Peerless Pump Company
A member of the Sterling Group

1050 South Milford Road
Suite 201B
P.O. Box 643
Highland, MI 48031
Telephone: (313) 887-0500
FAX: (313) 887-0692

INSTALLATION AND OPERATING INSTRUCTIONS

PUMP SERIAL # 463002

IMPORTANT - DO NOT DESTROY

LEAVE INSTRUCTIONS WITH USER FOR FUTURE REFERENCE.

Peerless Pump
A Sterling Company

HORIZONTAL FIRE PUMPS
OUTLINE — ENGINE DRIVEN

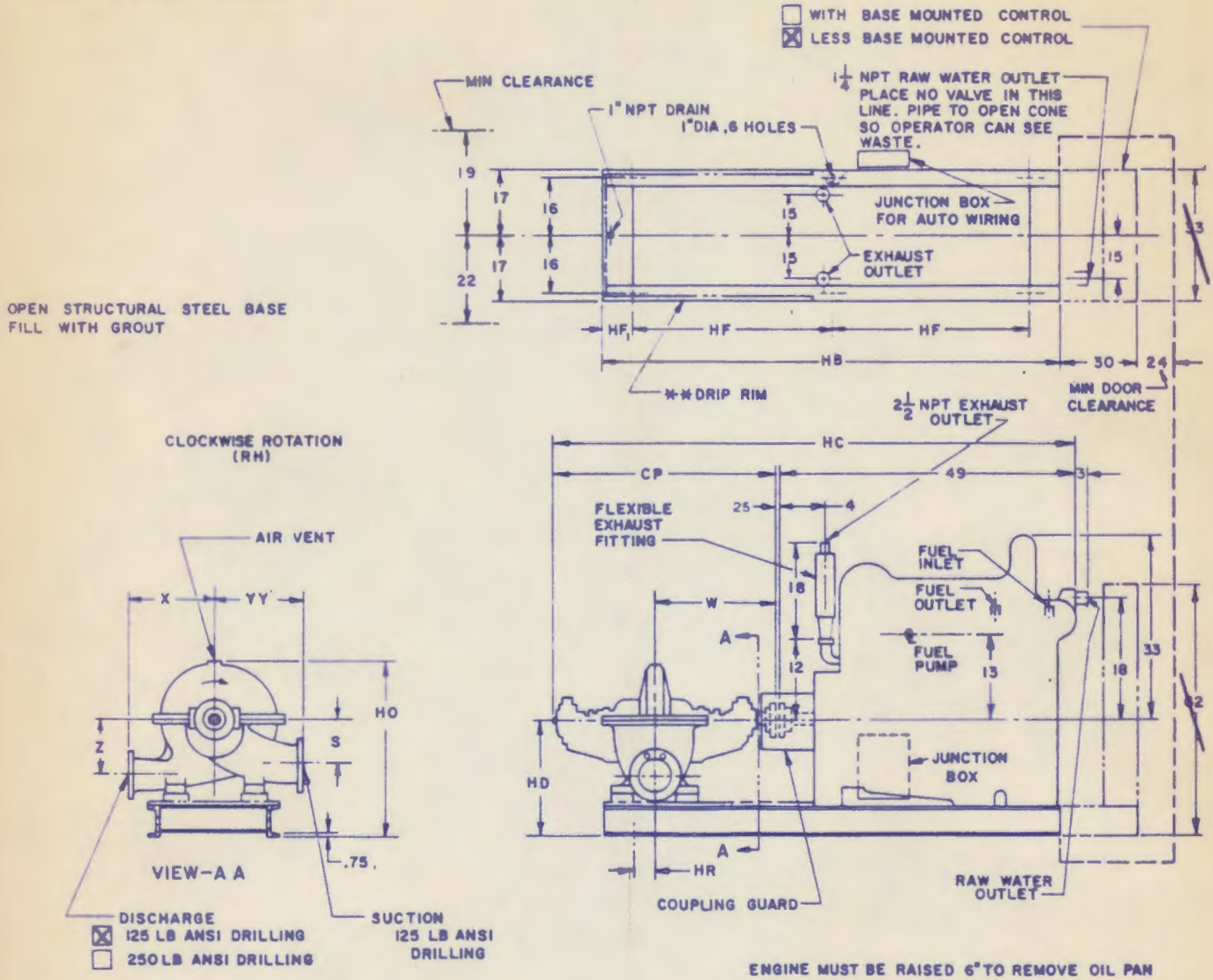
CATERPILLAR DIESEL ENGINES 3208 DINA (175), 3208 DINA (210)

X	Pump Model	Flange Size (Flat Faced)		Pump Dimensions						Pump Weight Lbs.
		Suction	Discharge	CP	S	W	X	YY	Z	
	5AEF11	6	5	29.0	6.75	16.00	12.00	13.00	6.75	380
	4AEF10	5	4	28.0	6.50	16.00	11.00	11.00	6.50	315
	5AEF14	6	5	30.75	7.00	17.25	14.00	13.00	8.50	505
	6AEF10	8	6	28.25	7.50	16.00	10.25	13.00	6.75	450
X	4AEF12	5	4	28.0	6.50	16.00	10.25	12.50	7.75	376
	~~6AEF12~~	~~6~~	~~6~~	~~33.75~~	~~7.00~~	~~19.00~~	~~12.00~~	~~18.50~~	~~8.25~~	~~750~~
	5AEF8	6	5	29.25	5.75	16.38	12.00	12.00	5.75	315
	6AEF14	8	6	31.25	9.00	17.50	14.50	16.00	9.50	610
	6AEF16	8	6	33.75	9.00	18.75	18.00	16.00	10.75	690
	8AEF15	10	8	33.75	9.00	19.00	16.00	17.69	10.0	850
	8AEF13	10	8	31.75	10.0	17.75	18.0	17.0	10.0	752

X	Engine Model	Pump Model	Unit Dimensions							Approximate Weight Lbs.				
			HB	HC	HD	HF	HF1	HO	HR	Base	Engine	Control	Complete Unit Less Control	Complete Unit With Control
	3208 DINA(175)	5AEF11	64	78.25	23.0	26	6	31	2	375	1800	600	2555	3155
	3208 DINA(175)	4AEF10	64	77.5	23.0	26	6	31	2	375	1800	600	2490	3090
	3208 DINA(175)	6AEF10	64	78	22.5	26	6	31	2	375	1800	600	2625	3225
	3208 DINA(175)	5AEF14	68	80	23.0	28	6	32.5	4	400	1800	600	2705	3305
	3208 DINA(175)	6AEF12	70	83	23.0	29	6	33	4	400	1800	600	2840	3440
X	3208 DINA(175)	4AEF12	64	77.5	23.0	26	6	30	2	375	1800	600	2551	3151
	~~3208 DINA(175)~~	~~6AEF14~~	~~70~~	~~81~~	~~23.25~~	~~29~~	~~6~~	~~34~~	~~5.5~~	~~400~~	~~1800~~	~~600~~	~~2910~~	~~3440~~
	3208 DINA(175)	6AEF16	70	83	25.0	29	6	33.5	4.5	400	1800	600	2890	3490
	3208 DINA(175)	8AEF13	68	81	25.0	28	6	36	4	400	1800	600	2952	3552
	3208 DINA (175)	5AEF8	64	78.5	23.0	26	6	29	2	375	1800	600	2490	3090
	3208 DINA(210)	8AEF13	68	81	25.0	28	6	36	4	400	1800	600	2952	3552
	3208 DINA(210)	6AEF12	70	83	23.0	29	6	33	4	400	1800	600	2840	3440
	3208 DINA(210)	8AEF15	70	83	25.0	29	6	36.75	4.5	400	1800	600	3100	3700

Note: Some suction or discharge flanges will be cast 250 Lb. ANSI Standard and drilled either 125 Lb. or 250 Lb. ANSI Standard (As indicated on outline drawing marked [X]).

SEE ATTACHED DRAWINGS



ENGINE MUST BE RAISED 6" TO REMOVE OIL PAN

FUEL INLET & FUEL OUTLET ARE ⅜ MALE TUBE FITTINGS 45° FLARE, ⅞—14 UNF THREADS

☐ STEEL DRIP RIM BASE FURNISHED (** SHOWN IN PHANTOM LINE _____)

☒ STEEL NON-DRIP RIM BASE FURNISHED

CUSTOMER BEHR INDUSTRIAL EQUIPMENT JOB NAME _____

P.O. NO. 19650 ITEM NO. _____

S.O. NO. PH832543 SERIAL NO. 463002

PUMP TYPE & SIZE 4AEF12 RPM 3000 G.P.M. 750 TOTAL HD. FT. 277

CERTIFIED FOR ☐ APPROVAL ☒ CONSTRUCTION BY R Morgan DATE 3-19-90

☐ UL ☒ FM LISTED

Subject to change unless certified for construction.

4852182-B

Peerless Pump
A Sterling Company

HORIZONTAL OR VERTICAL FIRE PUMPS

Diesel Engine Driven Units

ENGINE DATA

CATERPILLAR ENGINE MODEL 3208 DINA (175)

Cylinders 8, Block-V Type, Cycle-4, Compression Ratio: 16.5 to 1, Aspiration: Natural, Bore: 4.5 In., Stroke: 5.0 In., Cu. In. Displacement: 636.

