Refer to drawing DCS0502 for review of control system schematic.



Compressor System Pressure Control

The compressor discharge pressure is automatically balanced to match the fire pump discharge pressure. A line (1) is connected from a discharge gauge pressure tap (located on the discharge head) to the bottom port of the balance pressure diaphragm valve. As the pump discharge pressure is increased, the diaphragm valve (2) proportionally restricts control airflow from the receiver tank to the inlet valve. The inlet valve (3), being a positive pressure type valve, opens as the pressure in the control line decreases and closes as the control line pressure increases. Opening the inlet valve increases the air inlet volume that in turn increase the discharge air pressure (constant flow rate). Therefore, as the pump pressure increases, the control line pressure decreases, the inlet valve opens, and the air pressure/volume increases.

PRESSURE CONTROL SENSITIVITY

A needle type sensitivity valve (4) allows a small amount of control air to continually escape to the atmosphere, buffering the fluctuations (hunting) of the control system as it performs the balancing process. As a result, the inlet valve will respond slower to the pressure change, reducing modulator pulsation. If the sensitivity valve is set too far in or closed (clockwise rotation), no pressure modulation will take place. If it is too far open (counterclockwise rotation), pressure fluctuations will go unnoticed and pressure spikes will be unavoidable.

CONTROL SENSITIVITY ADJUSTMENT

Should the needle valve need adjustment, use the following as a guide. Start by closing the valve (4) completely. Then open it approximately 3 turns. Operate the unit at around 125 psi; begin by flowing about 1/3 the capacity of the air compressor. At this flow rate, the air inlet modulator valve will open to bring in air and then close as air pressure builds. The goal is to set the needle valve at a position where pressure fluctuations are minimized. If the red needle on the pressure gauge is fluctuating more than 20 psi above or below the water pressure, then the needle valve should be adjusted out or counterclockwise. As the pressures come closer to balancing, less flow meter fluctuation should also be noticed.

NOTE: *Some pressure modulation is normal and required for the system to auto-balance while delivering the compressed air foam system (CAFS). Expect pressure variation to range from 5–20 psi.*

Compressor System Pressure-Limiting Valve

A pressure-limiting valve (6) is incorporated in the control airline to limit maximum air pressure to a preset value. This valve is factory preset to and should be maintained at 150 psi. As such, the compressor control system will maintain a balance between water and air up to 150 psi.

PRESSURE-LIMITING VALVE ADJUSTMENT

Engage the pump and compressor using prescribed methods. Initiate water flow through the pump to assure circulation through the heat exchanger; maintain a 50–100 gpm flow rate. Increase the pump pressure to approximately 175 psi. Adjust the air pressure manual adjustment valve (6) clockwise to increase pressure, setting the air pressure (red needle) to 150 psi.

To test setting, open an airflow valve on a CAFS discharge until air pressure drops, then close it again. The pressure should quickly build back up to the maximum governed pressure as set by the manual pressure valve.

NOTE: *Choose a discharge that will safely discharge plain air to atmosphere such as deck gun. Do not discharge air into a pre-connected bed of lay flat hose.*

NOTICE

Do not over-speed the air compressor. Input RPM should not exceed that required to produce a rated air flow of 220 cfm at 150 psi maximum pressure.

Disengage the air compressor when service testing or performing UL test on the CAFS-equipped vehicle.

System Blow-Down (Depressurization)

After compressor shutdown, system pressure is bled off to guard against overloading drive components at start-up. If the receiver assembly is not depressurized on shutdown, oil will flood the compressor, filling the area above the screws. Oil trapped above the screws will then cause a hydraulic lockup when compressor rotation rapidly accelerates during start-up. A hydraulic lockup of this type can induce extreme loads on the power train.

A blow-down valve (5) is included in the system to automatically relieve system pressure at shutdown. The system blow-down valve (5) is a basic two-way pilot-operated pneumatic shuttle valve. When the compressor is operating, pilot pressure for shuttle valve port 'I', being connected to the inlet side of the compressor, is sensing a vacuum; ports 'R' and 'P' do not communicate.

At shutdown, the inlet valve (3) closes, acting as a check valve. At the same time, the inlet side of the compressor is pressurized from the receiver tank via the 1-1/2 in. discharge line. Pilot port 'I' is in turn pressurized, shifting the valve spool and connecting port 'R' to port 'P'. The receiver pressure is thus vented to the atmosphere inside the filter housing (3). Allow a 1-minute minimum time period between compressor shutdown and restart for system blow-down.

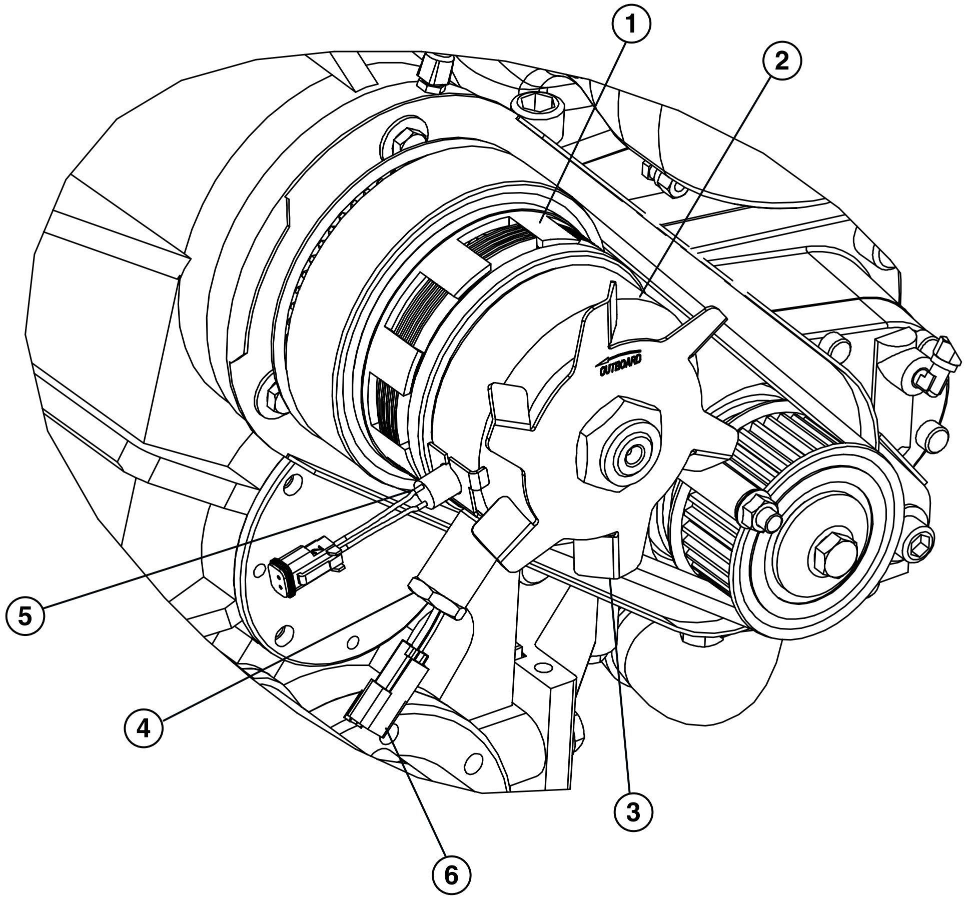
A separator tank pressure switch prohibits clutch engagement if the tank pressure is above 10 psi thus assuring system blow-down before restart. Always reduce engine rpm to 900 rpm or lower when switching the compressor engagement from DISENGAGE to ENGAGE.

NOTICE

Avoid immediate restart of the air compressor after shutdown. Allow 1 minute minimum time period between air compressor shutdown and restart for system blow-down.

Compressor Clutch Assembly

The compressor air end is driven via the fire pump impeller shaft through a high-performance Gates Poly Chain drive belt. Compressor engagement is controlled by an electric multi-plate clutch system providing hot shift capability. Chassis electrical power is utilized to provide engagement of the clutch.



1. Drive cup
2. Clutch
3. Cooling fan
4. Clutch anti-rotation bolt
5. Temperature sensor
6. Electric clutch power connection

12 VDC ±10% must be supplied to the clutch (2) for proper performance. If supplied voltage is too low, then the clamping force on the clutch discs may not be adequate to carry compressor torque loads at full capacity. This will result in clutch slippage and consequent overheating. Power is supplied to the clutch through the AutoCAFS Commander control module. Refer to *AutoCAFS Commander Operation and Installation Reference on page 112* for further details.

COMPRESSOR ENGAGEMENT RPM

The compressor may be engaged before or after the pump is engaged. However, do not engage compressor when the engine is turning faster than 900 rpm. Engine rpm must be reduced to 900 rpm or lower before engagement. The AutoCAFS Commander module will only allow compressor engagement at engine speeds below 900 rpm. The Commander will display 'RPM >900' when engagement is requested with rpm higher than 900 rpm. Refer to *AutoCAFS Commander Operation and Installation Reference on page 112* for further details on the AutoCAFS Commander control module.

COMPRESSOR DISENGAGE RPM

The compressor can be switched off (DISENGAGED) at any time or input speed.

NOTICE

Avoid immediate restart of the air compressor after shutdown. Allow 1 minute minimum time period between air compressor shutdown and restart for system blow-down.

MAXIMUM COMPRESSOR RPM

The air pressure will match the water pressure up to 150 psi if the pump input speed is adequate to maintain the flow rate setting.

NOTE: *Do not exceed 175 psi pump pressure while the compressor is engaged. The maximum air pressure has been factory pre-set to 150 psi.*

To avoid compressor over-speed, the commander will display a warning message 'OVERSPD' when engine rpm approaches maximum allowable compressor speed. The Commander is by default programmed to provide a visual speed warning at 3650 + pump ratio. As an example, if the pump has a 2.44:1 ratio, the over-speed warning would be at 1,500 engine rpm.

If the engine rpm continues to increase to the maximum allowable compressor rpm, 4500 + pump ratio, the Commander will automatically disengage the compressor. As an example, if the pump has a 2.44:1 ratio, over-speed disengagement would be at 1,844 engine rpm.

If the compressor is disengaged due to over-speed, engine rpm must be reduced to 900 rpm and the compressor system must blow-down before re-engagement can occur. Refer to *AutoCAFS Commander Operation and Installation Reference on page 112* for further details on the AutoCAFS Commander control module.

NOTICE

Do not over-speed the air compressor. Input RPM should not exceed that required to produce a rated air flow of 220 cfm at 150 psi maximum pressure.

Disengage the air compressor when service testing or performing UL test on the CAFS-equipped vehicle.

System Temperature Sensors

The AutoCAFS Commander incorporates two thermal sensors.

A transmission overheat warning will be displayed on the Commander if the temperature sensor (5) on the clutch rises above its limit. The Commander display will alternately flash 'SHUTDOWN' – 'TRANS HOT.' The Commander will automatically disengage the compressor clutch if an over-heat condition occurs.

A second thermal sensor is attached to the compressor air end with a digital display on the AutoCAFS Commander. This sensor is incorporated into the compressor engagement system to avoid compressor over-heating that may result in premature bearing failure, scored housing, or rotor seizure. If compressor temperature rises above normal operating temperature to 212° F, the Commander will flash a warning 'COMP HOT' and the compressor temperature will be displayed. *If temperature warning is indicated, shut down the compressor as soon as practical.* The compressor can be switched off (DISENGAGED) at any time or input speed.

If the compressor temperature is allowed to increase to 240° F, the AutoCAFS Commander will automatically disengage the compressor. At this time the Commander will alternately display 'SHUTDOWN' – 'COMP HOT' along with the actual compressor temperature.

Check for adequate water flow through the heat exchanger. Check for adequate oil level in the separator tank. See trouble-shooting guide for further options. *Do not restart compressor until source of problem is determined and rectified.*

NOTICE

If the air compressor temperature continues to rise to 240° F, the air compressor will be automatically disengaged.

COMPRESSOR MAINTENANCE

	Daily or After Use	25 Hours	6 Months	100 Hours	12 Months	2,000 Hours	24 Months
Check Oil Level	X[1]	X	X				
Check Air Filter		X[2]					
Change Oil/Filter				X	X		
Replace Air Filter				X[3]	X		
Check Safety Valve					X		
Inspect Hoses and Fittings						X	X
Inspect Drive Belt						X	X
Replace Oil Separator Elements						X	X

1. Check oil in stopped compressor (wait until air and oil are separated).
2. Check air filter more frequently under adverse/dusty operating conditions.
3. Check as conditions dictate.

The air filter is the most important filter in the system; if it is kept clean, the other filters will also stay cleaner. Always use a new filter element; DO NOT blow out the element with compressed air and reuse.

COMPRESSOR OIL

It is recommended that a circulation oil (hydraulic oil) or synthetic lubricating oil per the following specifications be used.

MINERAL OIL

Use compressor oil specially made for screw compressors, including antioxidants and rust, foaming, and wearing preventative components.

SYNTHETIC LUBRICANT

Use compressor oil specially made for screw compressors, including antioxidants and rust, foaming, and wearing preventative components.

VISCOSITY

- Maximum 500 mm^2/s (centistokes) at start-up temperature
- Minimum 7 mm^2/s at running temperature (185° F)

FLASH POINT

- Minimum 360° F

Under normal conditions, the above requirements are fulfilled using and ISO VG 32 oil.

Examples:

Phillips 66 MAGNUS OIL ISO VG 32 (mineral oil) or

Phillips 66 SYNDUSTRIAL E Compressor Oil 32 (synthetic)

Approximate Capacity – 12 to 16 qt

Compressor Oil Filter:	Part No. 1122802, (1) req'd
Compressor Separator Cartridge:	Part No. 1122702, (2) req'd
Air Filter Element:	Part No. 1122601, (2) req'd

NOTE: *Refer to pump and apparatus manual (Pump Assembly on page 5) for maintenance requirements of the main pump and components.*

Refer to proportioner manual (Foam Proportioner on page 131) for maintenance requirements on the foam proportioner system.

Oil Change

⚠ WARNING

Burn Hazard: Always allow the compressor system to cool before touching components. Compressor oil and components are hot when the compressor is first shut down.

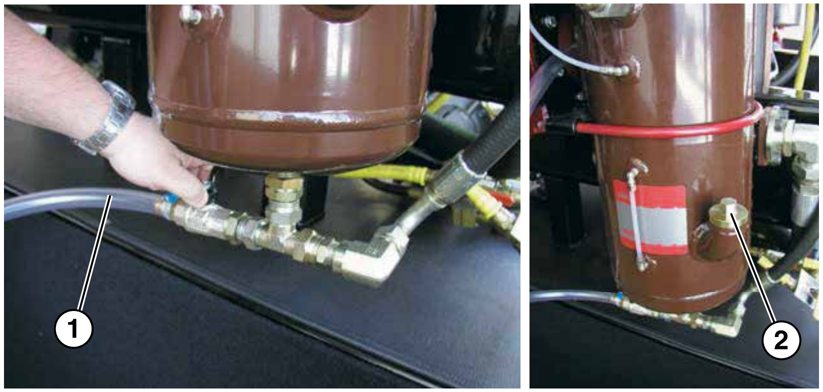
⚠ WARNING

High-Pressure Hazard: Avoid skin contact with high-pressure oil. Do not open the oil drain valve if the receiver is pressurized. Open the safety valve 4 to 5 turns before opening the oil/fill valve. High-pressure oil can penetrate your skin and result in serious injury.

NOTICE

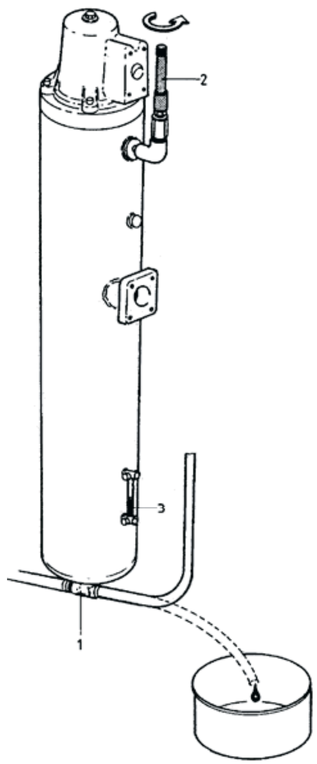
Use the recommended oil types only; do not mix different oil types.

Always be environmentally responsible. Follow the guidelines of the EPA or other governmental agencies for the proper disposal of hazardous material such as waste oil.



1. Drain valve
2. Fill port

Darley



1. Run the compressor to warm up the oil to approximately 110° F.
2. Stop the compressor and check that the receiver is not under pressure. After stopping, blow-down empties the compressor; wait approximately 2 min.
3. Secure apparatus so it cannot be started while maintenance is being performed.
4. Open safety valve (2) 4–5 turns.
5. Open drain/fill valve (1) and let oil run into suitable container.
6. Close drain/fill valve (1). Drain and clean fill hose.
7. Confirm correct oil type. Using a filtered funnel, fill receiver tank to mark on oil level indicator (3). Use care to assure oil system is kept clean and free of contamination.
8. Close safety valve (2).
9. Replace oil filter.
10. Run compressor for 1 min.
11. Stop compressor.
12. Allow air and oil to separate; re-check oil level.

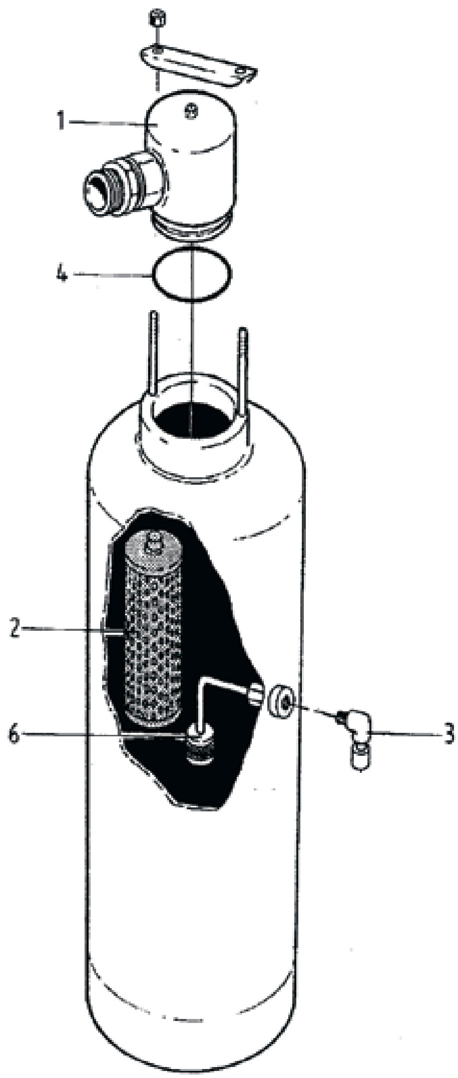
Replacing Oil Separator Element

⚠ WARNING

Burn Hazard: Always allow the compressor system to cool before touching components. Compressor oil and components are hot when the compressor is first shut down.

NOTICE

Always be environmentally responsible. Follow the guidelines of the EPA or other governmental agencies for the proper disposal of hazardous material such as used separator element.



REMOVAL

1. Stop the compressor and check that the receiver is not pressurized. After shutdown, allow 2 mins for system blow-down.
2. Make sure system cannot be started while maintenance is being performed.
3. Remove output valve (1).
4. Remove the separator elements (2) by removing the two SHCS that retain the elements.

INSTALLING

1. Carefully clean the sealing surfaces on the receiver and output valve (1).
2. Clean the 0.7 mm orifice in the oil return line which is located in the fitting sleeve at the compressor (see DWG DCS0500).
3. Clean the return oil screen filter (6) (inside the receiver) by blowing in pressurized air through fitting (3).
4. Install the new separator elements (2) in place. Secure with two SHCS.
5. Check the condition of the sealing of the output plate.
6. Inspect seal (4); replace if damaged.
7. Install the valve assembly (1).
8. Tighten retaining nuts alternately and evenly.

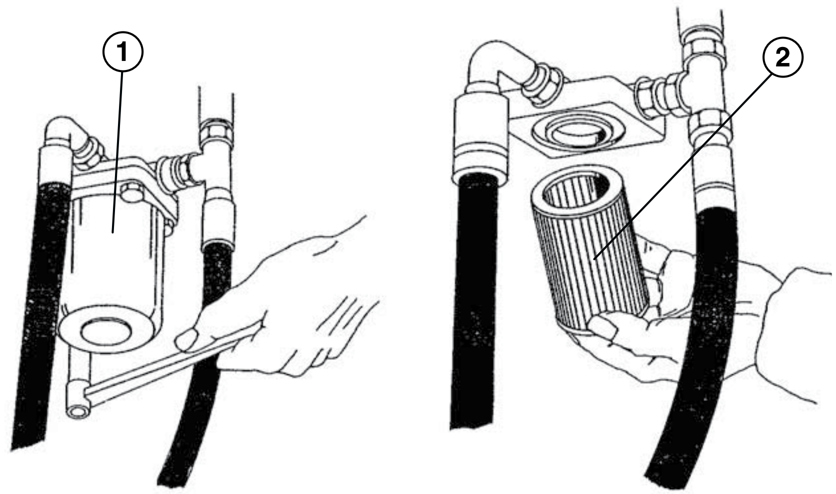
Replacing Oil Filter

⚠ WARNING

Burn Hazard: Always allow the compressor system to cool before touching components. Compressor oil and components are hot when the compressor is first shut down.

NOTICE

Always be environmentally responsible. Follow the guidelines of the EPA or other governmental agencies for the proper disposal of hazardous material such as used filter element.

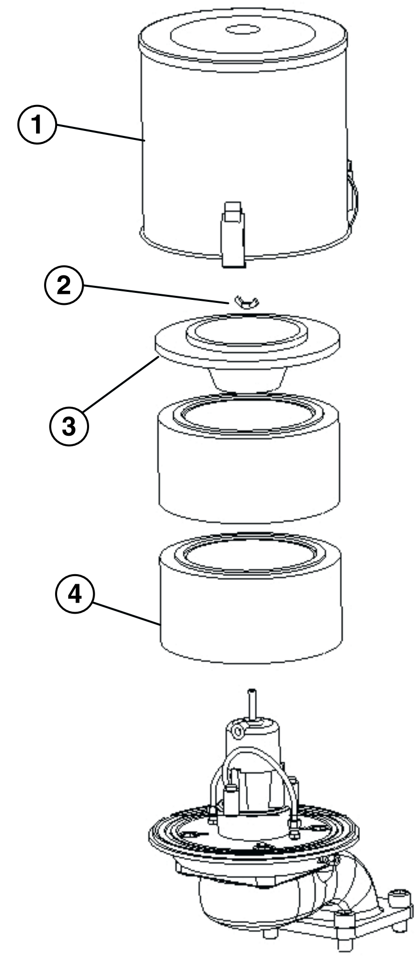


1. Stop the compressor and check that the receiver is not pressurized. After shutdown, allow 2 min for system blow-down.
2. Make sure system cannot be started while maintenance is being performed.
3. Remove the filter housing cover (1) and take out the old filter (2).
4. Install a new filter element (2).
5. Inspect cover O-ring and replace if required.
6. Replace cover.
7. Tighten the cover mounting screws alternately and evenly.

Replacing Air Filter Elements

WARNING

Burn Hazard: Always allow the compressor system to cool before touching components. Compressor oil and components are hot when the compressor is first shut down.



REMOVAL

1. Toggle three retaining clips and remove filter housing.
2. Remove wing nut (2) and retaining plate (3).
3. Remove and discard the filter elements (4).

INSTALLING

1. Carefully clean and inspect the sealing surfaces and housing components.
2. Install two new filter elements (4).
3. Assemble retainer plate (3) and wing nut (2).
4. Replace filter housing (1) and fasten three retainer clips.

Testing Safety Valve

⚠ WARNING

Burn Hazard: Always allow the compressor system to cool before touching components. Compressor oil and components are hot when the compressor is first shut down.

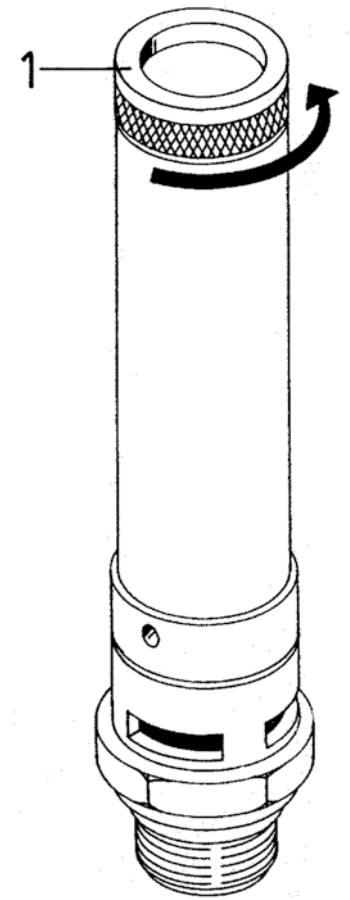
⚠ WARNING

Operation Hazard: NEVER operate the compressor system with a malfunctioning, modified, plugged, or missing safety valve. Observe local regulations when servicing the compressor system. All adjustments and repair work on the safety valve must be performed by a qualified mechanic.

The receiver tank safety valve provides for pressure relief should the control system malfunction. The valve is factory pre-set at 200 psi and is non-adjustable.

The operation of the valve can be confirmed by turning the safety valve cap (1) counterclockwise 1–2 turns while the receiver is pressurized. Air should be released as the valve is opened. Close valve.

Opening (safety blow-off) pressure of the valve must be tested with the valve removed from the receiver tank and connected to test air supply.



Belt Adjustment and Replacement

⚠ **WARNING**

Burn Hazard: Always allow the compressor system to cool before touching components. Compressor oil and components are hot when the compressor is first shut down.

⚠ **WARNING**

High-Pressure Hazard: Stop the air compressor and check that the receiver is not pressurized. After a shutdown, allow 2 minutes for system blow-down.

⚠ **WARNING**

Accidental Start-up Hazard: Apply lockout/tagout procedure to make sure the system cannot be started while maintenance is being performed.

A high-performance, poly chain, toothed belt drives the compressor. The belt is constructed using a combination of a chemical-resistant elastomeric compound and Kevlar® tensile cords that provide for virtually no elongation.

The belt has been properly tensioned on assembly. Under normal circumstances, the belt is maintenance-free and will last for years of service. Should adjustment or replacement become necessary, use the following steps as a guide.

In addition to *Figure 3 on page 96*, refer to drawings DLC1003, DCM0501 and DCM0700.

Darley

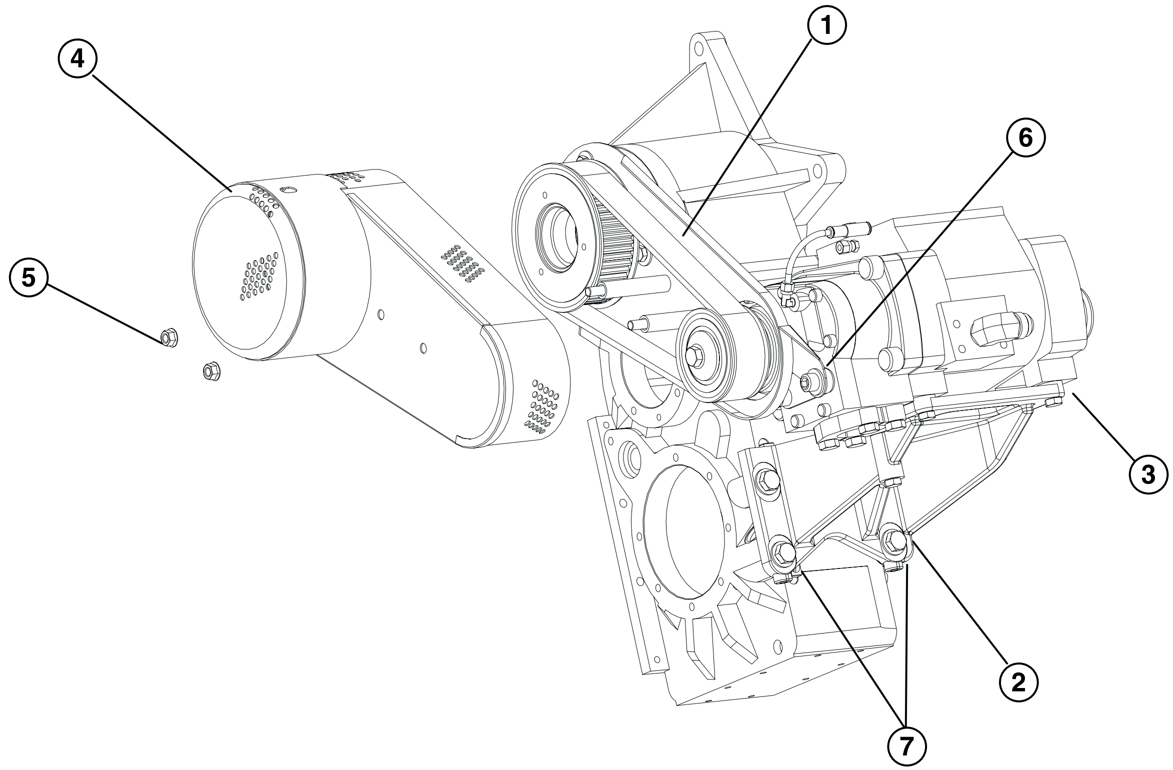


Figure 3

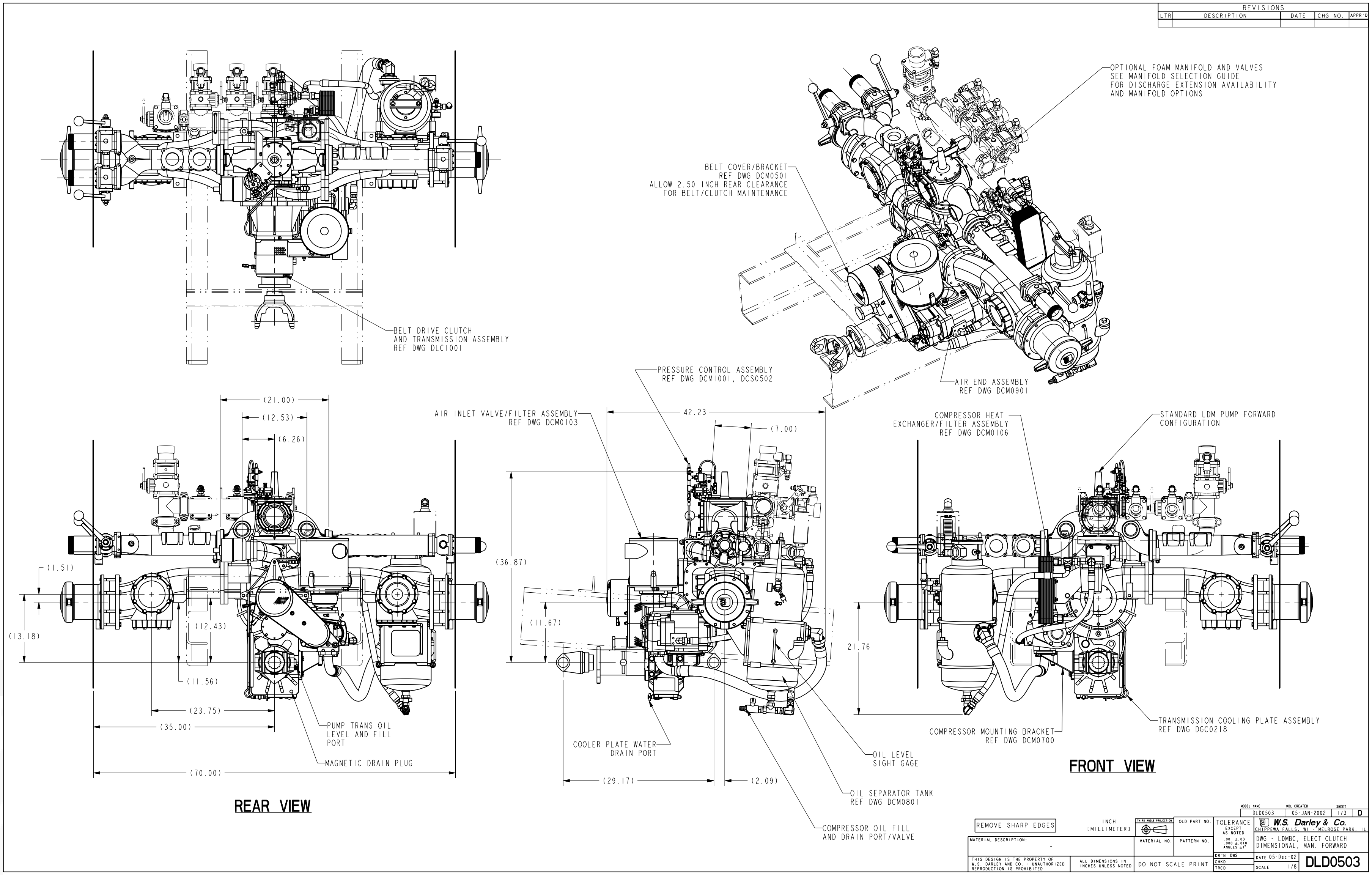
BELT INSPECTION AND ADJUSTMENT

1. Remove belt cover retaining nuts (5). Move and temporarily secure pressure balance valve assembly so it is out of the way.
2. Remove clutch electrical connection, anti-rotation post (55), and temperature sensor wire connection (Ref. Dwg DLC1003).
3. Remove belt cover (4).
4. Inspect belt (1) for wear. Note that it is normal for a small amount of dust to accumulate around the belt housing as the belt breaks in.
5. Check for proper belt tension. A 22-lb force applied in the middle of the belt span should deflect the belt approximately 3/16 (0.19) in.

6. Should belt tension adjustment be required:
    a. Loosen belt cover bracket mounting bolt (6) and four compressor bracket bolts (2).
    b. Install 3/8-16NC jackscrews in compressor bracket at location (7).
    c. Apply pressure to jackscrews until proper belt tension is achieved.
    d. Tighten 4 compressor bracket bolts (20, torque to 50 ft·lb).
    e. Tighten belt cover bracket mounting bolt (6).
    f. Remove jackscrews.
7. Replace belt cover (4), feeding temperature sensor wire through cover opening. Perforated edges of the cover should be positioned inside cover bracket flanges.
8. Secure belt cover with two retaining nuts (5).
9. Position temperature sensor and bracket (14) on clutch threaded wire inlet fitting. Apply 2–3 drops of Loctite® 243™ to male threads of wire inlet fitting. Slide anti-rotation post (55) over clutch wire connection and clamp bracket (14) in place. (Refer to drawing DLC1003.)

BELT REPLACEMENT

1. Remove belt cover retaining nuts (5). Move and temporarily secure pressure balance valve assembly so it is out of the way.
2. Remove clutch electrical connection, anti-rotation post (55), and temperature sensor wire connection (Ref. Dwg DLC1003).
3. Remove belt cover (4).
4. Loosen 4 compressor bracket bolts (2).
5. Remove belt cover bracket mounting bolt (6).
6. Remove 4 compressor bolts (3).
7. Without removing compressor drive sprocket from inside belt cover bracket clearance hole, lift and twist compressor assembly so that belt can be slipped over sprocket and removed.
8. Reverse procedure and slip new belt over sprockets.
9. Replace and tighten 4 compressor-mounting bolts (5).
10. Rotate and inspect the belt to confirm it has been seated properly.
11. Install 3/8-16NC jackscrews in compressor bracket at location (7).
12. Apply pressure to jackscrews until proper belt tension is achieved.
13. Tighten 4 compressor bracket bolts (2), torque to 50 ft·lb.
14. Rotate belt by hand and re-check tension.
15. Tighten belt cover bracket mounting bolt (6).
16. Remove jackscrews (7).
17. Replace belt cover (4), feeding temperature sensor wire through cover opening. Perforated edges of the cover should be positioned inside cover bracket flanges.
18. Reposition balance pressure valve assembly over cover mounting bolts and secure with two retaining nuts (5).
19. Position temperature sensor and bracket (14) on clutch threaded wire inlet fitting. Apply 2–3 drops of Loctite® 243™ to male threads of wire inlet fitting. Slide anti-rotation post (55) over clutch wire connection and clamp bracket (14) in place. (Ref. Dwg DLC1003.)