ITEM	1760 RPM	2100 RPM	2300 RPM	2400 RPM	2600 RPM	2800 RPM	3000 RPM
UL-FM Listed HP. (@ 60° F. [25° C.], 300 Ft. Elevation)	121	141	150	156	160	165	160
Air for Combustion, C.F.M. (@ 60° F. [15.6° C.])	272	318	343	353	378	396	416
Heat Rejection to Air, BTU/Min.	626	739	796	796	853	853	905
Max. Fuel Consumption, G.P.M.	.097	.117	.128	.135	.140	.152	.162
Lube Oil, Quarts	20	20	20	20	20	20	20
Waste Water, G.P.M. (Min.)	12	12	12	12	12	12	13
Cooling System Capacity, Gallons	13	13	13	13	13	13	13

Electric System, 24V, Neg. Ground, Jacket Water Heater 2250 Watts.
Air Cleaner, Dry Type.
Governor, Mechanical.
Exhaust, 2½ In. NPT, Qty. of 2; Water Cooled, (Maximum Back Pressure 1.98 In. Hg).
Lube Oil, Filter & Cooler with Bypass.
Fuel Oil Filter, One Element Type.
Starter, Alternator, Regulator.
Heat Exchanger Suitable for Fresh or Salt Water, 1¼ In. NPT Outlet.
Instruments: Ammeter, Lube Oil Pressure Gage, Jacket Water Temp. Gage, Tachometer.
Hourmeter.
Stub Shaft 2¾ In. Dia. x 4 In. Usable Length.
Overspeed Switch, Low Oil Pressure Switch, High Water Temp. Switch, Dual Starter Contactors, all wired to an 11 Terminal Junction Box for Direct Connection to an UL-FM Listed Dual Battery Automatic Engine Controller.
Raw Water Cooling System including, Pressure Regulator, Strainers, Solenoid Valve - Furnished on Horizontal Pumps only, Shut-Off Valves and Manual By-Pass Valve. Factory installed Piping from Pump Discharge to Engine Heat Exchanger on Horizontal Pumps Only.

This system will maintain an engine block temperature of 170° F (76.7° C.), based on the following conditions:

1. Cooling water must be free of contamination.
2. Cooling water temp. must not exceed 70° F. (21.1° C.).
3. Waste water piped to atmosphere (no back pressure).

COUPLING

Engine shaft will be connected to the pump shaft of a horizontal pump with a factory choice flexible coupling.
Engine shaft will be connected to the gear shaft of the vertical pump with a factory choice, universal drive shaft.

NOTE: THE TEMPERATURE OF THE PUMP ROOM MUST NEVER BE LESS THAN 40° F. (4.4° C.).

FILE 4851656
Rev. 12-88

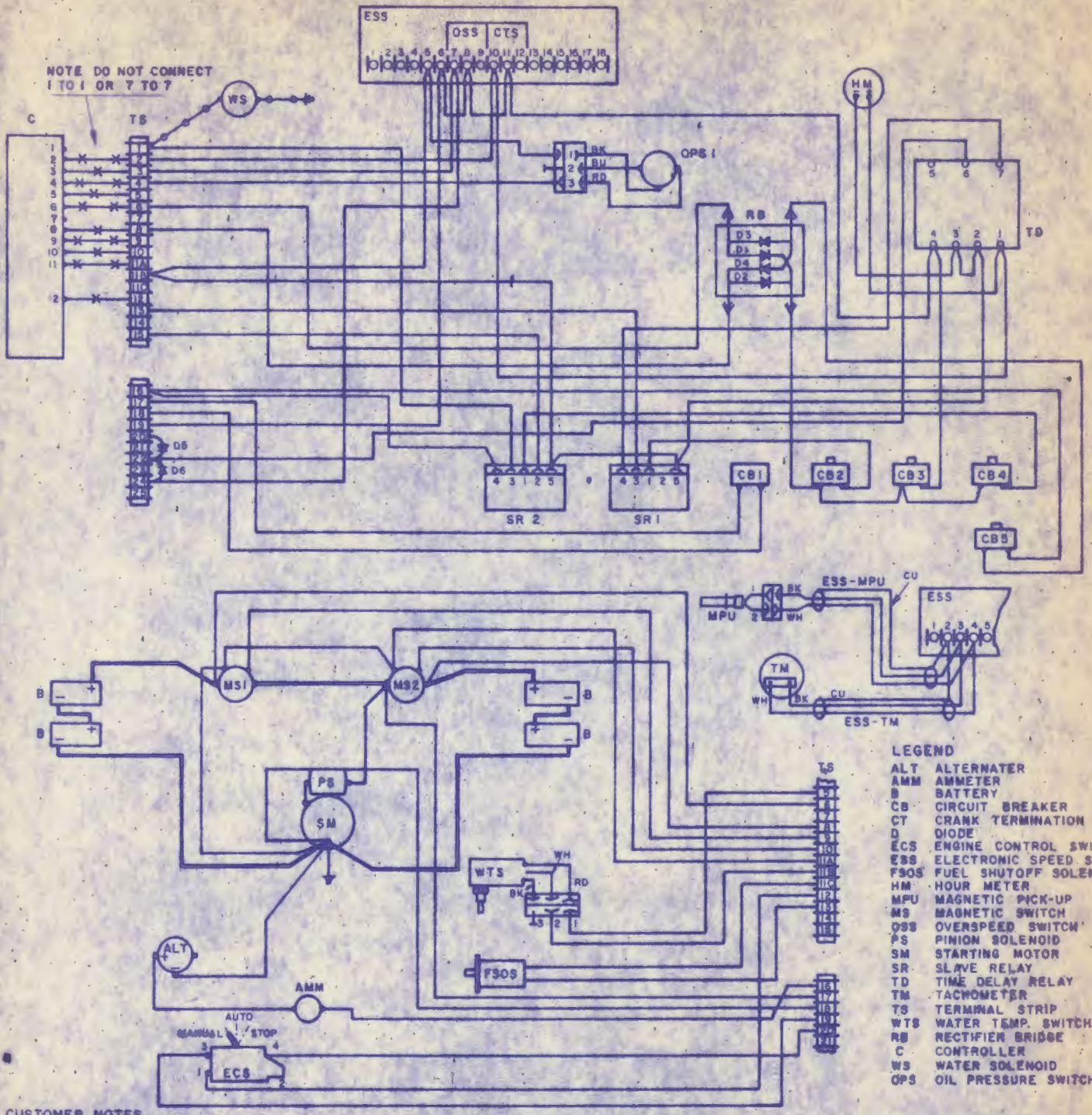
Peerless Pump Company

HORIZONTAL OR VERTICAL FIRE PUMPS

DIESEL ENGINE DRIVEN UNITS

WIRING DIAGRAM LESS MANTROL
DUAL BATTERY AUTOMATIC SYSTEM

THIS WIRING DIAGRAM FOR USE WITH 24 VOLT,
NEGATIVE GROUND CATERPILLAR ENGINE
MODEL (3208 175, 210, ~~DIT~~, DINA) (~~3306B DIT, DITA~~) (~~3406B DIT, DITA~~)



LEGEND

ALT	ALTERNATER
AMM	AMMETER
B	BATTERY
CB	CIRCUIT BREAKER
CT	CRANK TERMINATION
D	DIODE
ECS	ENGINE CONTROL SWITCH
ESS	ELECTRONIC SPEED SWITCH
FSOS	FUEL SHUTOFF SOLENOID
HM	HOUR METER
MPU	MAGNETIC PICK-UP
MS	MAGNETIC SWITCH
OSS	OVERSPEED SWITCH
PS	PINION SOLENOID
SM	STARTING MOTOR
SR	SLAVE RELAY
TD	TIME DELAY RELAY
TM	TACHOMETER
TS	TERMINAL STRIP
WTS	WATER TEMP. SWITCH
RB	RECTIFIER BRIDGE
C	CONTROLLER
WS	WATER SOLENOID
OPS	OIL PRESSURE SWITCH

CUSTOMER NOTES

1. BATTERIES AND BATTERY CABLES MARKED ——
   ☒ WILL BE FURNISHED FOR THIS JOB
   ☐ WILL NOT BE FURNISHED FOR THIS JOB
2. WATER SOLENOID FURNISHED FOR HORIZONTAL PUMP APPLICATION ONLY.
3. WIRING BY CUSTOMER MARKED —+—+— THIS WIRE SIZE TO BE NO SMALLER THAN 10 GA. FOR A LENGTH NO GREATER THAN 25 FEET (NOTE THIS WIRING BY PEERLESS IF CONTROLLER IS MOUNTED ON PUMP BASE)
4. SEE CONTROLLER INSTRUCTION BOOK FOR ADDITIONAL INFORMATION.

PEERLESS ASSEMBLY DEPARTMENT NOTES

(A) WIRING BY ENGINE MANUFACTURER MARKED — — OR ——
(B) WIRING BY PEERLESS MARKED —•—•—
(C) BATTERY CABLES MARKED ——

8-89

4851866-C

REPAIR INSTRUCTIONS

TYPE AE PUMPS
PACKED

Read this entire bulletin

before attempting to repair this pump. For installation and operation refer to instruction bulletin 2880549. Properly installed, your Peerless pump will give you satisfactory, dependable service. We urge that you carefully read these step-by-step instructions, to simplify any problems of installation, operation or repair.

Failure to read and comply with installation and operating instructions will void the responsibility of the manufacturer and may also result in bodily injury as well as property damage.

This bulletin is intended to be a permanent part of your pump installation and should be preserved in a convenient location for ready reference. If these instructions should become soiled, obtain a new copy from Peerless Pump. Include pump model and/or serial number with your request.

These instructions are prepared for a pump with grease or oil lubricated bearings and mechanical seals in the stuffing boxes. Optional features are covered by separate instruction sheets which are furnished when the equipment supplied includes these features.

Model numbers used in Table I are for the commercial pumps. Listed and approved fire pumps have the letters "AEF" in place of "AE" in the model number. Many models have suffix letters in the model number. These suffix letters have been intentionally omitted from Table I. However, when ordering repair parts, provide the complete model number including suffix letters and the pump serial number; both are stamped on the pump nameplate.

Peerless Pump
A Sterling Company

4851938
Rev. 9/89

WARRANTY

New equipment manufactured by Seller is warranted to be free from defects in material and workmanship under normal use and service for a period of one year from date of shipment; Seller's obligation under this warranty being limited to repairing or replacing at its option any part found to its satisfaction to be so defective provided that such part is, upon request, returned to Seller's factory from which it was shipped, transportation prepaid. This warranty does not cover parts damaged by decomposition from chemical action or wear caused by abrasive materials, nor does it cover damage resulting from misuse, accident, neglect, or from improper operation, maintenance, installation, modification or adjustment. This warranty does not cover parts repaired outside Seller's factory without prior written approval. Seller makes no warranty as to starting equipment, electrical apparatus or other material not of its manufacture, since the same are usually covered by warranties of the respective manufacturers thereof.

In the event, notwithstanding the terms of this agreement, it is determined by a court of competent jurisdiction that an express warranty has been given by Seller to Purchaser with respect to the head, capacity or other like performance characteristics of said equipment, Seller's liability for breach of the same shall be limited to accepting return of such equipment F.O.B. plant of manufacture, refunding any amount paid thereon by Purchaser (less depreciation at the rate of 15% per year if Purchaser has used equipment for more than thirty (30) days and cancelling any balance still owing on the equipment.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED, AND SELLER SPECIFICALLY DISCLAIMS ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

WARNING

- Do not operate this pump at any pressure, flow rate, or liquid temperature other than those for which the pump was originally purchased. Do not pump any other liquid than the one for which the pump was originally purchased without the consent of Peerless Pump or its authorized representatives. Disregard of this warning can result in pump failure and serious personal injury or death.

SECTION I — DISASSEMBLY

Before starting disassembly of the pump, it is recommended that a set of spare parts as shown on page 8 be obtained. Peerless Pump does not recommend reuse of gaskets, O-rings, packing rings, or ball bearings.

Shut down pump. Disconnect power to the pump driver before starting any repairs. Refer to Bulletin No. 2880549 for the procedure to follow.

WARNING

1-1. Disengage the coupling halves. Refer to the coupling manufacturers' instructions.

1-2. PUMP. (See Figure 1.) Disassemble pump to the extent required as follows:

a. Remove the nuts from the gland bolts (17B) and remove packing glands (17) from the shaft (6). The packing gland halves are separable.

b. Remove all nuts or cap screws from the upper casing (1B) and from the bearing caps (41 & 43). Match mark bearing caps to lower casing (1A).

c. Use the jack screws (not shown) on the bottom side of the lower casing split flange to separate the upper and lower casings. Turn the jack screws back below the split flange surface to avoid reassembly interference.

d. Attach hoist to customer-furnished eye bolt in upper casing. Use eye bolt to lift upper casing only. Eye bolt must have ½-13 UNC external thread.

e. Place slings around the shaft near the bearing housings and lift rotating element from lower casing (1A). Tap lightly on the underside of the bearing housings to separate the housings from the brackets.

f. Place rotating element in a convenient work place.

1-3. ROTATING ELEMENT. Disassemble in the following manner:

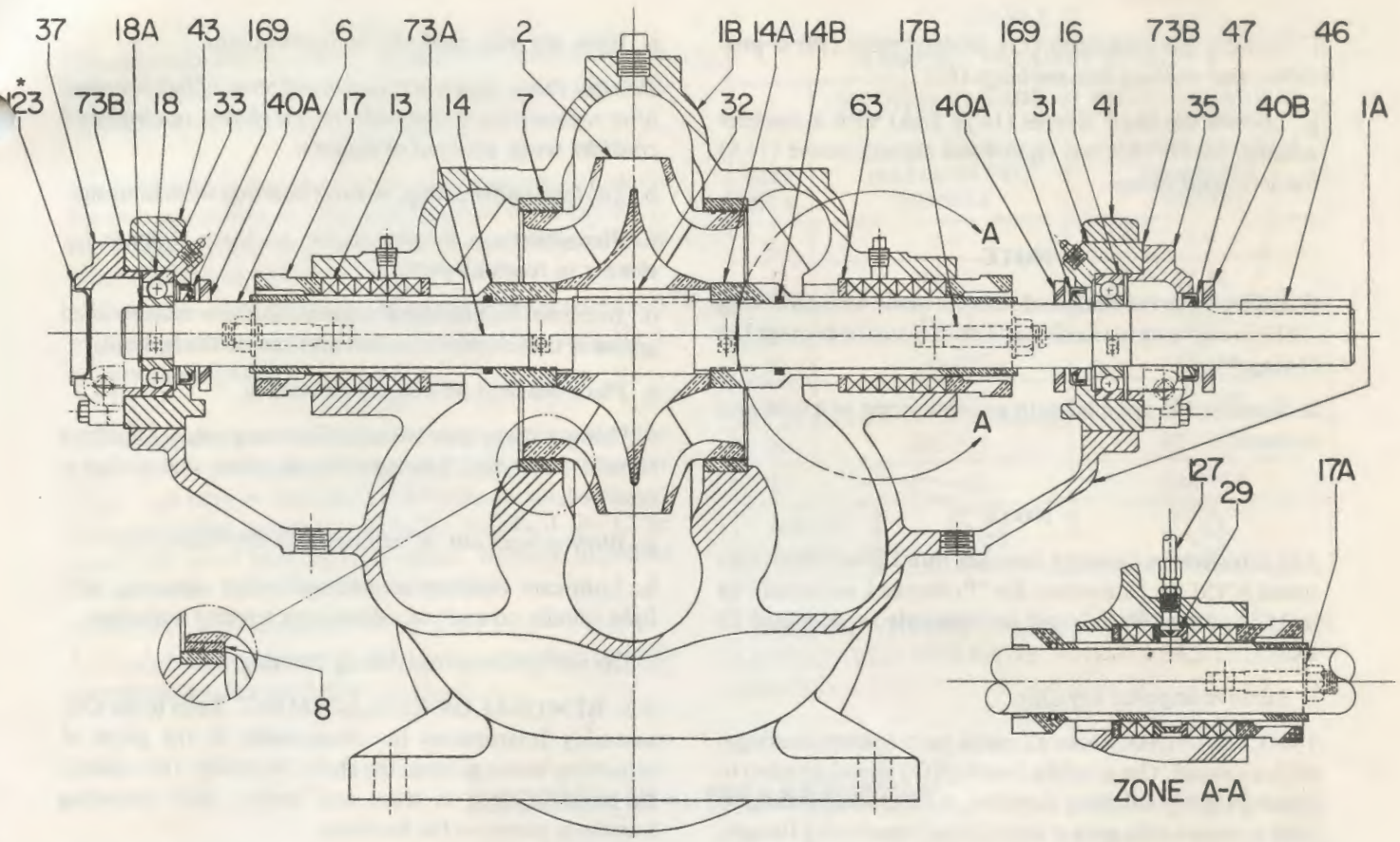
a. Loosen set screws and remove the coupling half. Tap from the back of the hub or use a puller. Remove coupling key (46), and outboard deflector (40B).

b. Take out cap screws to remove bearing covers (35, 37) and the gaskets (73B). Remove inboard bearing cover seal (47) from cover (35) only if replacement of seal is required.

c. Remove retaining ring (18A) from outboard end of shaft.

d. Remove housings (31 & 33), bearings (16 & 18), and bearing housing seals (169) as units with a bearing puller. Remove deflectors (40A).

e. Remove casing rings (7). On most pumps this may be done before removing the coupling half.



Item No.	Description
1A 1B	Lower Casing Upper Casing
2	Impeller
6	Shaft
7	Casing Ring
8	Impeller Ring (Optional)
13	Packing Ring
14, 14A	Shaft Sleeve
14B	Shaft Sleeve O-Ring
16	Inboard Ball Bearing
17	Packing Gland
17A	Gland Clip (when used)
17B	Gland Bolt
18	Outboard Ball Bearing
18A	Bearing Retaining Ring
29	Lantern Ring (Optional)
31	Inboard Bearing Housing

Item No.	Description
32	Impeller Key
33	Outboard Bearing Housing
35	Inboard Bearing Housing Cover
37	Outboard Bearing Housing Cover
40A	Inboard Deflector
40B	Outboard Deflector
41	Inboard Bearing Housing Cap
43	Outboard Bearing Housing Cap
46	Coupling Key
47	Inboard Bearing Cover Seal
63	Stuffing Box Bushing
73A	Casing Casket (Not Shown)
73B	Bearing Cover Gasket
123	Bearing End Cover *
127	Water Seal Piping (Optional)
169	Bearing Housing Seal

FIGURE 1

*** For oil lubricated construction, bearing end cover (123) is gasketed to the outboard bearing housing cover (37) with a silicone gasket material such as loctite superflex ultra blue.**

f. Remove packing rings (13), lantern rings (29) if provided, and stuffing box bushings (63).

g. Loosen the shaft sleeves (14 & 14A) with a spanner wrench. Sleeve (14) has right-hand thread, sleeve (14A) has left-hand thread.