REVISIONS
LTR
DESCRIPTION
DATE
CHG NO.
APPR'D
OPTIONAL FOAM MANIFOLD AND VALVES
SEE MANIFOLD SELECTION GUIDE
FOR DISCHARGE EXTENSION AVAILABILITY
AND MANIFOLD OPTIONS
BELT COVER/BRACKET
REF DWG DCM0501
ALLOW 2.50 INCH REAR CLEARANCE
FOR BELT/CLUTCH MAINTENANCE
BELT DRIVE CLUTCH
AND TRANSMISSION ASSEMBLY
REF DWG DLC1001
PRESSURE CONTROL ASSEMBLY
REF DWG DCM1001, DCS0502
AIR END ASSEMBLY
REF DWG DCM0901
AIR INLET VALVE/FILTER ASSEMBLY
REF DWG DCM0103
COMPRESSOR HEAT
EXCHANGER/FILTER ASSEMBLY
REF DWG DCM0106
STANDARD LDM PUMP FORWARD
CONFIGURATION
(21.00)
(12.53)
(6.26)
42.23
(7.00)
(36.87)
(1.51)
(13.18)
(12.43)
(11.56)
(23.75)
(35.00)
(70.00)
(11.67)
(29.17)
(2.09)
21.76
PUMP TRANS OIL
LEVEL AND FILL
PORT
MAGNETIC DRAIN PLUG
COOLER PLATE WATER
DRAIN PORT
OIL LEVEL
SIGHT GAGE
OIL SEPARATOR TANK
REF DWG DCM0801
COMPRESSOR OIL FILL
AND DRAIN PORT/VALVE
COMPRESSOR MOUNTING BRACKET
REF DWG DCM0700
TRANSMISSION COOLING PLATE ASSEMBLY
REF DWG DGC0218
REAR VIEW
FRONT VIEW
MODEL NAME
MDL CREATED
SHEET
DLD0503
05-JAN-2002
1/3
D
REMOVE SHARP EDGES
INCH
[MILLIMETER]
THIRD ANGLE PROJECTION
OLD PART NO.
TOLERANCE
EXCEPT
AS NOTED
.00 ±.03
.000 ±.010
ANGLES ±1°
W.S. Darley & Co.
CHIPPEWA FALLS, WI - MELROSE PARK, IL
MATERIAL DESCRIPTION:
MATERIAL NO.
PATTERN NO.
DWG - LDMBC, ELECT CLUTCH
DIMENSIONAL, MAN. FORWARD
THIS DESIGN IS THE PROPERTY OF
W.S. DARLEY AND CO. - UNAUTHORIZED
REPRODUCTION IS PROHIBITED
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INCHES UNLESS NOTED
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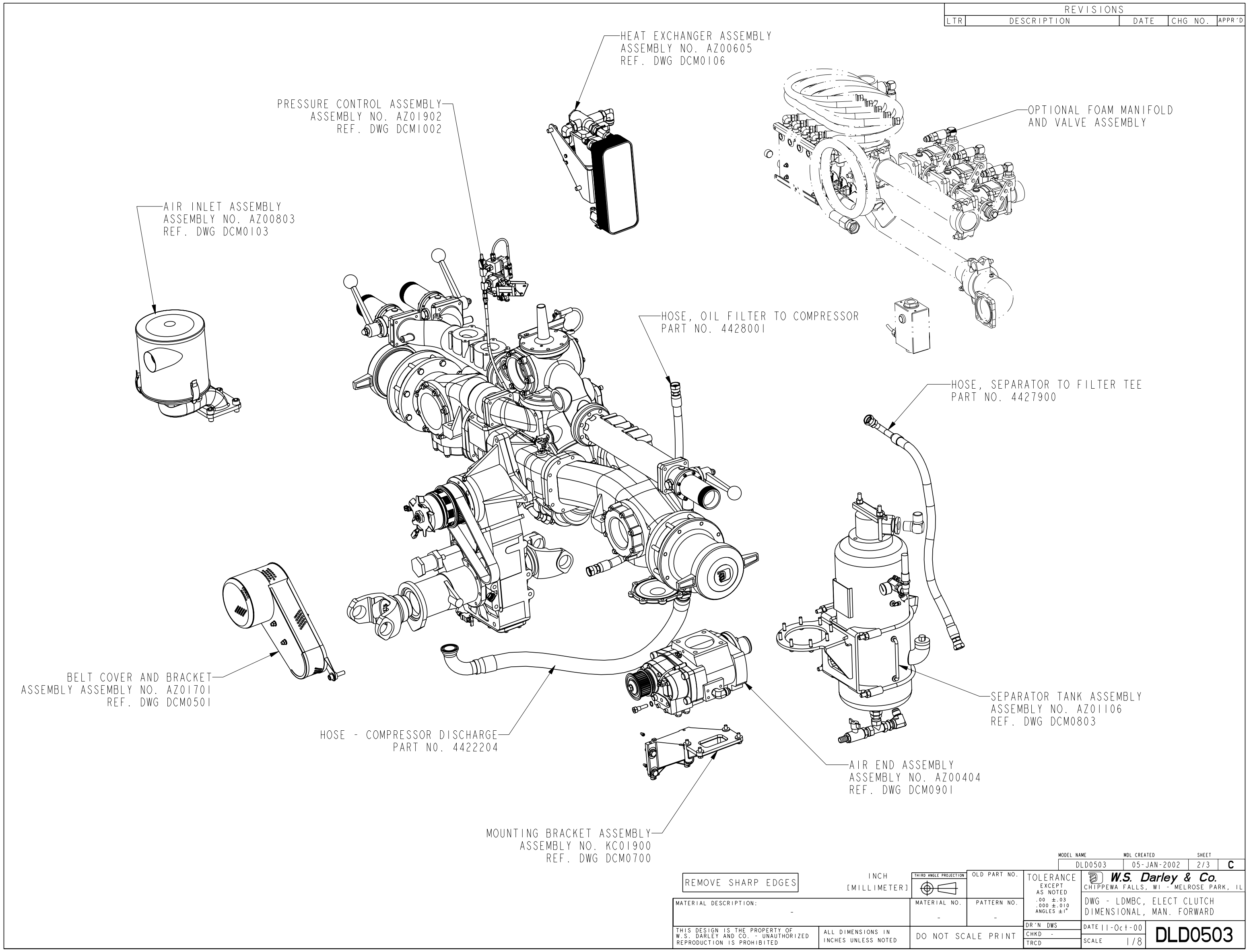
CHKD
TRCD
DATE 05-Dec-02
SCALE 1/8
DLD0503


REVISIONS
LTR
DESCRIPTION
DATE
CHG NO.
APPR'D
HEAT EXCHANGER ASSEMBLY
ASSEMBLY NO. AZ00605
REF. DWG DCM0106
OPTIONAL FOAM MANIFOLD
AND VALVE ASSEMBLY
PRESSURE CONTROL ASSEMBLY
ASSEMBLY NO. AZ01902
REF. DWG DCM1002
AIR INLET ASSEMBLY
ASSEMBLY NO. AZ00803
REF. DWG DCM0103
HOSE, OIL FILTER TO COMPRESSOR
PART NO. 4428001
HOSE, SEPARATOR TO FILTER TEE
PART NO. 4427900
BELT COVER AND BRACKET
ASSEMBLY ASSEMBLY NO. AZ01701
REF. DWG DCM0501
SEPARATOR TANK ASSEMBLY
ASSEMBLY NO. AZ01106
REF. DWG DCM0803
HOSE - COMPRESSOR DISCHARGE
PART NO. 4422204
AIR END ASSEMBLY
ASSEMBLY NO. AZ00404
REF. DWG DCM0901
MOUNTING BRACKET ASSEMBLY
ASSEMBLY NO. KC01900
REF. DWG DCM0700
MODEL NAME
MDL CREATED
SHEET
DLD0503
05-JAN-2002
2/3
C
REMOVE SHARP EDGES
INCH
[MILLIMETER]
THIRD ANGLE PROJECTION
OLD PART NO.
TOLERANCE
EXCEPT
AS NOTED
.00 ±.03
.000 ±.010
ANGLES ±1°
W.S. Darley & Co.
CHIPPEWA FALLS, WI - MELROSE PARK, IL
MATERIAL DESCRIPTION:
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MATERIAL NO.
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PATTERN NO.
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DWG - LDMBC, ELECT CLUTCH
DIMENSIONAL, MAN. FORWARD
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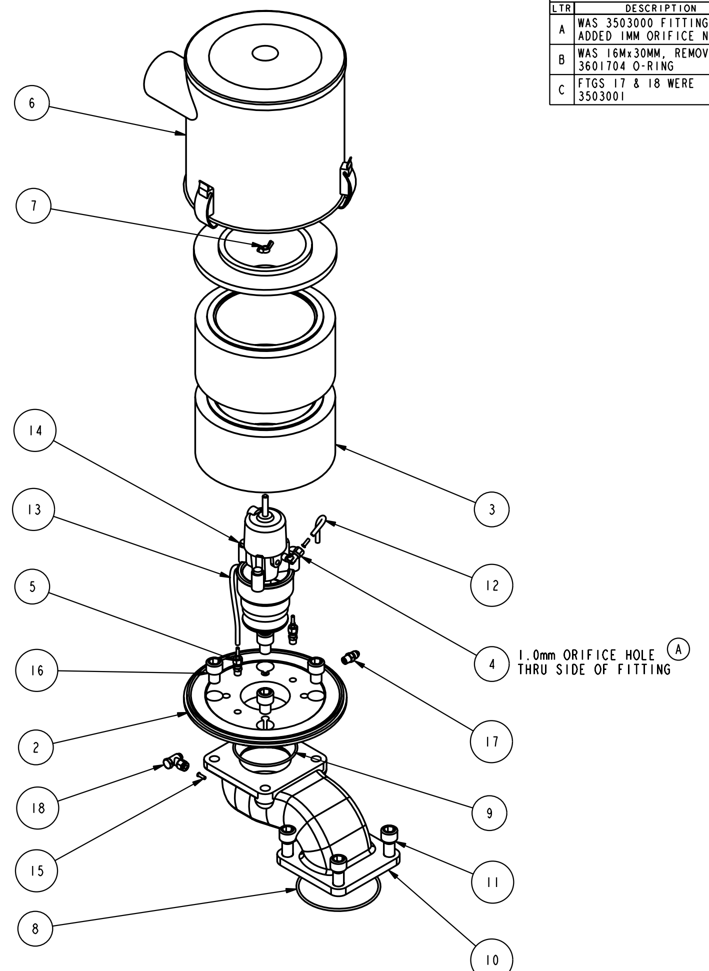
CHKD -
TRCD
DATE 11-Oct-00
SCALE 1/8
DLD0503

NO.	DESCRIPTION	NOTE	PART NO.	QTY.	
2	ADAPTER - AIR INLET ASSEMBLY	•	1644900	1	
3	ELEMENT - AIR CLEANER	•	1122601	2	
4	FITTING - 6MM OD TUBE x .12 BSPT, 90	•	3503012	1	
5	FITTING - .12BSP X 6MM TUBE	•	3503001	2	(A)
6	HOUSING - AIR FILTER	•	1122501	1	
7	NUT - WING, M8-1.25	•	5403500	1	
8	O-RING - 4.62 x 4.88 x 0.12		3601219	1	
9	O-RING - ADAPTER PLATE	•	3601705	1	
10	OFFSET - CAFS, AIR INLET		3106700	1	
11	SHCS - M16-2 x 30MM, GR8.8		5401212	4	
12	TUBE - CONTROL, 6 X 4MM X 116MM	•	1101941	1	
13	TUBE - CONTROL, 6 x 4mm x 230MM	•	1101942	1	
14	VALVE - INLET, POSITIVE	•	5204801	1	
15	SLEEVE - FTG, 4MM X 6MM TU		3503004	4	
16	SHCS - M16-2 x 20MM, GR8.8	•	5401216	4	(B)
17	FITTING - .12 BSPTM X .25 JICM		3501559	1	(C)
18	FTG - 6MM TU x .12 BSPP, BANJO		3503007	1	

• THESE PARTS ARE COMPONENTS OF ASSEMBLY AZ00804 (TAMROTOR 309 214 97)

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
A	WAS 3503000 FITTING ADDED 1MM ORIFICE NOTE	25FEB02	2002-35	DWS
B	WAS 16Mx30MM, REMOVED 3601704 O-RING	03MAY02	2002-74	DWS
C	FTGS 17 & 18 WERE 3503001	10JUL02	2002-110	DWS



MODEL NAME: AZ00803 | MDL CREATED: APR 12, 1999 | SHEET: 1/1 | C

REMOVE SHARP EDGES

INCH [MILLIMETER]

THIRD ANGLE PROJECTION

OLD PART NO.

TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1°

W.S. Darley & Co.
CHIPPEWA FALLS, WI - MELROSE PARK, IL

MATERIAL DESCRIPTION: -

MATERIAL NO.

PATTERN NO.

DWG - ASSEMBLY, AIR INLET, CAFS TAMROTOR, AZ00803

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DR'N DWS
CHKD TED
TRCD

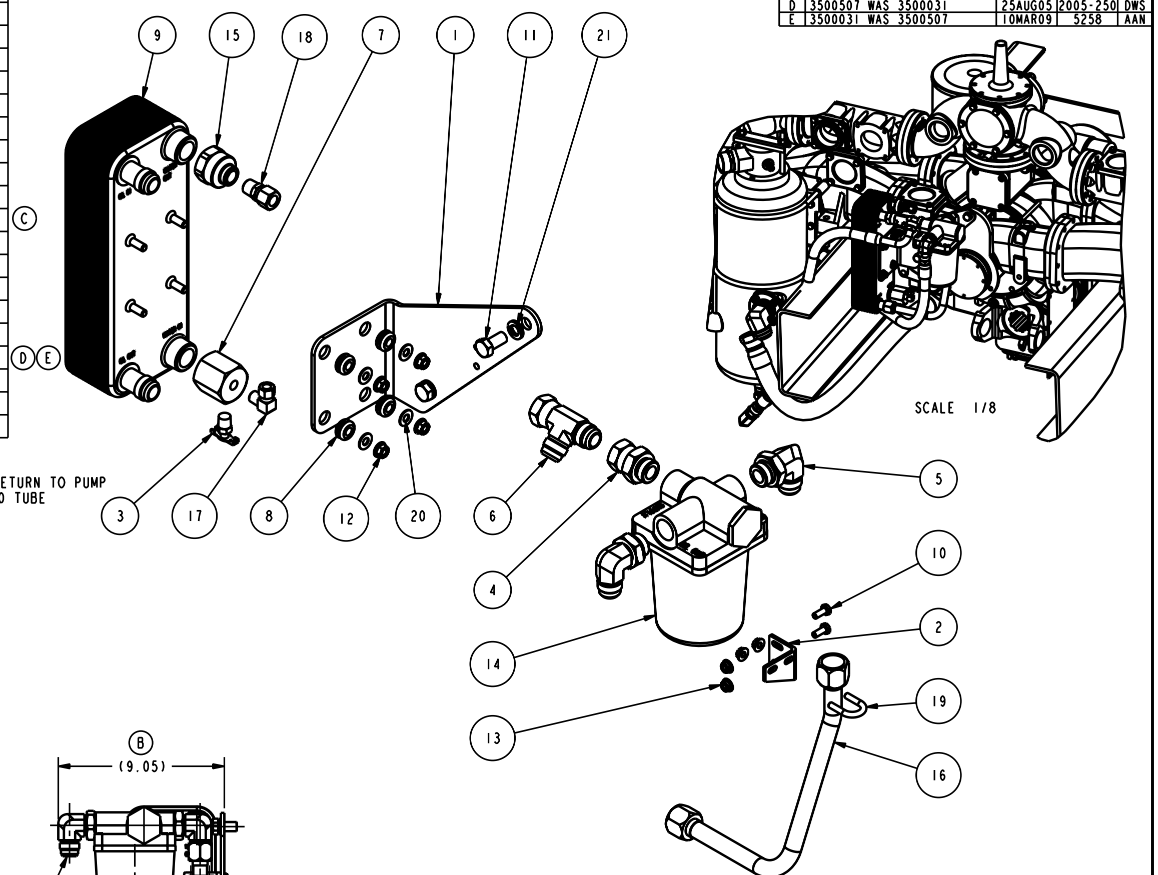
DATE 09-Jun-99
SCALE 1/4

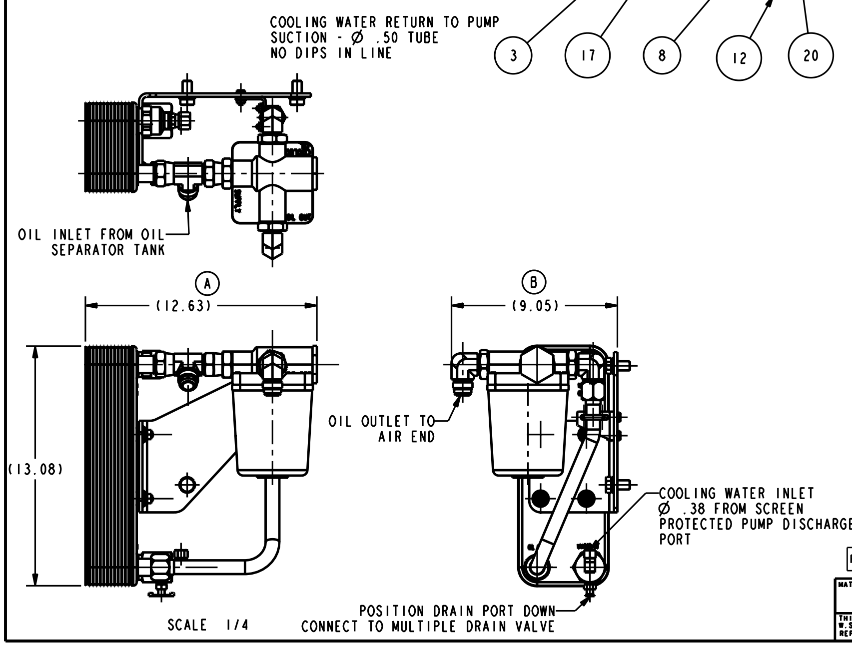
DCM0103

NO.	DESCRIPTION	PART NO.	QTY.
1	BRACKET - HEAT EXCH	4016500	1
2	BRACKET - SUPPORT, FILTER	4017700	1
3	DRAINCOCK - 0.250 NPTM, 9KC BR	5203600	1
4	FITTING - .75BSPPMx.75JICFE SWIV	3501535	1
5	FITTING - .75BSPPMx.75JICM, 90	3501537	2
6	FITTING-TEE, SWIVEL NUT RUN	3501534	1
7	FTG - 1.00 NPTF DRAIN TEE	3503005	1
8	GROMMET - .38 ID x .63 MTG OD	4401725	4
9	HEAT EXCH - LDMBC BRAZED PLATE	4215102	1
10	HHCS - .250-20 x 0.63, GR5	5400001	2
11	HHCS - .500-13 x 1.00, GR5	5400065	2
12	NUT - FLANGED, M8-1.25, TOPLOC	5403603	4 (C)
13	NUT - FLANGED TOP LOCK	5403504	4
14	OIL FILTER - W/THERMOSTAT	4420902	1
15	REDUCER - PIPE, 1.00 X 0.38	1080214	1
16	TUBE - HEAT EXCHANGER	4427803	1
17	TUBE FITTING - EL, .38 x .25	3500511	1
18	TUBE FITTING - STR, .50 x .38	3500031	1 (D) (E)
19	U-BOLT - .25"	4406801	1
20	WASHER - FLAT, 0.31 ID, SST	3603812	4
21	WASHER - LOCK, 0.500 ID	3603505	2

REVISIONS

LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
A	12.63 WAS 11.80	18JUL01	2001-181	DWS
B	9.05 WAS 9.13	18JUL01	2001-181	DWS
C	5403603 WAS 5403468	18OCT04	2004-262	DWS
D	3500507 WAS 3500031	25AUG05	2005-250	DWS
E	3500031 WAS 3500507	10MAR09	5258	AAN





REMOVE SHARP EDGES

INCH [MILLIMETER]

MATERIAL DESCRIPTION:

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ALL DIMENSIONS IN INCHES UNLESS NOTED

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TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1°

MODEL NAME: AZ00605 | MDL CREATED: 23-APR-2001 | SHEET: 1/1 | C

W.S. Darley & Co. ITASCA, IL - CHIPPEWA FALLS, WI

DWG - ASSEMBLY, HEAT EXCH. TAMROTOR, AZ00605

DR'N DWS | CHKD TED | TRCD

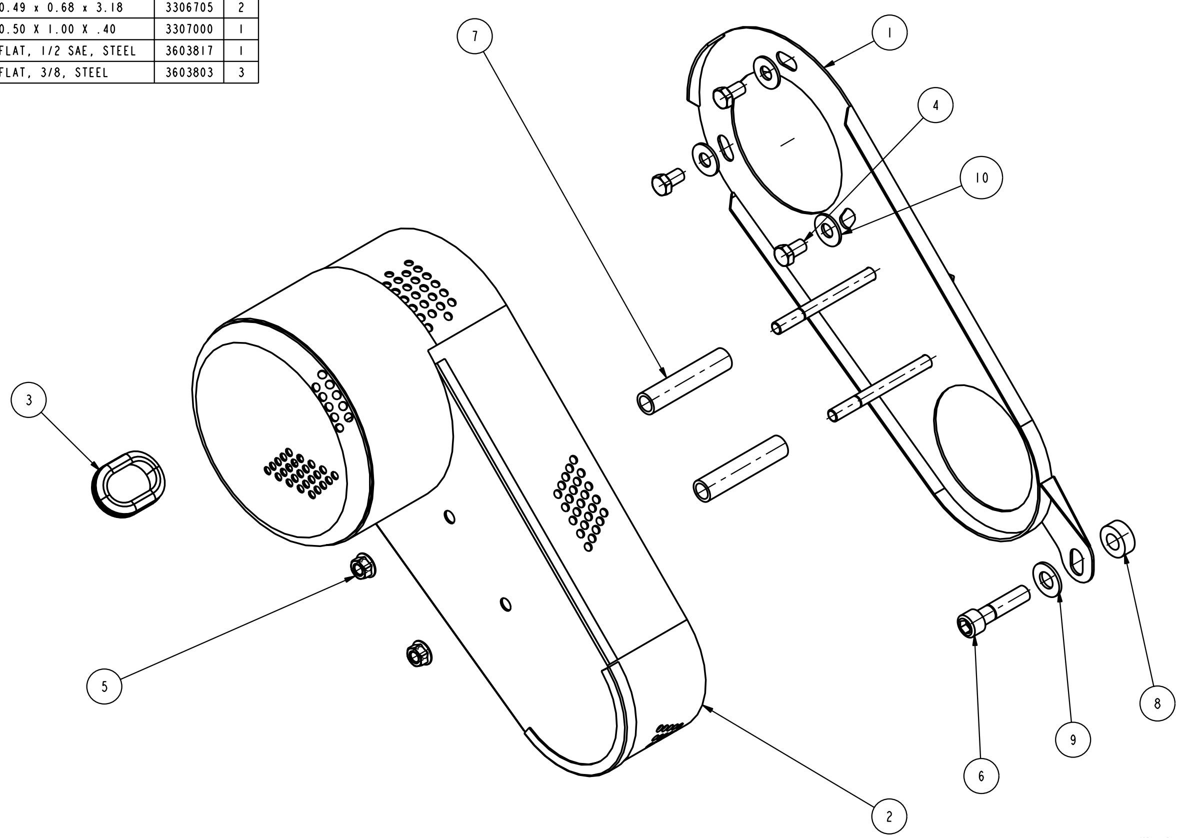
DATE 04-May-01 | SCALE 5/16 | DCM0106

Darley

NO.	DESCRIPTION	PART NO.	QTY.
1	BRACKET - BELT COVER	4027900	1
2	COVER - BELT, ELECTRIC CLUTCH	2505401	1
3	GROMMET - 1.50 ID X 1.75 MTG OD	4401726	1
4	HHCS - .375-16 x 0.63, GR5	5400033	3
5	NUT - FLANGED TOP LOCK	5403468	2
6	SHCS - M12-1.75 x 50MM, GR8.8	5401211	1
7	SPACER - 0.49 x 0.68 x 3.18	3306705	2
8	SPACER - 0.50 X 1.00 X .40	3307000	1
9	WASHER - FLAT, 1/2 SAE, STEEL	3603817	1
10	WASHER - FLAT, 3/8, STEEL	3603803	3

LTR	DESCRIPTION	DATE	CHG NO.	APPR'D

REVISIONS



REMOVE SHARP EDGES

INCH [MILLIMETER]

THIRD ANGLE PROJECTION

OLD PART NO.

MODEL NAME AZ01701 | MDL CREATED 14-JUNE-2002 | SHEET 1/1 | C

TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1°

W.S. Darley & Co.
CHIPPEWA FALLS, WI - MELROSE PARK, IL

DWG - ASSEMBLY DETAIL, CAFS BELT COVER/BRKET, ELECT CLUTCH

MATERIAL DESCRIPTION: -

MATERIAL NO. -

PATTERN NO.

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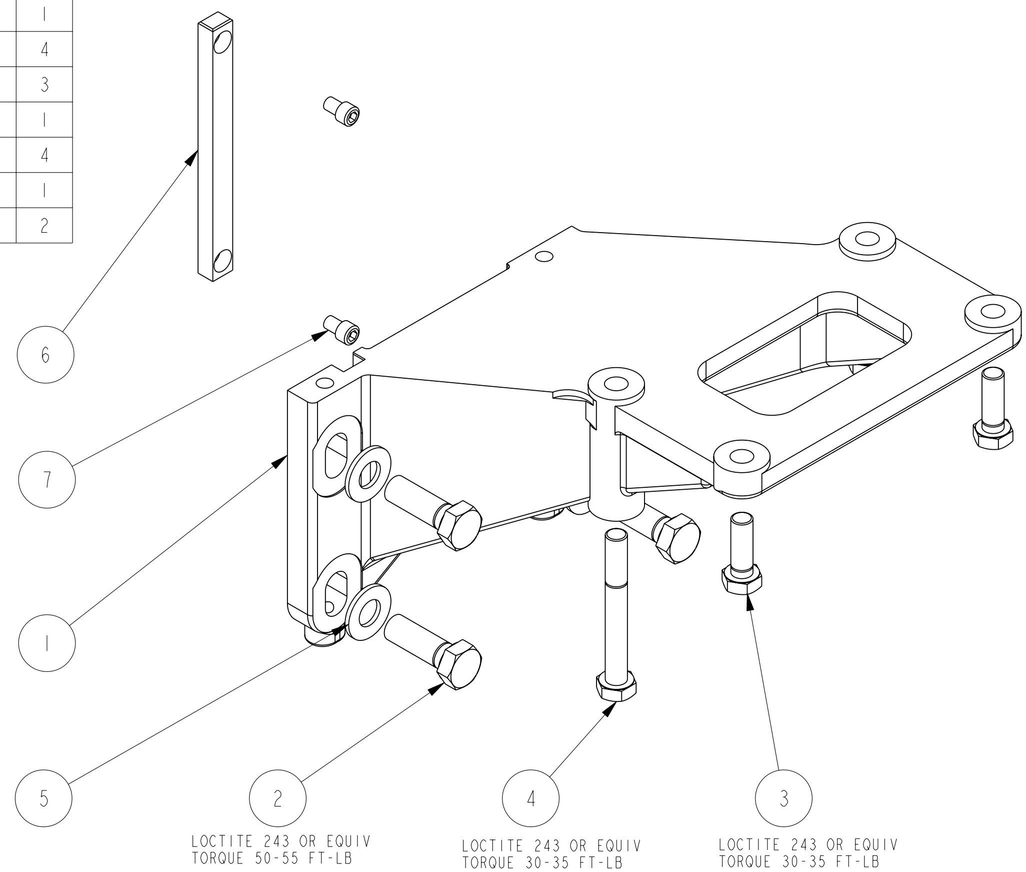
DR'N DWS
CHKD TED
TRCD

DATE 14-Jun-02
SCALE 1/2

DCM0501

NO.	DESCRIPTION	PART NO.	QTY.
1	BRACKET - COMPRESSOR MOUNT	4027800	1
2	HHCS - .500-13 x 1.50, GR5	5400067	4
3	HHCS - M10-1.50 x 30MM, GR8.8	5400309	3
4	HHCS - M10-1.50 x 80MM, GR8.8	5400305	1
5	WASHER - FLAT, 1/2 SAE, STEEL	3603817	4
6	KEY - 0.38 x 0.50 x 5.50	3602311	1
7	SHCS - .250-20 x 0.38, GR8	5401000	2

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D



MODEL NAME: KC01900 | MDL CREATED: JUNE 14, 1999 | SHEET: 1/1 | B

REMOVE SHARP EDGES

INCH [MILLIMETER]

THIRD ANGLE PROJECTION

OLD PART NO.

TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1°

W.S. Darley & Co.
MELROSE PARK, IL - CHIPPEWA FALLS, WI

MATERIAL DESCRIPTION: -

MATERIAL NO. -

PATTERN NO.

DWG - ASSEMBLY, MTG BRACKET LDMC/TAMROTOR

DR'N DWS
CHKD TED
TRCD

DATE 14-Jun-99
SCALE 1/2

DCM0700

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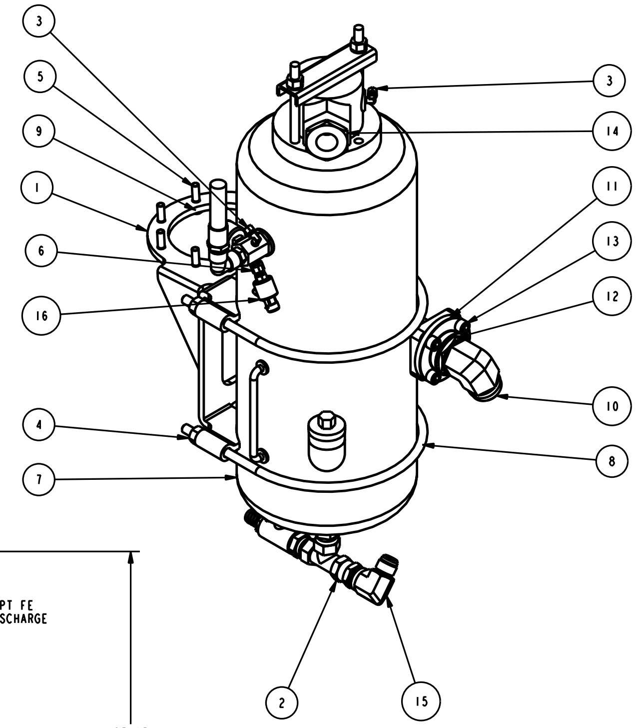
DO NOT SCALE PRINT

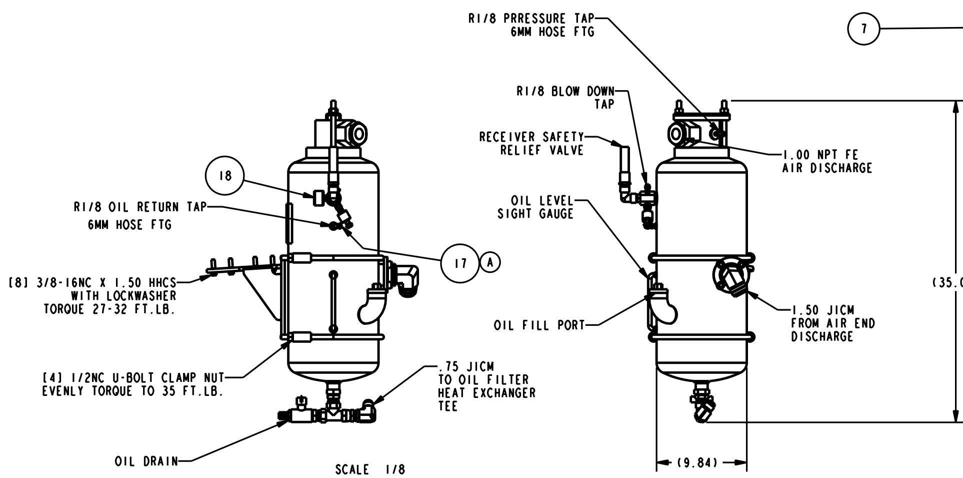
Darley

NO.	DESCRIPTION	PART NO.	QTY.
1	BRACKET - OIL RECEIVER TANK	4028102	1
2	FITTING-.75NPTMx.75BSPPS SWV	3501550	1
3	FITTING - .12 BSPT X 6MM HOSE, 90	3503000	3
4	NUT - HEX, .500-13, HEAVY, GR2	5403018	4
5	HHCS - .375-16 x 1.50, GR5	5400038	8
6	FITTING - .12 NPT M X .25NPTF	3501556	1
7	TANK - OIL RECEIVER	4218600	1
8	U-BOLT - TANK MOUNTING	4406805	2
9	WASHER - LOCK, 0.375 ID	3603503	8
10	FITTING-1.50 JICMx1.50 NPS, 90	3501543	1
11	FLANGE - RECEIVER TANK INLET	1925300	1
12	O-RING - 2.38 x 2.56 x 0.09	3601123	1
13	SHCS - M12-1.75 x 30MM, GR8.8	5401213	4
14	ADAPTER - 1.5 BSPTM x 1.0 NPTF	1602301	1
15	FITTING-.75 JICMx.75 NPTF, 90	3501551	1
16	TRANSDUCER - PRESSURE, 300 PSI	4224500	1 * REF
17	FTG - SLEEVE, 4MM x 6MM TU	3503507	3 (A)
18	GAGE - AIR PRESS, 0-16 BAR	2603093	1

* REF PART 4224500 IS A COMPONENT OF 2603400 CONTROL

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
A	ADDED BARB FITTINGS	03/11/08	2008-080	RJG





MAX. PRESSURE: 205 PSI
OIL VOLUME: 12.7 QTS.
APROXIMATE WEIGHT: 140 LBS w/OIL

REMOVE SHARP EDGES

INCH [MILLIMETER]

MATERIAL DESCRIPTION: -

THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

OLD PART NO. | MATERIAL NO. | PATTERN NO.

TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1°

DR'N DWS | CHKD TED | TRCD

MODEL NAME AZ01106 | MDL CREATED 15-FEB-2002 | SHEET 1/1 | C

W.S. Darley & Co. ITASCA, IL - CHIPPEWA FALLS, WI

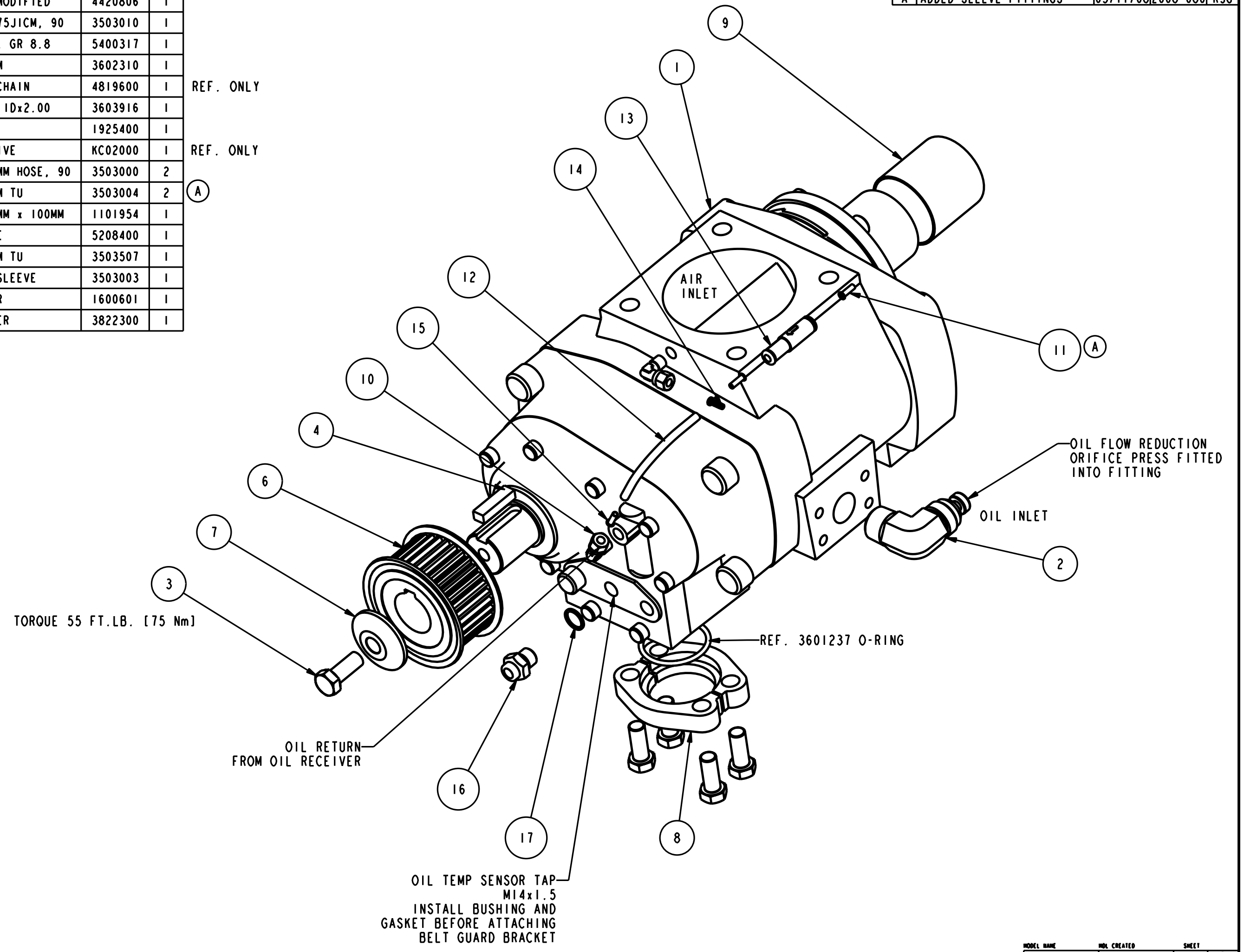
DWG - ASSEMBLY, RECEIVER TANK LDMC/TAMROTOR, SIDE FILL

DATE 15-FEB-02 | SCALE 1/4 | DCM0803

NO.	DESCRIPTION	PART NO.	QTY.	
1	COMPRESSOR - 225 CFM, MODIFIED	4420806	1	
2	FITTING - .75BSPTM x .75JICM, 90	3503010	1	
3	HHCS - M12-1.75 x 30MM, GR 8.8	5400317	1	
4	KEY - 10MM x 8MM x 36MM	3602310	1	
6	SPROCKET - GATES POLY CHAIN	4819600	1	REF. ONLY
7	WASHER - SPECIAL, 0.53 IDx2.00	3603916	1	
8	FLANGE ASSEMBLY	1925400	1	
9	SLEEVE - SHAFT PROTECTIVE	KC02000	1	REF. ONLY
10	FITTING - .12 BSPT X 6MM HOSE, 90	3503000	2	
11	SLEEVE - FTG, 4MM X 6MM TU	3503004	2	(A)
12	TUBE - OIL RETURN, 6x4MM x 100MM	1101954	1	
13	VALVE - CHECK, 6MM TUBE	5208400	1	
14	FTG - SLEEVE, 4MM x 6MM TU	3503507	1	
15	ORIFICE - 0.7MM X 4MM SLEEVE	3503003	1	
16	BUSHING - THERMO SENSOR	1600601	1	
17	GASKET - BUSHING, COPPER	3822300	1	

REVISIONS

LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
A	ADDED SLEEVE FITTINGS	03/11/08	2008-080	RJG



REMOVE SHARP EDGES

INCH [MILLIMETER]

THIRD ANGLE PROJECTION | OLD PART NO. | MATERIAL NO. | PATTERN NO.

MATERIAL DESCRIPTION: -

THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1°

DR'N DWS
CHKD TED
TRCD

MODEL NAME AZ00404 | MDL CREATED 07-DEC-2004 | SHEET 1/1 | C

W.S. Darley & Co.
ITASCA, IL - CHIPPEWA FALLS, WI

DWG- ASSEMBLY, AIR END
LDMC/TAMROTOR ENDURO 12 TS

DATE 07-Dec-04
SCALE 1/2

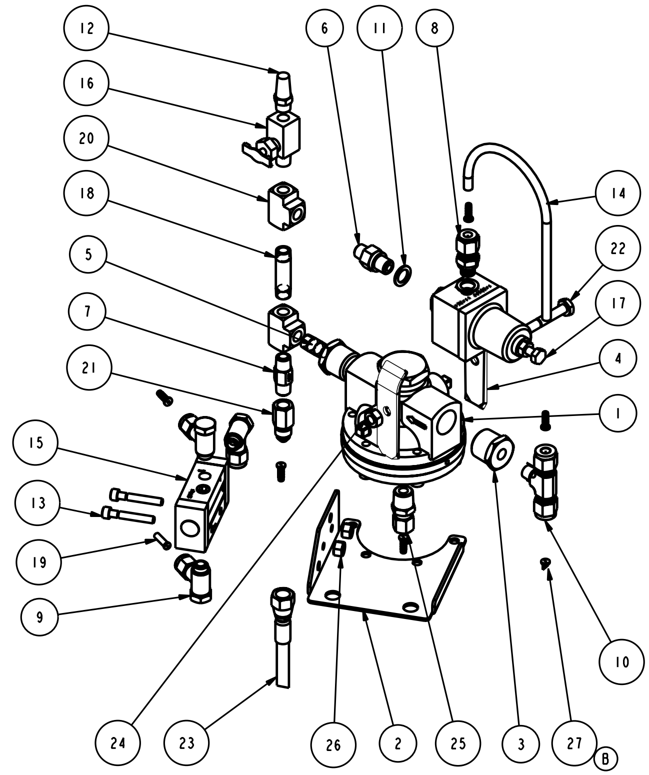
DCM0901

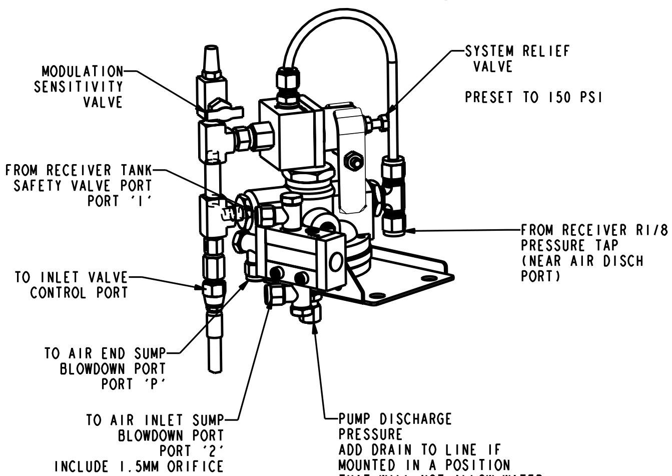
Darley

NO.	DESCRIPTION	PART NO.	QTY.	
1	BALANCED PRESSURE VALVE - CAFS	AZ00108	1	
2	BRACKET - CONTROL MODULE	4028301	1	
3	BUSHING - PIPE, 0.50 x 0.13 BR	1080650	2	
4	BRACKET - PRESSURE REGULATOR	4028900	2	
5	NIPPLE - PIPE, .12 CLOSE, BR	1081000	1	
6	FTG - .12NPTM X .12BSPPM	3503503	1	
7	FILTER - INLINE, .12 NPT DBL MALE	1124000	1	
8	FTG - 6MM OD TUBE x .12 BSPP	3503502	1	
9	FTG - 6MM TU x .12 BSPP, BANJO	3503007	3	
10	FTG - 6MM x 6MM x .12NPTM, TEE	3503501	1	
11	FTG - GASKET, TYPE RP	3503506	2	
12	MUFFLER - AIR EXHAUST	3503006	1	
13	SHCS - NO.10-24 x 1.25, SST	5401422	2	
14	TUBE - CONTROL ASSEMBLY	1101953	1	
15	VALVE - BLOW DOWN	5208301	1	
16	VALVE - NEEDLE, 0.12 x 0.12 BR	5203802	1	
17	VALVE - PILOT, PRESS REGULATOR	5208200	1	
18	NIPPLE - PIPE, .12 X 1.50, BR	1081053	1	
19	ORIFICE - 1.5MM x 4MM SLEEVE	3503018	1	(A)
20	TEE - PIPE, 1/8NPT BR	1080422	2	
21	FITTING - .12 NPT FE X .25 JICM	3501560	1	
22	HHCS - .250-20 x 1.75, GR5	5400007	1	
23	HOSE - CONTROL LINE, .25 X 36	4428600	1	
24	NUT - HEX, .250-20, NYLOC, SST	5403403	1	
25	TUBE FITTING - STR, .25 x .25	3500009	1	
26	NUT - HEX, 10-24, NYLOC, SST	5403506	2	
27	FTG - SLEEVE, 4MM x 6MM TU	3503507	6	(B)

REVISIONS

LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
A	WAS 3503002 1.0MM ORIFICE	14MAY03	2003-70	DWS
B	ADDED BARB FITTINGS	03/12/08	2008-080	RJG





SCALE 1/2

REMOVE SHARP EDGES

INCH
(MILLIMETER)

THIRD ANGLE PROJECTION

MATERIAL DESCRIPTION: -

MATERIAL NO. | PATTERN NO. | OLD PART NO.