NOTE

A seal between the shaft and sleeve is made with an O-ring (14B) in a groove in the sleeve. Use care not to damage the O-ring.

h. Remove the impeller with an arbor press or a tube and hammer.

NOTE

The interference between impeller hub ID and shaft OD meets ANSI B4.1 standards for "Preferred Limits and Fits for Cylindrical Parts" and corresponds to standard fit LC-1.

i. Remove impeller key (32).

1-4. CLEANING. Clean all metal parts (except bearings) with a solvent. Use a bristle brush (NOT metal or wire) to remove tightly adhering deposits. A fiber scraper may be used to remove the gasket and shellac from casing flanges.

a. Blow dry with clean dry compressed air.

Peerless Pump does not recommend reuse of ball bearings after removal from the shaft. If you choose to clean and consider reuse, proceed as follows:

b. To clean ball bearings, remove bearings from housings.

c. Place bearings in wire basket so there is space for cleaner to reach all parts.

d. Immerse in Stoddard solvent. Agitate basket until grease is thoroughly loosened and can be flushed out.

e. Place bearings on a screened surface.

f. Using a spray gun with air filter and clean Stoddard solvent, flush each bearing until all grease and sludge is removed.

g. Blow solvent out of bearings with dry filtered air.

h. Lubricate bearings immediately after cleaning with light spindle oil and place them in a covered container.

i. Do not spin bearings during cleaning.

1-5. REMOVAL OR REPLACEMENT. Refer to the Disassembly Instructions for disassembly to the point of removing bearings from the shaft. Normally, they should be removed only to clean and inspect after operating trouble is traced to the bearings.

SECTION II — INSPECTION AND REPAIR

2-1. INSPECTION. Visually inspect parts for damage affecting serviceability or sealing. Emphasize inspection of mating parts having relative motion — wear rings, for example. Perform detail inspection as follows:

a. Check O-rings and bearing cover gaskets for cracks, nicks or tears; packing rings for excessive compression, fraying or shredding, embedded particles (dirt or metal). Replace if defective in any way.

b. Mount the shaft between centers or on vee blocks. Check for eccentricity throughout entire length with a dial indicator; eccentricity must not exceed 0.003 inch total indicator reading. Check that threads are clean and sharp. Surfaces on which bearings mount must be smooth, have a finish of 32 microinches or better, and the shoulders square and free from nicks.

c. Measure the OD of the impeller wear surface or impeller ring (8) and the ID of the casing ring (7). Compute the diametrical clearance (ID minus OD) and compare with the limits given in Table I. If measured diametrical clearance exceeds two times values in Table I, repair to restore design clearance is recommended. ID surface of casing ring must be smooth and concentric with ring OD.

d. Examine impeller passages for cracks, dents, gouges or embedded material.

2-2. REPAIR. Make needed repairs in the following manner:

a. If ID of casing rings (7) is grooved, scored or eccentric, replace the casing rings.

b. If impeller wear surfaces or impeller rings (8) are defective, the impeller must be machined to install new impeller rings. Be sure machining is concentric with impeller bore. Use care NOT to reduce hub OD when machining off old impeller rings.

TABLE I

IMPELLER/CASE WEAR RING DIAMETRICAL CLEARANCE	
.015/.019	.018/.022
2AE11 3AE9 3AE14 4AE10 4AE11 4AE12 5AE8 5AE11 5AE12 5AE14 6AE10 6AE11 6AE12 6AE14 6AE16 6AE18 8AE12 8AE13 8AE15 8AE17 8AE20 10AE12 10AE14 10AE20	10AE16

NOTE

Clearances in Table I are for standard bronze or cast iron fitted pumps. For materials with a tendency to gall, such as stainless steel, increase clearances by .010 inch.

NOTE

For bronze impellers and rings, the rings are shrunk on the hub according to standard fit FN-4 of ANSI B4.1. Hardened impeller rings are installed according to ANSI B4.1 standard fit FN-1.

c. Install new impeller rings (8) on the impeller (shrink or press depending on material). The impeller ring ID is factory-machined for proper fit.

NOTE

Standard pumps are furnished without impeller rings; the wear surface is an integral part of the impeller. Impeller wear rings may be field-installed by machining. Refer to note following paragraph 2-2b for standard fits to be produced when making such repair. Replace impellers which cannot be salvaged by such repair.

e. Replace worn shaft sleeves.

f. Straighten or replace shafts having excessive run-out (eccentricity). See paragraph 2-1b.

TABLE II

SIZE INCH	TORQUE VALUE (FT.-LB.)* MEDIUM CARBON STEEL SAE J429 GRADE 5 105-120,000 PSI TENSILE	MEDIUM CARBON ALLOY STEEL SAE J429 GRADE 8 150,000 PSI TENSILE
¼	7-8	8-9
⅜	23-25	32-34
½	59-62	76-83
⅝	120-125	151-166
¾	210-225	268-295
⅞	305-325	433-477
1	421-465	648-715
HEAD SYMBOLS		

*TORQUE VALUES SHOWN ARE FOR CLEAN LUBRICATED THREADS; AND GASKETED JOINTS.

SECTION III — REASSEMBLY

3-1. ROTATING ELEMENT. (See Figure 1) Reassemble as follows:

a. Coat the shaft (6) lightly with oil.

b. Place impeller key (32) in shaft keyway.

c. Align impeller (2) on shaft and install with an arbor press or brass tubular sleeve and hammer. Guard against bending shaft. When assembled, the impeller vanes must rotate in the proper direction. (See Figure 3), and impeller hub must be centered on shaft journal.

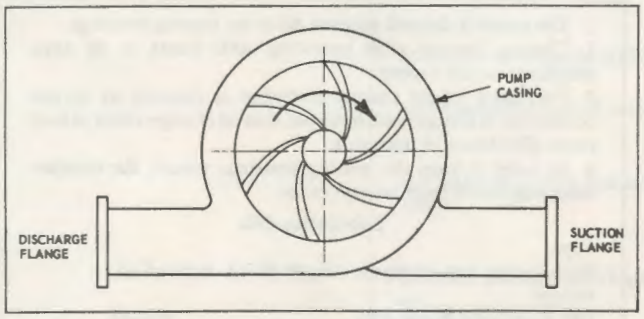


FIGURE 3. VANE POSITION FOR PROPER ROTATION

d. Coat shaft sleeve O-rings (14B) with oil and install in shaft sleeves (14 & 14A). Apply approximately 3 drops of Loctite 242 to sleeve threads on shaft, and tighten sleeves against impeller.

e. Install the stuffing box bushings (63).

f. Locate casing rings (7) on impeller.

g. Place inboard deflectors (40A) on shaft.

h. If previously removed, install bearing housing seals (169) into housings (31 & 33). Insert bearings (16 & 18), into housings (31 & 33).

i. Press housing-bearing-seal assemblies on shaft to seat bearings against shaft shoulders.

j. Install bearing retaining ring (18A) in groove against the outboard bearing.

k. Install gaskets (73B) on bearing covers. Use factory supplied parts or cut replacement gaskets from 1/16 inch No. 444 Vellumoid. (SAE P3415A). **EXCEPTION:** For all models using 3306 size outboard bearing, gasket 73B is 1/32 thick.

l. Attach inboard and outboard bearing covers (35, 37). In the assembled position, the grease drain tap must be located at bottom in a horizontal plane.

m. Install outboard deflector (40B), and coupling key (46); assemble coupling half on the shaft and tighten the setscrews.

3-2. PUMP. Complete the assembly of pump as follows:

a. Use factory supplied casing gasket (73A) or use the upper casing (1B) as a template to cut a casing gasket (73A) from 1/64 inch Vellumoid (SAE P3313B). It is very important that specified material and thickness be used for casing gasket. Machined surfaces of both casings must be perfectly clean and free from burrs and nicks.

b. Affix the new casing gasket to lower casing (1A) with shellac.

c. Use slings around the shaft near bearings to set rotating element into lower casing. Position the casing rings (7) and both bearing housings so that all dowel pins engage in slots in the lower case split surface.

d. Assemble both bearing caps per match marks and tighten the cap screws.

e. Adjust the shaft sleeves (14 & 14A) to center the impeller in the lower casing volute, and tighten both shaft sleeves with a spanner wrench.

f. Cover the top side of the casing gasket with a mixture of graphite and oil. Install the gland bolts (17B). Carefully locate the upper casing on the lower, making certain the dowel pins engage. Install cap screws and tighten working from the center of the casing to each end, to the torque values in Table II. If any cap screws require replacement, use only parts with equal or greater tensile strength. See Table II. Rotate shaft by hand to check that it turns freely.

g. Push the stuffing box bushings (63) to the rear of the stuffing boxes. Insert two packing rings, lantern ring (29) if provided, and three packing rings. Insert each ring separately and stagger the joints of successive rings 90°. Insert the packing glands (17) and set the gland bolt nuts finger tight — DO NOT USE A WRENCH.

h. Rotate shaft by hand to check that it turns freely.

i. Replace all drain plugs if removed during disassembly.

j. Relubricate the bearings. Refer to Table IV.

It is most important to provide proper lubrication and keep bearings clean. Frequency of lubrication must be determined by experience, as it depends upon bearing size, speed, operating conditions and environment. Table III should be used only as a guide for re-lubrication.