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ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1°

DR'N DWS
CHKD TED
TRCD

MODEL NAME AZ01902 | MDL CREATED 06-JUNE-2002 | SHEET 1/1 | C

W.S. Darley & Co.
ITASCA, IL - CHIPPEWA FALLS, WI

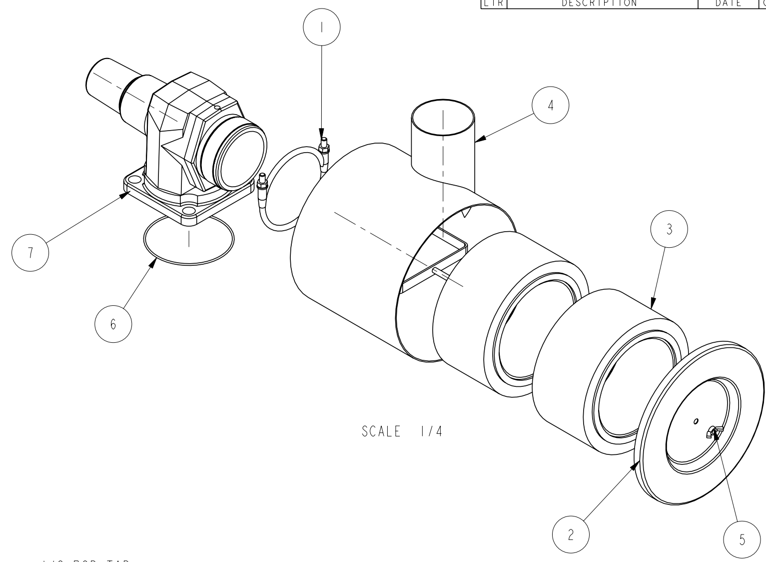
CAFS - PRESSURE CONTROL ASSY
LDMBC, DISCH HD MNT

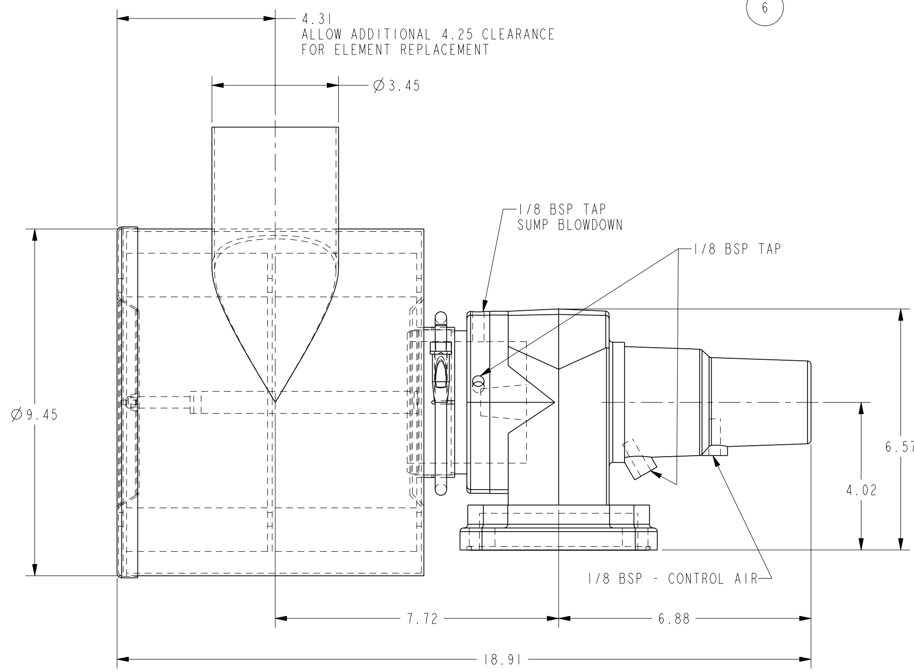
DATE 06-JUNE-02
SCALE 1/2

DCM1002

NO.	DESCRIPTION	PART NO.	QTY.
1	U-BOLT - AIR FILTER CLAMP	4406806	1
2	COVER - AIR FILTER	1122503	1
3	ELEMENT - AIR CLEANER	1122601	2
4	HOUSING - AIR CLEANER, HORIZ.	1122502	1
5	NUT - WING, M8-1.25	5403500	1
6	O-RING - 4.75 x 4.94 x 0.09	3601114	1
7	VALVE - INLET, HORIZONTAL	5204802	1

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D





NOTES:

1] POSITIVE CONTROL AIR INLET VALVE - SEE DCS0501 SCHEMATIC FOR CONTROL LINE CONNECTION DETAILS

2] REF ASSEMBLY AZ00704 (DWG DCM1400) FOR REMOTE AIR CLEANER MOUNTING COMPONENTS

OPTIONAL HORIZONTAL INLET VALVE

MODEL NAME: 5204803 | MDL CREATED: 06-DEC-2000 | SHEET: 1/1 | C

REMOVE SHARP EDGES

INCH [MILLIMETER] | THIRD ANGLE PROJECTION | OLD PART NO.

TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1°

W.S. Darley & Co.
CHIPPEWA FALLS, WI - MELROSE PARK, IL

MATERIAL DESCRIPTION: | MATERIAL NO. | PATTERN NO.

VALVE - ASSY, INLET, E12, HORIZ.
REF. TAM. ASSY 503 619 01

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ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

DR'N DWS | CHKD TED | TRCD

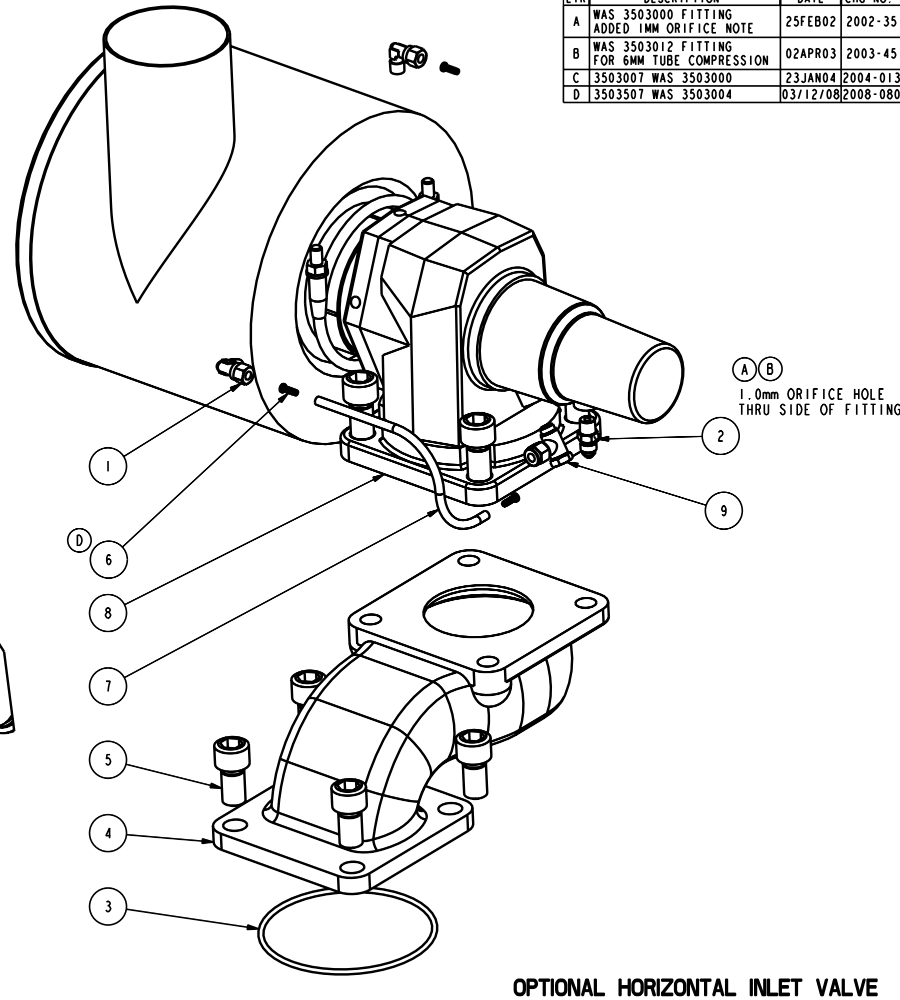
DATE 21-Dec-00 | SCALE 1/2

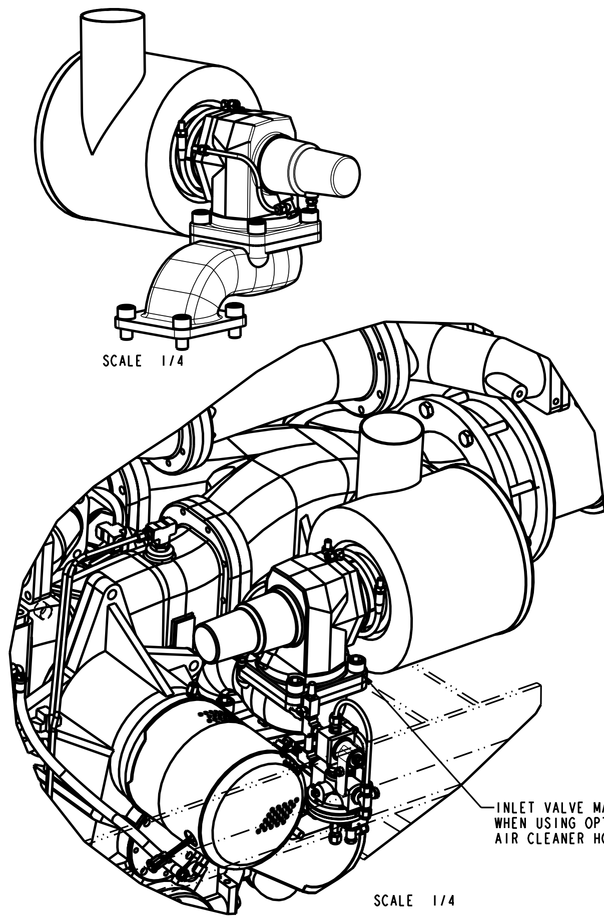
5204803

NO.	DESCRIPTION	PART NO.	QTY.	
1	FITTING - .12 BSPT X 6MM HOSE, 90	3503000	2	
2	FITTING - .12 BSPTM X .25 JICM	3501563	1	(A)(B)
3	O-RING - 4.62 x 4.88 x 0.12	3601219	1	
4	OFFSET - CAFS, AIR INLET	3106700	1	
5	SHCS - M16-2 x 30MM, GR8.8	5401212	8	
6	FTG - SLEEVE, 4MM x 6MM TU	3503507	3	(D)
7	TUBE - CONTROL, 6x4x200MM	1101957	1	
8	VALVE - ASSY, INLET, E12, HORIZ.	5204803	1	
9	FTG - 6MM TU x .12 BSPP, BANJO	3503007	1	(C)

REVISIONS

LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
A	WAS 3503000 FITTING ADDED 1MM ORIFICE NOTE	25FEB02	2002-35	DWS
B	WAS 3503012 FITTING FOR 6MM TUBE COMPRESSION	02APR03	2003-45	DWS
C	3503007 WAS 3503000	23JAN04	2004-013	DWS
D	3503507 WAS 3503004	03/12/08	2008-080	RJG





OPTIONAL HORIZONTAL INLET VALVE

REMOVE SHARP EDGES

INCH [MILLIMETER]

MATERIAL DESCRIPTION: | MATERIAL NO. | PATTERN NO. | OLD PART NO.

TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1°

W.S. Darley & Co. ITASCA, IL - CHIPPEWA FALLS, WI

MODEL NAME: AZ00806 | MDL CREATED: 06-DEC-2000 | SHEET: 1/1 | C

DWG - ASSY, HOR. INLET VALVE W/OFFSET

DR'N DWS | CHKD TED | TRCD

DATE 15-Dec-00 | SCALE 1/2 | DCM1300

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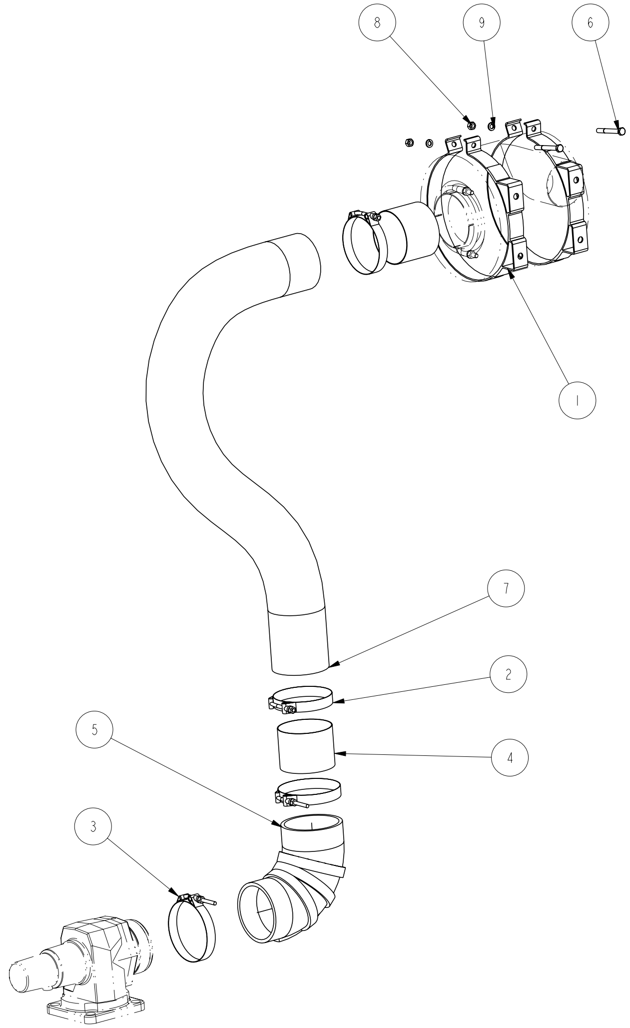
ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

NO.	DESCRIPTION	PART NO.	QTY.
1	BRACKET - MOUNTING, AIR FILTER	4025301	2
2	CLAMP - T-BOLT, 4.25"	4402623	2
3	CLAMP - T-BOLT, 4.50"	4402626	2
4	COUPLING - HOSE, 4.00 OD	4418600	2
5	ELBOW - 4.00 ID AIR INLET	4428400	1
6	HHCS - .313-18 x 2.75, GR5	5400025	2
7	HOSE - 4.00 x 72, 1.50 CUFFS	4402361	1
8	NUT - HEX, .313-18, GR2	5403001	2
9	WASHER - LOCK, 0.313 ID	3603502	2

REVISIONS

LTR	DESCRIPTION	DATE	CHG NO.	APPR'D



OPTIONAL REMOTE AIR CLEANER
HOSE AND BRACKET ASSEMBLY
FOR HORIZONTAL INLET VALVE

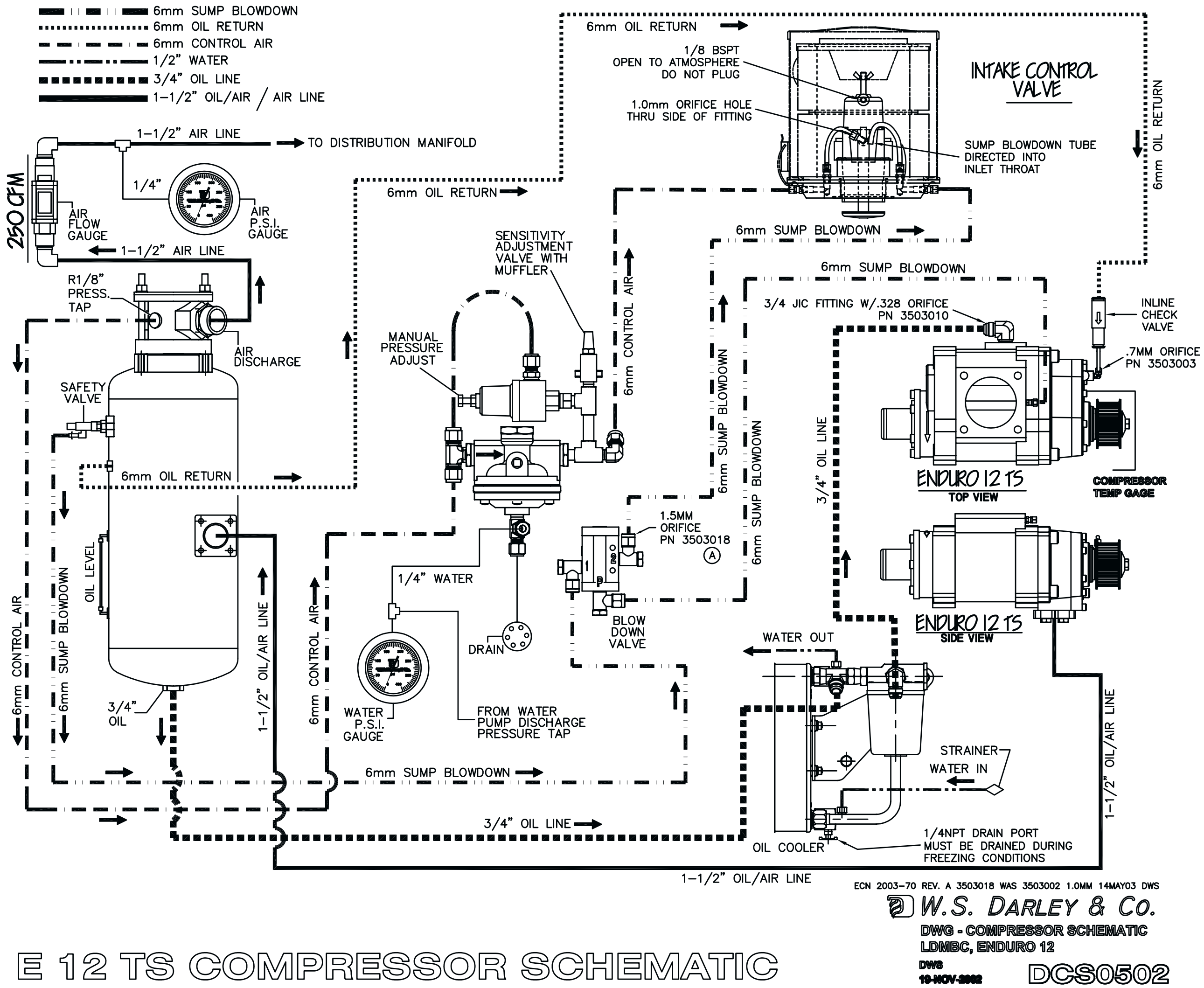
MODEL NAME AZ00704 | MDL CREATED 13-DEC-2000 | SHEET 1/1 | C

REMOVE SHARP EDGES | INCH [MILLIMETER] | THIRD ANGLE PROJECTION | OLD PART NO. | TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1° | W.S. Darley & Co. CHIPPEWA FALLS, WI - MELROSE PARK, IL

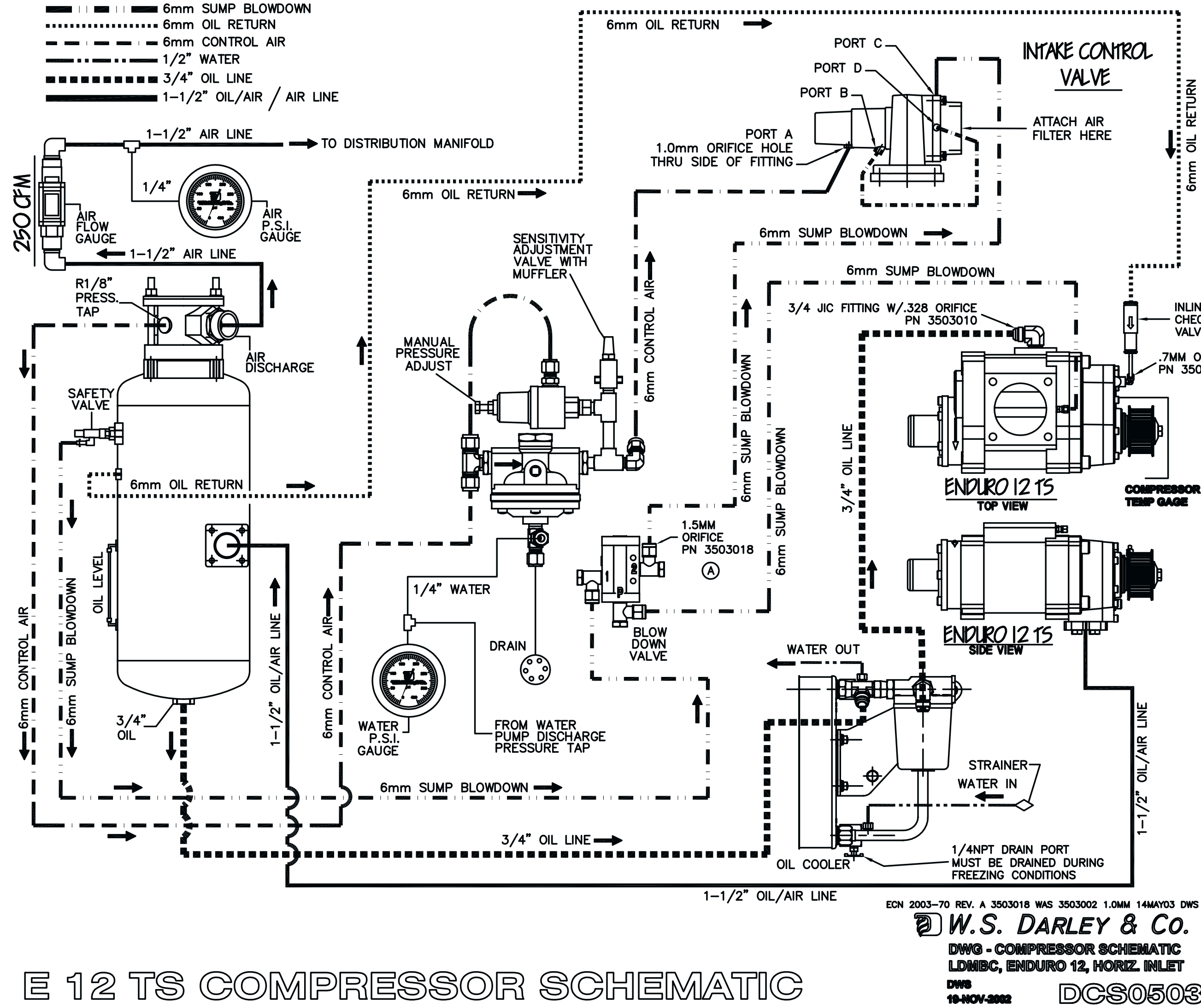
MATERIAL DESCRIPTION: | MATERIAL NO. | PATTERN NO. | DWG - ASSY, AIR CLNR REMOTE

THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. - UNAUTHORIZED REPRODUCTION IS PROHIBITED | ALL DIMENSIONS IN INCHES UNLESS NOTED | DO NOT SCALE PRINT | DR'N DWS | CHKD TED | TRCD | DATE 14-Dec-00 | SCALE 3/16 | DCM1400

Darley



E 12 TS COMPRESSOR SCHEMATIC



E 12 TS COMPRESSOR SCHEMATIC

Description

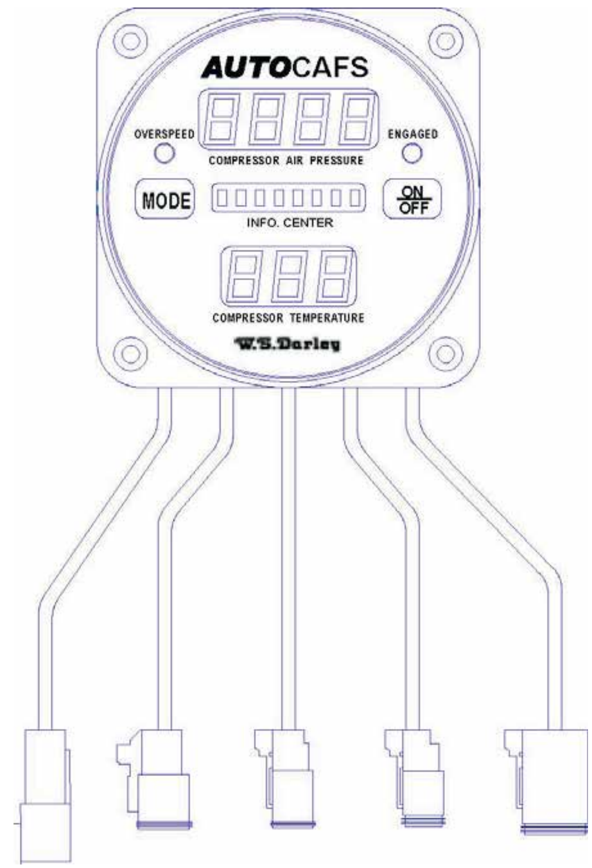
The Darley AutoCAFS Commander control is a programmed logic controller designed to simplify and safeguard the start-up and operation of Darley compressed air foam systems.

The AutoCAFS Commander can be incorporated to monitor and control compressor operation on the Darley AutoCAFS II LDMBC midship CAFS system as well as PTO driven CAFS compressors driven via an electric hot shift type PTO.

The Commander continuously monitors system input speeds, pressures and temperatures. By comparing these values to predetermined acceptable values, the Commander will allow compressor engagement if speeds, pressures and temperatures are within limits. Once the compressor has been engaged, the Commander monitors and displays compressor system temperature and pressure. If these values exceed a pre-set value, the Commander display exhibits a warning. If temperatures or speeds continue to increase to a higher pre-set value, the Commander will then automatically disengage the compressor.

Please review the following documentation for complete feature description, operation instructions, and installation reference.

Darley AutoCAFS Commander



The AutoCAFS Commander System

The system consists of the following components:

1. The control unit
2. Air pressure sensor – 0–300 psi
3. Extension cables – 5 cables supplied
    a. power cable
    b. data bus cable
    c. electric clutch cable
    d. air pressure sensor cable
    e. 1/0 signal and audible warning cable
4. Temperature sender
5. Warning buzzer

Features

A) POWER

12 V, Option for 24 V

B) PROGRAMMABLE DATA USING THE MODE AND ON/OFF BUTTONS

C) DISPLAY

1. Compressor Air Pressure reading: 0–300 psi (0– 2,000 kPA, 0–20.0 bar)
2. Compressor Oil Temperature reading: 0–250° F (0–120° C)
3. Engine RPM: 0–3,000 RPM
4. Airflow in SCFM
5. Compressor operating hours: 0.1 hour increment up to 9,999.9 hours
6. ON/OFF LED
7. OVERSPEED LED

D) ENGINE SPEED SIGNAL

Either from alternator pulse count or J1939 data bus. Default setting is J1939 data bus.

E) TRANSMISSION TEMPERATURE

Thermostat with a single pole open contact.

F) AIR PRESSURE SIGNAL

From pressure transducer, 0–300 psi

G) WARNINGS

1. "HI RPM"
2. "COMP. HOT"
3. "SLOWDOWN"
4. "HI PRESS"
5. "OVERSPD"
6. "SHUTDOWN" – "COMP. HOT"
7. "SHUTDOWN" – "LO FOAM"
8. "SHUTDOWN" – "TRAN HOT"
9. "RPM >900"

H) OPERATING BUTTONS:

A. ON/OFF button
B. MODE button

I) COMPRESSOR OPERATING HOURS

a. The timer is enabled each time the compressor is engaged. An internal memory will keep track of the total operating hours.

1. Control unit

The control unit is the 'brain' for the AutoCAFS Commander system. It performs all the controls and also allows control only when all the necessary conditions are met. It also monitors the system and alerts the operator of any system faults or failures. There are several display windows and buttons on the control unit:

i. Compressor air pressure window: This is a 4-digit LED window. It will display the air pressure from 0–300 psi (pressure in kPA and bar will be displayed when selected).

ii. Compressor oil temperature window: This is a 3-digit LED window. It will display the compressor oil temperature from 0–250° F (temperature in Celsius will be displayed if selected).

iii. An information display window: 8 characters alphanumeric display. This window will display the engine RPM, compressor operating hours, airflow, and also any faults or warnings occurred during the operation.

iv. ON/OFF button: Turn the compressor ON and OFF. In order to turn the compressor on, the ON/OFF button has to be pressed and held for 2 sec. The green LED above the button will illuminate to indicate that the compressor is ON. This green LED will illuminate only if all the conditions are met and an electrical signal has been sent to engage the clutch. Press and hold the ON/OFF button for 2 sec to turn off the system.

v. MODE button: The MODE button allows the operator to view the engine RPM, airflow, and compressor hours. Other information can be added in the future.

2. Pressure sensor

The pressure sensor is used to detect the air pressure in the compressor. It has a pressure range of 0–300 psi.

3. Extension cables

- **a.** power cable: 5 ft long with 3-pin Deutsch connector
- **b.** data bus cable: 12 ft long with 2-pin Packard connector
- **c.** electric clutch cable: 12 ft long with 2-pin Deutsch connector
- **d.** air pressure sensor cable: 12 ft long with 4-pin Deutsch connector
- **e.** 1/0 signal and audible warning cable: 8-pin Deutsch connector with 10 ft cable for transmission thermostat, 14 ft cable with 3-pin Deutsch for compressor temperature sensor, and (4) 8 in. long pigtails

4. Compressor temperature sensor

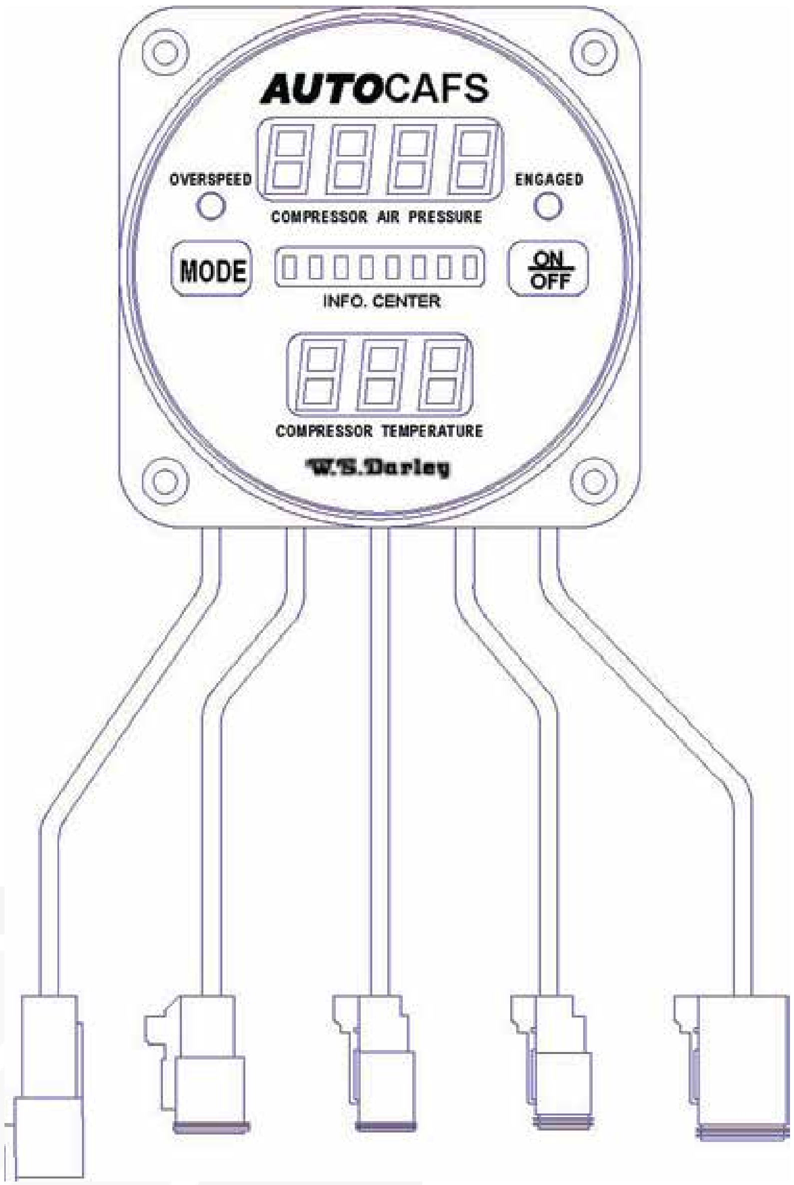
The temperature sensor supplied will be 1/8 NPT with a temperature range of 0° F to 250° F.