TABLE III
GREASING FREQUENCY
(See Table IV for amounts)

SERVICE	GREASE EACH
Normal, 8-hour day operation. Room free of dust and damaging atmosphere.	6 Months
Severe, 24-hour day operation. Room with moderate dust and/or damaging atmosphere, or outdoor service.	1 Month
Light, approximately 10-hour week. Room relatively free of dust and damaging atmosphere.	1 Year

TABLE IV
AMOUNT OF GREASE FOR BALL BEARINGS

OUNCES	GRAMS	BEARING SIZE
1	28	206/305
2	56	207/306
2¼	63	208/307
2½	70	210/308
3½	100	212/310
4½	128	213/311

GREASE SPECIFICATION:
Use Lithium soap base, worked penetration, meeting NLGI Grade 2 specifications. Minimum dropping point 355° F., operating temperature range of -10° F to 240° F. Obtain grease from your local supplier.

k. Oil. (Pumps are shipped without oil in the bearing housings.) Be sure to fill and adjust constant level oilers before initial start of pump.

(1) Adjust dust cap to lowest possible position on base fittings.

(2) The pipe nipple and base fitting must be level; check with spirit level. If pipe nipple is bent, replace it. A constant level oiler that is not level will not provide proper lubrication to the bearings.

(3) Fill bottle, screw it into the dust cap as far as it will go — do not force. Allow the oil to flow into the bearing housing. Repeat this procedure until there remains a supply of oil in the bottle. Nevel fill bearing housing through base fitting.

(4) Check the breather tube for cleanliness. The breather tube must be used with the oil lubrication system.

(5) The bottle on the constant level oilers is made of plastic, and it will be damaged by oil temperature over 170° F or solvents such as alcohol. For these conditions, use a glass bottle.

LUBRICATING INSTRUCTIONS

1. The pump is shipped without oil in the bearing housings.
2. Change first oil after operating 1000 hours or 60 days, whichever occurs sooner.
3. Frequency of oil change thereafter is dictated by service conditions. It is suggested, however, that oil changes occur at least every 3000 hours of operation.
4. In order to keep the bearing housings vented, the breather tubes and filters must be kept clean.

Lubricating Oils

Type:
High quality non-detergent straight H.V.I. mineral oil
Weight:

Brg. Operating Range (°F)	Weight
0 - 150	150 SSU at 100° F
150 - 200*	300 SSU at 100° F
200 - 250*	500 SSU at 100° F

*Maximum oil temperature in plastic oiler bottle 170° F

l. Consult the driver manufacturer's Maintenance instructions for lubricants and relubrication procedures for the driver bearings.

3-3. TROUBLES. To reliably establish the performance of either the pump or driver, instruments such as tachometers, pressure gauges and electric meters must be in proper working condition and preferably of recent calibration. In many cases, much time and expense have been expended with faulty instruments. Table VI lists a number of troubles commonly occurring. If unable to determine the cause, and remedy the trouble from this list, refer the problem to the Peerless Pump representative.

TABLE VI

TROUBLES

TROUBLE	PROBABLE CAUSE	REMEDY
Overload on driver	Pump speed high.	Motor voltage higher than name plate rating will cause the motor to run faster. Either reduce motor voltage or trim impeller diameter. On other drives, reduce speed if possible. If speed reduction not realized, trim impeller diameter.**
	Total head lower than rating.	Check suction and discharge pressures and determine the total dynamic head. If TDH lower than ratings, throttle discharge to rated TDH or, if this is not possible, reduce impeller diameter.**
	Tight packing.	Stop pump – follow proper repacking procedure. Check for scored sleeve; and for sleeve run-out if packing wears rapidly. Replace sleeve and packing as required.
	Liquid is of higher specific gravity or viscosity than rating.	Check with Peerless distributor to determine if a larger motor is required.
	Mechanical trouble of pump or driver.	See if pump and motor turn freely. Check impeller fit, shaft straightness and ball bearings.
Pump vibrates or is noisy	Driver unbalanced.	Disconnect driver and operate it alone. Check pump for large pieces of debris, such as wood, rags, etc.
	Misalignment.	Realign pumping unit.
	Cracked foundation.	Replace foundation.
	Worn ball bearings.	Replace bearings. Check lubricants for proper grade. Check pump alignment.
Failure to deliver liquid or sufficient pressure	Pump not primed.	Reprime.
	Pump not up to speed.	Check for low motor voltage or motor overload. Other drives, increase driver speed when possible.
	Discharge head too high.	Check to see that all discharge valves are opened and the discharge line is free from obstructions. In some cases, the installation has to be altered or a pump of suitable rating must be provided.
	Insufficient available NPSH.	Check NPSH requirements of pump and increase system NPSH accordingly.
	Incorrect direction of rotation.	Check the impeller assembly for correct rotation either by removing upper case or through priming connection. Check rotation of driver.
	Air leaks in suction line or through stuffing boxes.	Tighten packing. Check for air leaks between sleeve and shaft and replace O-ring if there is an air leak. Check all suction line joints for bad gaskets and loose joints.
	Impeller passages restricted.	Disassemble the pump and clean impeller.
	Worn wearing rings.	Replace worn parts.
	Damaged impeller.	Replace or repair impeller.
	Foot valve too small or restricted by dirt.	Replace with adequate size foot valve or clean foot valve.
Pump loses prime after starting	Air leaks in suction line.	Tighten packing. Check for air leaks between sleeve and shaft and replace O-ring if there is an air leak. Check all suction line joints for bad gaskets and loose joints.
	Insufficient available NPSH.	Check NPSH requirements of the pump and increase the system available NPSH accordingly.

**Always obtain new trim diameter from Peerless representative.

Peerless Pump
A Sterling Company
2005 Martin Luther King, Jr. Street Indianapolis, IN 46207 (317) 925-9661
1441 Peerless Way Montebello, CA 90640 (213) 726-1232

SPARE PARTS. To keep delays to a minimum when pump repairs are required, we suggest that the following spare parts be stocked:

(a) One set of bearings (16) & (18), bearing seals (47) & (169), and bearing cover gaskets (73B).

(b) One set of shaft sleeves (14) & (14A) and sleeve O-rings (14B).

(c) One set of casing rings (7).

(d) One set of impeller rings (8).

(e) One casing gasket (73A).

For installations where downtime is critical, a complete rotating element should be stocked.

(f) One set of packing rings (13). Packing can be obtained from your local supplier.

For installations where downtime is critical, a complete rotating element should be stocked.

To obtain quick and accurate service when ordering spare parts, provide the following information:

(A) Pump size and type as noted on nameplate.

(B) Pump serial number as noted on nameplate.

(C) The name and number of the parts as shown on the sectional drawings.

(D) Quantity required of each item.

Aid may be obtained from the Peerless Pump representative or an authorized distributor for planning an adequate supply of spare parts.

NOTICE: Materials of construction, specifications, dimensions, design features, and application information, where shown in this bulletin, are subject to change and/or modification without notice by Peerless Pump at their option.

Printed in U.S.A.

Horizontal Centrifugal Pumps

Instructions

- Installation
- Operation

Peerless Pump
A Sterling Company

2880549
Rev. 9/88

TABLE OF CONTENTS

Read this entire bulletin

before attempting to install, operate or repair this pump. Properly installed, your Peerless pump will give you satisfactory, dependable service. We urge that you read carefully these step-by-step instructions, to simplify any problems of installation, operation or repair.

NOTE:

The bearing structure in all Peerless horizontal products is not designed to accept external loads from belt drive arrangements. When it is necessary to belt drive the pump, the customer must provide a separate jack-shaft with a bearing structure suitable for the intended belt loading.

Failure to read and comply with installation and operating instructions will void the responsibility of the manufacturer and may also result in bodily injury as well as property damage.

This bulletin is intended to be a permanent part of your pump installation and should be preserved in a convenient location for ready reference. If these instructions should become soiled, obtain a new copy from Peerless Pump. Include pump model and/or serial number with your request. Repair instructions for the pump are covered in a separate bulletin.

WARRANTY

New equipment manufactured by Seller is warranted to be free from defects in material and workmanship under normal use and service for a period of one year from date of shipment; Seller's obligation under this warranty being limited to repairing or replacing at its option any part found to its satisfaction to be so defective provided that such part is, upon request, returned to Seller's factory from which it was shipped, transportation prepaid. This warranty does not cover parts damaged by decomposition from chemical action or wear caused by abrasive materials, nor does it cover damage resulting from misuse, accident, neglect, or from improper operation, maintenance, installation, modification or adjustment. This warranty does not cover parts repaired outside Seller's factory without prior written approval. Seller makes no warranty as to starting equipment, electrical apparatus or other material not of its manufacture, since the same are usually covered by warranties of the respective manufacturers thereof.

In the event, notwithstanding the terms of this agreement, it is determined by a court of competent jurisdiction that an express warranty has been given by Seller to Purchaser with respect to the head, capacity or other like performance characteristics of said equipment. Seller's liability for breach of the same shall be limited to accepting return of such equipment F.O.B. plant of manufacture, refunding any amount paid thereon by Purchaser (less depreciation at the rate of 15% per year if Purchaser has used equipment for more than thirty (30) days) and cancelling any balance still owing on the equipment.

This warranty is expressly in lieu of any other warranties, expressed or implied, and Seller specifically disclaims any implied warranty of merchantability or fitness for a particular purpose.

See grouting requirement on page 5.

SECTION I INTRODUCTION

1-1. This bulletin provides general instructions for the installation and operation of horizontal, centrifugal pumps manufactured by Peerless Pump, Indianapolis, Indiana.

1-2. After carefully uncrating or unpacking, check the equipment against the shipping papers and inspect for damage incurred during shipment. Immediately notify the carrier of any damage or shortage found.