5. Warning buzzer

6. Transmission thermostat

Operations:

1. RPM must be 900 rpm or less to engage the compressor.
2. Pressure must be less than 10 psi in order to engage.
3. AUTO ON feature: The system will turn ON automatically when the interlock is engaged and conditions and (2) above are met. The system can be turned off with the ON/OFF switch.
4. Automatic disengagement occurs when RPM reaches 4,500/pump ratio.
5. Over-speed warning occurs when the engine RPM exceeds 3,650/pump ratio. The warning LED will go off when the engine RPM drops to 3,600/pump ratio.
6. Oil temperature over-heat warning occurs at 212° F (default).
7. Compressor high-temperature shut-down. Disengage the compressor at 240° F (default).
8. Audible warning when the foam level is low. The compressor is also disengaged when the foam level in the tank is low.
9. Display messages when compressor engagement is not allowed.
10. Display messages for any system fault:
    - **i.** E3 – “NO RPM” – no RPM signal detected
    - **ii.** E5 – “NO PRESS” – no pressure transducer detected
    - **iii.** E10 – “NO TEMP” – no oil temperature sensor detected
11. Audible warning active when:
    - **i.** RPM over-speed
    - **ii.** Compressor oil temperature – over-heat
    - **iii.** Transmission temperature – over-heat
    - **iv.** Foam in tank is too low



POWER

- 12 volt
- Ground
- Interlock

DATA BUS

- J1939 (+)
- J1939 (-)
- Shield

ELECTRIC CLUTCH

- 12 volt
- Ground

PRESURE SENSOR

- 4 pin

I/O SIGNALS – 8 PIN

- 12 VDC
- Ground
- Temperature signal
- Transmission thermostat
- Audible warning
- Low foam level warning
- Airflow (4-20 mA)
- Airflow (4-20 mA)

DISPLAY

1. Compressor Air Pressure reading: Using 0–300 psi sensor, units of measure selectable.
   - a. 0–300 psi
   - b. 0–2,000 kPA
   - c. 0–20 bar
2. Compressor oil temperature reading:
   - a. 0–250° F or
   - b. 0–120° C
   - c. dot matrix display:

     Engine RPM – default display

     RPM 1450

     Airflow in SCFM

     AIR 65

     Compressor operating hours

     HR. 1154

SWITCHES

1. ON/OFF
   - a. Active only when the 'INTERLOCK' is on
   - b. Press and hold for 2 sec to turn ON the air compressor
   - c. Press and hold for 2 sec to turn OFF the air compressor
2. MODE
   - a. Toggle the information between engine RPM, airflow, and air compressor operating hours
   - b. Use to get into the programming mode

OPERATIONS

1. Turn compressor ON
   - a. 'INTERLOCK' is on – the system turns ON when initial start-up conditions "c" and "d" are met.
   - b. OR ON/OFF button is pressed and held for 2 sec.
   - c. Air pressure is < 10 psi.
   - d. Compressor oil temperature is < 212° F (100° C)
   - e. Turn 'Engaged' LED on when the compressor is engaged. (After all conditions are met.)
2. Shut down compressor if:
   - a. Engine RPM > 4,500/pump ratio (for example, 4,500/2.44 = 1,844 rpm)
   - b. Compressor temperature > 240° F (115° C)
   - c. Low foam level (input signal)
   - d. High transmission temperature (input signal)

3. System faults:

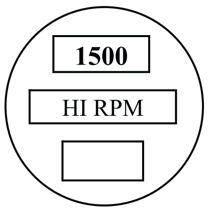
a. E3 – no RPM data

b. E5 – no pressure transducer detected

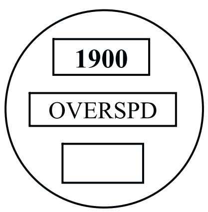
c. E10 – no oil temperature sensor detected

4. System warnings:

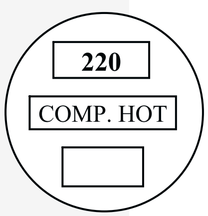
a. “HIRPM” – 4,500/pump ratio > RPM >= 3,650/pump ratio
Flash “HI RPM” and 1500



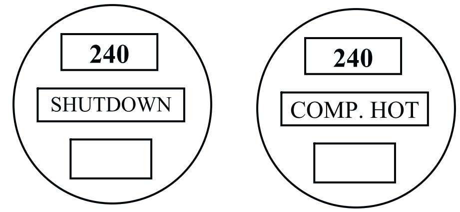
b. “OVERSPD” – RPM > 4,500/pump ratio
Flash “OVERSPD” and 1900



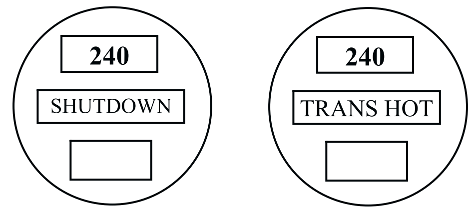
c. “COMP. HOT” – 212° F (100) < Oil temperature < 240° F (115)
Flash “COMP. HOT” and 220



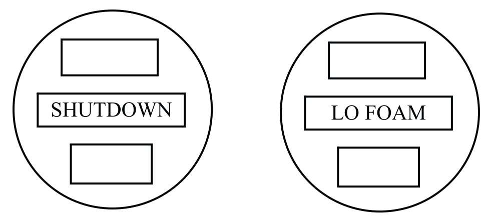
d. “SHUTDOWN”, “COMP.HOT” – Oil temperature > 240° F, Flash



e. “SHUTDOWN”, “TRAN HOT” – From transmission temp. overheat input, Flash



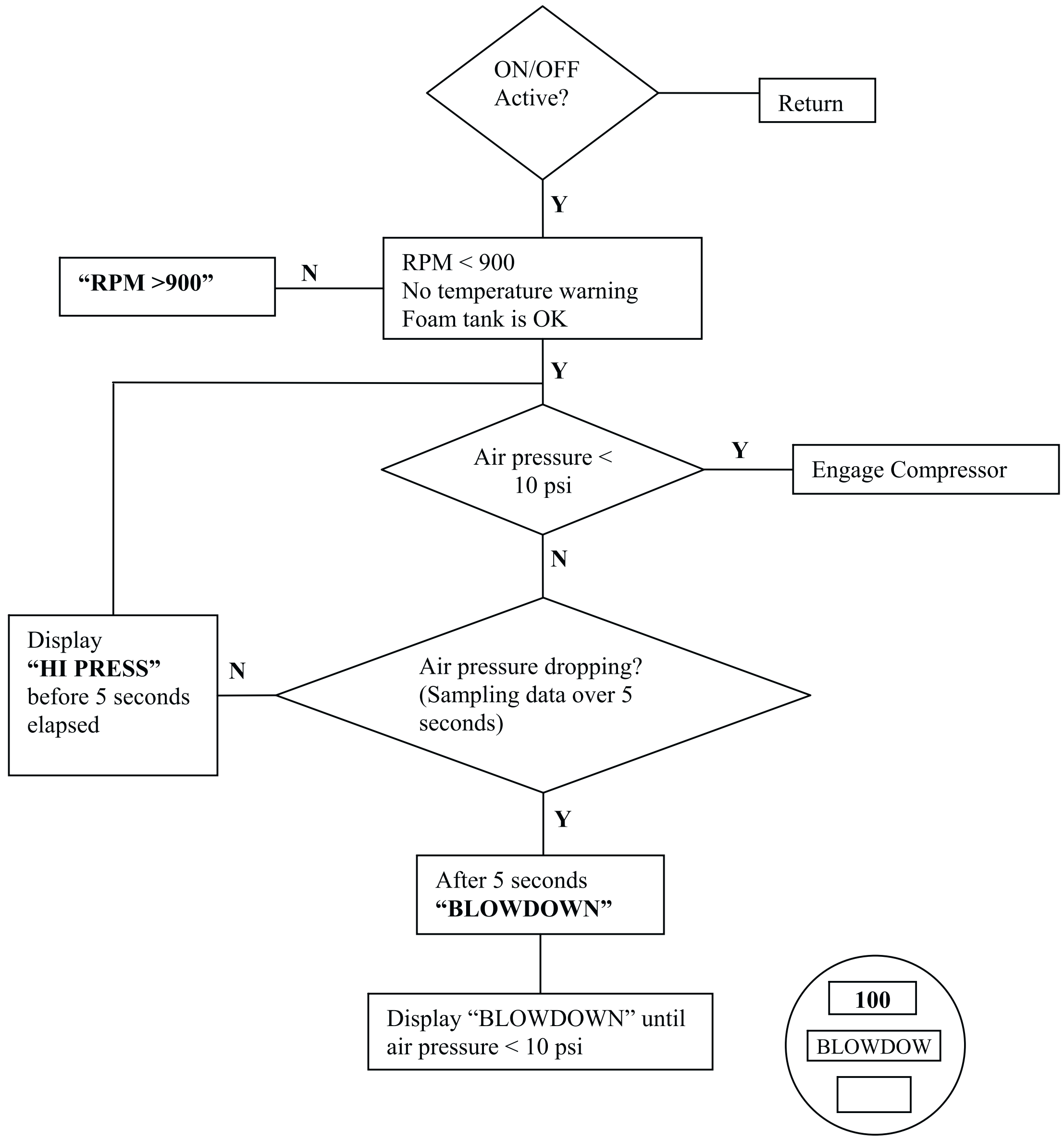
f. “SHUTDOWN”, “LO FOAM” – From Foam tank input, Flash



g. “BLOWDOWN” – Flash

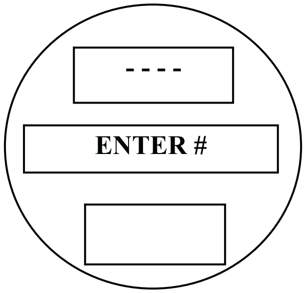
i. When compressor pressure is > 10 psi

ii. When an operator is trying to turn the compressor on


ON/OFF Active?
Return
Y
RPM < 900
No temperature warning
Foam tank is OK
N
"RPM >900"
Y
Air pressure < 10 psi
Y
Engage Compressor
N
Air pressure dropping? (Sampling data over 5 seconds)
N
Display "HI PRESS" before 5 seconds elapsed
Y
After 5 seconds "BLOWDOWN"
Display "BLOWDOWN" until air pressure < 10 psi
100
BLOWDOW

CODES

I. Press and hold "MODE" for 3 sec to enter the data entry mode.

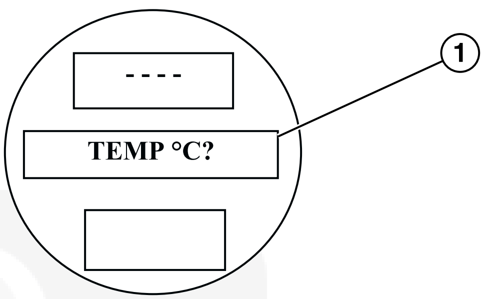


II. Press "MODE" and then "ON/OFF" to enter code.

III. Use "MODE" to select the digit and "ON/OFF" to change the number.

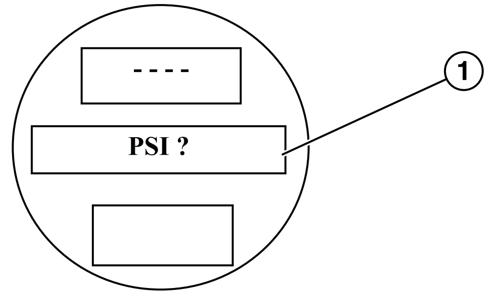
IV. Press and hold both "MODE" and "ON/OFF" for 3 sec to exit.

1. Select °F or °C for compressor oil temperature reading – default to °F
CODE – 310



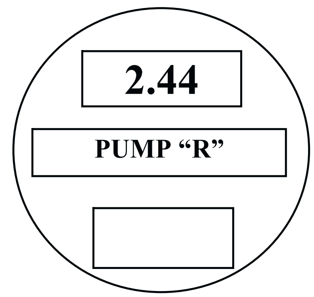
1. Toggle

2. Select pressure to be in PSI, kPA, BAR – default to "PSI"
CODE – 311

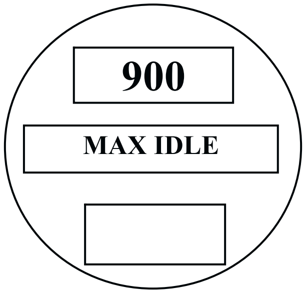


1. Toggle

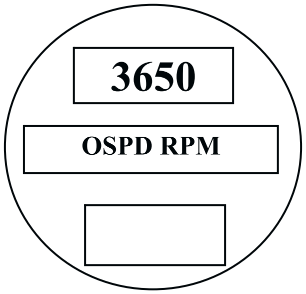
3. Select pump ratio – default to 2.44
CODE – 312



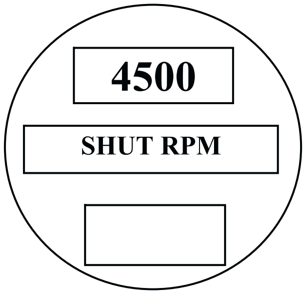
4. Set the maximum idle RPM allowed for engagement – default = 900
CODE – 313



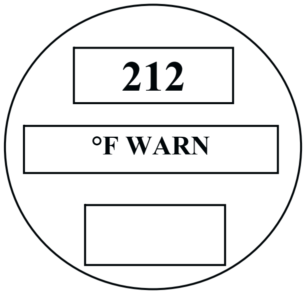
5. Set new pump RPM for over-speed warning – default = 3650
CODE – 314



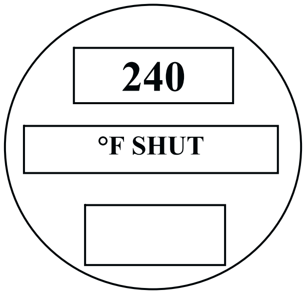
6. Set new pump RPM for automatic compressor disengagement – default = 4500
CODE – 315



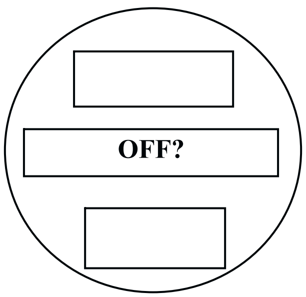
7. Set the compressor temperature over-heat warning – default = 212 (100° C)
CODE – 316



8. Set the compressor over-heat shut-down temperature – default = 240 (115°C)
CODE – 317



9. Select system to tum ON automatically when Interlock is engaged
CODE – 321

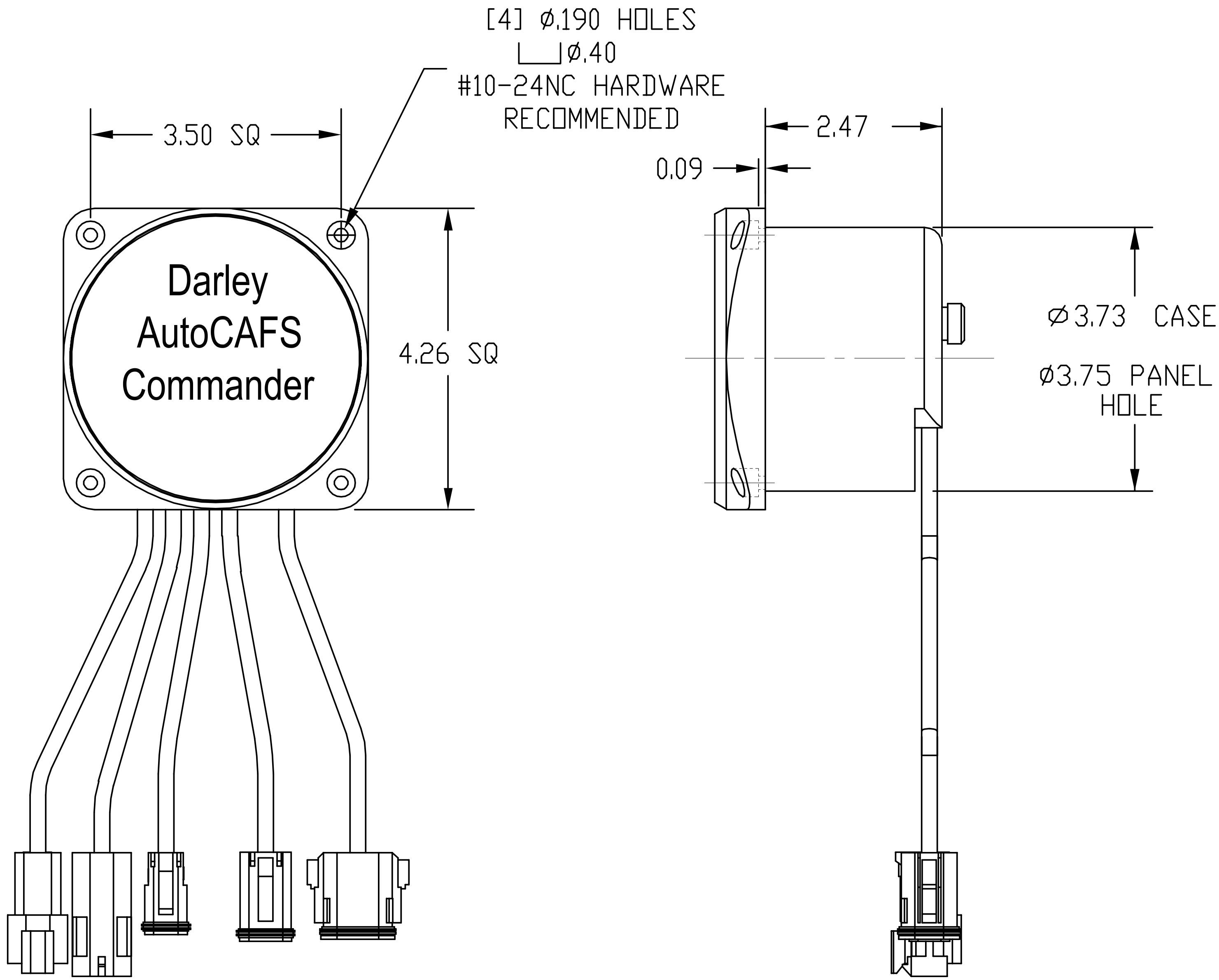


Installation

INSTALL CONTROL MODULE

NOTE: *The control module should be mounted on the pump control panel.*

1. Measure and mark mounting location for control module panel cutout and mounting screw holes. Make sure there is clearance behind the panel for the module and cables before cutting holes. Refer to the following diagram for layout and dimensions.
2. Cut out a 3.75 in. (95.25 mm) diameter hole and drill four holes for mounting screws.
3. Place control module in position and secure with four screws (#10-24NC mounting hardware is recommended).


[4] Ø.190 HOLES
⌴ Ø.40
#10-24NC HARDWARE
RECOMMENDED
3.50 SQ
4.26 SQ
Darley
AutoCAFS
Commander
2.47
0.09
Ø3.73 CASE
Ø3.75 PANEL
HOLE

INSTALL PRESSURE TRANSDUCER

The air pressure transducer is mounted to a port on the air/oil separator tank below the main discharge pressure check valve. To correctly read air system pressure during operation as well as during system blow-down, the transducer must be connected to a port located before the system minimum pressure discharge check valve.

1. Mount the transducer in a 1/4-18 NPT threaded air pressure port. A 1/8 BSPP male x 1/4 NPT female adapter is required for attachment to the LDMBC separator tank.

NOTICE

Do not use the main body that houses the electronics to tighten the pressure transducer. Damage to the transducer may occur.

2. Tighten the transducer with a wrench on the lower hex fitting.
3. Connect the pressure transducer cable from the control module to the pressure transducer.

1. Air receiver tank
2. Air system minimum pressure discharge check valve
3. Pressure transducer port location

NOTE: *1/8 BSPP male x 1/4 NPT female adapter required.*

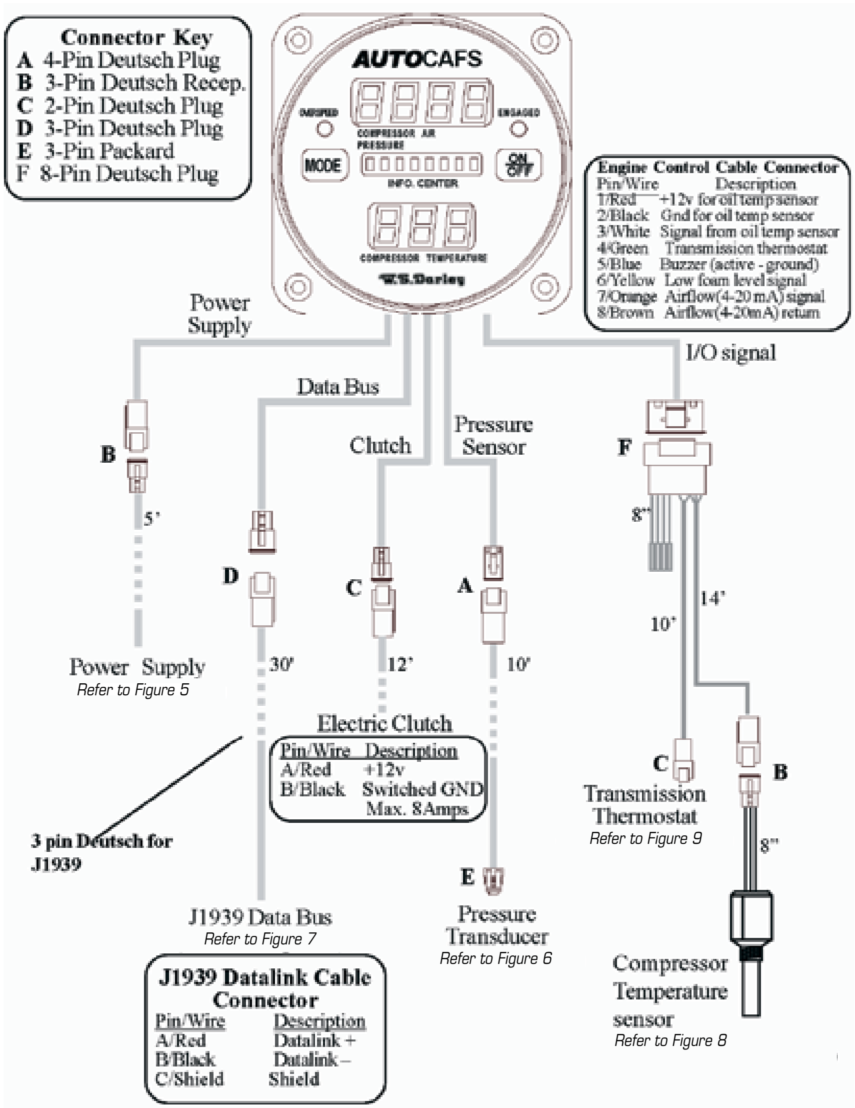


Figure 4 – WS Darley AutoCAFS Module Wiring

Wiring

The following figures include the schematics, wiring diagrams, block diagrams, and cables for the AutoCAFS.

NOTE: *If optional 24 VDC unit is installed references, to +12 VDC will be +24 VDC.*

POWER

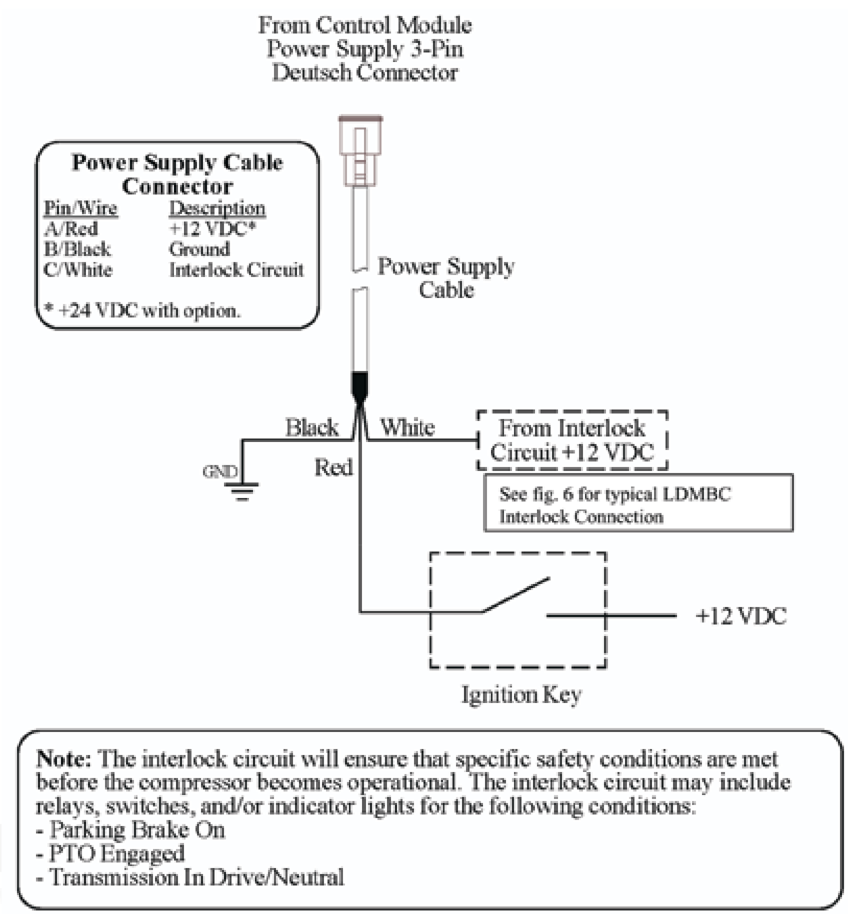


Figure 5 – Power Supply Wiring

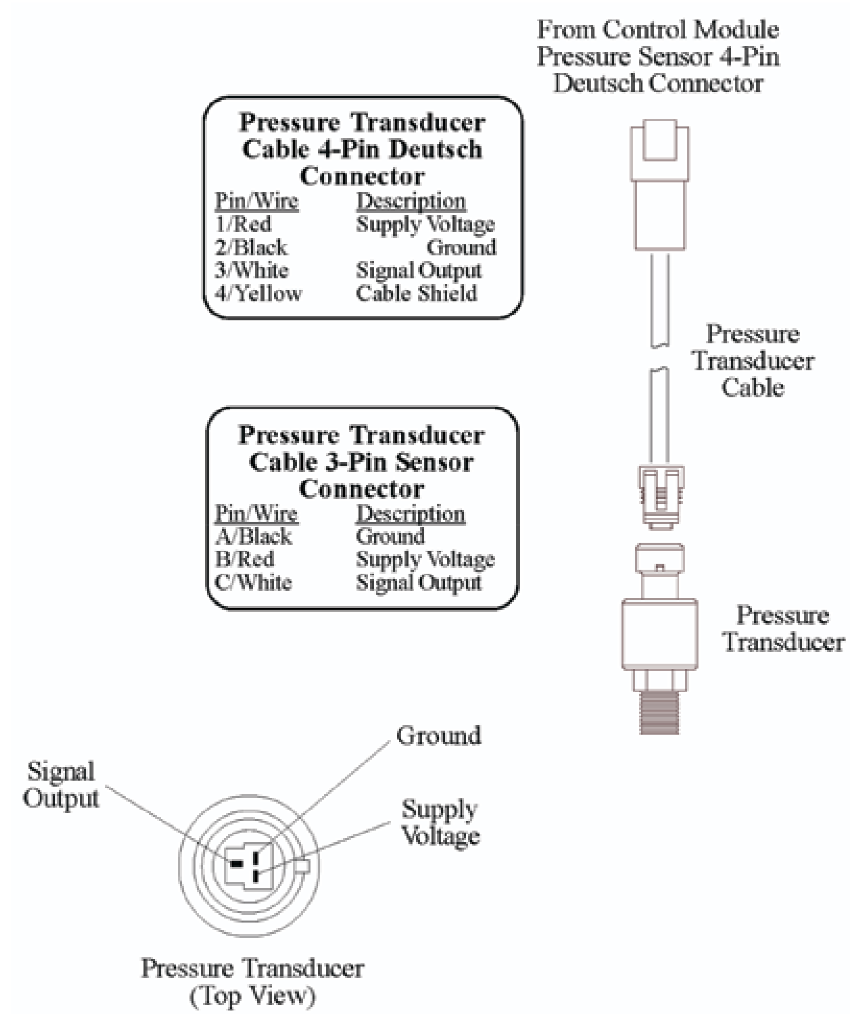


Figure 6 – Pressure Transducer Wiring

J1939 DATA BUS

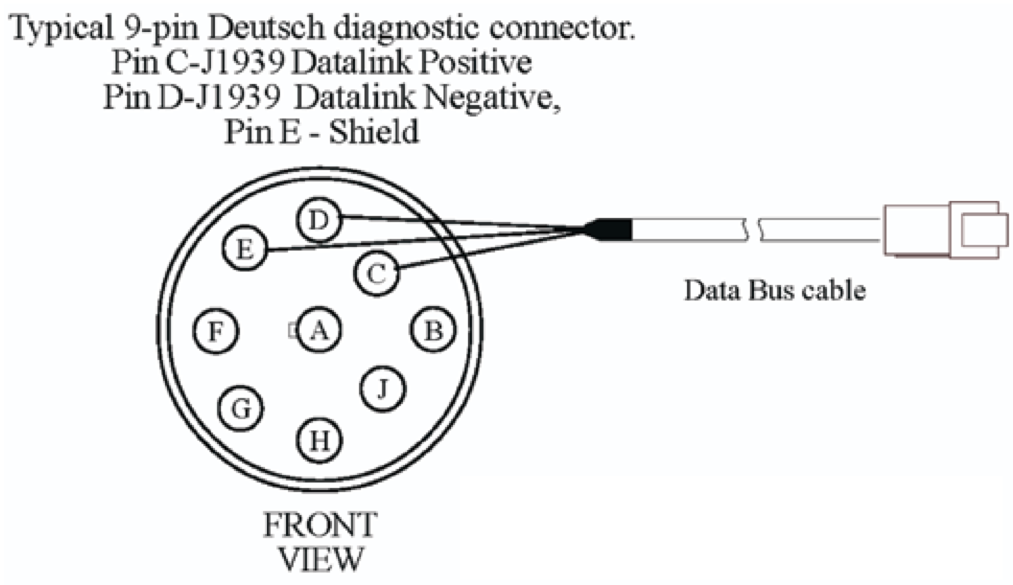


Figure 7 – Data Bus Wiring

I/O SIGNAL

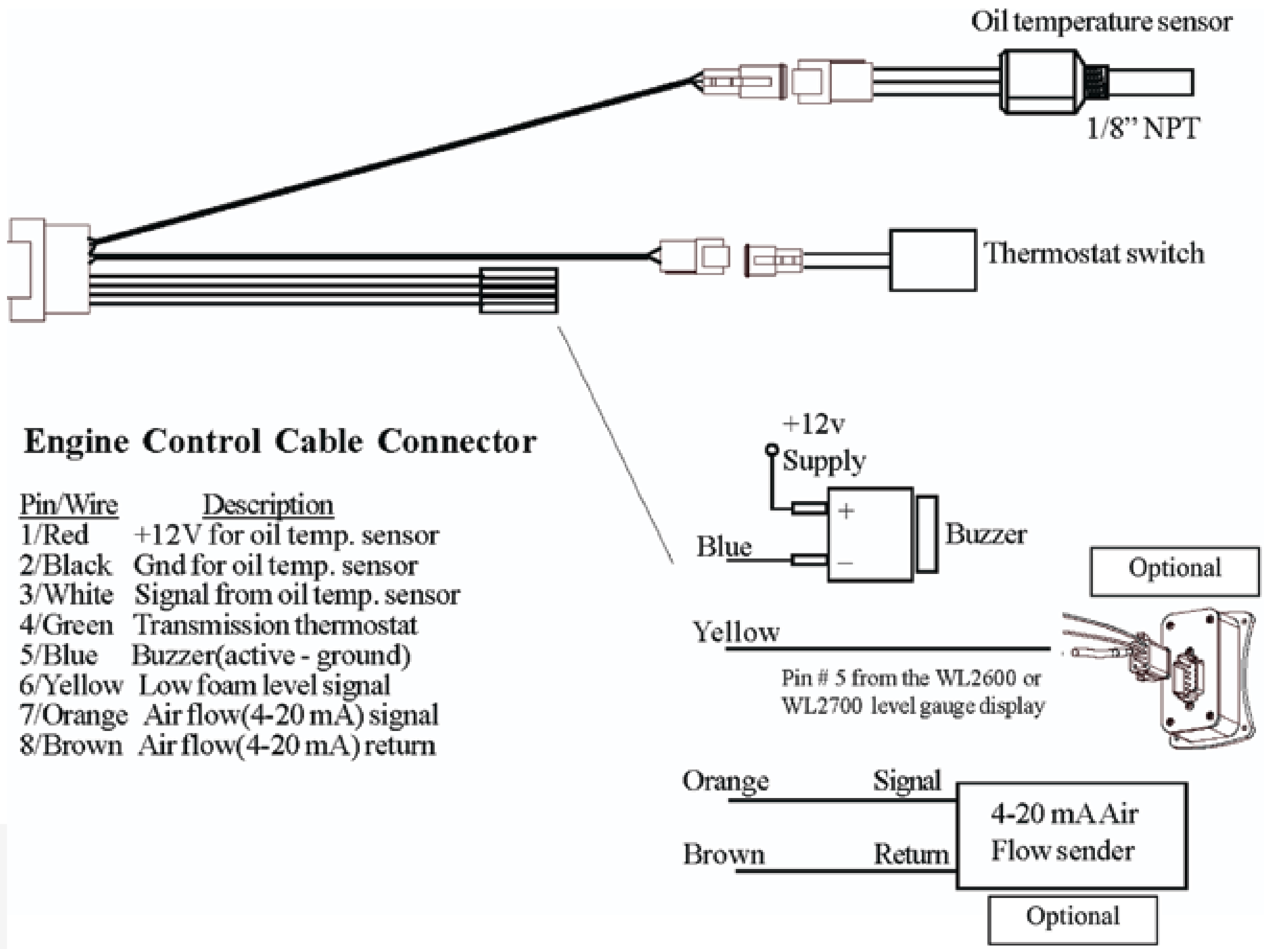


Figure 8 – Other Input/Output Wiring

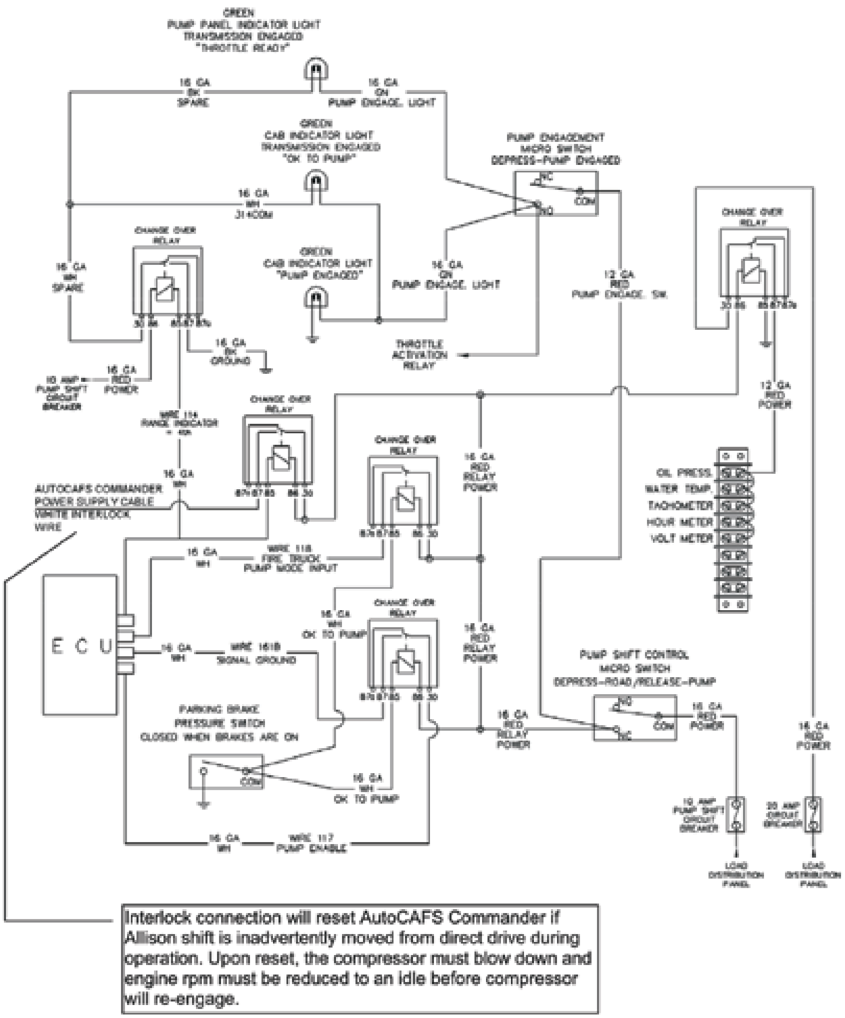


Figure 9 – Typical Interlock Wiring

Program Access Mode

When in the program access mode, the digital display will show operator inputs, program options, and error codes. To gain access to the program features, a three-digit program code must be entered. Review the Program Code Descriptions or refer to *Table 11 on page 130* for the proper three-digit code.

NOTE: *There is a timeout feature that will return the program to normal operation in 3 seconds if input is not detected at the buttons.*

SELECT PROGRAM ACCESS MODE

Press the MODE button and hold it until the display shows four dashes. The program access mode is ready for a code number to be input. Refer to *Table 11 on page 130.*

ENTER PROGRAM CODE NUMBER

NOTE: *There is a timeout feature that will return the program to normal operation in 3 seconds if input is not detected at the buttons.*

1. Select the Program Access Mode (four dashes are shown in the display).
2. Press the ON/OFF button. The display will show the number 100 and the first digit 1 will flash. Each time the ON/OFF button is pressed, the number will scroll up by 1. Set the first digit to the number desired.
3. Press the MODE button. The second digit shown in the display will flash. Each time the MODE button is pressed, the number will scroll up by 1. Set the second digit to the number desired.

4. Press the ON/OFF button. The third digit shown in the display will flash. Each time the ON/OFF button is pressed, the number will scroll up by 1. Set the third digit to the number desired.

When a valid three-digit program code is entered, the display will show a program value or an option. If an invalid code is entered, the display will show an error code.

NOTE: *When a valid code has been entered and the display shows a programed value or an option, the timeout feature is disabled.*

CHANGE VALUES OR OPTIONS

Press the MODE button to select the digit that is to be changed. The digit will flash. Press the ON/OFF button to change the digit or the option choice.

EXIT PROGRAM ACCESS MODE

Press both the MODE and then ON/OFF buttons and hold until four dashes are shown in the display. Release the buttons and enter a new code or after 3 seconds the program will time out and return to normal operation.

Table 11

Code Number	Settings	Default Value
3-1-1	To select °F or °C	°F
3-1-0	To select psi, kPA, Bar	PSI
3-1-2	To set pump ratio	2.44
3-1-3	Set max. engine RPM for engagement	900 engine RPM
3-1-4	High pump RPM for warning only	3,650 pump RPM
3-1-5	High pump RPM for disengagement	4,500 pump RPM
3-1-6	To set oil temp. warning only	212° F
3-1-7	To set oil temp. for disengagement	240° F
3-2-1	To set 'Auto ON' function	OFF

The following text is a generic description of the operating procedures for a FoamPro Model2001 foam proportioner. Please refer to the manual supplied with your apparatus for specific operating instructions for your unit.

This apparatus has been fitted with a compressed air foam system. In addition to the main UL pump, there are two basic subsystems that comprise a compressed air foam system on an apparatus. Number one is the addition of a foam concentrate proportioner to inject foam concentrate into the discharge side of the water pump. Number two is the addition of an air compressor system to supply compressed air for foam making. Operation of the apparatus with only the foam concentrate proportioner functioning will result in the apparatus functioning as a conventional foam-equipped unit. Various nozzles and devices may be used to create and discharge foam. Operation of the apparatus with proportioner and air compressor engaged will result in the engine being capable of creating compressed air foams. Compressed air foams are generally applied through smooth bore type nozzle devices.

The air compressor has a rated capacity of 220 cfm (cubic feet per minute). It attains this capacity at approximately 1,500 engine rpm. The air compressor is driven by an auxiliary gear case mounted directly to the pump split shaft gear case. The pump and compressor gear ratios are matched to provide approximately 500 gpm at 125 psi water flow while simultaneously providing 220 cfm at 125 psi air flow. It is important to remember that during operations from a pressurized hydrant source, engine RPM will be slower; therefore compressor output will be reduced. If high compressor flows are required, operate from draft or from the booster tank. Engine RPM will then be high enough to assure adequate compressor performance. Another option is to turn on the discharge relief valve, set it for the desired pressure, and throttle pump up to the necessary RPM for maximum compressor output.

The benefits of compressed air foam use are variable, but they are directly proportionate to the knowledge of the user. Please read and understand this operations manual before operating the unit.

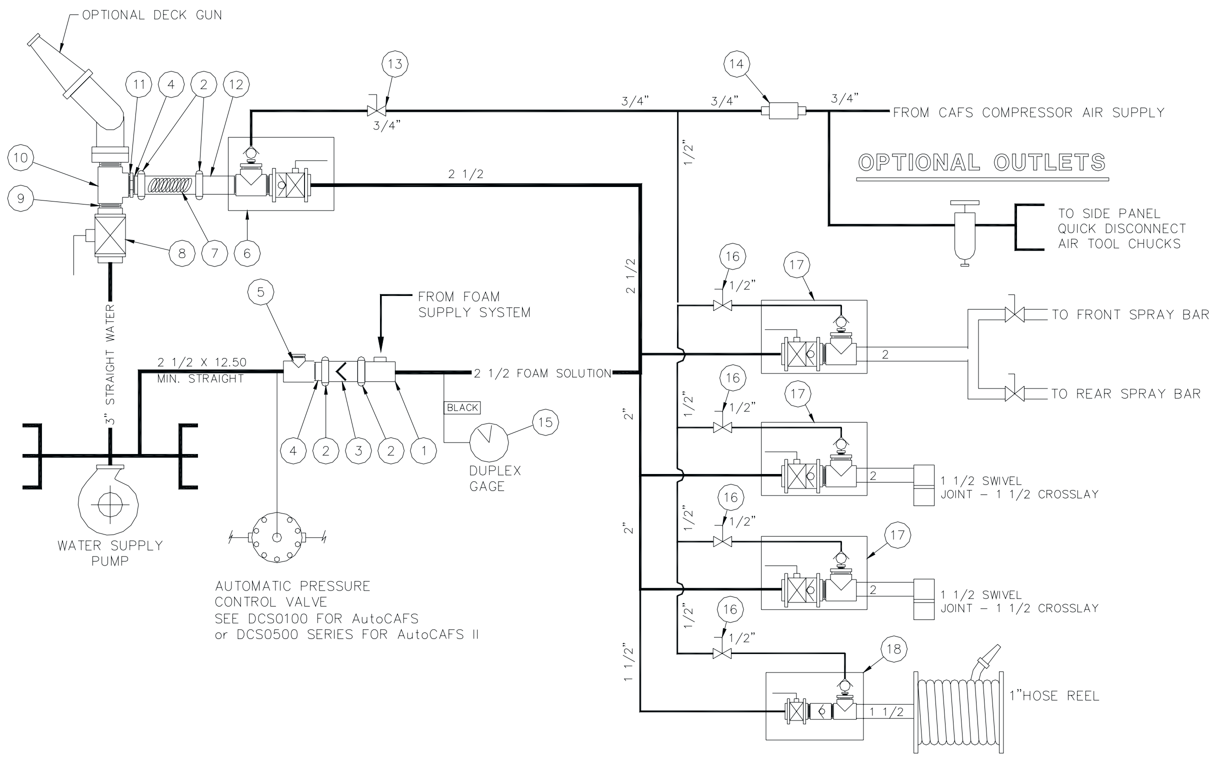


Figure 10 – Example of Typical Compressed Air Foam Schematic

FoamPro Electronic Foam Proportioner

This unit is equipped with a FoamPro 2001 automatic, electronic, discharge side, foam proportioning system.

The foam proportioner is a built-in, fully self-contained, flow-meter-based, direct injection system.

There are five basic units that make up the system. They are the injection pump, motor, paddle-wheel type flow meter, injection fitting, and the panel-mounted, digital, push-button, control module unit.