1-3. The type and size of pump was selected to meet requirements specified by purchaser. Among the more important are these:

- Type of Liquid Pumped
- Temperature, Viscosity, Specific Gravity
- Flow Rate
- Suction Pressure or Lift
- Total Head
- Type Driver
- Motor and its electric power supply characteristics
- Engine
- Steam turbine and its steam supply and exhaust conditions
- Other (as described)

1-4. If any one of these requirements has changed since the order was placed, particularly the suction condition, we strongly recommend that such change be reviewed with the Peerless representative. If the performance curve previously furnished has been lost, the representative will furnish another copy.

WARNING

Do not operate this pump at any pressure, flow rate, or liquid temperature other than those for which the pump was originally purchased. Do not pump any other liquid than the one for which the pump was originally purchased without the consent of Peerless Pump or its authorized representatives. Disregard of this warning can result in pump failure and serious personal injury or death.

CAUTION

Operation of the pump under conditions differing widely from those for which the pump selection was based may result in reduced parts life.

1. Inadequate NPSH at any capacity will result in cavitation damage to the impeller and casing.
2. Operation at a reduced capacity for prolonged

periods may shorten the useful life of the seals or packing, shaft sleeves, bearings, and the shaft. Fire pumps are applied with full knowledge that operation at reduced capacity will occur.

SECTION II INSTALLATION

2-1. LOCATION. Select a location for the pumping unit (pump, baseplate, coupling and driver) which will:

(A) Be clean, well ventilated, properly drained and provide accessibility for inspection and maintenance (see outline drawing for dimension). Out door installations may require protection from the elements, particularly freezing.

(B) The suction supply system must provide the pump with Net Positive Suction Head (NPSH) equal to or greater than that required by the pump at any capacity on its operating curve. Ask your Peerless representative for assistance if you do not understand how to calculate or measure suction supply system NPSH.

2-2. FOUNDATION. Concrete (reinforced as necessary or required) is most widely used for the foundation. In sufficient mass, it provides rigid support, which minimizes deflection and vibration. It may be located on soil, structural steel or building floors, provided the combined weight of the pumping unit and foundation does not exceed the allowable bearing load of the support. Allowable bearing loads of structural steel and floors can be obtained from Engineering handbooks; building codes of local communities give the recommended allowable bearing loads for different types of soil.

2-3. Before pouring the foundation, locate the foundation bolts by the use of a template frame and provide anchorage as shown in Figure 1. See the outline drawings furnished with each pump for the exact location of the foundation bolts. When pouring, allow for a grout thickness of ¾ to 1½ inches. Roughen top surface to provide a good bond of the grout. Ordinarily, the proportions used as 1 part cement to 3 parts sand and 4 parts medium aggregate.

2-4. MOUNTING AND LEVELING THE UNIT

CAUTION

Use qualified personnel (riggers) to lift or move unit at any time. Never lift unit using hooks or slings on shafts. Never place eyebolts in tapped holes except for removal of a part to perform service work.

When the unit is received with the pump and the driver mounted on the base plate, it should be placed on the foundation and the coupling halves disconnected. The coupling should not be reconnected until the alignment operations have been completed. The base plate should be supported on rectangular metal blocks and shims or on metal wedges having a small taper. The support pieces should be placed close to the foundation bolts (Figure 2). On large units, small jacks made of cap screws and nuts are very convenient. In each case the supports should be directly under the part of the baseplate carrying the greatest weight and spaced closely enough to give uniform support. A spacing of 24 inches is suggested on medium size units. A gap of about ¾ inches to 1½ inches should be allowed between the baseplate and the foundation for grouting.

Adjust the metal supports or wedges until the shafts of the pump and driver are level. Check the coupling faces as well as the suction and discharge flanges of the pump for horizontal or vertical position by means of a level. Correct the positions, if necessary, by adjusting the supports or wedges under the baseplate as required.

Pumps and drivers mounted on a common baseplate were accurately aligned before shipment. **All baseplates are flexible to some extent and, therefore, must not be relied upon to maintain the factory alignment.**

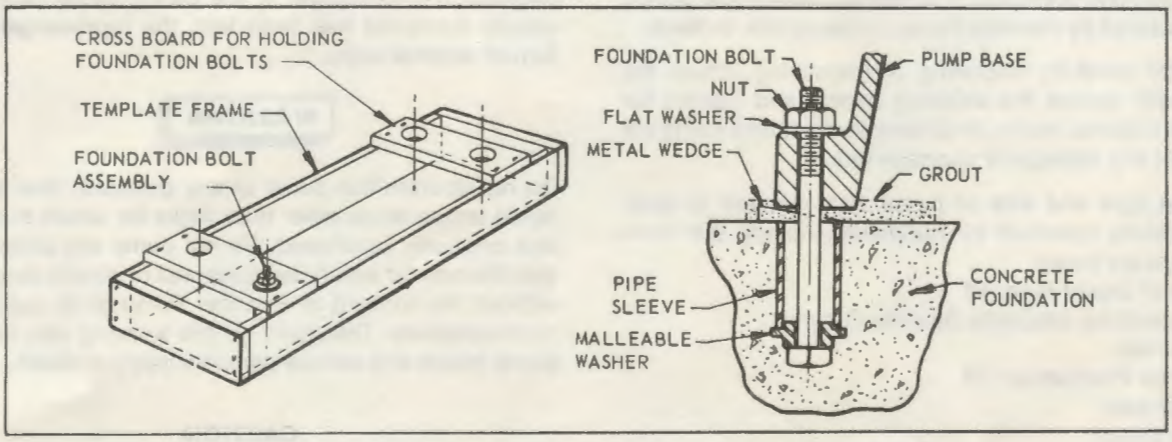


FIGURE 1. FOUNDATION BOLT LOCATION AND ANCHORAGE

Realignment is necessary after the complete unit has been leveled on the foundation and again after the grout has set and foundation bolts have been tightened. The alignment must be checked after the unit is piped and rechecked periodically as outlined in the following paragraphs. To facilitate accurate field alignment, we do not dowel the pumps or drivers on the baseplates before shipment.

2-5. ALIGNMENT. Reliable, trouble-free and efficient operation of a pumping unit requires correct alignment of pump and driver shafts. Misalignment may be the cause of:

(A) Noisy pump operation

(B) Vibration
(C) Premature bearing failure
(D) Excessive coupling wear

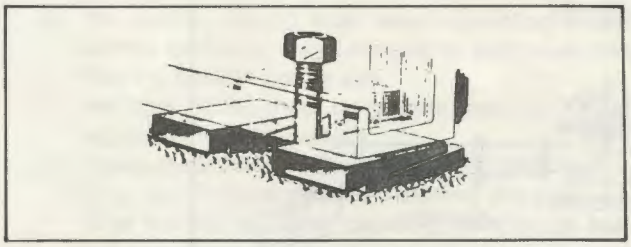


FIGURE 2. ADJUSTING WEDGES FOR MOUNTING

Factors that may change the alignment of the pumping unit are:

(A) Setting of the foundation
(B) Springing of the baseplate
(C) Piping strains
(D) Settling of the building
(E) Shift of pump or driver on the foundation

2-6. The following checking procedure applies to a pumping unit consisting of a pump, flexible coupling and driver mounted on a common baseplate. Check alignment as follows:

a. Disconnect the coupling halves.

b. Set the coupling gap to the dimension shown in Table 1 or Table 3.

c. Test for parallel and angular alignment with a straight edge and feeler gauge as shown in manufacturer's instructions at end of this section. With coupling halves stationary, make trials at four places 90° apart. Perfect alignment occurs when a straight edge is level across the coupling halves and the same gauge just enters between the halves, both conditions at all points.

d. An alternate test for parallel and angular alignment may be made with a dial indicator mounted as shown in Figure 3. Proceed as follows:

(1) Scribe the index lines on the coupling halves (as shown) or mark where the indicator point rests.

(2) Set indicator dial to zero.

(3) Slowly turn BOTH coupling halves so that index lines match, or indicator point is always on the mark.

(4) Observe dial reading to determine whether pump or driver needs adjustment.

(5) Acceptable parallel and angular alignment occurs when total indicator reading (complete turn) does not exceed limits shown on either a tag or decal on the unit or on the unit outline drawing.

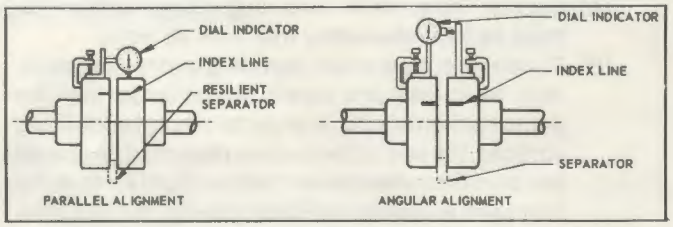


FIGURE 3. TESTING ALIGNMENT, DIAL INDICATOR

When significant operating temperature differential will exist between the pump and driver (i.e. steam turbine drive with pump handling cold liquid), thermal growth will cause the hotter unit to rise. Compensate for this growth by initially setting the hotter unit 0.003 inch to 0.005 inch low. When both units are at normal operating temperature, a final check of coupling alignment must be made. Correct the alignment if necessary.

NOTE

Check for correct electric motor rotation as described in paragraphs a and b under paragraph 2-15 while coupling halves are disconnected.

2-7. Correct excessive parallel and angular misalignment by slightly shifting the leveling wedges under the baseplate. Tap lightly (in or out) with a hammer. Retest alignment after each shifting of a wedge.

a. In some instances, for factory-aligned pumping units, it may be necessary to change the shims under the pump or driver, or even relocate these factory-positioned units on the baseplate. Make such changes only after it is certain alignment cannot be obtained by shifting of the wedges.

b. If wedges are shifted or shims changed a substantial amount to obtain proper alignment, recheck the piping alignment and level of the shafts.

NOTE

Pumping unit shafts must be level, have proper alignment and the piping must mate with the pump flanges without strain. All three conditions must be correct to provide proper performance and long life of the pumping unit.

2-8. Recheck alignment, and correct as required, after:

(A) Mounting,
(B) The grout has hardened,
(C) Foundation bolts are tightened,
(D) Piping is connected,
(E) Pump, driver, or baseplate is moved for any reason.

2-9. GROUTING

Unless otherwise specified on the unit outline drawing, the baseplate must be completely filled with grout and the leveling wedges grouted in place. The product warranty is void if this instruction is not followed.

When the alignment is correct, the foundation bolts should be tightened evenly but not too firmly. The unit can then be grouted to the foundation. Foundation bolts should not be fully tightened until the grout is hardened, usually about 48 hours after pouring. Installation without grout completely filling the baseplate is acceptable only when recommended by specific notation on the unit outline drawing.

Grouting that completely fills a baseplate is also necessary for minimum vibration levels, since a very stiff base is uneconomical and unnecessary except for portable units. Grout compensates for uneveness in the foundation and baseplate and distributes the weight of the unit uniformly over the foundation. It also prevents the unit from shifting after mounting and alignment. It is essential that the pumping unit be expertly grouted by use of non-shrinking grout. The mix required varies with the type of unit to be grouted, location and amount of grout. The instructions included with the non-shrinking grout package will provide the required information for the proper mix for individual applications. Grout the unit as follows:

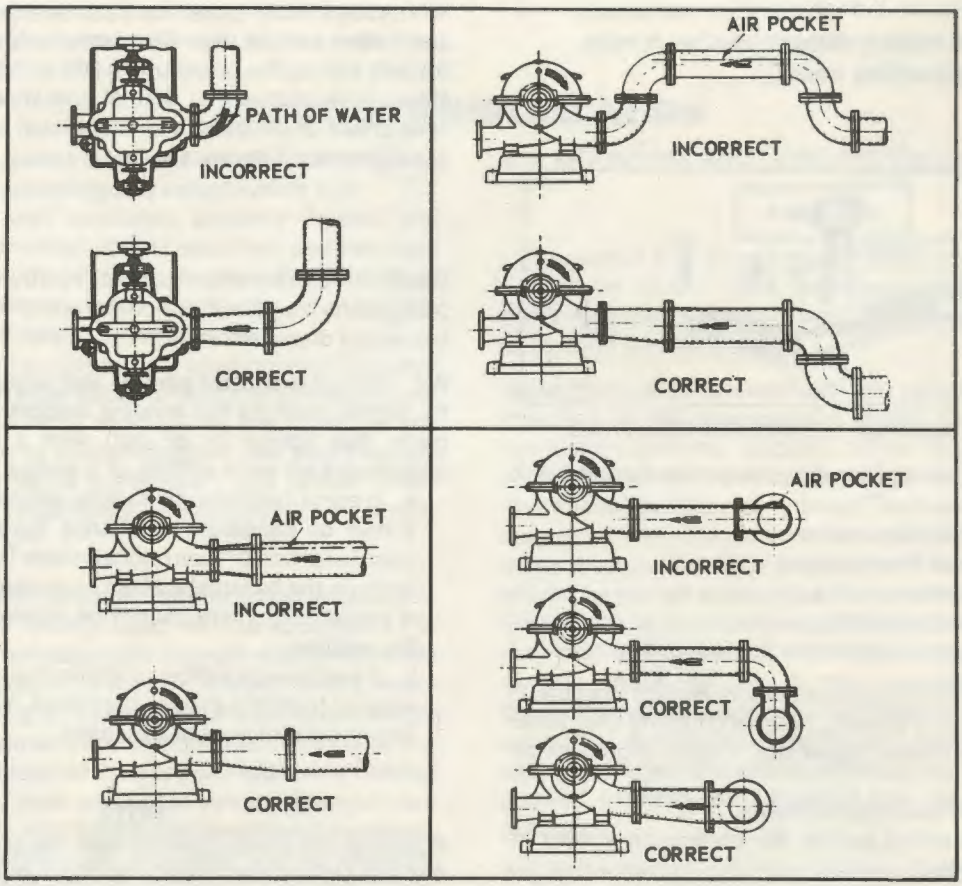


FIGURE 4. SUCTION PIPING ARRANGEMENTS

a. Build a form of plywood or think planking around the foundation to contain the grout. Support adequately to prevent deformation.

b. Soak the top of the concrete pad thoroughly with water before grouting. Remove all surface water before pouring.

c. A recommended mix of grout that is satisfactory for most applications is as follows:

(1) One part of normal Portland cement (94 lbs.)
(2) One part of Embeco cement (100 lbs.)
(3) One part coarse clean sand (100 lbs.)
(4) Approximately 5 gallons of water
(5) If the thickness of the grout has to be above approximately 2 inches, add 1½ parts of ¼ inch pea gravel (1½ cubic feet) and an additional ½ gallon of water to the mixture.

d. Pour the grout through the holes provided in the baseplate or through open ends of steel channel baseplates. While pouring, tamp liberally in order to fill all cavities and prevent air pockets.

NOTE

If pouring and tamping the group will trap air in some places, temporarily place small diameter tubes (thick-walled rubber hose) to provide venting. Remove the tubes after grout has filled the cavity, before pouring the remainder.

e. After the grout has thoroughly hardened, tighten the foundation bolts and connect the piping. BE CERTAIN PIPING DOES NOT STRAIN PUMP.

f. Check the alignment after the piping is connected and the foundation bolts are tightened.

g. Connect the coupling halves.

h. Approximately fourteen days after the grout has been poured or when the grout has thoroughly dried, apply an oil base paint to the exposed edges of the grout to prevent air and moisture from coming in contact with the grout.

2-10. PIPING. The suction and discharge piping should be arranged for the simplest, most direct layout, to be of sufficient size and be internally free of foreign material. The piping must never be pulled into position by the flange bolts. It must be independently supported and arranged so that expansion and contraction, due to temperature changes, will not cause misalignment. If the installation requires a low noise level of operation, the suction and discharge piping of the system should be connected to the pump suction and discharge flanges with rubber flexible connectors.

2-11. The suction piping, if not installed properly, is a potential source of faulty operation. To achieve best performance, provide for the following:

(A) Suction lines, when operating under suction lift, must be kept absolutely free from air leaks.
(B) The suction pipe, when operating under suction lift, must be at least one pipe diameter larger than the pump suction nozzle. In order to prevent eddies and vortices, the end of the suction pipe must be at least two pipe diameters below the free liquid surface. If a foot valve is used to facilitate priming, the foot valve must have a minimum flow area 1½ times the area of the suction pipe. The suction at all points and should not contain loops or high spots in which air can be trapped.

(C) A strainer should be installed in the suction line. The screen must be checked and cleaned periodically. The openings in the screen must be smaller than the sphere size allotted for the impeller.
(D) A pump operating under suction lift should never use a gate or globe valve in the suction line.
(E) The suction piping size, when operating under suction pressure, may be equal to, but never less than the suction nozzle size.
(F) Available NPSH must be greater than the NPSH requirement of the pump.
(G) Piping should be cleaned mechanically and chemically, and flushed prior to installing the pump. A large number of pump packing, mechanical seal and seizure troubles are due to improperly cleaned systems.
(H) The pump should also be inspected internally for foreign matter that may have entered the pump.

2-12. DRIVER. When the driver of the pumping unit is to be mounted in the field on a baseplate furnished by Peerless, the driver bolt holes for some models must be added as follows: Set the baseplate with the pump on the foundation and level the unit as in paragraph 2-5. Set the driver on the baseplate, and align the coupling halves as described in paragraph 2-7 for parallel alignment. Mark the driver bolt holes. Remove the driver and drill and tap the baseplate for the driver bolts. Set the driver on the baseplate and align completely.

2-13. Safe and efficient operation of a pumping unit driven by an engine, whether gas, diesel, or gasoline, requires the installation to satisfy the following requirements:
(A) Be well ventilated in order to keep the ambient temperature as low as possible. Taking 60° F as a datum point, every 10° F rise in temperature reduces the horsepower of the engine by approximately 1%.
(B) Provide ample air for proper combustion.
(C) Provide the engine with an efficient exhaust system so that the combustion gases dis-charge with a minimum of back pressure.
(D) Provide for a fuel system of adequate capacity which meets the local codes.
(E) Provide ample accessibility to service engine.
(F) Provide correct rotation of the pump. Engine rotation is determined at the factory. No change of engine rotation can be made in the field.

It is recommended that the operator become familiar with the installation and service manual supplied by the engine manufacturer.

2-14. For electric motor drives, connect power supply to conform with national and local codes. Line voltage and wire capacity must match the ratings stamped on the motor nameplate.

a. Only when the coupling halves are disconnected, momentarily energize the motor to check that rotation is in the same direction as the arrow on the pump.
b. If motor is three-phase type, reverse rotation (if required) by inter-changing any two of the three power leads. The rotation of most single phase motors is fixed by internal wiring and cannot be easily changed.