An optional three-way "Foam Supply Valve" may be installed behind an access door on the side pump panel. It has four basic functions.

1. On Position – To allow foam to travel from the foam tank to the FoamPro pump
2. Off Position – To shut off the foam tank for cleaning of the strainer
3. To serve as an overboard pickup hose
4. Drain Position – To drain the foam tank using the overboard pick-up/drain hose

To utilize the overboard pickup hose, the hose must first be primed.

1. Insert hose into pail of foam
2. Turn cal/inject valve on FoamPro discharge fitting to calibrate/flush position. Run FoamPro pump in "Simulated Flow" mode to prime. See Hypro manual for instructions. Switch cal/inject valve to inject.

The unit operates by sensing water flow. The paddle wheel flow meter sends a signal to the control unit displaying this flow. If the unit is turned on, the microprocessor control sends a signal to the injector motor to begin injecting foam concentrate into the plumbing based on the percentage set at the control module.

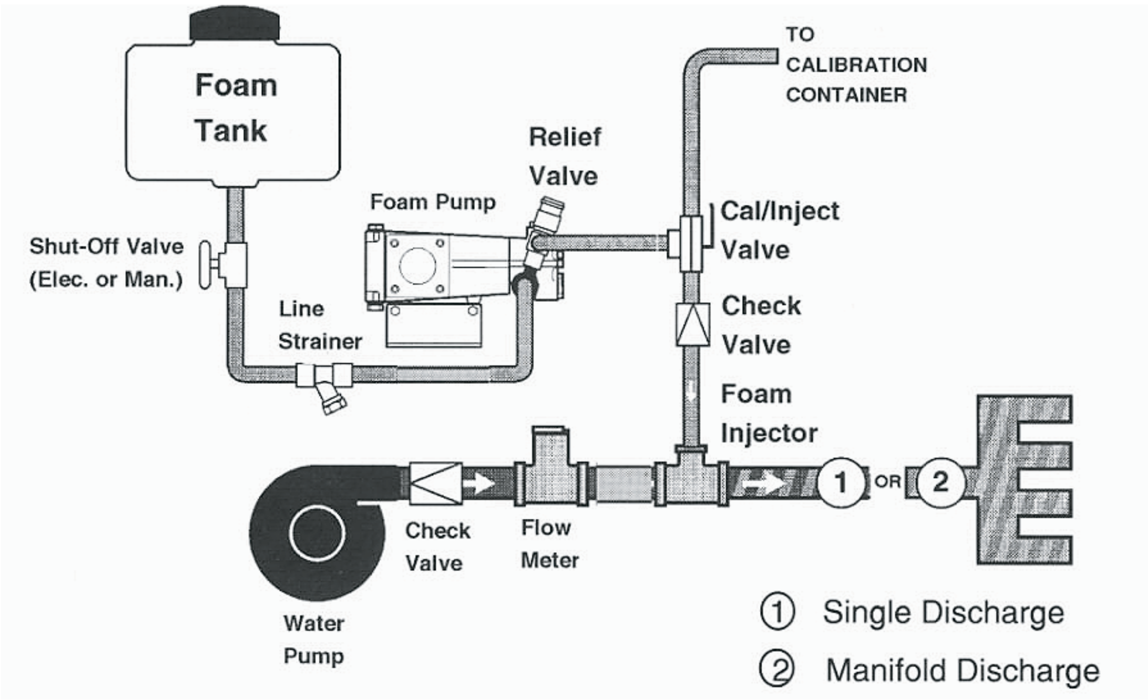


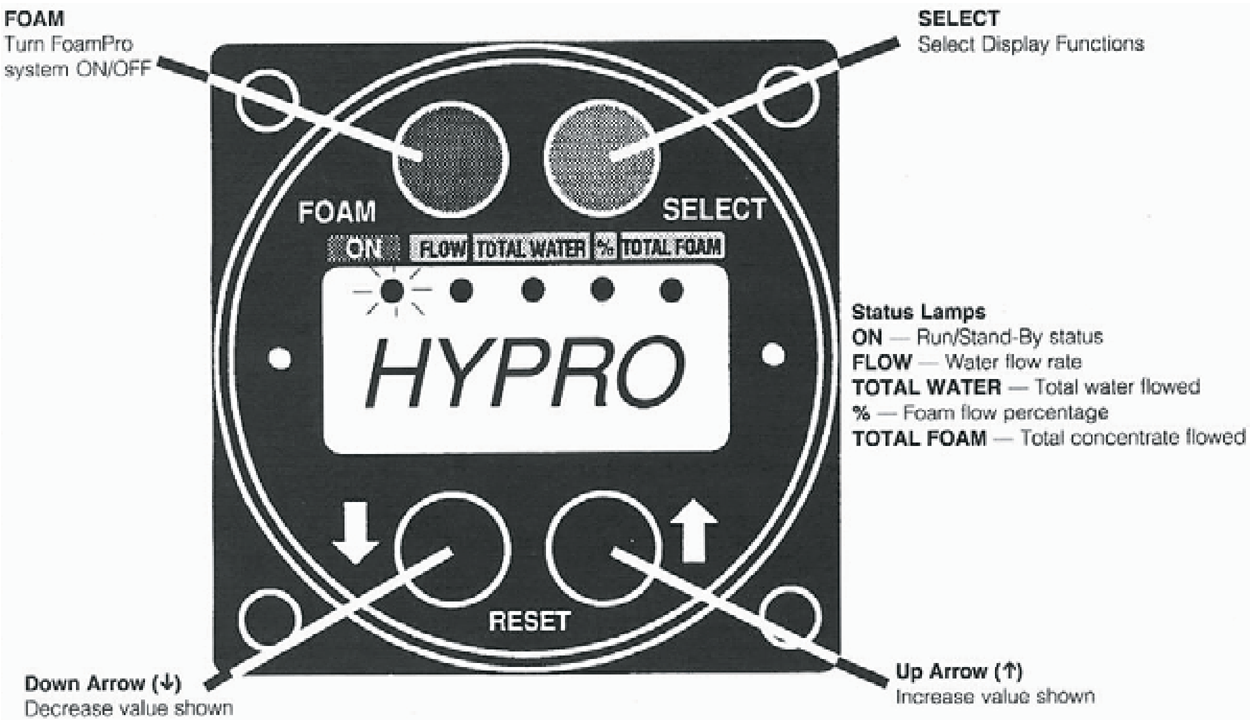
Figure 11 – FoamPro 2001 Basic System Layout

This system allows for continuous operation without interruption of foam concentrate flow. If the level of foam in the supply tank is reaching empty, a low concentrate (LO CON) warning will flash on the display. The tank then must be refilled within 2 min or the unit will automatically shut down to avoid doing damage to the injector pump. If the unit has shut down, a no concentrate (NO CON) message will be displayed. The foam percentage to water ratio is adjustable from 0.1% to 9.9% in 0.1% increments. Weather affects viscosity of the concentrates. Therefore, the ratio can be adjusted to the user's choosing.

The microprocessor-based, panel-mounted control unit can perform multiple functions. It performs the basic function of turning the unit on or off. It also has two buttons with up/down arrows to adjust the injection percentage ratio of the foam to water. These buttons also play a part in the initial setup of the unit's calibration. With the selector button in the upper right-hand corner of the unit, four functions can be accomplished.

SELECTOR BUTTON FUNCTIONS

1. Flow Mode: Displays present water flow out any of the CAFS discharges, even if the foam system is not turned on.
2. Total Water Mode: Displays total water flowed since the unit began to flow water.
3. Percentage (%) Mode: Displays the present ratio that foam will be injected at, if the unit is turned on.
4. Total Foam Mode: Displays the total amount of foam, rounded off to the nearest gallon, injected since the unit was last turned on.



The following chart gives the approximate water treatment capacities and relative flow times for various foam concentration settings. The chart is based on a water flow rate of 120 gpm and a single tank capacity of 30 gal.

Meter Setting	U.S. Gallons Treated	Flow Time – 30 Gal Tank
0.1%	30,000	250 min
0.2%	15,000	125 min
0.3%	10,000	83.3 min
0.5%	6,000	50 min
1.0%	3,000	25 min
3.0%	1,000	8.3 min

FOAM PROPORTIONER

TO GET FOAM

1. Push the red on/off button.
2. The foam percentage default is set at 0.3%; adjust if desired.

TO FLUSH SYSTEM

1. Turn off the foam system by pushing the red on/off button. The red light below the button will go off.
2. Flow water out of the foam discharge for 2 min.

To drain unit of water when in freezing weather, tum dual tank selector switch, if so equipped, to flush (center) position, and open all pump drains. Refer to Hypro 2001 installation/operators manual for other specific operation or maintenance information.

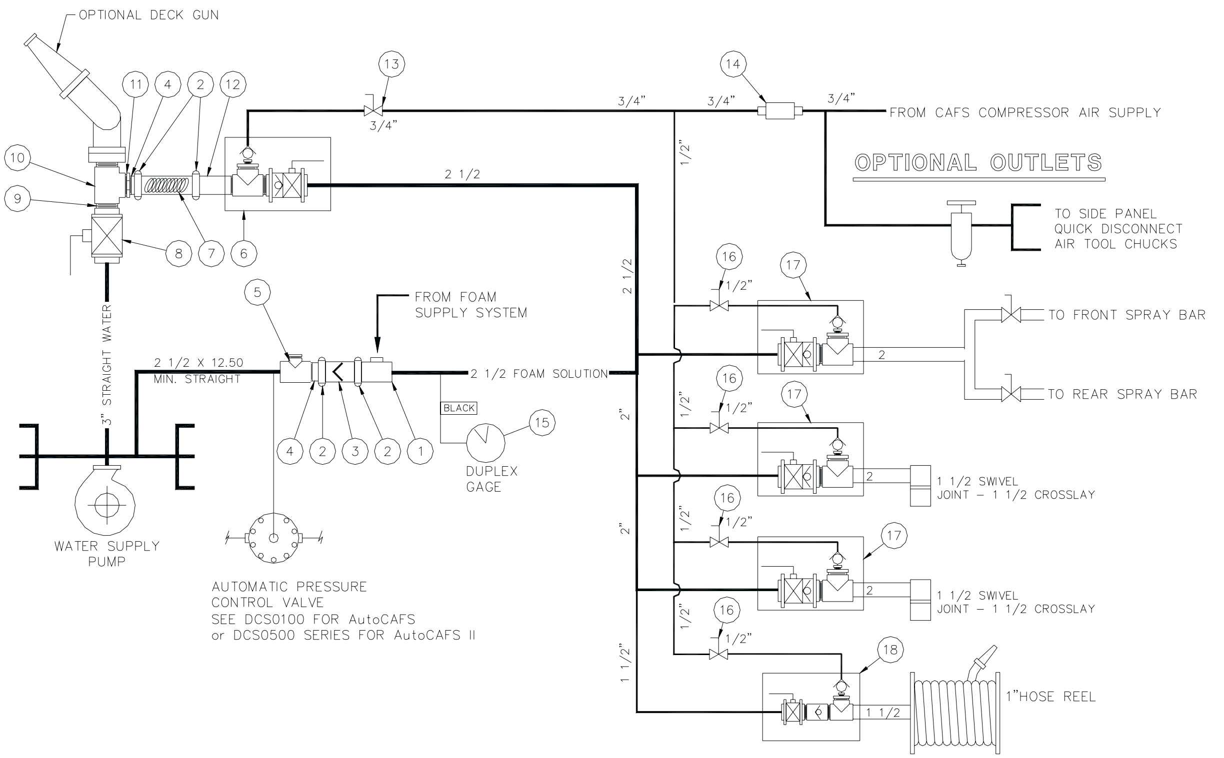


Figure 12 – Typical Compressed Air Foam Schematic

This apparatus has been fitted with a compressed air foam system. In addition to the main UL pump, there are two basic subsystems that comprise a compressed air foam system on an apparatus. Number one is the addition of a foam concentrate proportioner to inject foam concentrate into the water on the discharge side of the water pump. Number two is the addition of an air compressor system to supply compressed air for generating foam.

Operation of the apparatus with only the foam concentrate proportioner functioning will result in the apparatus functioning as a conventional foam-equipped unit. Various nozzles and devices may be used to create and discharge foam.

Operation of the apparatus with the proportioner and air compressor engaged will result in the engine being capable of creating compressed air foam. Compressed air foam is generally applied through smooth bore devices.

It is important to remember that during operations from a pressurized hydrant source, engine RPM will be slower, causing the compressor output to be reduced as well. If high airflow is required, operate from draft or from the booster tank. Engine RPM will then be high enough to ensure adequate compressor performance. Another option is to turn on the discharge relief valve, set it for the desired pressure, and throttle the pump up to the necessary RPM for maximum compressor output.

The benefits of compressed air use are variable and are directly proportional to the knowledge of the user. Please read and understand the operations manuals before operating the unit.

The following chart gives the approximate water treatment capacities and relative flow times for various foam concentration settings. This chart is based on a water flow rate of 120 gpm and a single foam concentrate tank capacity of 30 gal.

Meter Setting	U.S. Gallons Treated	Flow Time – 30 Gal Tank
0.1%	30,000	250 min
0.2%	15,000	125 min
0.3%	10,000	83.3 min
0.5%	6,000	50 min
1.0%	3,000	25 min
3.0%	1,000	8.3 min

TO GET FOAM

1. Push the red on/off button (Hypro FoamPro 2001 & 2002 only).
2. The foam percentage default is set at 0.3%; adjust as desired.

TO FLUSH SYSTEM

1. Turn off the foam system.
2. Flow water out of the foam discharge for 2 min.

To drain water from unit during freezing weather, turn dual tank selector switch to flush (center) position (as applicable), and open all pump drains.

Compressed Air Foam System Operation

1. Referring to *Pump Shifting Procedure on page 22*, shift water pump to ENGAGED position.
2. Engage the air compressor by pressing and holding the AutoCAFS Commander ON/OFF button down for 2 sec.

NOTE: *The compressor can be switched on before or after the pump is engaged. However, do not engage the compressor when the engine is turning faster than 900 rpm. Reduce the engine rpm before engagement. An interlock has been implemented to limit the engagement rpm to 900 rpm.*

3. Establish water flow in the main pump. Open the tank to the pump valve and the tank refill valve slightly to provide water circulation through the pump.

NOTICE

The air compressor is cooled by water supplied by the fire pump and circulated through a water/oil heat exchanger. Water circulation must be established before or immediately following compressor engagement to assure proper cooling. Also, if water is continually circulated back to tank, cooling water will be heated. Operating with a continuously refreshed water supply eliminates this concern.

NOTICE

A temperature sensor is incorporated into the AutoCAFS Commander control module to avoid compressor over-heating, which may result in rotor seizure. If compressor temperature rises above normal operating temperature to 212° F, a warning, 'COMP HOT', will flash on the Commander display panel.

If temperature warning is indicated, shut down the compressor as soon as practical. The compressor can be switched off (DISENGAGED) at any time or input speed. Check for adequate water flow through the heat exchanger. Check for adequate oil level in the separator tank.

NOTICE

If the air compressor temperature continues to rise to 240° F, the air compressor will be automatically disengaged.

4. Turn on the foam proportioning system. When a FoamPro 2001 or 2002 is enabled, a red indicator light will be on steady. Light will flash as foam is injected. If a FoamPro 1601 system is used then upon turning the system "on," the red low foam indicator light will flash once to inform that the system is enabled.

NOTICE

Do not over-speed the air compressor. Input RPM should not exceed that required to produce a rated air flow of 220 cfm at 150 psi maximum pressure.

Disengage the air compressor when service testing or performing UL test on the CAFS-equipped vehicle.

AUTOMATIC BALANCED AIR PRESSURE CONTROL

Air pressure will match water pressure up to 150 psi if the pump input speed is adequate to maintain the flow rate setting.

NOTE: *Do not exceed 175 psi pump pressure while compressor is engaged. Maximum air pressure has been factory pre-set to 150 psi. (To avoid compressor over-speed, the AutoCAFS Commander control is programmed to provide a visual speed warning at 3,650 pump ratio. Additionally the Commander is programmed to disengage the compressor at an input speed of 4,500 pump ratio.)*

NOTE: *Oil Separator Tank Safety Relief Valve – 200 psi.*

5. Increase engine speed to the desired operating pressure using the throttle or governor control provided. Common compressed air foam system (CAFS) operating pressures range from 100 – 150 psi. National Fire Protection Association (NFPA) standard recommends 125 psi.
6. Slowly open the CAFS discharge valve that is desired. Open completely to first fill the hose with foam solution. Then close the valve to approximately 1/3 open.
7. Open the accompanying airflow valve approximately 50% full open or turn the toggle switch "ON" to activate the preset air flow to the desired CAFS discharge.
8. Monitor the water and air flow rates on the flow meters and adjust to desired ratio. A 1 to 1 mix is a good ratio to start with. For example, 40 gpm to 40 cfm. If a higher water flow is used, then the foam will be wetter. If a higher air flow is used, then the foam will be drier. Many operating guideline variables exist. A variety of standard operating procedures may be necessary to meet different incident objectives. For example, a drier

(shaving cream type foam) will be necessary to provide exposure protection. It can be achieved by using a low flow rate of water (25 gpm) and a higher flow rate of air (40 cfm). To achieve a large fire knock-down, higher flow rates of water (60 gpm) will be more desirable. At water flow rates over 50 gpm, air flow rates should be used at about an equal 1 to 1 ratio for best results.

Foam Type	Hose Size	Foam Solution GPM	Air Flow CFM
Very Dry – Fluffy	1 in.	10	25
Dry to Medium	1 in.	20	20
Medium to Wet	1 in.	25	10
Very Dry – Fluffy	1-1/2 in. or 1-3/4 in.	15	60
Dry	1-1/2 in. or 1-3/4 in.	20	60
Medium	1-1/2 in. or 1-3/4 in.	40	60
Wet	1-1/2 in. or 1-3/4 in.	60	60
Very Wet	1-1/2 in. or 1-3/4 in.	70	50
Dry	2-1/2 in.	50	100
Medium	2-1/2 in.	80	100
Wet	2-1/2 in.	120	100

The above rates are based upon having a large ball shutoff and a large, smooth bore tip approximately equal to the hose size. Fog nozzle tips will almost always limit flow rates, and usually reduce the flow of air. Dry foam types are next to impossible to achieve with fog nozzles. High-gallonage fog nozzles do work very well for interior attack if solution flow gpm is high from 50–70 gpm and air flow rates are moderate 40–60 cfm.

9. Monitor the booster tank level and temperature during prolonged operation from tank only.
10. Monitor compressor temperature. Normal operating temperature is 170° F–185° F. If compressor temperature rises above normal operating temperature to 212° F, the Commander display will flash 'COMP HOT'. If temperature warning is indicated, shut down the compressor as soon as practical. The compressor can be switched off (DISENGAGED) at any time or input speed.

NOTICE

If the air compressor temperature continues to rise to 240° F, the air compressor will be automatically disengaged.

Steps for Shutdown

1. Close air valves.
2. Reduce pressure to idling condition.
3. Flush foam system per instructions.
4. If desired, use air to expel water from hose lines during freezing weather.
5. Disengage compressor.

NOTICE

Avoid immediate restart of the air compressor after shutdown. Allow 1 minute minimum time period between air compressor shutdown and restart for system blow-down.

Compressed Air for Air Tool Usage

1. Using standard shifting procedures, shift the compressor and fire pump to the 'ENGAGED' position.

NOTE: *The water pump must be engaged and running to utilize the air compressor for operating air tools.*

2. Establish water flow in the main pump. Open the tank to the pump valve and tank refill valve slightly to provide water circulation through the pump.
3. The air pressure for operating air tools is automatically balanced with the water pump pressure. Maximum is 150 psi.

NOTE: *Output capacity of air compressor is determined by pump RPM. Higher RPMs may be required to flow desired output if high flow rates are necessary.*

4. Monitor the air flow and pressure. Increase the engine speed if necessary to supply the needed air volume.
5. Monitor the booster tank temperature during prolonged operation from the tank only.

   REMEMBER: The air compressor lubrication system is water cooled by the main water pump. If water is continually circulated back to the tank, cooling water will be warmed.
6. Monitor the compressor temperature. The normal operating temperature is 170° F–185° F. If the compressor temperature rises above the normal operating temperature to 212° F, the Commander display will flash 'COMP HOT'. If the temperature warning is indicated, shut down the compressor as soon as practical. If the air end temperature continues to rise to 240° F, the compressor will be automatically disengaged. Check for adequate water flow through the heat exchanger. Check for adequate oil level in the separator tank.

   Important reminder: The air compressor can be disengaged (shifted out of gear) at any time if the need arises.

NOTICE

Never engage the air compressor when the pump input shaft speed is greater the 900 rpm. Only engage the air compressor when the pump input shaft speed is less than 900 rpm.

Usable Hose and Flow Rate Combinations

A proportioner setting of 0.3% is usually adequate for making compressed air foam in hose lines. Setting the proportioner for a lesser percentage will yield "wetter" appearing foam. Setting the proportioner to a higher percentage will yield "drier" appearing foam. Setting the proportioner too low (below 0.2%) may result in pulsation (water slugs) in the hose. This is due to not having enough concentrate in the solution to form foam in the hose.

Much has been made over the ability of compressed air systems to create foam of shaving cream consistency. This foam is very stable and possesses a long drain time. However, the firefighter must make sure that this type of foam will release enough water to suppress fire if it is used in a direct attack. This "shaving cream" foam usually is only suited to defensive operations involving barrier of fuel pre-treatment operations.

⚠ WARNING

Sudden Movement Hazard: Always have the hose nozzle operators brace themselves when using Compressed Air Foam System (CAFS) as if they were opening a nozzle on a high-pressure water line. The initial reaction force of opening the hose nozzle is much greater than the normal operating force. The force on the operator will drop off quickly, becoming much easier to handle than a typical water line. Be sure to:

1. Open and close the valves slowly.
2. Do not run with just air/water.
3. Shut off the air when the foam tank is empty.
4. Be prepared for high reactions; open the nozzle slowly.

Observe the following:

- Do not exceed system rated pressure, capacity or speed.
- Follow local regulations on the use of hearing protection.
- Use only hoses with pressure rating higher than their intended use.
- Remove all pressure from the hoses before disconnecting.
- Shut down and depressurize completely before attempting maintenance.

Hose Lays

Hose Diameter	Water GPM	Air CFM	Tip	Pressure	Hose Length
1 in.	20	20	3/4 in.	125–150	>200 ft
1 in.	15	15	1/2 in.	125–150	>400 ft
1-1/2 in.	30–40	30–40	1 in.	110–150	>800 ft
1-1/2 in.	50–60	50–60	1-1/4 in.	110–150	>400 ft
1-3/4 in.	30–40	30–40	1 in.	110–150	>1,400 ft
1-3/4 in.	50–60	50–60	1-1/4 in.	110–150	>700 ft

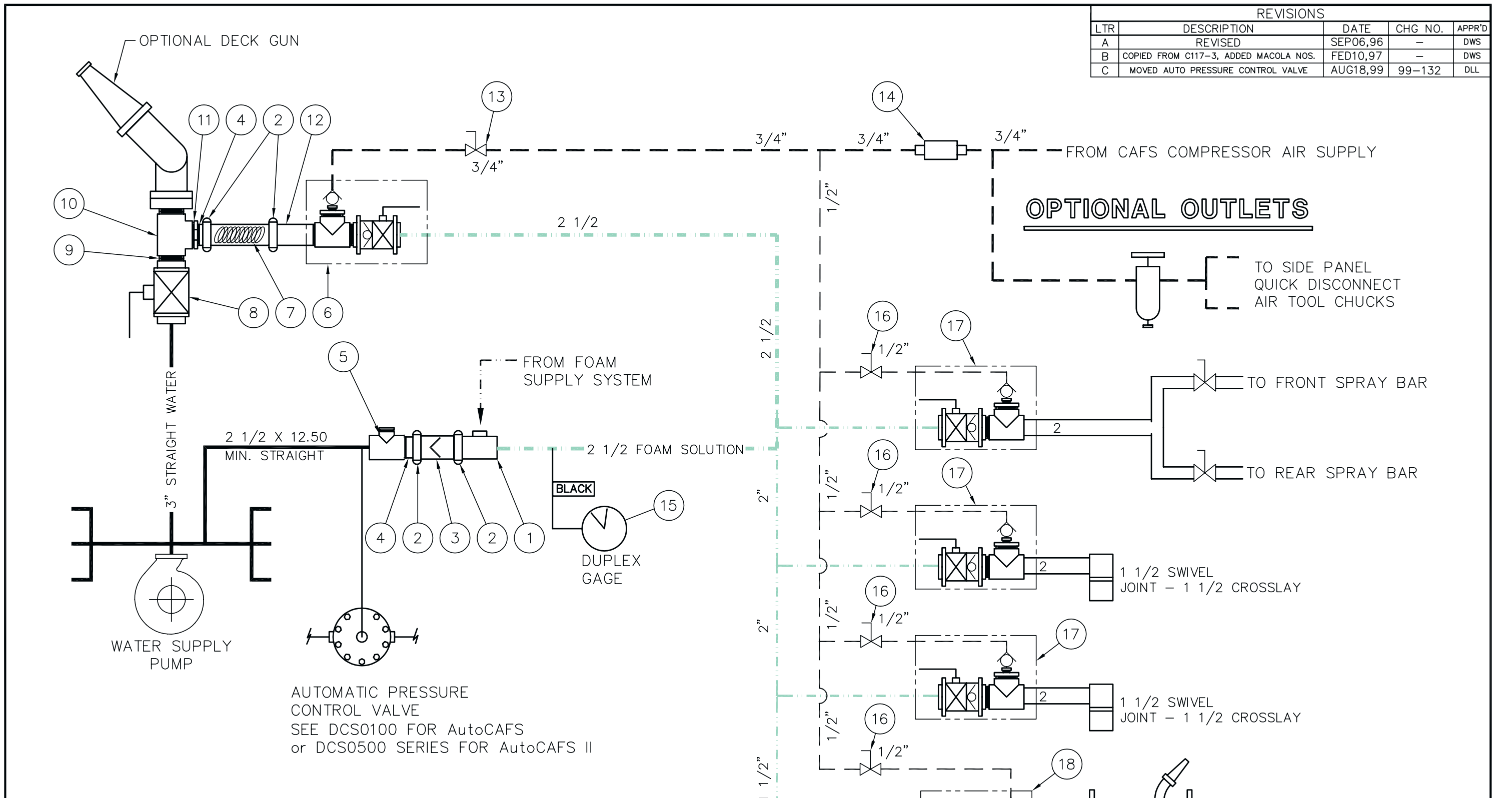
On short hose lays (less than 200 ft) of 1-3/4 in. hose, the operator may establish flows of up to 70 gpm water and 60 cfm air. This is a very effective initial attack flow for structural fires.

The figures above are based on making mid-range foam in terms of “wetness” and drain time. Using a smaller tip will yield wetter foam with some increase in reach. Using a larger tip will yield drier foam with an accompanying decrease in reach.

The foam concentrates designed for use on class B fires will work well with a compressed air foam system. The primary benefit of compressed air over nozzle aspiration lies in the extended drain times that compressed air foams exhibit and the increased discharge distance.

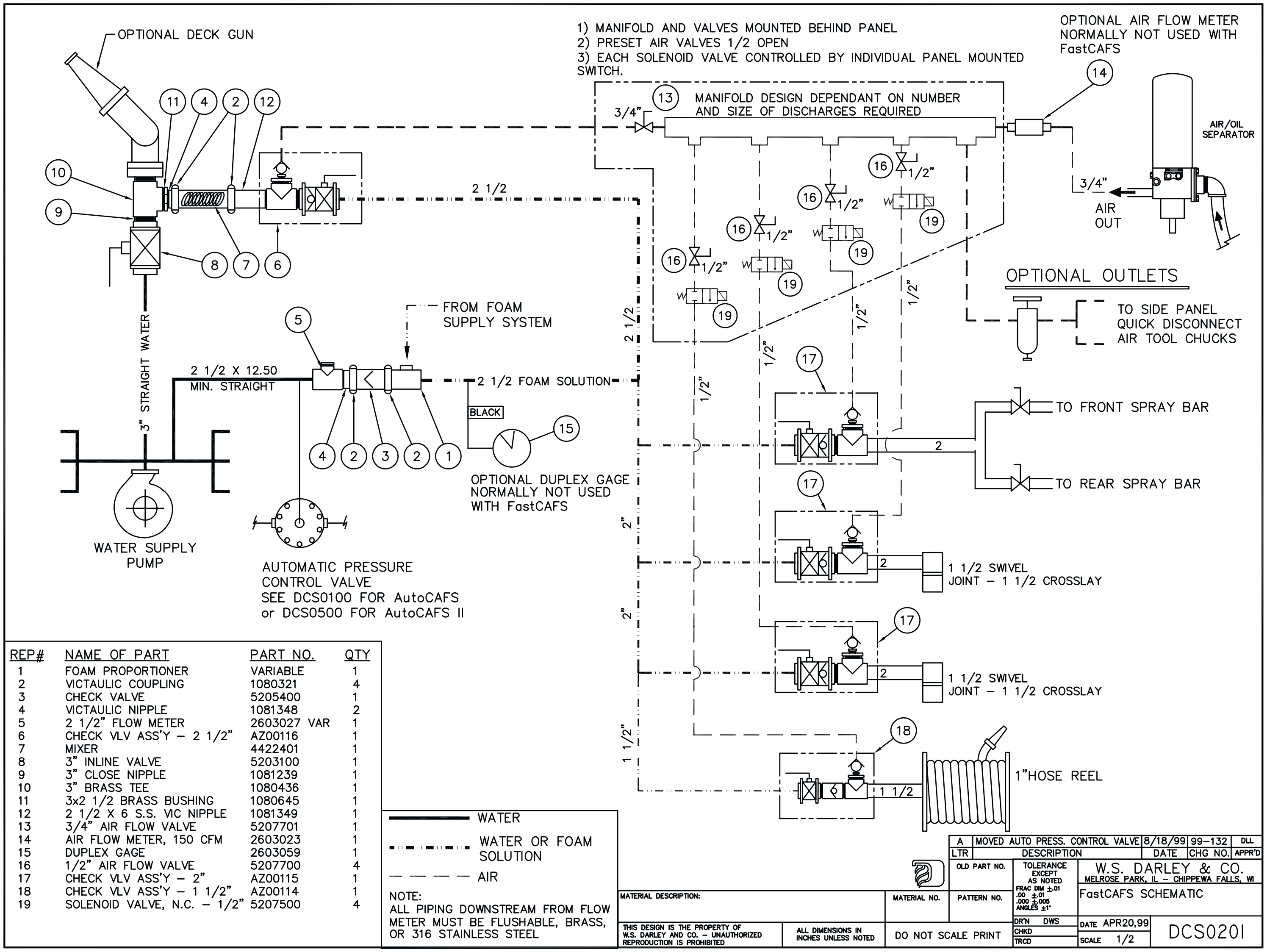
The drain time is usually measured as a “quarter drain” time. This is the time that it takes for foam to have 25% of the water drain from the bubble structure. Some aspirated foams have a quarter drain time as fast as 2 min. Compressed air foam made with the same concentrate ratio may have a quarter drain time of up to 15 min. A long quarter drain time is very important on incidents involving un-ignited fuel, where water runoff from tactical operations is a problem.

A long quarter drain time is also desirable during many operations involving class A foam. Defensive operations involving exposure protection of fire line construction are two primary tactics that utilize the long quarter drain time of compressed air foam. The long quarter drain time allows the firefighter to position water on the subject fuel for an extended period of time. This characteristic coupled with the active fuel-wetting characteristic of class A foam makes a very good fire barrier.

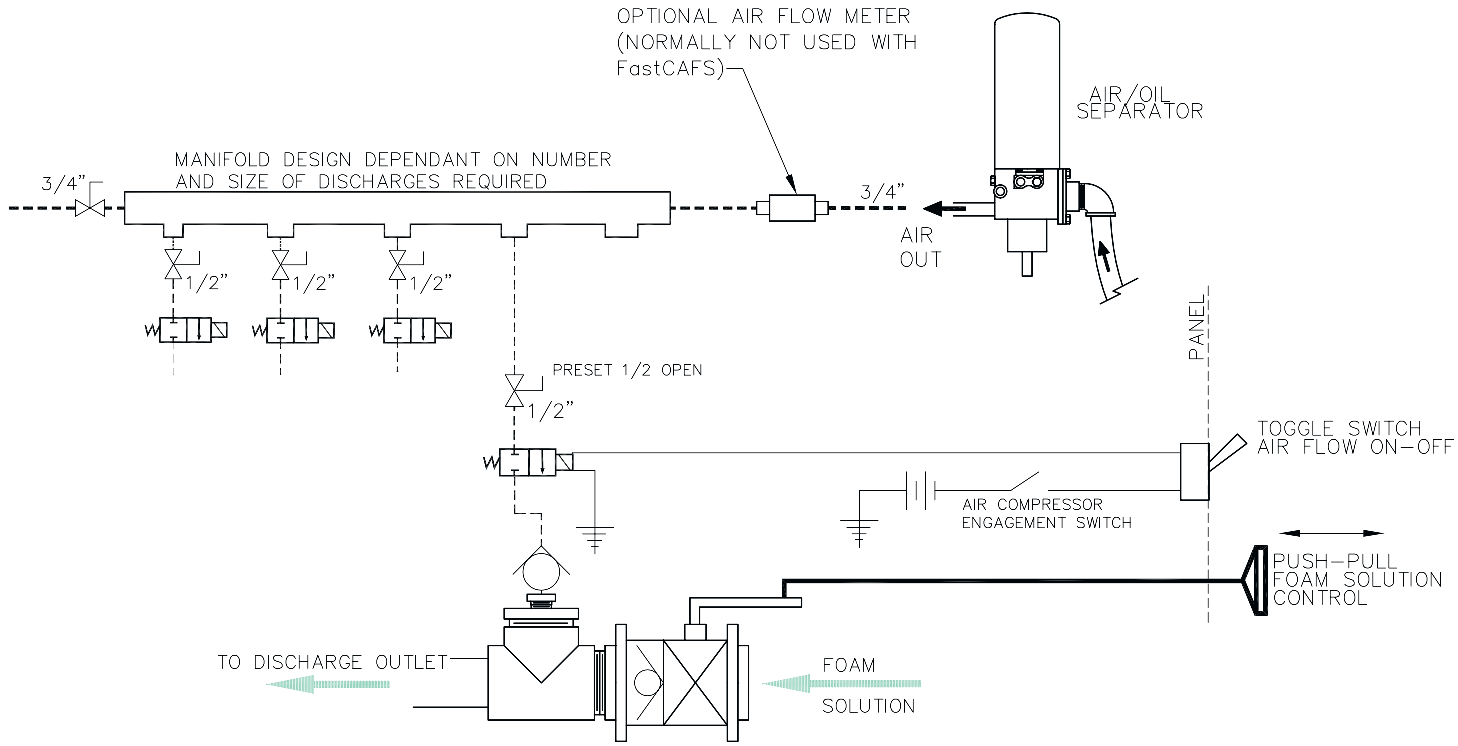


REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
A	REVISED	SEP06,96	–	DWS
B	COPIED FROM C117-3, ADDED MACOLA NOS.	FED10,97	–	DWS
C	MOVED AUTO PRESSURE CONTROL VALVE	AUG18,99	99-132	DLL

REP#	NAME OF PART	PART NO.	QTY
1	FOAM PROPORTIONER	VARIABLE	1
2	VICTAULIC COUPLING	1080321	4
3	CHECK VALVE	5205400	1
4	VICTAULIC NIPPLE	1081348	2
5	2 1/2" FLOW METER	2603027 VAR	1
6	CHECK VLV ASS'Y – 2 1/2"	AZ00116	1
7	MIXER	4422401	1
8	3" INLINE VALVE	5203100	1
9	3" CLOSE NIPPLE	1081239	1
10	3" BRASS TEE	1080436	1
11	3x2 1/2 BRASS BUSHING	1080645	1
12	2 1/2 X 6 S.S. VIC NIPPLE	1081349	1
13	3/4" AIR FLOW VALVE ASS'Y	AZ00111	1
14	AIR FLOW METER, 150 CFM	2603023	1
15	DUPLEX GAGE	2603059	1
16	1/2" AIR FLOW VALVE ASS'Y	AZ00110	4
17	CHECK VLV ASS'Y – 2"	AZ00115	1
18	CHECK VLV ASS'Y – 1 1/2"	AZ00114	1



REP#	NAME OF PART	PART NO.	QTY
1	FOAM PROPORTIONER	VARIABLE	1
2	VICTAULIC COUPLING	1080321	4
3	CHECK VALVE	5205400	1
4	VICTAULIC NIPPLE	1081348	2
5	2 1/2" FLOW METER	2603027 VAR	1
6	CHECK VLV ASS'Y – 2 1/2"	AZ00116	1
7	MIXER	4422401	1
8	3" INLINE VALVE	5203100	1
9	3" CLOSE NIPPLE	1081239	1
10	3" BRASS TEE	1080436	1
11	3x2 1/2 BRASS BUSHING	1080645	1
12	2 1/2 X 6 S.S. VIC NIPPLE	1081349	1
13	3/4" AIR FLOW VALVE	5207701	1
14	AIR FLOW METER, 150 CFM	2603023	1
15	DUPLEX GAGE	2603059	1
16	1/2" AIR FLOW VALVE	5207700	4
17	CHECK VLV ASS'Y – 2"	AZ00115	1
18	CHECK VLV ASS'Y – 1 1/2"	AZ00114	1
19	SOLENOID VALVE, N.C. – 1/2"	5207500	4



1) MANIFOLD AND VALVES MOUNTED BEHIND PANEL
2) PRESET AIR VALVES 1/2 OPEN
3) EACH SOLENOID VALVE CONTROLLED BY INDIVIDUAL PANEL MOUNTED SWITCH
4) AIR PRESSURE CONTROL VALVE SYSTEM IS MOUNTED BEHIND PANEL PRESET TO DESIRED OPERATING PRESSURE

INCH
[MILLIMETER]

THIRD ANGLE PROJECTION

OLD PART NO. —

TOLERANCE
EXCEPT AS NOTED
.00 ±.03
.000 ±.010
ANGLES ±1°

W.S. DARLEY & Co.
MELROSE PARK, IL – CHIPPEWA FALLS, WI

MATERIAL DESCRIPTION: —

MATERIAL NO. —

PATTERN NO. —

INSTR – FastCAFS ASSEMBLY
—

DR'N DWS
CHKD —
TRCD

DATE APR20,99
SCALE 1/16

1205510

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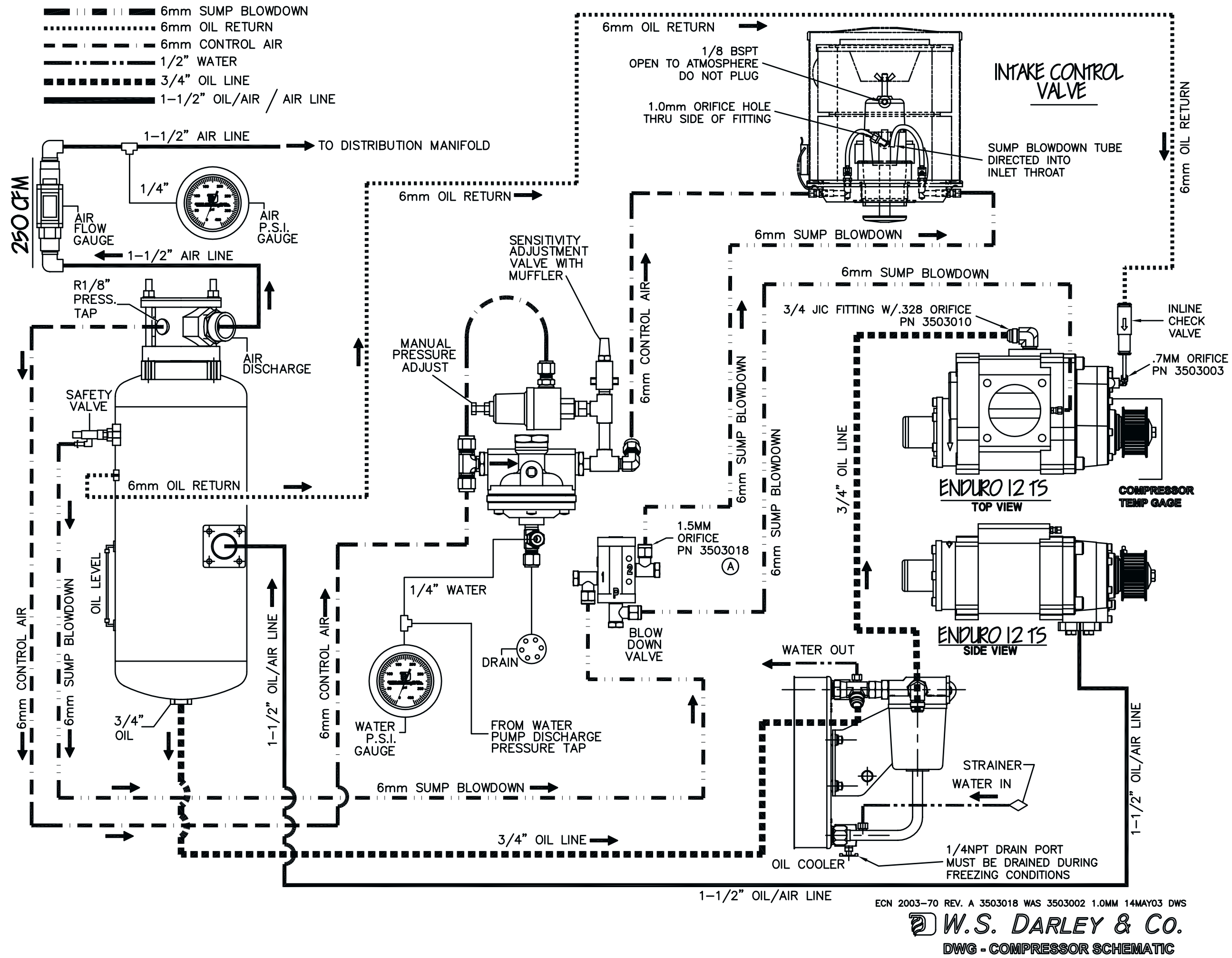
ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

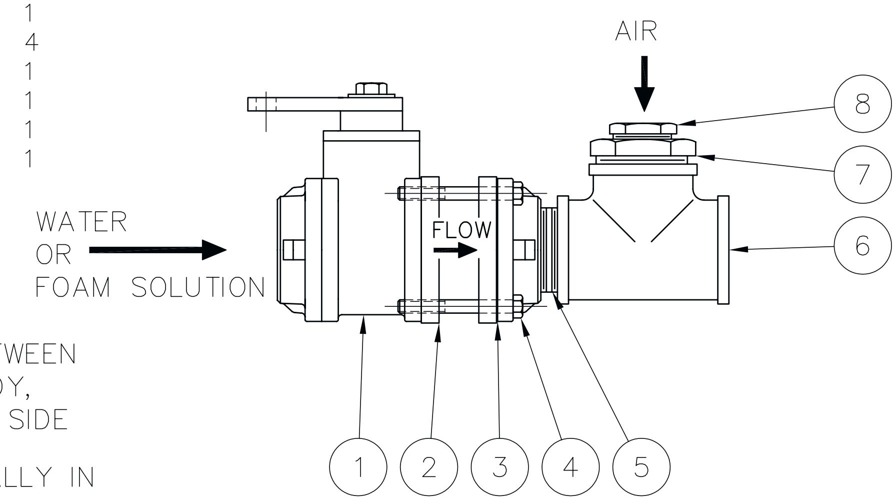


E 12 TS COMPRESSOR SCHEMATIC

REP#	NAME OF PART	QTY
1	BALL VALVE	1
2	CHECK VALVE	1
3	GASKET	1
4	HEX HD CAP SCREW	4
5	CLOSE NIPPLE	1
6	TEE	1
7	BUSHING	1
8	CHECK VALVE	1

REVISIONS

LTR	DESCRIPTION	DATE	CHG NO.	APPR'D



NOTES:

POSITION CHECK VALVE #2 BETWEEN VALVE FLANGE AND VALVE BODY, INCLUDING GASKET ON FLANGE SIDE

TIGHTEN #4 CAP SCREWS EQUALLY IN A CROSSING PATTERN
TORQUE TO 25–30 FT.LBS.

DO NOT MOUNT AT AN ATTITUDE THAT WILL TRAP WATER ABOVE CHECK VALVE #2

PROVIDE DRAIN TAPS WHERE REQUIRED

REF. AZ00115
AZ00116

OLD NO. C152

TOLERANCE EXCEPT AS NOTED
FRAC DIM ±.01
.00 ±.01
.000 ±.005
ANGLES ±1°

W.S. DARLEY & CO.
MELROSE PARK, IL – CHIPPEWA FALLS, WI

2" & 2 1/2" CHECK VALVE ASSEMBLY

MATERIAL DESCRIPTION:

MATERIAL NO.

PATTERN NO.

DR'N DWS
CHKD
TRCD

DATE MAR10,94
SCALE 1/4

DCM0301

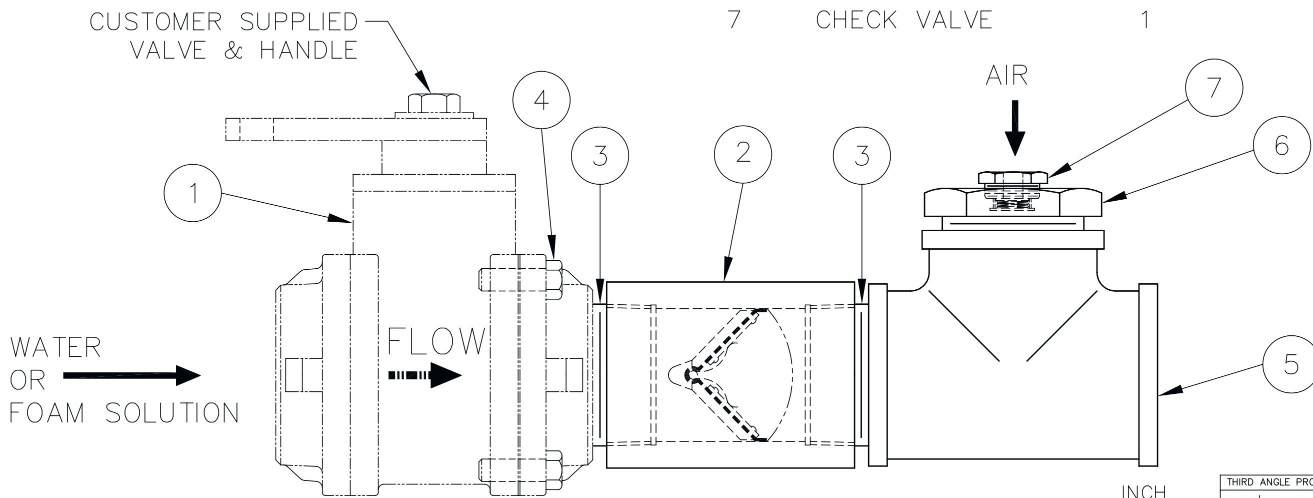
ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D

NOTES:
1) POSITION CHECK VALVE #2 BETWEEN VALVE FLANGE AND TEE.
2) TIGHTEN #4 CAP SCREWS EQUALLY IN A CROSSING PATTERN TORQUE TO 25–30 FT.LBS.
3) DO NOT MOUNT AT AN ATTITUDE THAT WILL TRAP WATER ABOVE CHECK VALVE #2
4) PROVIDE DRAIN TAPS WHERE REQUIRED

REP#	NAME OF PART	QTY
1	BALL VALVE	1
2	CHECK VALVE	1
3	CLOSE NIPPLE	2
4	HEX HD CAP SCREW	4
5	PIPE TEE	1
6	BUSHING	1
7	CHECK VALVE	1



INCH [MILLIMETER]

THIRD ANGLE PROJECTION

REF. – AZ00128

MATERIAL DESCRIPTION: –	MATERIAL NO. –	PATTERN NO. –
OLD PART NO. –		
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. – UNAUTHORIZED REPRODUCTION IS PROHIBITED	ALL DIMENSIONS IN INCHES UNLESS NOTED	DO NOT SCALE PRINT

TOLERANCE EXCEPT AS NOTED
.00 ±.03
.000 ±.010
ANGLES ±1°

DR'N	DLL
CHKD	DWS
TRCD	

W.S. DARLEY & Co.
MELROSE PARK, IL – CHIPPEWA FALLS, WI

4" CHECK VALVE ASSEMBLY
–

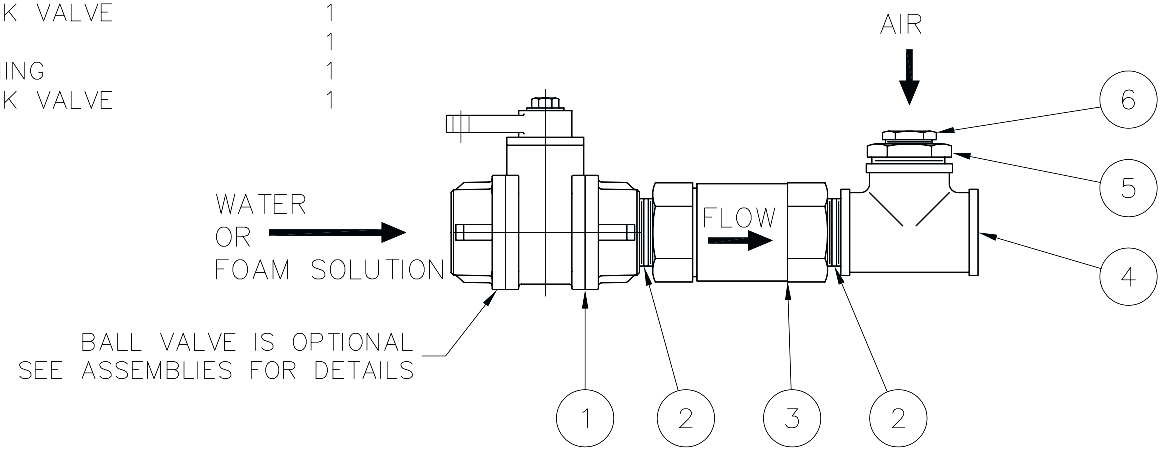
DATE 2/12/99
SCALE 1/4

DCM0302

Darley

REP#	NAME OF PART	QTY
1	BALL VALVE	1
2	CLOSE NIPPLE	2
3	CHECK VALVE	1
4	TEE	1
5	BUSHING	1
6	CHECK VALVE	1

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D



NOTES:

DO NOT MOUNT IN AN ATITUDE THAT WILL TRAP WATER ABOVE CHECK VAIVE #3

PROVIDE DRAIN TAPS WHERE REQUIRED

BALL VALVE, CHECK VALVE, AND AIR INLET TEE CAN BE MOUNTED AT ANY DISTANCE RELATIVE TO EACH OTHER AS LONG AS CHECK VALVE IS INSTALLED TO ELIMINATE AIR FEEDBACK INTO WATER/SOLUTION LINE

REF. AZ00114

OLD NO. C151	TOLERANCE EXCEPT AS NOTED FRAC DIM ±.01 .00 ±.01 .000 ±.005 ANGLES ±1°	W.S. DARLEY & CO. MELROSE PARK, IL – CHIPPEWA FALLS, WI
MATERIAL DESCRIPTION:	MATERIAL NO.	PATTERN NO.
		1 1/2" CHECK VALVE ASSEMBLY
DR'N DWS	DATE MAR10,94	DCM0300
CHKD	SCALE 1/4	
TRCD		

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

AutoCAFS II Troubleshooting Guide

Symptom	Possible Causes	Corrective Action
Air compressor will not engage	Pump input RPM is too fast	Reduce throttle setting
	Separator tank pressurized	Allow time for blow-down Check blow-down valve and pressure sensor switch
	Circuit breaker/fuse open	Reset; diagnose and correct cause
	Faulty/loose control connections	Inspect and repair
	Compressor over heated	Find cause and correct
	Clutch coil failure	Replace clutch
	AutoCAFS Commander failure	Replace
Air compressor will not make any air pressure or air pressure is too low	Air compressor is not engaged	Engage air compressor using proper shifting procedures
	Air compressor pressure limiting valve set too low	Adjust pressure setting; raise the air pressure (red needle) to 150 psi
	RPM of engine too low to support the flow of air being discharged	Increase engine RPM; relief valve may need to be used to hold pump pressure within range
Air pressure too low to run air tools from idle through 1,200 rpm range	Independent air tool regulator set too low	Raise regulator pressure by pulling up on knob and turning clockwise
	Pump RPM too low, water/air pressure low	Increase engine RPM
CAFS over-speed indicated 'HI RPM'	Engine RPM too fast	Reduce throttle setting to normal operating speed

Symptom	Possible Causes	Corrective Action
Compressor over-heating 'COMP HOT'	Oil temperature has exceeded the recommended maximum operating temperature of approximately 212° F	Disengage air compressor; if fire-fighting, return to conventional water or foam solution fire-fighting practices
	Water pump has not been circulating water and has over-heated	Circulate fresh water through the water pump so that the heat exchanger receives cool water flow through it to cool the oil
	Oil/water heat exchanger has water supply blocked; either the supply line, return line, or the heat exchanger body has a blockage	Remove the water return line on the suction side of the pump, try to locate the source of the blockage, remove obstruction
	Thermo-valve in oil filter mounting block has failed or has become obstructed	Remove obstruction from thermo-valve or replace oil filter mounting block/thermo-valve housing WSD # 4420902
	Oil level low	Add oil
	Oil filter blocked	Replace
Transmission high temp shutdown 'TRANS HOT'	Pump transmission lubricant level incorrect	Inspect and correct
	Pump transmission bearing failure	Rebuild transmission
	Compressor clutch slipping • Clutch voltage low, must be 12 VDC ±10% • Clutch disc contamination • Clutch disc wear	• Check voltage and correct • Inspect and clean clutch discs • Replace clutch discs
	Compressor clutch dragging when disengaged	Inspect and replace clutch disc springs
Compressor automatically disengages	Compressor over-heated above 240° F	See above
	Input RPM too fast	Disengage compressor switch • Reduce throttle setting to idle • Wait 1 min for system blow-down • Engage compressor switch
	Transmission over-heated	See above

Symptom	Possible Causes	Corrective Action
Air pressure continually rises and cannot be controlled without opening an air flow valve to dump excess pressure	Check for loose connection in 1/4 in. air pressure control line to the air inlet valve	Tighten all hose fittings and air pressure control line connections
	Plugged control line or orifice	Clean lines and orifices NOTE: Lowering control pressure into inlet valve will result in air compressor building pressure
Hose line is erratic, jumping all over, hard to hang onto the line	Condition known as "slug flow" created by lack of foam solution or too low of %; water and air do not mix without foam added	Eliminate air flow in line until foam concentrate can be introduced at the proper rate of 0.3%. Some foam concentrates may require special consideration or attention. (i.e., higher %)
Foam is too dry, can't soak into anything or absorb much heat	Ratio of air to water is too high or a very long hose line is being used	Increase water flow or decrease air flow, or slightly close nozzle
	Foam percentage is too high	Lower the percentage using the gray down arrow button
Foam is too wet and runny, not making shaving cream type foam	Ratio of water to air is too high	Reduce water flow/increase air flow
	Foam percentage is too low	Be sure proportioner is set at least 0.3% and use good foam
	Incorrect nozzle on hose line, fog nozzles break up bubbles	Nozzle must be full flow with a large smooth bore tip
	Kink in hose or too short of run of hose (100 ft minimum)	Straighten out kink in hose or add lengths to the hose line
Insufficient air output	Air filter dirty	Replace
	Oil separator blocked	Replace
	Intake valve faulty	Inspect and repair
	Manual pressure valve faulty or incorrectly set	Inspect and reset
	Faulty balance valve	Inspect, clean, repair
	RPM is too low	Increase RPM
Receiver tank safety valve blows at 200 psi Valve blows at less than 200 psi	Air pressure control valve is set too high	Adjust control valve *(see Air Compressor System Components, Operation, Maintenance on page 80)*
	Safety valve is defective	Replace safety valve

Symptom	Possible Causes	Corrective Action
Oil consumption high Oil is coming out of hand lines/air tool chucks	Oil level in hydraulic oil reservoir tank is too high	Check and adjust oil level with compressor off
	Oil/air separator cartridge has become clogged or defective	Replace separator cartridge
	Too much condensation in the oil	Inspect oil, drain and replace
	Oil return line or orifice clogged	Clean
	Wrong type oil	Drain all components and hoses, replace oil with correct type
	Oil leak	Repair
Air compressor surges, which raises and lowers RPM, pressure, and also cfm flow of air	While air is flowing, the air inlet modulator valve opens and closes to keep air pressure win the proper range. This is most noticeable in the 20–80 cfm range.	This is a normal and required occurrence. The surging should be at a rate fast enough to keep air pressure from falling too low. Adjustment to the surge cycle can be accomplished by turning the needle valve on the pressure control assembly.
Compressor drive overloaded at start-up (system still pressurized at start-up)	System blow-down has not been completed	Allow at least 1 minute from shutdown to start-up for system blow-down
	Faulty blow-down valve	Replace
	Faulty separator tank pressure-sensing valve	Replace
	Intake valve leaking or open	Inspect and repair

FOAM PROPORTIONER SECTION

Symptom	Possible Causes	Corrective Action
Foam pump runs but produces no foam flow	Foam pump is not primed	See foam pump priming (page 20 in FoamPro manual)
Foam pump loses prime, makes a chattering noise	Air leak in suction hose or fittings	Fix leaks
	Suction line is blocked or kinked	Remove suction hose and check for loose lining. Inspect for blockage or remove kinks.
	Clogged suction strainer	Clean strainer

Symptom	Possible Causes	Corrective Action
No characters in the digital display	The main power switch on the motor is not turned on	Turn on power toggle switch
	Cables are defective or installed improperly	Inspect cables and secure connections or replace if defective
System is powered up and the foam on/off switch has been pressed, but the foam pump will not run	No water is flowing in any of the foam discharges	Flow water out a desired foam discharge
	Flow meter is obstructed or defective	Remove obstruction or replace flow meter
	Foam tank level sensor is sending low foam level signal	Fill foam tank if low or repair level sensor if it is incorrectly operating
	Control cable is defective	Check connections or replace cable
LO. CON appears in the digital display	Foam concentrate level in tank is low	Refill concentrate tank with the proper foam type
	Low level tank sensor is incorrectly sensing low level	Repair or replace level sensor
NO. CON appears in the digital display This automatically happens 2 min after LO.CON appears in display	Foam concentrate level in tank is empty	Refill concentrate tank with the proper foam type
	Tank level sensor is incorrectly sensing empty tank level	Repair or replace level sensor
Foam pump runs full speed when main power circuit is turned on	Poor ground either to motor driver or mounting bracket	Make sure screws are tight and that good ground is maintained
	Bad motor driver box	Replace motor driver box
Display shows a ?	Flow meter is sensing water flow, but the rate is too low for precise proportioning	This is common at start-up and shutdown of water flow. Check flow meter or flow more water.
System returns to standby mode or HYPRO appears in display momentarily while pumping	Insufficient power supply	Inspect and correct power and ground connections and wiring
	Current resistance in wiring circuits	Make sure a minimum 8 AWG wire is used to install to battery

Class A Foam References

The National Wildfire Coordinating Group (NWCG) has sponsored the publication of the following items produced by the NWCG Working Teams. Copies of each of these items may be ordered from the National Interagency Fire Center (NIFC). To order, mail or fax a purchase order or requisition to:

National Interagency Fire Center
ATTN.: Supply
3905 Vista Avenue
Boise, Idaho 83705

FAX 208-387-5573

Orders must be from agencies or organizations, not private individuals. Use the "NFES" number for the item(s) you are ordering. Do not send money, checks, or money orders with the order. Phone orders are not accepted. You will be billed the cost of the item(s) after the items are sent. Orders from other than Federal wild land fire agencies or State land protection agencies will receive an 18% surcharge on the bill. Transportation charge, other than mail, will also appear on the bill. Questions regarding ordering procedures can be addressed to the NIFC Supply Office, 208-387-5542. Questions regarding billing procedures can be addressed to NIFC Finance Office, 208-387-5533.

PLEASE NOTE THAT THE NIFC FIRE CACHE PERFORMS INVENTORY DURING THE MONTH OF JANUARY. ORDERS ARE NOT PROCESSED DURING INVENTORY. ORDERS RECEIVED DURING THIS INVENTORY PERIOD ARE DATE STAMPED AND PROCESSED IN THE ORDER THEY WERE RECEIVED.

ESTIMATED PRICES ARE SHOWN FOR SOME OF THE ITEMS. ACTUAL PRICES WILL NOT BE KNOWN UNTIL ITEMS HAVE BEEN RECEIVED. ACTUAL COSTS WILL BE CHARGED WHEN FILLING ORDERS.

PLEASE INSURE THAT ALL ORDERS HAVE CORRECT NFES #s FOR THE ITEMS BEING ORDERED.

INTRODUCTION TO CLASS A FOAM, 1989

13:00 minute videotape, VHS size only

NFES 2073

First of a videotape series dealing with foam use. This tape is a brief introduction to class A Foam technology covering foam chemistry, foam-generating equipment, and examples of foam application. PMS 445-1.

THE PROPERTIES OF FOAM, 1993

15:00 minute videotape, VHS size only

NFES 2219

Second in a videotape series about class A foam. Explains how class A foam enhances the abilities of water to extinguish fire and to prevent fuel ignition. Basic foam concepts including drain time, expansion, and foam type are explained. This revised 1993 version differs from the original1992 videotape only in the way "foam types" are categorized. The original 1992 version described foam types as "foam solution, fluid, dripping and dry." The 1993 revision of the video describes foam types as "foam solution, wet, fluid and dry." PMS 445-2.

CLASS A FOAM PROPORTIONERS, 1992

23:10 minute videotape, VHS size only

NFES 2245

Third in a videotape series about class A foam. Explains how common foam proportioner devices, which add a measured amount of foam concentrate to a known volume of water, work. Advantages and disadvantages are presented. PMS 445-3.

ASPIRATING NOZZLES, 1992

10:13 minute videotape, VHS size only

NFES 2272

Fourth in a videotape series about class A foam, the difference between low and medium expansion nozzles, and appropriate uses for each nozzle. PMS 445-4

COMPRESSED AIR FOAM SYSTEMS, 1993

20:00 minute videotape, VHS size only

NFES 2161

Fifth in a videotape series about class A foam. Describes equipment, including water pumps, air compressors, drive mechanisms, and nozzles, used to generate compressed air foam. Presents rules of thumb for simple and reliable foam productions. Explains procedures for safe operation. Compares compressed air foam to air-aspirated foam. Presents advantages and disadvantages of the system.

FOAM VS. FIRE, PRIMER, 1992

NFES 2270

This 9-page publication covers the basics of using class A foams and discusses their adaptability to present application equipment. First is a series of three “Foam vs. Fire” publications. PMS 446-2.

FOAM VS. FIRE, CLASS A FOAM FOR WILD LAND FIRES, 1993

NFES 2246

This 28-page publication explains how to get the most fire-fighting punch from water by converting water to class A foam. Discusses how and why foam works. Explains drain time, expansion ratio, foam type, proportioning, aspirating nozzles and compressed air foam systems. Also discusses application for direct attack, indirect attack, mop-up, structure protection, and safety considerations. Slightly revised from 1992 edition to clarify foam types and descriptions. Second in a series of three “Foam vs. Fire” publications. PMS 446-1.

For those who would like a list of training materials and other publications available from NIFC, please order:

NFES 3362 1994 NWCG NFES Publications Catalog
(Available April 1, 1994)

Foam Manifold Configuration and Price Guide

Including Darley AutoCAFS AIR (Air Injection Regulator)
Air distribution manifold assembly

INTRODUCTION

The Darley CAFS manifold system is a complete package offering all the components required to equip your apparatus with injection ports and check valves for foam concentrate and compressed air injection. For foam-only applications, a complete manifold assembly may be configured to include a foam concentrate back flow check valve, foam concentrate injection port, FoamPro flow meter port, and a number of 2 in. and 2-1/2 in. outlet ports. The addition of CAFS discharge valve assemblies and air discharge distribution components complete the system for compressed air foam operation. All components are integrated with a stainless steel modular piping system.

Although designed for direct mounting to the LDMBC pump, the foam manifold is readily adaptable to all CAFS installations.

In addition, a FastCAFS air distribution valve assembly is available for complete “motorized” electric valve control of individual air injection ports. This actuated electric valve provides for smooth air injection flow rate resulting in smooth, no-shock operation. The FastCAFS air distribution assembly incorporates a stainless steel manifold with 6 ports and one 12 VDC “motorized” electric valve for each CAFS discharge valve assembly. An optional air flow meter may be mounted directly to the outlet port of the oil separator tank for air flow measurement and air valve calibration. A 72 in. primary air hose is provided for connection of the distribution manifold to the air flow meter, providing flexible remote mounting in the pump compartment.

To properly configure the pump discharge extensions and the foam manifold components to best support your apparatus requirements, the following options must be specified. Primary discharge extension configuration, foam manifold orientation on the pump, manifold configuration, and number of 2 in. and 2-1/2 in. CAFS valves.

Use the following guide to configure the compressed air foam manifold to best fit your application.

To indicate desired manifold configuration, tabulate selection in the following format:

HL003 _ _ - _ - _ _

(1) (2) (3)

1. Primary Discharge Extension Assembly
2. F or R
3. Manifold option suffix 00, 01, 02

Example:

HL00301-F-01 would indicate a primary discharge head assembly with two 2-1/2 in. Darley valves on the driver side and one 2-1/2 in. Darley valve on the passenger side. The foam manifold would be mounted on the forward side of the pump and would be configured as show in drawing DCM1501. This is the OEM Standard foam manifold configuration and is represented by drawing DCM1501 as shown on *page 162*.

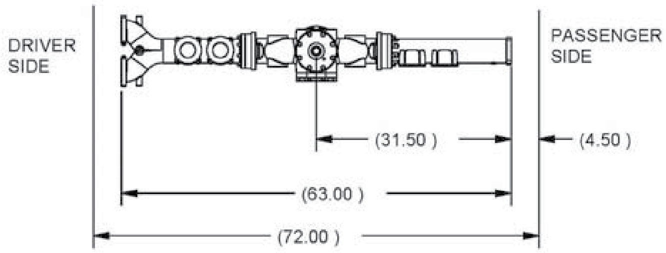
To complete the package, indicate on the option list the quantity of 2 in. and 2-1/2 in. CAFS valves required, air distribution manifold preference, and quantity of 1/2 in. air distribution valves. If a manifold opening is not required, specify quantity and size of Akron flange kit to substitute for CAFS valve assembly.

Six variations in the primary discharge extension assembly are available for attachment of the foam manifold system. Each of these assemblies is specifically designed to provide an attachment point in either the forward or rearward direction for the foam manifold while providing for the most widely used panel discharge valve configuration.

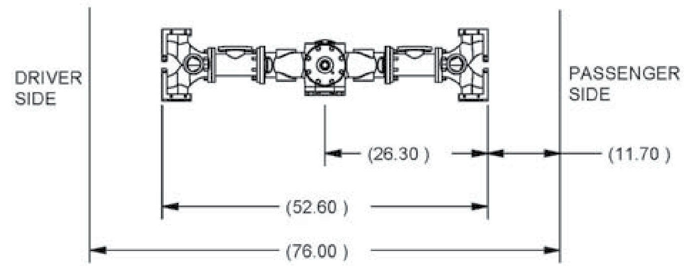
Please review the following assemblies noting the body width, type of panel discharge valve, and number of panel discharge valves. With this information as a guide, select desired HL003_ _ series Head Assembly.

DISCHARGE EXTENSION OPTIONS FOR FOAM MANIFOLD ATTACHMENT

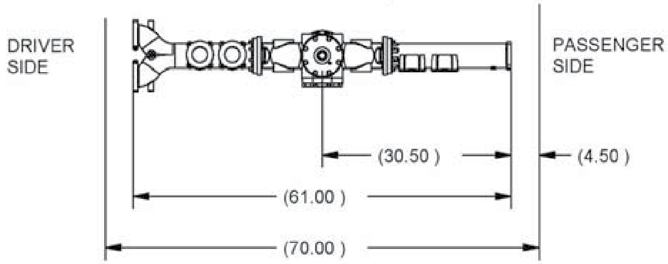
HL00301 HEAD ASSY - LDM DISCH W/EXT
CONFIG FOR 72" PANEL WIDTH, DARLEY VALVES



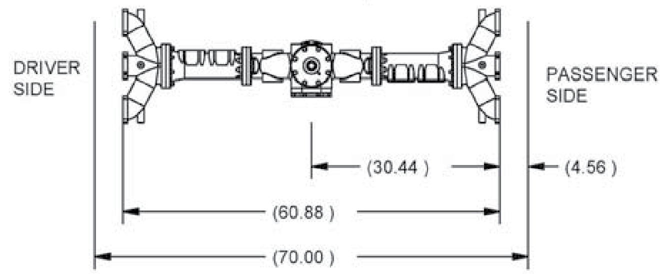
HL00303 HEAD ASSY - LDM DISCH W/EXT
CONFIG FOR 76" PANEL WIDTH, DARLEY VALVES



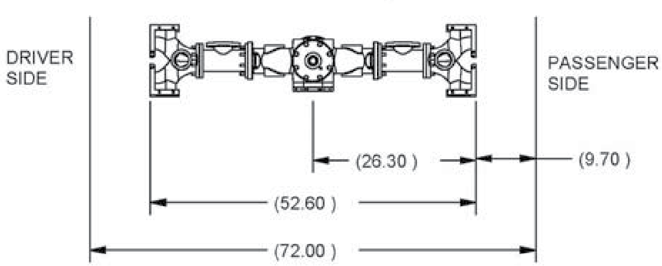
HL00302 HEAD ASSY - LDM DISCH W/EXT
CONFIG FOR 70" PANEL WIDTH, DARLEY VALVES



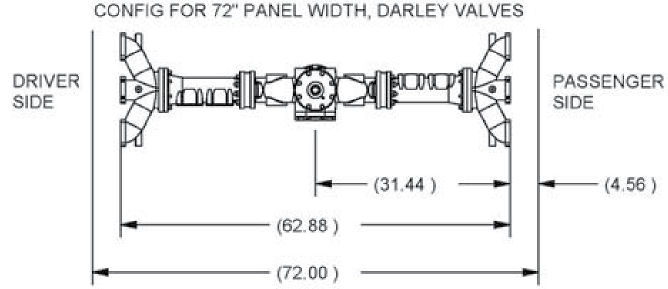
HL00304 HEAD ASSY - LDM DISCH W/EXT
CONFIG FOR 70" PANEL WIDTH, DARLEY VALVES



HL00303 HEAD ASSY - LDM DISCH W/EXT
CONFIG FOR 72" PANEL WIDTH, AKRON VALVES

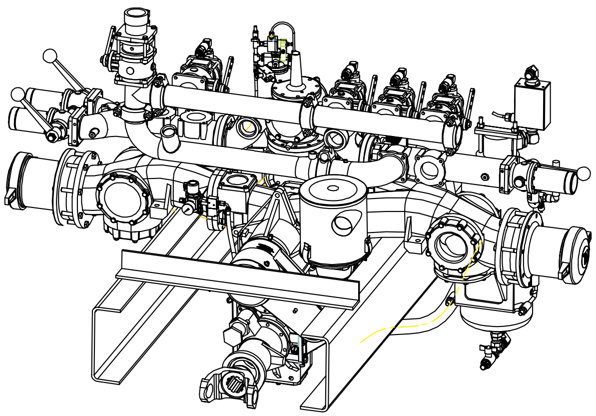


HL00305 HEAD ASSY - LDM DISCH W/EXT
CONFIG FOR 72" PANEL WIDTH, DARLEY VALVES

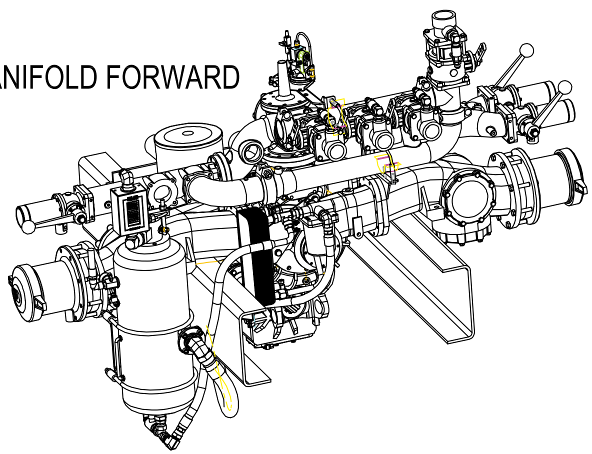


How will the manifold be located on the discharge head, forward or rear?

R MANIFOLD REAR



MANIFOLD FORWARD

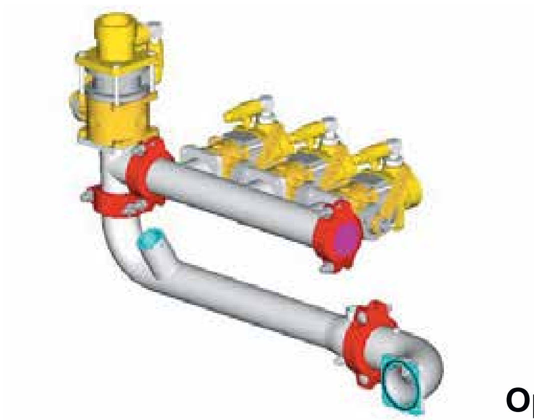


Three basic options are available for manifold configuration.

Option 00: Drawing DCM1500, (2) Flange for 2-1/2 in. CAFS Valve, (3) Flange for 2 in. CAFS Valve; Extensions may be rotated to position valves in a horizontal or vertical orientation.

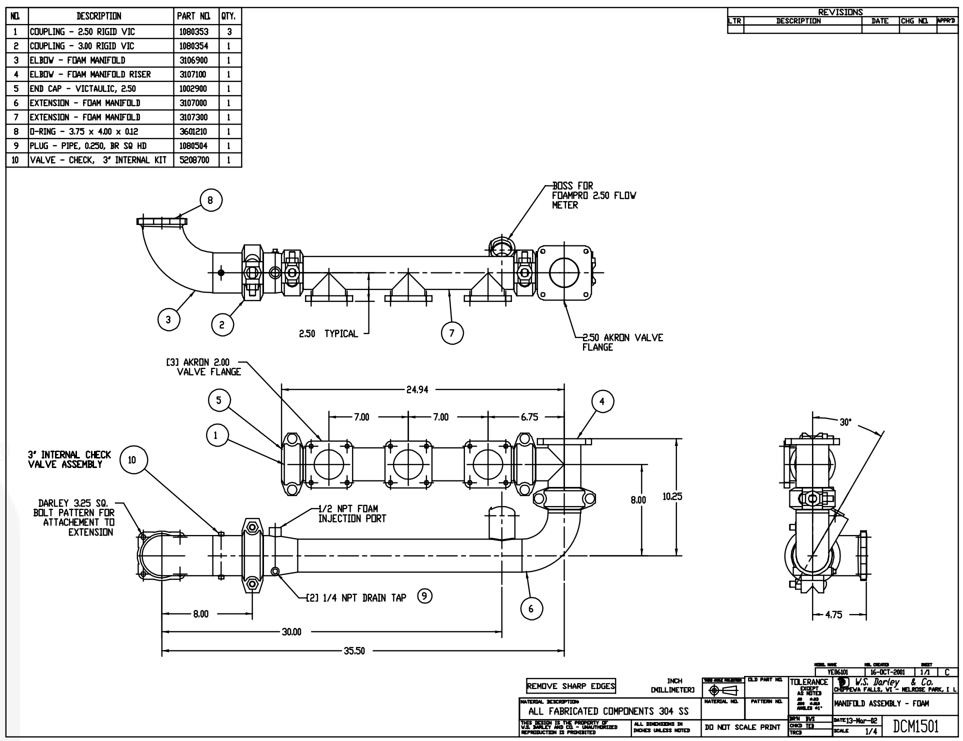
Option 01: Standard OEM Configuration – Drawing DCM1501, (1) 2-1/2 in. flange for CAFS Valve, (3) Flange for 2 in. CAFS Valve; Extensions may be rotated to position valves in a horizontal or vertical orientation. Additional (3) outlet manifold extension can be optionally added for expansion.

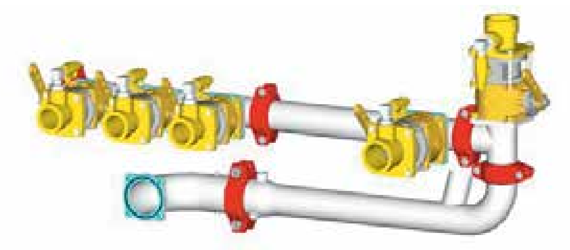
Option 02: Drawing DCM1502, (2) 2-1/2 in. Victaulic rolled groove, (3) 2 in. Victaulic rolled groove.



Option 01 - OEM Standard

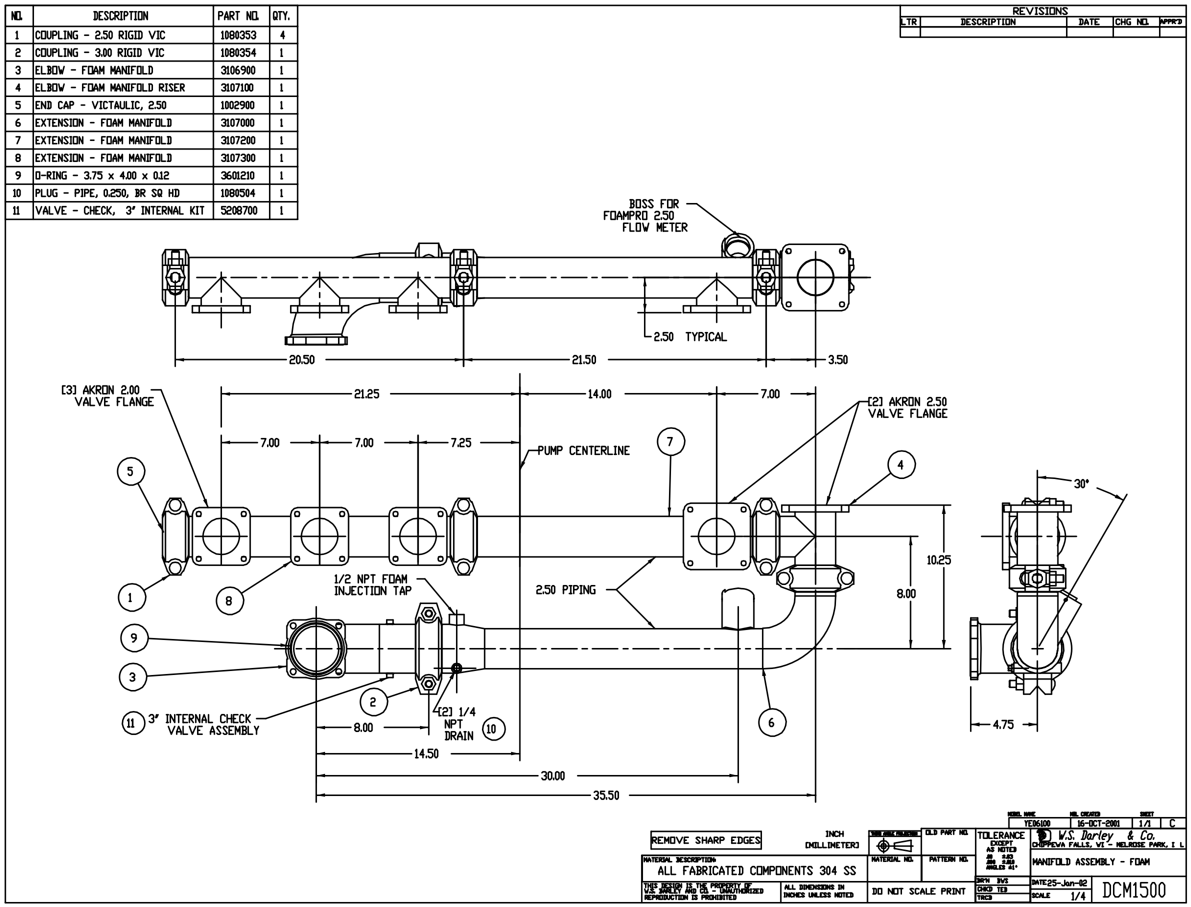
NO.	DESCRIPTION	PART NO.	QTY.
1	COUPLING - 2.50 RIGID VIC	1080353	3
2	COUPLING - 3.00 RIGID VIC	1080354	1
3	ELBOW - FOAM MANIFOLD	3106900	1
4	ELBOW - FOAM MANIFOLD RISER	3107100	1
5	END CAP - VICTAULIC, 2.50	1002900	1
6	EXTENSION - FOAM MANIFOLD	3107000	1
7	EXTENSION - FOAM MANIFOLD	3107300	1
8	O-RING - 3.75 x 4.00 x 0.12	3601210	1
9	PLUG - PIPE, 0.250, BR SQ HD	1080504	1
10	VALVE - CHECK, 3" INTERNAL KIT	5208700	1

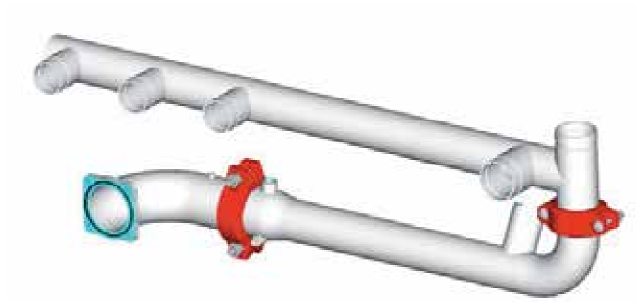




Option 00

NO.	DESCRIPTION	PART NO.	QTY.
1	COUPLING - 2.50 RIGID VIC	1080353	4
2	COUPLING - 3.00 RIGID VIC	1080354	1
3	ELBOW - FOAM MANIFOLD	3106900	1
4	ELBOW - FOAM MANIFOLD RISER	3107100	1
5	END CAP - VICTAULIC, 2.50	1002900	1
6	EXTENSION - FOAM MANIFOLD	3107000	1
7	EXTENSION - FOAM MANIFOLD	3107200	1
8	EXTENSION - FOAM MANIFOLD	3107300	1
9	O-RING - 3.75 x 4.00 x 0.12	3601210	1
10	PLUG - PIPE, 0.250, BR SQ HD	1080504	1
11	VALVE - CHECK, 3" INTERNAL KIT	5208700	1

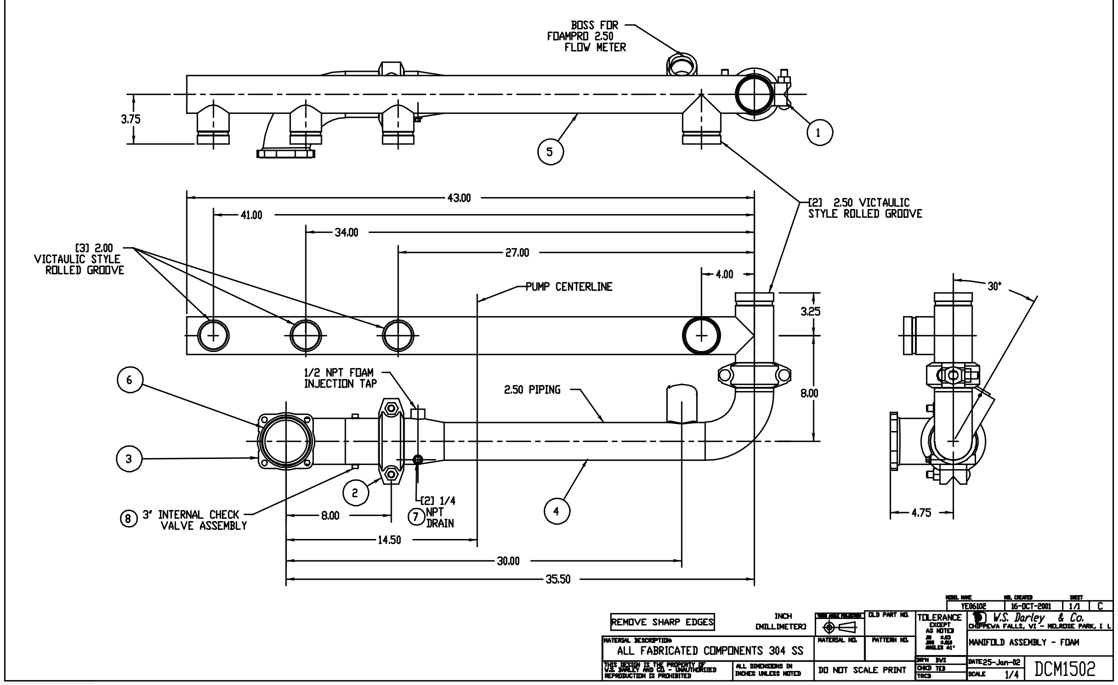




Option 02

NO.	DESCRIPTION	PART NO.	QTY.
1	COUPLING - 2.50 RIGID VIC	1080353	1
2	COUPLING - 3.00 RIGID VIC	1080354	1
3	ELBOW - FOAM MANIFOLD	3106900	1
4	EXTENSION - FOAM MANIFOLD	3107000	1
5	EXTENSION - FOAM MANIFOLD	3107500	1
6	O-RING - 3.75 x 4.00 x 0.12	3601210	1
7	PLUG - PIPE, 0.250, BR SQ HD	1080504	1
8	VALVE - CHECK, 3" INTERNAL KIT	5208700	1

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D

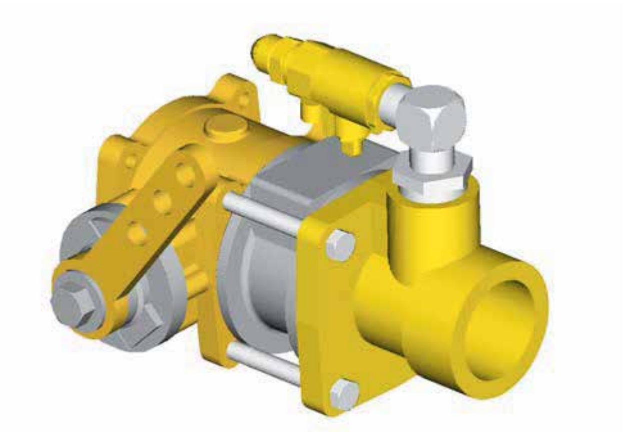


This manifold assembly would be used in applications where it is desired to run extension piping from the manifold to individual flow meters (not supplied). OEM-supplied Akron x Victaulic flange is required to attach compressed air foam system (CAFS) valve assembly to manifold.

CAFS DISCHARGE VALVE ASSEMBLIES

Darley compressed air foam system (CAFS) discharge valve assemblies incorporate a foam solution check valve, air inlet check valve, and an adjustable air inlet flow control valve. The CAFS valve assemblies are available in 2 in. and 2-1/2 in. sizes. Use a 2 in. valve assembly for crosslays and pre-connects. A 2-1/2 in. CAFS valve assembly is applicable to 2-1/2 in. discharge lines or deck guns. For dimensional information on the 2 in. valve assembly, part number AZ02500, refer to drawing DCM0303. For the 2-1/2 in. assembly, part number AZ02600, refer to drawing DCM0304.

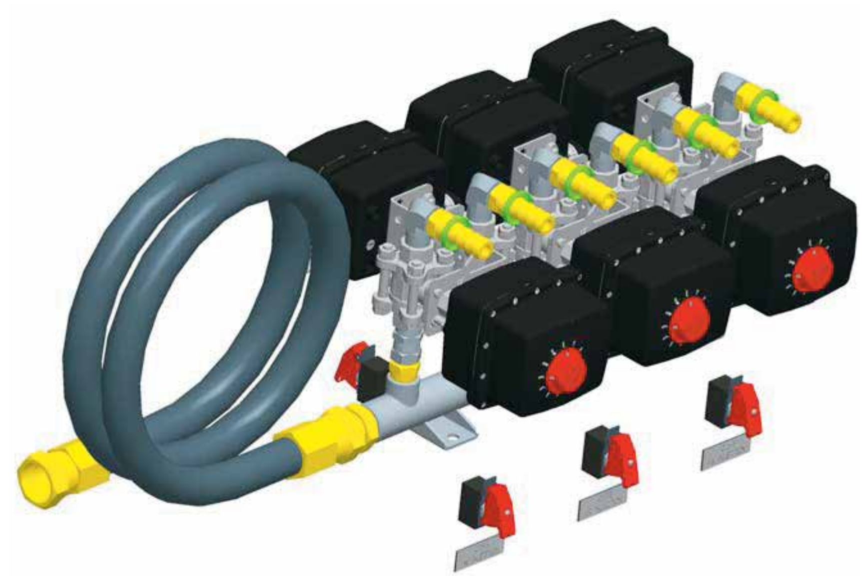
The standard OEM Manifold, DCM1501, is configured for (1) 2-1/2 in. and (3) 2 in. CAFS valve assemblies. If additional valves are required, please indicate total number of valves desired on the Option-Pricing form.



Optionally, the CAFS discharge valve assembly is available complete with an integrated electric valve actuator and panel control. For dimensional information on the actuated 2 in. valve assembly, part number AZ02700, refer to drawing DCM0305. For the 2-1/2 in. assembly, part number AZ02800, refer to drawing DCM0306.

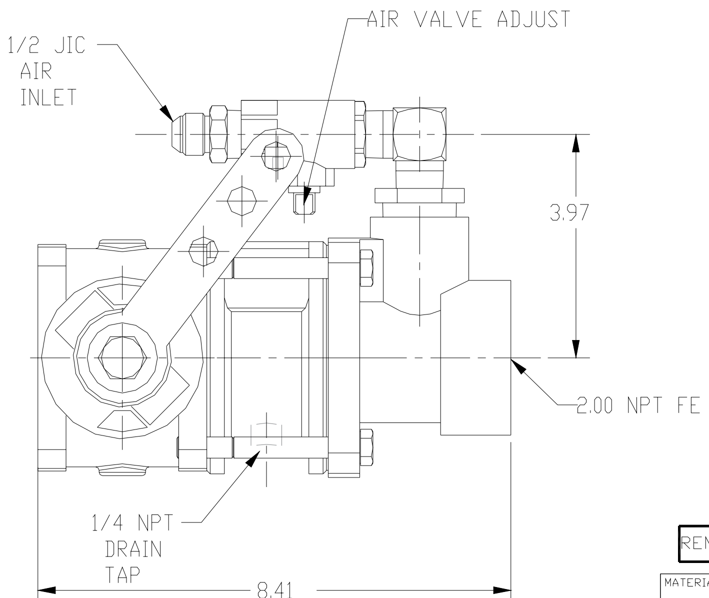
CAFS AIR DISTRIBUTION VALVE ASSEMBLIES

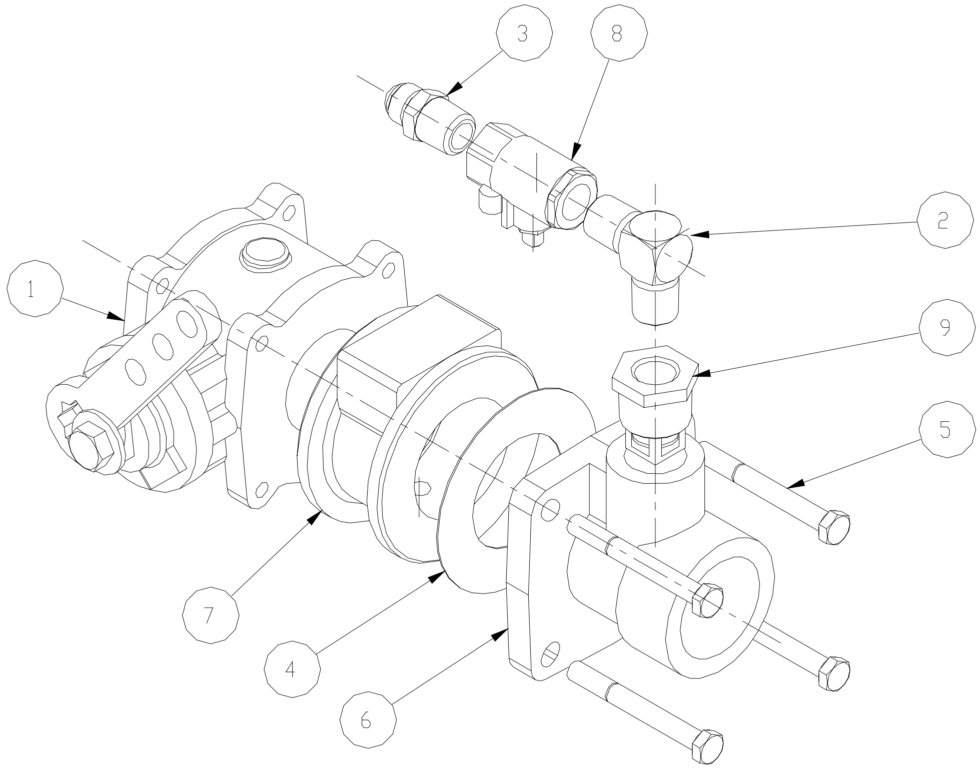
Darley AutoCAFS AIR (Air Injection Regulator) air distribution manifold assembly, AZ02302, is available for complete "motorized" valve controlof individual air injection ports. The AutoCAFS AIR distribution assembly incorporates a stainless steel manifold with 6 ports for the application (1) 12 VDC air distribution actuated valve for each compressed air foam system (CAFS) discharge valve assembly. Optionally, assembly AZ02303 includes an air flow meter that is mounted directly to the outlet port of the compressor system oil separator tank for air flow measurement and air valve calibration. A 72 in. primary air hose is provided for connection of the distribution manifold to the air flow meter, providing flexible remote mounting in the pump compartment. Please refer to DCM1701 for dimensional information.



NO.	DESCRIPTION	PART NO.	QTY.
1	BODY - AKRON VALVE, 2.00	5202901	1
2	ELBOW - PIPE, .50 NPT DBL MALE	1080736	1
3	FITTING - .50 NPTM x .50 JICM ADAPTER	3501526	1
4	GASKET	3806306	1
5	HHCS - .375-16 x 3.25, GR5	5400045	4
6	NIPPLE - FOAM INJECTION, 2.00	1925800	1
7	VALVE - 2.00 CHECK, MODIFIED	5204601	1
8	VALVE - CAFS AIR FLOW, 0.50	5207700	1
9	VALVE - CHECK, 0.50" DURABLO	5204400	1

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D





MODEL NAME: AZ02500 | MDL CREATED: 28-FEB-2002 | SHEET: 1/1 | B

REMOVE SHARP EDGES

INCH [MILLIMETER]

THIRD ANGLE PROJECTION | OLD PART NO.

TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1°

W.S. Darley & Co. MELROSE PARK, IL - CHIPPEWA FALLS, WI

CAFS - 2.00 CHECK VALVE ASSY

MATERIAL DESCRIPTION: | MATERIAL NO. | PATTERN NO.

DR'N DWS | CHKD TED | TRCD

DATE 08-Mar-02 | SCALE 1/2 | DCM0303

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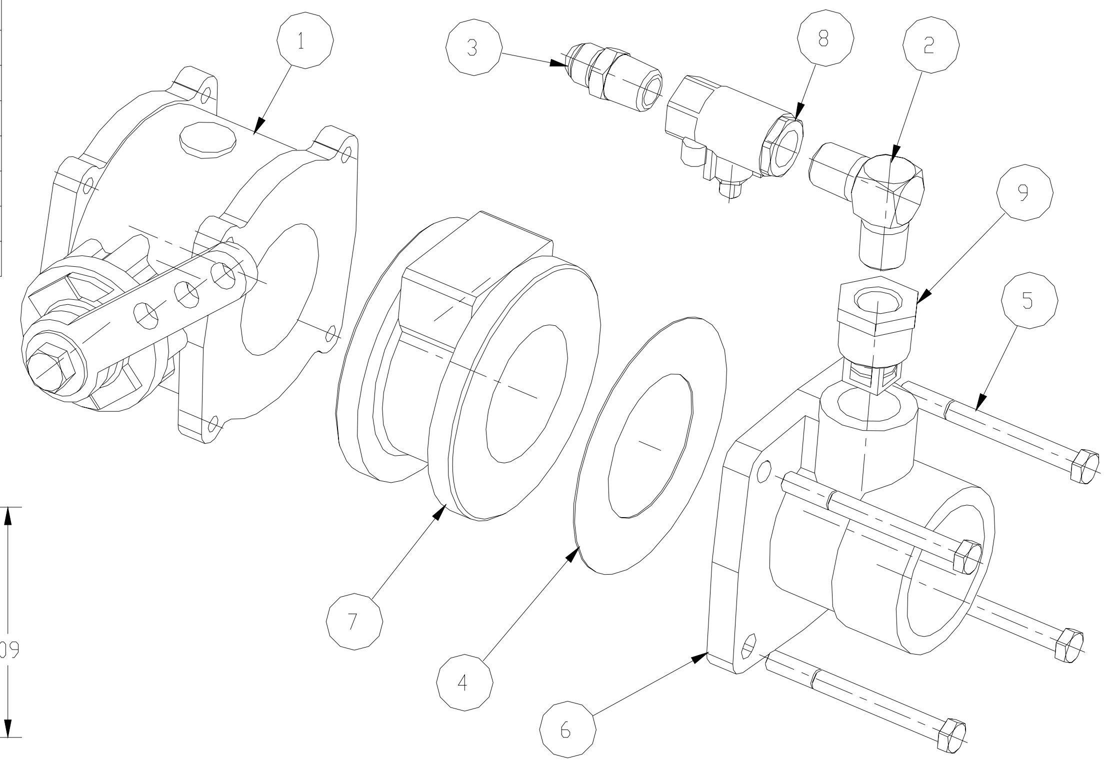
ALL DIMENSIONS IN INCHES UNLESS NOTED

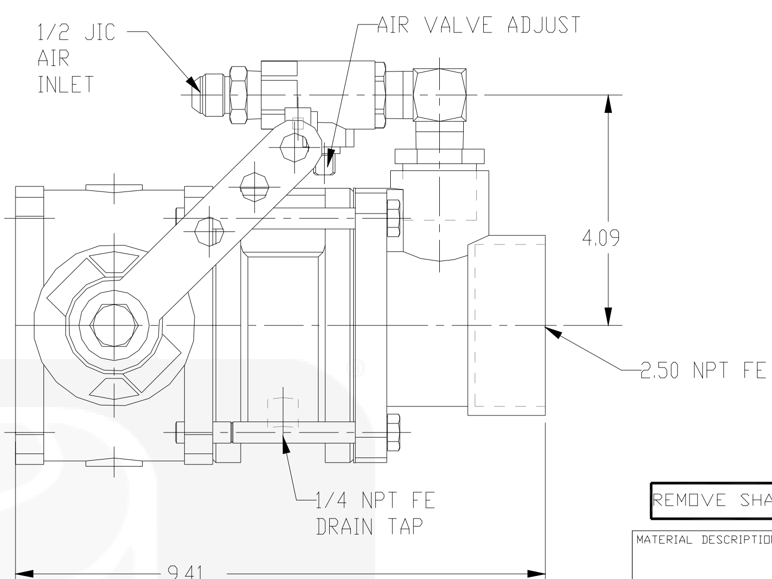
DO NOT SCALE PRINT

NO.	DESCRIPTION	PART NO.	QTY.
1	BODY - AKRON VALVE, 2.50	5203002	1
2	ELBOW - PIPE, .50 NPT DBL MALE	1080736	1
3	FITTING - .50 NPTM x .50 JICM ADAPTER	3501526	1
4	GASKET	3806307	1
5	HHCS - .375-16 x 3.75, GR5	5400047	4
6	NIPPLE - FOAM INJECTION, 2.50	1925801	1
7	VALVE - 2.50 CHECK, MODIFIED	5205101	1
8	VALVE - CAFS AIR FLOW, 0.50	5207700	1
9	VALVE - CHECK, 0.50" DURABLO	5204400	1

REVISIONS

LTR	DESCRIPTION	DATE	CHG NO.	APPR'D





MODEL NAME: AZ02600 | MDL CREATED: 28-FEB-2002 | SHEET: 1/1 | B

REMOVE SHARP EDGES

INCH [MILLIMETER]

THIRD ANGLE PROJECTION

OLD PART NO.

TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1°

W.S. Darley & Co.
MELROSE PARK, IL - CHIPPEWA FALLS, WI

CAFS - 2.50 CHECK VALVE ASSY

MATERIAL DESCRIPTION:

MATERIAL NO. | PATTERN NO.

DR'N DWS
CHKD TED
TRCD

DATE 11-Mar-02
SCALE 1/2

DCM0304

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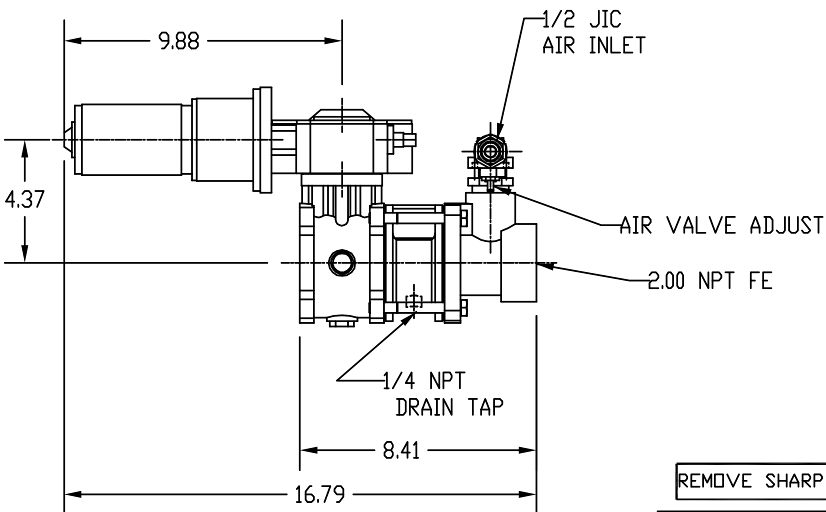
ALL DIMENSIONS IN INCHES UNLESS NOTED

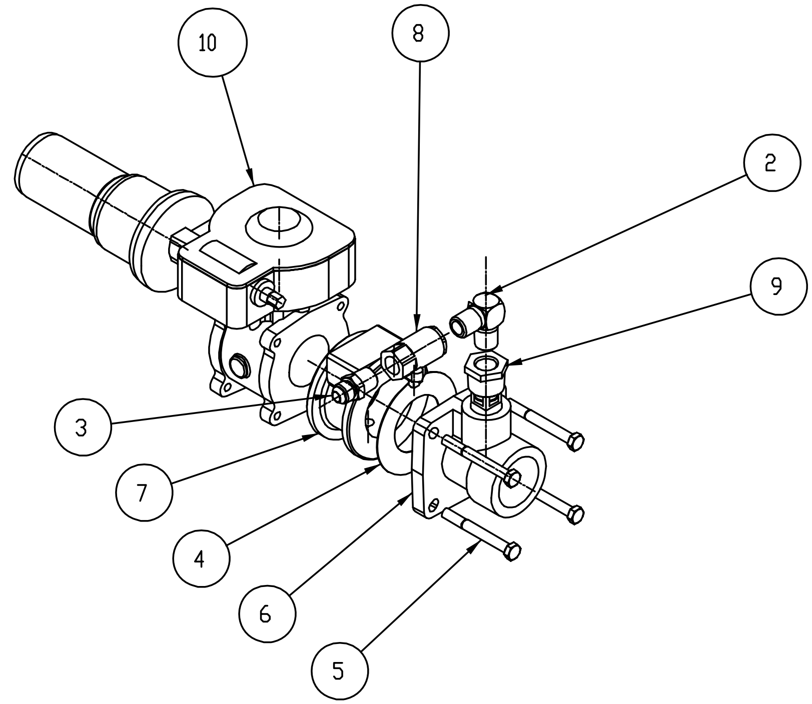
DO NOT SCALE PRINT

NO.	DESCRIPTION	PART NO.	QTY.
2	ELBOW - PIPE, .50 NPT DBL MALE	1080736	1
3	FITTING - .50 NPTM x .50 JICM ADAPTER	3501526	1
4	GASKET	3806306	1
5	HHCS - .375-16 x 3.25, GR5	5400045	4
6	NIPPLE - FOAM INJECTION, 2.00	1925800	1
7	VALVE - 2.00 CHECK, MODIFIED	5204601	1
8	VALVE - CAFS AIR FLOW, 0.50	5207700	1
9	VALVE - CHECK, 0.50" DURABLO	5204400	1
10	VALVE - AKRON BALL, 2.00", SUB-ASSY	5202902	1

REVISIONS

LTR	DESCRIPTION	DATE	CHG NO.	APPR'D





MODEL NAME AZ02700 | MDL CREATED 29-AUG-2004 | SHEET 1/1 | B

REMOVE SHARP EDGES

INCH
[MILLIMETER]

THIRD ANGLE PROJECTION

OLD PART NO.

TOLERANCE
EXCEPT
AS NOTED
.00 ±.03
.000 ±.010
ANGLES ±1°

W.S. Darley
MELROSE PARK, IL - CHIPPEWA FALLS, WI

CAFS - 2.00 VALVE & CHECK
W/ELECT ACTUATOR

MATERIAL DESCRIPTION:

MATERIAL NO. | PATTERN NO.

DR'N DWS
CHKD JSS
TRCD

DATE 29-Aug-04
SCALE 1/4

DCM0305

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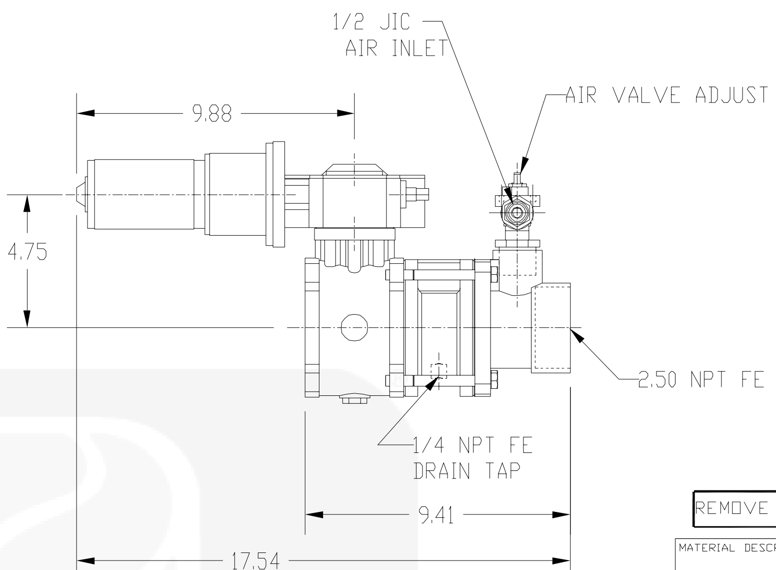
ALL DIMENSIONS IN INCHES UNLESS NOTED

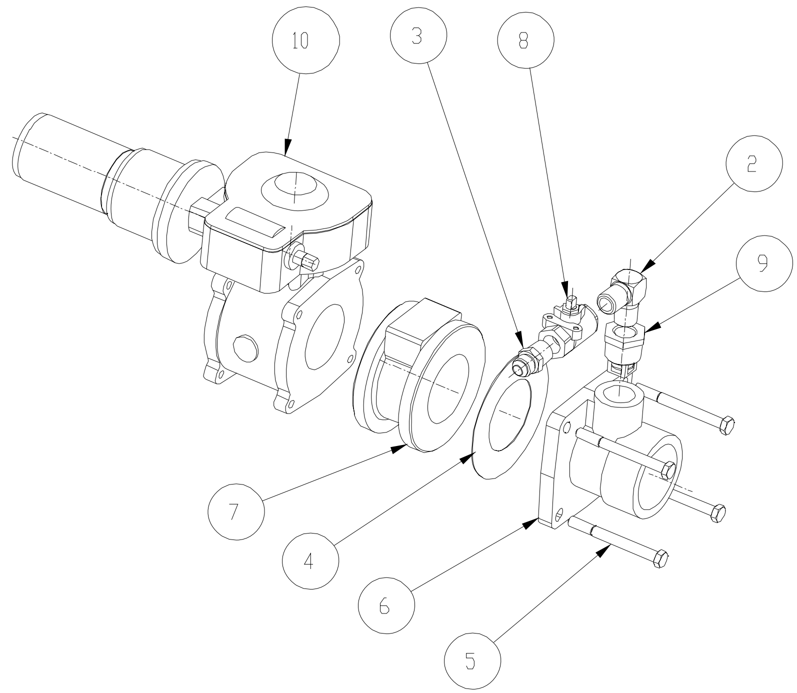
DO NOT SCALE PRINT

NO.	DESCRIPTION	PART NO.	QTY.
2	ELBOW - PIPE, .50 NPT DBL MALE	1080736	1
3	FITTING - .50 NPTM x .50 JICM ADAPTER	3501526	1
4	GASKET	3806307	1
5	HHCS - .375-16 x 3.75, GR5	5400047	4
6	NIPPLE - FOAM INJECTION, 2.50	1925801	1
7	VALVE - 2.50 CHECK, MODIFIED	5205101	1
8	VALVE - CAFS AIR FLOW, 0.50	5207700	1
9	VALVE - CHECK, 0.50" DURABLO	5204400	1
10	VALVE - AKRON BALL, 2.50, SUB-ASSY	5203003	1

REVISIONS

LTR	DESCRIPTION	DATE	CHG NO.	APPR'D





MODEL NAME: AZ02800 | MDL CREATED: 29-AUG-2004 | SHEET: 1/1 | B

REMOVE SHARP EDGES

INCH [MILLIMETER]

THIRD ANGLE PROJECTION

OLD PART NO.

MATERIAL DESCRIPTION:

MATERIAL NO.

PATTERN NO.

TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1°

W.S. Darley & Co.
MELROSE PARK, IL - CHIPPEWA FALLS, WI

CAFS - 2.50 VALVE & CHECK W/ELECT ACTUATOR

DR'N DWS
CHKD JSS
TRCD

DATE 29-AUG-04
SCALE 1/4

DCM0306

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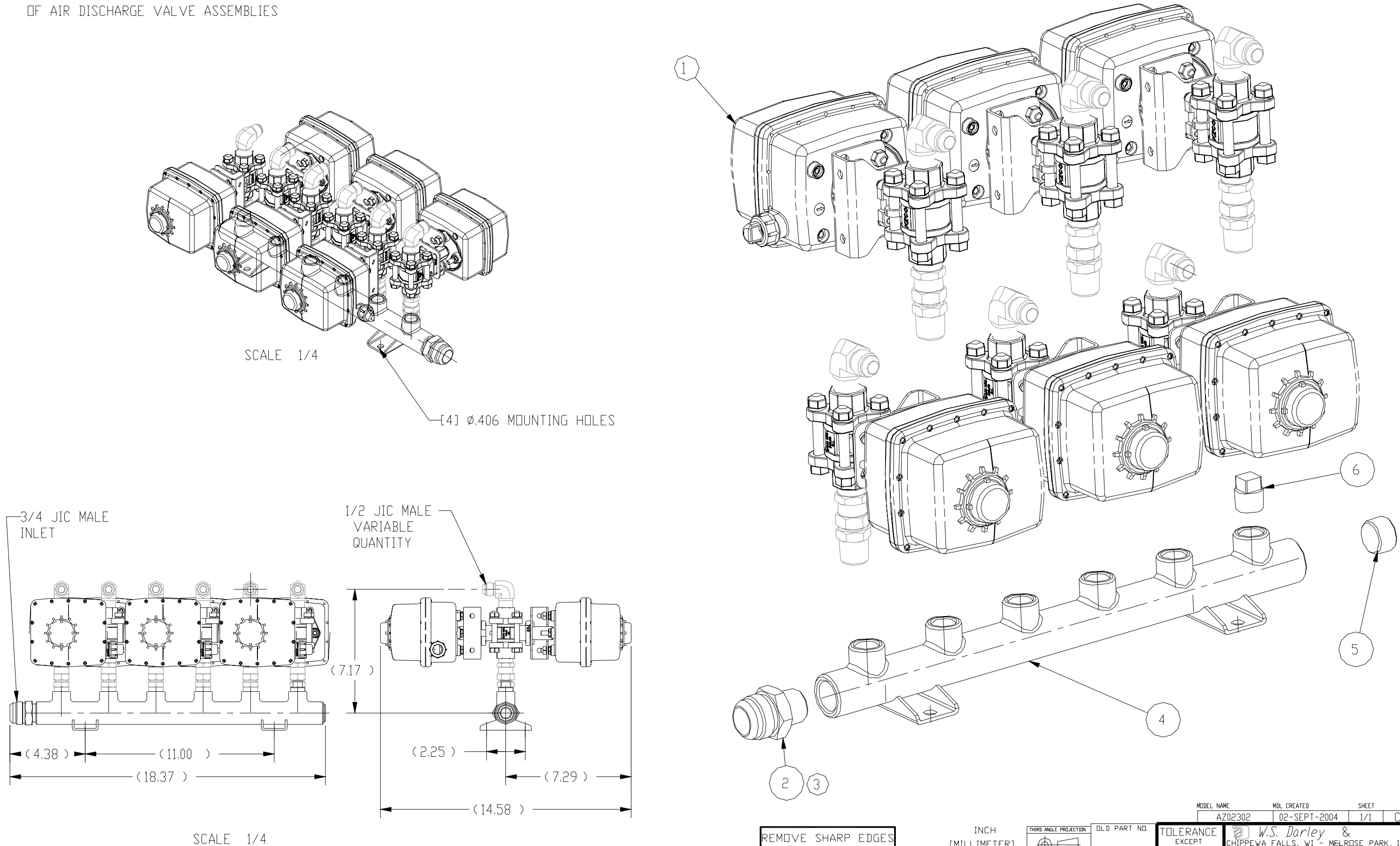
ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

NO.	DESCRIPTION	PART NO.	QTY.	
1	CAFS - 1/2 AIR DIST VALVE ASSY	AZ02402	6	VARIABLE *
2	FITTING - .75 NPTM x 1.00 JICM ADAPTER	3501528	1	
3	HOSE - 1.00 X 72 AIR LINE	3520510	1	
4	MANIFOLD - AIR DISTRIBUTION	3107401	1	
5	PLUG - PIPE .75 HEX BRASS	1080539	1	
6	PLUG - PIPE, 0.500, BRS SQ HD	1080512	1	VARIABLE *

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D

* QUATITY VARIES DEPENDING ON NUMBER OF AIR DISCHARGE VALVE ASSEMBLIES



REMOVE SHARP EDGES

INCH [MILLIMETER]

THIRD ANGLE PROJECTION

MODEL NAME	MDL CREATED	SHEET	
AZ02302	02-SEPT-2004	1/1	C

OLD PART NO.	
MATERIAL DESCRIPTION:	
MATERIAL NO.	PATTERN NO.
TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1°	W.S. Darley & Co. CHIPPEWA FALLS, WI - MELROSE PARK, IL
DR'N DWS	CAFS - AIR DIST MANIFOLD ASSY SLOW OPEN VALVE
CHKD TED	DATE 02-SEP-04
TRCD	SCALE 1/2
	DCM1701

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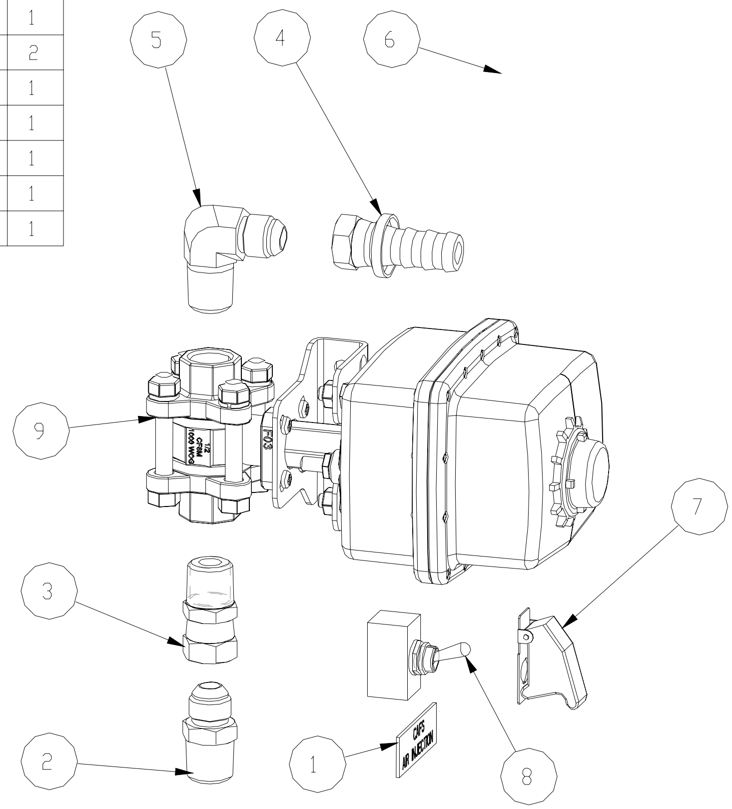
ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

NO.	DESCRIPTION	PART NO.	QTY.
1	DECAL - CAFS AIR INJECTION	1973900	1
2	FITTING - .50 NPTM x .50 JICM ADAPTER	3501526	1
3	FITTING - BRASS ADAPTER	3502026	1
4	FITTING - BARB, .63 x .50, SWVL	3502008	2
5	FITTING - BRASS ELBOW	3502028	1
6	HOSE - .63 X 72 AIR LINE	3520501	1
7	SWITCH - TOGGLE, COVER, RED	2600088	1
8	SWITCH - TOGGLE, DPDT, ON-ON	2600125	1
9	VALVE - ACTUATED, 12V, .50NPT FE	5209400	1

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D



MODEL NAME	MDL CREATED	SHEET	
AZ02402	03-SEPT-2004	1/1	B

REMOVE SHARP EDGES

INCH [MILLIMETER]

THIRD ANGLE PROJECTION

OLD PART NO.

MATERIAL DESCRIPTION:

MATERIAL NO. | PATTERN NO.

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ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

TOLERANCE EXCEPT AS NOTED
.00 ±.03
.000 ±.010
ANGLES ±1°

DR'N DWS
CHKD JSS
TRCD

W.S. Darley & Co.
MELROSE PARK, IL - CHIPPEWA FALLS, WI

CAFS - 1/2 AIR DIST VALVE ASSY
SLOW OPEN VALVE

DATE 03-Sep-04
SCALE 1/2

DCM1801

OPTION-PRICING

Part No.	Description	List Price	Qty.	Total
YE06100	Manifold complete, option 00 – drawing DCM1500, (2) flange for 2-1/2 in. CAFS valve, (3) flange for 2 in. CAFS valve – extensions may be rotated to position valves in a horizontal or vertical orientation orientation.	$3365		
YE06101	Manifold complete, option 01 – Standard OEM Configuration – drawing DCM1501, (1) 2-1/2 in. flange for CAFS valve, (3) flange for 2 in. CAFS valve – extensions may be rotated to position valves in a horizontal or vertical orientation. Additional (3) outlet manifold extension, part no. YE06103, may be optionally added.	$2650		
YE06102	Manifold complete, option 02 – drawing DCM1502, (2) 2-1/2 in. Victaulic for CAFS valve, (3) 2 in. Victaulic outlets for customer remote mounting of CAFS valves	$2392		
YE06103	20 in. extension, (3) flange for 2 in. CAFS valve, 2.50 rigid Victaulic coupling included	$780		
AZ02500	2 in. CAFS discharge valve assembly complete per drawing DCM0303	$1137		
AZ02600	2-1/2 in. CAFS discharge valve assembly complete per drawing DCM0304	$1345		
AZ02700	2 in. CAFS discharge valve assembly complete with electric valve actuator per drawing DCM0305	$3683		
AZ02800	2-1/2 in. CAFS discharge valve assembly complete with electric valve actuator per drawing DCM0306	$3858		
AZ02302	Darley AutoCAFS AIR, Air distribution manifold per drawing DCM1701. Includes stainless steel manifold, bracket, clamps, and 1 in. x 72 in. supply hose. Add AZ02402 1/2 in. air distribution valves as required.	$575		
AZ02303	Darley AutoCAFS AIR, Air distribution manifold with air flow meter, reference drawing DCM1701. Includes stainless steel manifold, bracket, clamps, 250 cfm air flow meter, and 1 in. x 72 in. supply hose. Add AZ02402 1/2 in. air distribution valves as required.	$1290		
AZ02402	1/2 in. air distribution valve assembly complete per DCM1801. (1) AZ02402 is required for each CAFS outlet.	$600		
YF06201	2 in. blank flange cover	$155		
YF06202	2-1/2 in. blank flange cover	$130		

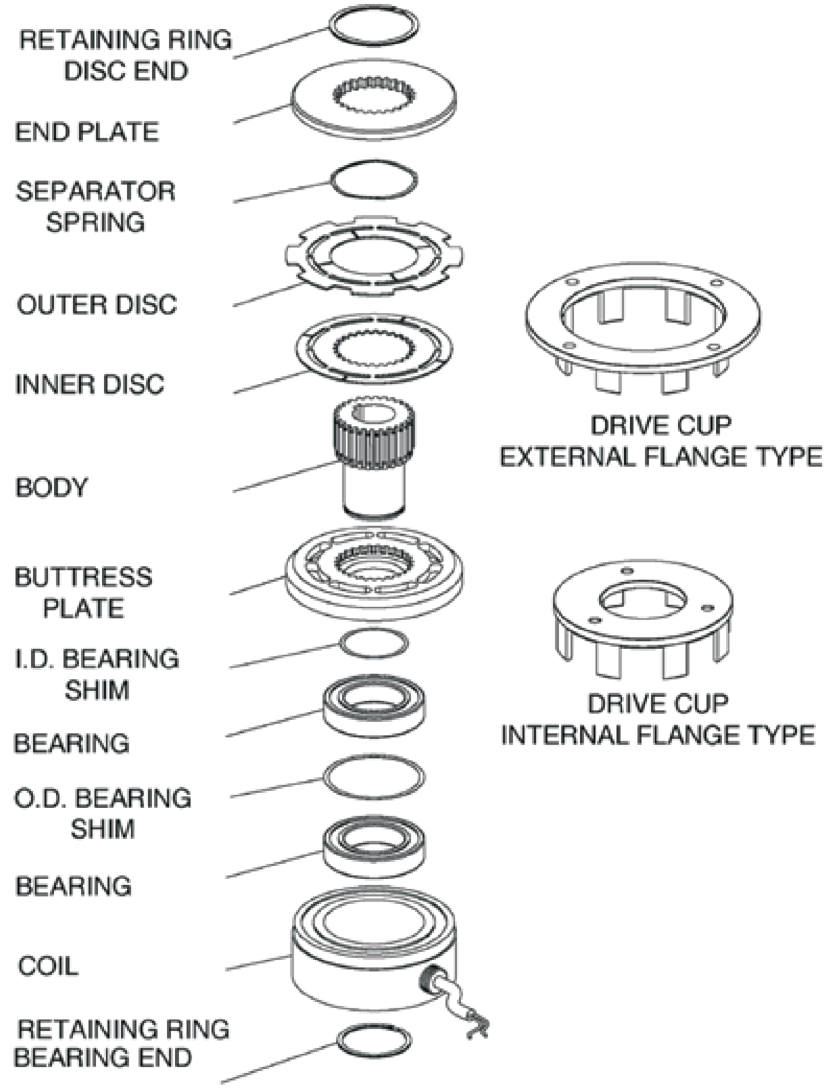
Manifold Configuration HL003_ _-_-_ _

Darley

Electric Clutch Maintenance and Repair Guide

CARLYLE JOHNSON MAXITORQ®

Model EMA
Electric Multiple Disc Clutch



⚠ WARNING

Always disconnect power and air and lock out/tag out machine before performing service or removing or reinstalling your clutch. On-machine measurements must be performed with power and air disconnected. Where voltage readings are required, electrical meters must be attached with power and air disconnected.

Routine Maintenance

PREVENTIVE MAINTENANCE

Maxitorq® multiple disc clutches need little or no maintenance in normal use. Discs on clutches run dry may be washed in kerosene to remove any foreign material and restore clutch performance.

When a clutch is operated in oil, the oil may eventually break down along the friction surfaces. Over time, the hardened surfaces will wear. Discs should be visually inspected from time to time to make sure warping and galling have not occurred. If any such wear is observed, disc replacement is necessary.

REPLACEMENT OF CLUTCH DISCS

Always replace a disc set. Do not mix old and new discs on a clutch.

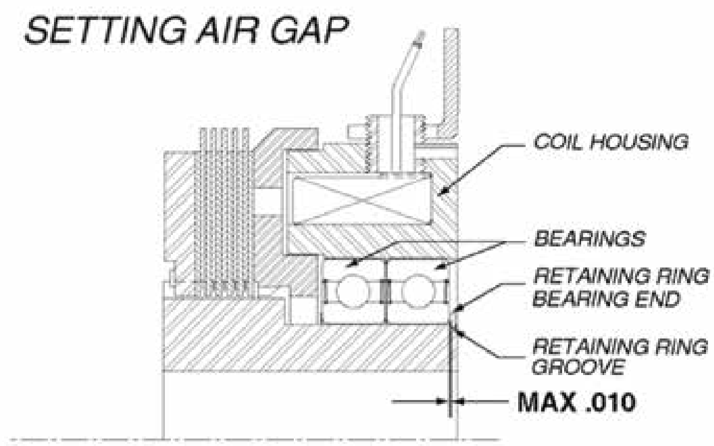
Although springs may be reused if they are still serviceable, frequently they lose their hardness, and clutch performance, particularly disengagement and neutral drag, become a problem. We recommend purchasing a complete disc/spring set to restore like-new performance.

Follow Disassembly Instructions 1 through 3 ONLY. Assemble following Reassembly Instructions 10 through 13 ONLY.

REPLACEMENT OF BEARING OR COIL HOUSING ASSEMBLY

Follow Disassembly Instructions 1 through 8. Assemble following Reassembly Instructions 1 through 13.

Always replace ball bearings if replacing coil housing assembly. The shim between the bearings may be reused if it is not damaged.



GENERAL TROUBLESHOOTING ISSUES

1. Check for worn parts. Obviously damaged or worn parts must be replaced to ensure correct clutch operation. Determine whether this wear is due to normal operation over a long period of use, or improper installation, maintenance, or clutch contamination. Replacing worn parts will provide only temporary improvement if a more fundamental problem is present and goes undetected.
2. Check alignment of clutch and drive cup. Review *Drive Cup Alignment on page 177*. Improper alignment will asymmetrically load the clutch and drive cup support bearings, causing premature wear, and possibly interfering with clutch operation.
3. Check for contamination of clutch discs. Discs in dry applications may become contaminated with oils from adjacent bearings or other external sources, which will prevent the clutch from transmitting full torque. Slippage is frequently caused by such contamination. Clean the discs as outlined under *Disc Contamination on page 178*.

4. Check clearances and air gap. Check that the relationship of the drive cup to the buttress plate meets our specifications as outlined under *Drive Cup Alignment on page 177*. Also verify that when the clutch is disengaged, it will rotate freely with no binding or interference. See *Air Gap on page 177*.
5. Check fuses and electrical power. If the circuit is fused, check that the fuse is good. If the fuse is being replaced, be sure the proper type fuse is installed in accordance with the equipment manufacturer's specifications. If no specifications are available, see *Fuse on page 178* for recommended fuse application.

   If the fuse is OK, or if no fuse is in the circuit, verify that power is reaching the clutch. To operate correctly, the clutch must receive voltage within 10% of the nominal rated voltage of the clutch coil.
6. Check for missing or damaged parts. If the clutch has been subjected to repair, removal and reinstallation, check to see if the clutch has been reassembled correctly. Review the parts diagram included in this manual and replace or repair any damaged or missing parts.

SPECIFIC TROUBLESHOOTING ISSUES

CLUTCH FAILS TO ENGAGE/NO TORQUE TRANSMITTED WHEN POWER APPLIED

Check the following items with the clutch installed:

1. Alignment
2. Fuse
3. Coil
4. Electrical connection
5. Drive cup engagement

Remove the clutch to check the following:

6. Contamination
7. Drive cup wear
8. Disc wear
9. Air gap

CLUTCH "SLIPS"/ONLY PARTIAL TORQUE TRANSMITTED WHEN POWER APPLIED

Check the following items with the clutch installed:

1. Alignment
2. Clutch voltage

Remove the clutch to check the following:

3. Contamination
4. Drive cup wear
5. Disc wear
6. Air gap
7. Springs

"NEUTRAL DRAG"/CLUTCH TRANSMITS TORQUE WHEN DISENGAGED

NOTE: *A small amount of torque is transmitted in the neutral "disengaged" position. This is normal with multi-disc clutches. At very low speeds, up to 2% of the static torque may be transmitted. At high neutral speeds, this value will fall to 1% or less. If significant torque transmission is evident when the clutch is disengaged, the clutch should be repaired.*

Check the following items with the clutch installed:

1. Alignment
2. Residual magnetism

Remove the clutch to check the following:

3. Contamination
4. Drive cup wear
5. Air gap
6. Springs

MAINTENANCE/REPAIR PROCEDURES

AIR GAP

The permanent air gap between the stationary coil housing and the buttress plate is established by machined tolerances when manufactured. It should not be disturbed. However, disassembly and reassembly of the clutch requires verification that the original clearances are restored.

The air gap should be verified before Loctite® is applied to the I.D. of the ball bearings for permanent assembly.

Check the clearance between the retaining ring groove on the bearing end of the clutch body, and the lower ball bearing. See the diagram on *page 160*. The maximum clearance allowed is 0.010 in. If greater, the clutch has not been reassembled correctly. Install additional I.D. bearing shims to correct. Up to 4 may be used. If installation of 4 shims does not reduce the clearance to <0.010 in., the clutch is assembled incorrectly or worn beyond repair. Reverify assembly. If no problem can be located and the proper clearance cannot be restored, contact the factory for assistance.

After achieving proper air gap clearance, the clutch must turn freely when disengaged, with no interference.

DRIVE CUP ENGAGEMENT

The drive cup must fully engage all outer discs. Adjust alignment of the drive cup if necessary or repair/replace the external components or clutch mounting to correct any deficiency.

DRIVE CUP ALIGNMENT

The clutch and drive cup must be concentric within 0.005 T.I.R. Misalignment may be caused by improper clutch mounting; improper mounting or support of the drive cup; worn bearings supporting the drive cup; improperly installed or missing anti-rotation strap; or if rigid conduit is used in providing electrical service to the clutch, it may be distorting the alignment of the clutch.

Clearance between the drive cup fingers and buttress plate must be approximately 1/16 in. around the entire circumference. This dimension must be uniform around the circumference of the drive cup.

DRIVE CUP WEAR

Improper alignment, support, worn bearings, or extreme service may eventually wear “grooves” into the fingers of the drive cup. This will interfere with the compression and separation of discs, preventing proper engagement/disengagement of the clutch. If any such wear is evident, replace the drive cup, and if needed, its supporting mechanism. Any further damage to clutch discs may require disc replacement. Verify alignment after reassembly.

FUSE

If the circuit is fused, check the fuse condition. If the fuse is blown, replace with the same type/rating as specified by the equipment manufacturer.

If no specifications are given, use a fuse that will tolerate an in-rush current approximating 135% of the nominal rating of the clutch coil.

NOTE: *Always follow the manufacturer’s recommendation for fuse replacement. The fuse protects upstream equipment in the machinery, not the clutch. Use Table 12 on page 181 ONLY if no manufacturer’s instructions are given.*

COIL

Check the coil resistance for open or shorted condition. Follow *Table 12 on page 181* for nominal resistance. Coil leads must be disconnected from the power source before taking a resistance reading. Shorted or open coils must be replaced.

The coil housing assembly includes the coil and its housing. The coil is encapsulated in epoxy resin, and must only be repaired by the factory. A complete replacement coil housing assembly may be purchased, or the failed assembly may be returned to the factory for coil replacement.

CLUTCH VOLTAGE

Attach a voltmeter to the clutch with the power OFF. When power is applied to the clutch, it must be ± 10% of the nominal voltage rating of the coil. If sufficient power is not being applied to the clutch, full engagement and full torque transmission will not take place. Repair or replace the power supply to assure good clutch actuation.

DISC CONTAMINATION

Disc contamination of clutches run dry may be caused by oils from external sources or other debris. Discs may be flushed with kerosene to remove oils or other contaminants, and restore normal operation.

Bearings in the vicinity of the clutch (for example, used to support the drive cup), should be adequately shielded to prevent clutch disc contamination. Clutches run in oil must not contain extreme pressure additives. We recommend automatic transmission fluid (ATF) oils such as Dexron II for this application.

DISC WEAR

After extended use, clutch discs will wear to the point where replacement is necessary. In a dry application, if normal operation is not restored to a slipping clutch with kerosene flushing, then disc replacement is necessary.

In oil-bathed applications, oil will eventually break down along the friction surfaces. Over time, the hardened surfaces become worn to a point where warping or galling occurs. This damage can be clearly seen by checking the disc surfaces, and requires prompt disc replacement to maintain good clutch performance.

Always replace discs and springs as a set. The factory can supply disc/spring kits.

SEPARATOR SPRINGS

If the clutch transmits excess torque when in neutral, separator springs may be worn or bent. Springs should be replaced under these circumstances.

Proper spring performance is achieved when discs are uniformly spaced in the disengaged position.

Contact the factory to purchase replacement springs. It is a good idea to replace the discs at the same time to restore the clutch to like-new performance.

RESIDUAL MAGNETISM

Occasionally, after installation of a new or rebuilt clutch, the clutch may build up residual magnetism after the first few cycles and fail to disengage properly when power is removed. This condition can be easily overcome by reversing the power leads to the coil, energizing the clutch momentarily, and then restoring the leads to their original polarity. The clutch should now fully engage when power is applied, and fully disengage when power is removed from the coil.

ELECTRICAL CONNECTIONS

Check that all electrical connections are properly made. There is no polarity to the clutch leads; either one may be considered positive (+).

CLUTCH ASSEMBLY

1. Place the clutch on a workbench with the coil housing on the bottom.
2. Remove the retaining ring, disc end from the top of the body.
3. Remove the end plate, discs, and separator springs.
4. Turn the clutch over and support the assembly on the buttress plate.
5. Remove the retaining ring, bearing end from the body where it protrudes through the coil housing.
6. Press the body out from the coil housing. This will allow removal of the I.D. bearing shim(s) and the buttress plate from the body.
7. To remove the ball bearings, turn the coil housing over so that the epoxy resin side is facing down.
8. Support the coil housing; do not allow pressure to be applied to the epoxy resin area of the housing; and press out the ball bearings and O.D. bearing shim. Because pressure must be applied to the inner race when pressing out bearings, ball bearings may not be reused once removed.

CLUTCH REASSEMBLY

1. Support the coil housing so that the epoxy resin side is facing up.
2. Apply Loctite® 271™ sparingly to the O.D. of the first ball bearing and press into the coil housing. Make sure the bearing is fully seated.

NOTICE

Do not put the two bearings together with a shim between them and attempt to press them in as a single unit. The ball bearings will not seat squarely using this procedure, and the clutch will be damaged in use.

3. Insert a single O.D. shim on top of the first ball bearing.

4. Apply Loctite® 271™ sparingly to the O.D. of the second ball bearing and press into the coil housing. Make sure the bearing is fully seated.
5. Assemble the buttress plate to the body and place the same number of I.D. bearing shims on the smooth end of the body as were removed during disassembly. The shim I.D. is the same size as the I.D. of the bearing.
6. Press the body into the coil housing.
7. Turn the clutch over and observe the relationship of the retaining ring groove on the body to the lower ball bearing. Make sure there will be less than 0.010 in. clearance between the retaining ring, bearing end when installed, and the bearing. If the clearance exceeds 0.010 in., press the body out and install additional I.D. bearing shims to reduce the clearance to less than 0.010 in. Up to 4 shims may be installed if necessary. (If more than 4 shims are required, the clutch may be improperly assembled. Check the assembly procedures carefully, and if necessary, contact the factory for assistance.)
8. When the proper clearance has been achieved, press out the body and apply Loctite® 271™ sparingly to the I.D. of the ball bearings. Press the body back into the coil housing for permanent assembly.
9. Install the retaining ring, bearing end on the body.
10. Install an inner disc. Inner discs differ from outer discs in that they have smaller O.D. and have a toothed I.D. to fit over the spline on the body.
11. Install an outer disc with a separator spring in the center.
12. Continue installing the discs, alternating between inner discs and outer discs until all discs and springs have been installed. Most (but not all) standard clutches have five outer discs.

Install the end plate and the retaining ring, disc end. The clutch assembly is now complete. The clutch body should tum freely without any binding or interference.

CLUTCH ELECTRICAL CHARACTERISTICS

Clutch Model	EMA 0475 – 12 VDC (Darley)
Coil Power (watts)	58
Current Draw (amps)	4.8
Fuse Size (amps)	10
Coil Resistance (ohms)	10

Table 12

Clutch Model	24V DC Coil				100V DC Coil			
	Coil Power (watts)	Current Draw (amps)	Fuse Size (amps)	Coil Resistance (ohms)	Coil Power (watts)	Current Draw (amps)	Fuse Size (amps)	Coil Resistance (ohms)
EMA 0265	48	2.0	2-1/2	12	33	0.3	1	299
EMA 0325	48	2.0	2-1/2	12	49	0.5	1	204
EMA 0375	40	1.7	2-1/2	15	41	0.4	1	244
EMA 0425	41	1.7	2-1/2	14	48	0.5	1	208
EMA 0475	58	2.4	3	10	62	0.6	1	161
EMA 0625	58	2.4	3	10	64	0.6	1	157
EMA 0800	68	2.8	4	9	78	0.8	1-1/4	128
EMA 0950	96	4.0	5	6	97	1.0	1-1/2	103
EMA 1150	89	3.7	5	7	115	1.1	1-1/2	87

NOTE: *Always follow equipment manufacturer's recommendation on fuse type/size.*
Use the above chart only if fuse size is not specified.
Use a fuse that will tolerate an in-rush current of 135% of nominal rating.

AutoCAFS II – TESTING REFERENCE GUIDE

General: This reference guide is based on the Darley Model LDMBC midship, Enduro 12

TS, AutoCAFS II package with an electric compressor clutch. This compressor system has a 220 cfm rating at 125 psi and provides for automatic air pressure balancing.

INSTRUCTIONS

1. PREPARE COMPRESSOR FOR RUNNING TEST:

    1.1. The test technician should have available for reference and must be familiar with the LDMBC 'OPERATION INSTRUCTION' manual, part number 1200597.

    1.2. The first step, before testing the system, is to make sure that all equipment has been properly installed. All air compressor related components should be clean and free of obstructions before installation. Follow installation instructions and component layout diagrams and verify correct installation.

    1.3. Once this has been established, be sure to have the correct oil type and proper oil level in both the compressor system and the water pump gear case.

        1.3.1. Air Compressor: 32 weight (hydraulic air compressor oil). For example, Phillips Magnus ISO VG 32 RX mineral oil (refer to Operation Instructions for further specifications). Fill the oil tank reservoir to the high-level mark on the sight tube. Depending on total length of hoses, more oil may need to be added after unit begins running and oil circulates throughout the system.

⚠ WARNING

The oil separator tank is pressurized after compressor shutdown until system blow-down is complete. Allow 2 min for system pressure blow-down before opening the oil fill valve.

⚠ CAUTION

Do not overfill the oil reservoir. If the oil level is above the maximum level, the separator elements may not be able to handle the flow of air/oil mixture being supplied. The result may be an oily air discharge mist when the air flow valve is opened.

    1.4. The water pump transmission requires SAE BOW – 90 GL4/GL5 gear lube oil filled to the proper level on the dipstick.

2. Additional Testing Equipment

    2.1. A calibrated 250 cfm air flow meter with valve must be installed on the air compressor reservoir outlet. A calibrated, 300-psi gauge should be installed on the air flow meter.

3. Prime and prepare the pump for water discharge. Begin rotating the pump with the engine at idle speed. RPM should be as low as possible when the air compressor is engaged. Turn on the air compressor by pressing and holding the "On/Off"' button on the AutoCAFS Commander for 2 sec. The light next to the "On/Off" button will be illuminated. The compressor will now begin to build air pressure. The air pressure is controlled by the pump pressure.

3.1. Observe the following precautions:

3.1.1. RPM should be as low as possible when the air compressor is engaged.

NOTICE

Never engage the air compressor when the pump input shaft speed is greater than 900 rpm. Only engage the air compressor when the pump input shaft speed is less than 900 rpm.

3.1.2. Allow 1 min between compressor stop and start for system blow-down.

3.1.3. Once the compressor is engaged, do not exceed 3,650/pump ratio input rpm. For example, 3,650/2.44 = 1,500 rpm for 2.44 pump ratio.

3.1.4. During all tests it is important to keep cool, fresh water circulating through the water pump. Water flow from the pump is used to cool the air compressor oil using a brazed plate type heat exchanger.

3.2. Check to see that there are no oil or air leaks in the air compressor system.

Do not proceed until all leaks are repaired. Check the oil separator tank oil level. Shut down the compressor and adjust the oil level as required.

3.3. Begin by raising the water pump pressure slowly to 75 psi. The water pump should have a discharge valve gated slightly open to circulate water. Once again, check to see that all fittings are tight and no leaks are found. A leak can cause a malfunction in air pressure adjustment and control. Commonly leaks will cause air pressure to rise higher than attempted settings.

THERE ARE 7 STEPS TO TEST THE AIR COMPRESSOR SYSTEM:

- Ensure that all AutoCAFS Commander settings are correct
- Pump ratio 2.44 standard, 2.67 optional
- Pressure-limiting valve adjustment setting
- Control pressure sensitivity adjustment
- Maximum air flow test
- Temperature test
- Blow-down test
- Speed calibration test

4. Pressure-Limiting Valve Adjustment Setting – Reference drawing DCM1002

4.1. This test is designed to set the maximum air pressure limiting control to 150 psi. The water pump pressure determines how much pressure the air compressor will produce.

4.2. The water pump pressure must be increased to at least 160 psi.

4.3. Open the air flow valve slightly. Flow approximately 40–50 cfm.

Darley

4.4. The pressure-limiting valve, normally bracket-mounted to the pump discharge head, has a threaded adjustment screw with a locking nut to hold the setting in place. First loosen the lock nut. The threaded bolt must be turned in clockwise to raise the governed pressure and counterclockwise to lower the pressure. Adjust the air pressure to a governed maximum factory setting of 150 psi. Tighten the lock nut.

4.5. Close the air flow valve to verify that the compressor stays at 150 psi. Re-open the valve to flow over 100 cfm then close it again. Verify that the air compressor stays at 150 psi.

5. Control Pressure Sensitivity Adjustment – Reference drawing DCM1002

5.1. This test is designed to set the sensitivity of the air pressure balancing system.

5.2. It is important to properly adjust the needle valve, which is bracket-mounted to the pump discharge head. The needle valve's function is to dampen the control pressure bleed-off line, reducing modulator sensitivity. As a result, the inlet valve will respond slower to pressure change, thus reducing modulator pulsation. If it is set too far in or closed (clockwise rotation), no pressure modulation will take place. If it is open too far (counterclockwise rotation), pressure fluctuations will go unnoticed and pressure spikes will be unavoidable. For example, when a CAFS discharge is closed at the nozzle, pressure may build until the pressure relief valve releases at 200 psi. Should the needle valve need adjustment, use the following as a guide. Start by closing the valve (4) completely. Then open it approximately 3 turns. Operate the unit at around 125 psi; begin by flowing about 1/3 the capacity of the air compressor. At this flow rate, the air inlet modulator valve will open to bring in air and then close as air pressure builds. The goal is to set the needle valve at a position where pressure fluctuations are minimized. If the air pressure gauge is fluctuating more than 20 psi above or below the water pressure, then the needle valve should be adjusted out or counterclockwise. As the pressures come closer to balancing, less flow meter fluctuation should also be noticed. Note: Some pressure modulation is normal and required for the system to auto-balance while delivering compressed air foam system (CAFS). Expect pressure variation to range from 5–20 psi. Pressure fluctuations should be pulsing at the beat of at least 1 per sec but no more than 20 in a 10-sec period.

6. Air Flow Test

The air flow test is performed to verify that the system can flow at least 220 cfm of air at 125 psi.

NOTE: *The water pump will commonly need to be flowing at least 500–1,000 gpm to keep both the air compressor and the water pump both operating at 125 psi.*

6.1. To test the air flow capability of the unit, start by running the pump at approximately 140 psi. This will be approximately 3,200/pump ratio rpm (1,300 rpm for 2.44:1 ratio). The desired goal is to try to find the lowest RPM required flowing 220 cfm and at least 450 gpm all while both the air compressor and the water pump are at 125 psi. Commonly water flow is required to be higher than 450 gpm due to the necessary reduction of the pressure of the pump. Open at least 2 of the pumps 2-1/2 in. discharges until the water pump pressure is 125 psi. Begin to flow the air by opening the air flow valve until the air pressure begins to drop below 125 psi. Slowly close the air discharge valve raising the air pressure back to 125 psi. This will be the maximum air flow of the unit at this RPM. If the airflow is not at least 220 cfm, higher RPM may be needed to attain this rating.

6.2. Record air and water flow and pressure along with input RPM and power requirement on the pump test sheet.

7. Operating Temperature Test

The operating temperature test can be performed during the maximum air flow test.

7.1. To test the operating temperature of this system, you will need to operate the air compressor at over 150 cfm at 70–75º F ambient temperature for at least 10 mins, to check that the thermostatic valve in the oil filter assembly is working properly. The lubricating/cooling oil in the oil reservoir, if 170º F or less, travels through the oil filter before going to the air compressor. If the oil temperature is higher than 170º F, the thermostatic valve in the oil filter mounting block will redirect the flow of oil through the heat exchanger before entering the opposite side of the oil filter housing and then onto the air compressor.

7.2. The oil temperature should not exceed 170º F by more than 20º or it may indicate a limited flow, or high-temperature water flow through the heat exchanger. There is a high-temperature over-heat warning message for both the air compressor and the clutch on the AutoCAFS Commander.

7.3. Observe and record the compressor temperature on the test sheet.

7.4. Using the infrared temperature sensor, measure the clutch temperature. The normal temperature range is 110–125° F. The upper limit is 135° F.

7.5. Using the infrared sensor, measure the outboard pump bearing cap. The normal temperature range is 180–200° F. The upper limit is 210° F.

7.6. Observe the fan to confirm the air flow direction is from the rear screen opening forward over the clutch and belt.

7.7. If the compressor temperature rises above the normal operating temperature to 212° F, the compressor 'COMP HOT' warning will flash on the Commander display. If temperature warning is indicated, shut down the compressor as soon as practical by depressing the "On/Off" button for 2 sec. The compressor can be switched off (DISENGAGED) at any time or input speed. Check for adequate water flow through the heat exchanger. Check for adequate oil level in the separator tank. See troubleshooting guide for further options.

NOTICE

If the air compressor temperature continues to rise to 240° F, the air compressor will be automatically disengaged.

8. System Blow-Down

8.1. After compressor shutdown, the system pressure is bled off to guard against overloading the drive components at start-up. If the receiver assembly is not depressurized on shutdown, oil will flood the compressor, filling the area above the screws. Oil trapped above the screws will then cause a hydraulic lock-up when the compressor rotation rapidly accelerates during start-up. A hydraulic lock-up of this type can induce extreme loads on the power train. Refer to the instruction manual for a detailed explanation of the blow-down process.

8.2. fter compressor clutch disengagement, observe the test gauge mounted on the separator tank below the safety relief valve. Record the time it takes for the system pressure to bleed down to 0 psi. The system should blow down in 1 min or less.

8.3. Confirm that the clutch exhibits minimal drag when disengaged. With the pump idling and the clutch disengaged, observe that the compressor belt is not moving.

9. Speed Protection

9.1. Speed control is included in the compressor engagement circuit. The AutoCAFS Commander has been calibrated by the apparatus manufacturer to allow compressor engagement only at engine speeds below 900 rpm and allows for a maximum compressor operating speed. RPM signal for the speed control needs to be wired to the data bus. Refer to *AutoCAFS Commander Operation and Installation Reference on page 112* for further details on the AutoCAFS Commander control module.

9.2. To verify complete system, switch off the compressor ENGAGED switch, raise the engine RPM above 900 rpm, and switch the compressor on; the clutch connector should not be energized. Reduce the engine throttle to below 900 rpm; the clutch connector should be energized. Raise the RPM to above high limit and power to the connector should be de-energized. Reduce RPM and the power should remain off until the RPM is below the low limit setpoint and blow-down is achieved. Adjust if required using the AutoCAFS Commander programming sheet as a guide.

9.3. Shut down the pump and engine.

NOTICE

Avoid immediate restart of the air compressor after shutdown. Allow 1 minute minimum time period between the air compressor shutdown and restart for system blow-down.

10. If the unit being tested has performed as stated and conforms to the test requirements, then the system is ready for delivery.

11. After shutdown, thoroughly drain water from the compressor heat exchanger and feed lines.

12. Visually inspect the belt for adjustment and tracking. The belt adjustment can be checked by pushing a 1/8-diameter rod through the cover perforations on the middle of the belt span width. As a guide, a 22-lb force in the middle of the belt span should deflect the belt approximately 3/16 in.

13. Confirm that all control tubes are bundled and wire-tied in a neat and orderly fashion.

Detailed Specifications

When preparing specifications for a new compressed air foam-equipped apparatus, use the following technical specifications to assure that your apparatus will be equipped with the most advanced CAFS system available, Darley AutoCAFS II.

SINGLE-STAGE FIRE PUMP – CAFS COMPATIBLE

The pump shall be a Darley LDMBC single-stage fire pump, capable of a water flow rating from 1,000 to 1,750 gpm.

Power to drive the pump shall be provided by the same engine used to propel the apparatus. The pump shall be midship mounted and designed to operate through an integral transmission, including a means for power selectivity to the driving axle or to the fire pump.

The pump casing shall be a fine-grain cast-iron alloy, vertically split, with a minimum 30,000 psi tensile strength and bronze fitted.

The pump shall contain a cored heating jacket feature that, if selected, can be connected into the vehicle antifreeze system to protect the pump from freezing in cold climates.

The impeller shall be a high-strength bronze alloy of mixed flow design, accurately balanced and splined to the pump shaft for precision fit and durability. The impeller shall feature a double-suction inlet design with opposed volute cutwaters to minimize radial thrust.

The seal rings shall be renewable, double-labyrinth, wraparound bronze type.

The pump shaft shall be precision-ground stainless steel with long-wearing chromium oxide hard coating under the packing glands. The shaft shall be splined to receive broached impeller hubs, for greater resistance to wear, torsional vibration, and torque imposed by the engine.

A stuffing box shall be provided and shall be of the plunger injection style, utilizing a plastallic composite packing equalizing pressure around the shaft. Packing shall be renewed by removing the plunger, inserting the packing, and reinstalling the plunger. This packing design shall be provided to minimize friction, heat generation, and apparatus downtime. This feature is designed to allow replacement and/or adjustment of packing within a 15-min time period.

Due to the advantages of the above packing feature, rope or braid type packing gland designs are not acceptable.

The bearings provided shall be heavy-duty, deep-groove, radial type ball bearings. They shall be oversized for extended life. The bearings shall be protected at all openings from road dirt and water splash with oil seals and water slingers.

The transmission case shall be heavy-duty cast-iron alloy with adequate oil reserve capacity for low operating temperatures. The transmission case shall contain a magnetic drain plug for draining the gearcase oil and a dipstick for checking and filling the level of the gearcase through its opening. The transmission shall also allow the use of an external heat exchanger for increased cooling under extreme conditions.

The pump driveshaft shall be precision-ground, heat-treated alloy steel, with a minimum 2-1/2 in. x 10 in. splined ends. Gears shall be helical design, and shall be precision cut for quiet operation and extended life. The gears shall be cut from high-strength alloy steel, carburized, heat-treated, and ground. The gear face shall be 2-3/8 in. minimum.

The gearshift shall be a heat-treated alloy steel splined spur gear to engage either the pump drive gear or the truck drive shaft gear. The pump and apparatus manufacturer's engineering department shall select the gear ratio of the pump.

Due to the advantages of the above gear and drive feature, chain drive and designs requiring additional lubrication are not acceptable.

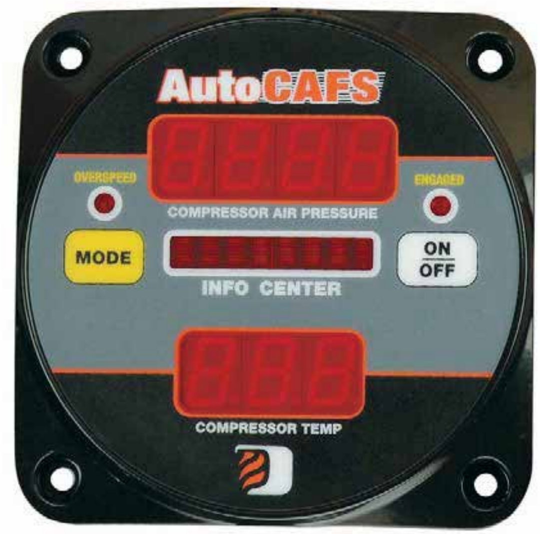
A discharge manifold, as supplied as part of the pump by the pump manufacturer, shall include a discharge check valve assembly to allow priming of the pump from draft with discharges open and caps off. No exceptions.

Due to the importance of the above discharge manifold and check valve assembly intended to be included with the overall pump design, there shall be no exception allowed to this requirement.

The discharge outlets shall have extensions with companion flange openings to allow ease of service. Two ports shall be provided on a pump panel for testing of vacuum and pressure readings. A weather-resistant Performance Data Plate shall be installed on a pump panel.

The pump priming system, heat exchanger system, discharge and suction valves, relief valves, pump shift, and master drain shall be as detailed elsewhere in these specifications.

Two manuals covering the fire pump, pump transmission, and selected options of the fire pump shall be provided with the apparatus.



CAFS COMPATIBLE

The pump transmission shall be designed to accommodate an integrated air compressor mounting bracket. This bracket shall be installed to properly align a rotary screw air compressor with an external sprocket driven by the pump transmission.

The air compressor shall be driven using a Gates “Poly Chain GT” belt drive system.

The air compressor drive sprocket shall be supplied with an electric multi-plate industrial clutch, providing engagement at idle and disengagement at any RPM. The AutoCAFS shall be supplied with the “Commander” control and instrumentation system. The AutoCAFS Commander display shall include a digital air pressure, oil temperature, and RPM display. A mode button can be used to display air flow (if so equipped) and total air compressor system hours. The system shall incorporate an automatic, high CAFS oil temperature shutdown to avoid damage to the rotary screw air compressor. The system also provides electronic protection to prohibit air compressor engagement if engine rpm is higher than recommended and also features blow-down protection.

AUTOCAFS – COMPRESSED AIR FOAM SYSTEM

DESCRIPTION

This fire apparatus shall be equipped with a high-energy, automatic compressed air foam system (AutoCAFS).

RATINGS

The fire pump and air compressor shall be sized to provide at least 220 cfm (cubic feet per minute) of compressed air while simultaneously flowing at least 440 gpm (gallons per minute) of water flow. The pressure of the system shall be set at 125 psi for the duration of this test as outlined in the National Fire Protection Association (NFPA) document 1906. This rating is consistent with the NFPA recommendation that the water pump shall discharge 2 gal of water for every 1 cfm of compressed air discharge. Fire pumps with UL ratings in excess of 1,000 gpm commonly flow near capacity while simultaneously operating the air compressor at full output.

COMPONENTS

The air compressor shall be high-quality, industrial-rated, modulating, continuous-duty, and of rotary screw design. The air compressor shall be mechanically driven by the main pump and shall be so designed as to provide optimum performance at 70% of rated engine RPM. The air compressor drive train shall provide a means to engage and disengage the air compressor as required.

The air compressor system shall include a pressurized oil lubrication system, oil reservoir with receiver/separator element, oil filter, inlet air filter, and modulating air inlet control. The air compressor shall be provided with a pressure control system to automatically balance the air pressure to the water pressure. The air compressor inlet valve shall open and close to provide the air flow desired while maintaining the air system pressure to the water pump pressure to within 5 psi differential. This balancing system is essential for safe operation of a compressed air foam system.

The air compressor lubrication system shall require cooling water to be supplied from the fire pump through a brazed plate-type heat exchanger to cool the air compressor oil. The water flow to this oil cooler shall be supplied using a flushed strainer system to ensure a consistent flow of cooling water. The oil temperature shall be thermostatically controlled to remain at a consistent operating temperature within a range from 170° F to 180° F.

PANEL-MOUNTED CONTROLS

The air compressor system shall have mounted on the operator's control panel an AutoCAFS Commander control that displays all pertinent CAFS information including air compressor pressure, CAFS oil temperature, and system RPM. The Commander also provides the necessary temperature warning and shutdown, RPM protection, and blow-down related safety systems.

Gauges and controls shall be positioned and clearly marked so as to provide simple and easy operation.

Each of the components of this Automatic Compressed Air Foam System (air compressor, drive system, foam proportioner, and control and instrumentation system) shall be sized, driven and installed to produce a well operating and reliable CAFS unit.

The compressed air foam system (AutoCAFS) shall be completely installed and tested by the fire pump manufacturing facility before delivery. No exceptions.