2-15. DOWELING. To comply with Hydraulic Institute recommendations, all pumps should be dowelled. Pump feet can be drilled for dowels at the factory or in the field. Bases or risers are not drilled at the factory.
a. Doweling the pump accomplishes the following:
(A) Prevents lateral movement.
(B) Eases realignment if the pump is removed from the base.
(C) Temporarily holds the pump should the holddown bolts loosen.

2-16. We recommend installation of straight dowel pins as shown in Figure 5 as follows:
a. Check the coupling alignment after the unit has been in operation approximately one week. Correct if necessary (refer to paragraphs 2-7 and 2-8).
b. Through opposite pump feet, drill through the riser (if used) and into the base (when necessary), holes of the same diameter (1/64 inch less than dowel pin) as in the feet to the proper depth for the pins (see Figure 5). Clean out the chips.
c. Ream the holes in the pump feet and base to the proper diameter for the pins (light push fit). Clean out the chips.
d. Install a spare nut (or cap) on the pins to prevent damaging the threads. Insert pins to a depth which leaves sufficient thread to attach nut.
e. Attach nuts and tighten — do not pull dowel.
f. If the pump was not drilled at the factory for dowels, use the following to determine dowel pin diameter. Measure the mounting bolt hole diameter in the pump foot.
Dowel Diameter = Foot bolt hole diameter minus ⅜".

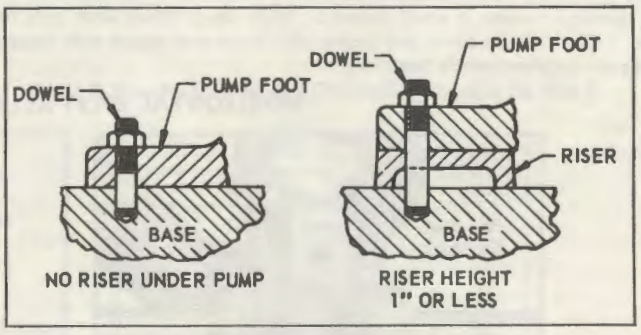
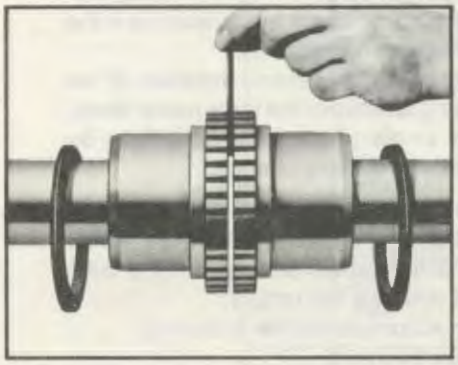


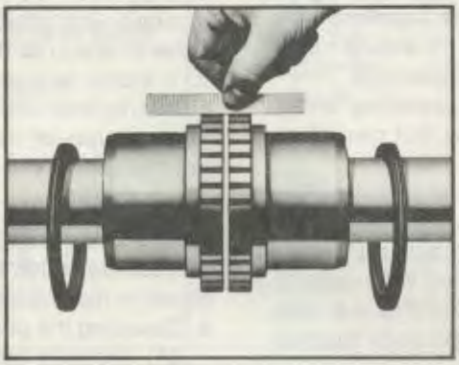
FIGURE 5. DOWELING METHODS

INSTRUCTIONS
PEERLESS PUMPS WITH FALK STEELFLEX COUPLINGS



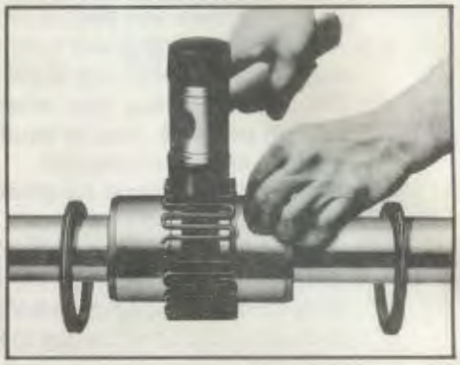
GAP & ANGULAR ALIGNMENT

Use a spacer bar equal in thickness to the gap specified in Table 1. Insert bar, as shown above, to same depth at 90° intervals and measure clearance between bar and hub face with feelers. The difference in minimum and maximum measurements must not exceed the ANGULAR limit specified in Table 1.



OFFSET ALIGNMENT

Align so that a straight edge rests squarely (or within the limits specified in Table 1) on both hubs as shown above and also at 90° intervals. Check with feelers. The clearance must not exceed the OFFSET limit specified in Table 1. Tighten all foundation bolts and repeat Steps 2 and 3. Realign coupling if necessary. NOTE: Use a dial indicator for more accurate alignment.

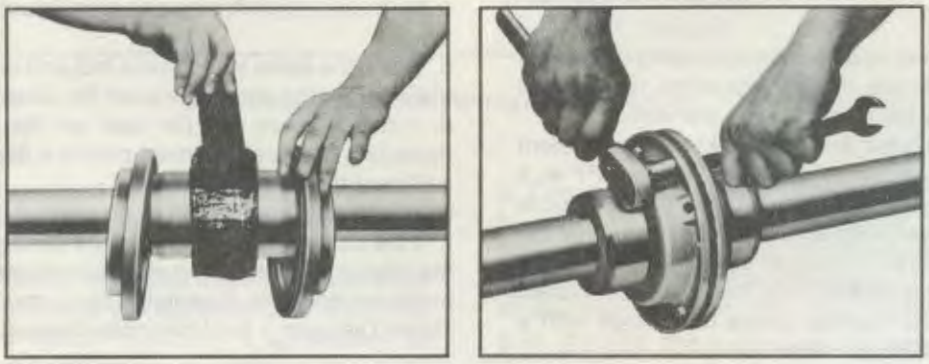


INSERT GRID

Pack gap and grooves with specified lubricant before inserting grid. When grids are furnished in two or more segments, install them so that all cut ends extend in the same direction; this will permit cover installation. Spread the grid slightly to pass it over the coupling teeth and seat with a soft mallet.

NOTE: COVER MAY BE EITHER OF TWO TYPES AS SHOWN BELOW.

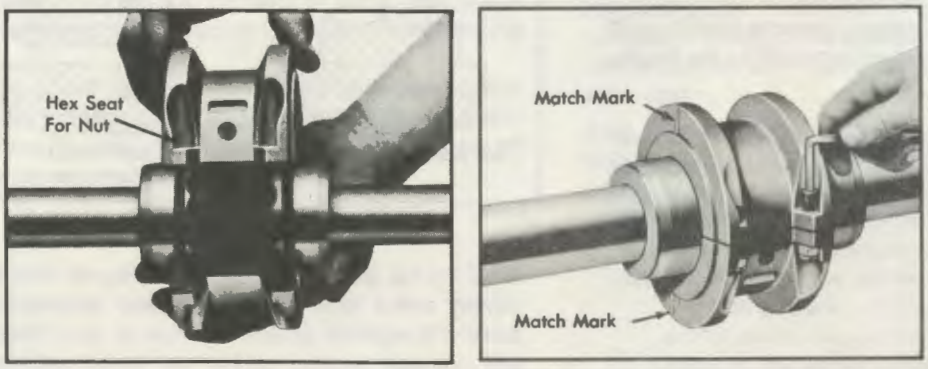
VERTICAL SPLIT STEEL COVER



PACK WITH GREASE AND ASSEMBLE COVERS

Pack the spaces between and around the grid with as much lubricant as possible and wipe off excess flush with top of grid. Make certain lube plugs are removed to ease in cover assembly. Slide cover halves with seals onto hubs and position with lube holes 180° apart (90° apart for Sizes 150 thru 170). Line up cover and gasket bolt holes and secure with fasteners; tighten to torque specified in Table 1. CAUTION: Make certain lube plugs are installed before operating.

HORIZONTAL SPLIT ALUMINUM COVER



VERTICAL COUPLINGS

PACK WITH GREASE AND ASSEMBLE COVERS

Pack the spaces between and around the grid with as much lubricant as possible and wipe off excess flush with top of grid. Position seals on hubs to line up with grooves in cover. Position gaskets on flange of lower cover half and assemble covers so that the match marks are on the same side (see above). If shafts are not level (horizontal) or coupling is to be used vertically, assemble cover halves with the lug and match mark UP, or on the high side. Secure cover halves with fasteners and tighten to torque specified in Table 1. (Note that Sizes 20 thru 70 have a self-locking feature for the stop nuts.) CAUTION: Make certain lube plugs are installed before operating.

(Continued next page)

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TABLE 1 INSTALLATION DATA · (Dimensions-Inches)

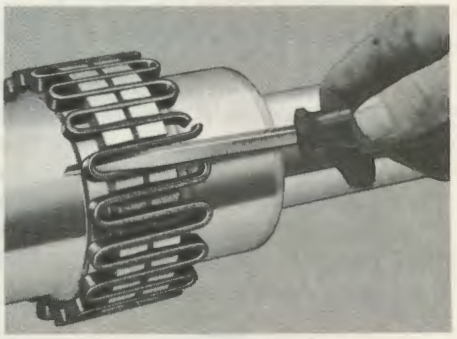
SIZE	Gap	Operating■ Alignment Limits		Cover Bolt Torque (lb-in)	Max Speed (rpm)	Lube Wt (lb)
		Offset (Max)	Angular (Max)			
20T	.125	.005	.005	100	4500	.06
30T	.125	.005	.005	100	4500	.06
40T	.125	.005	.005	100	4500	.12
50T	.125	.005	.005	200	4500	.12
60T	.125	.010	.010	200	4350	.19
70T	.125	.010	.010	200	4125	.19
80T	.125	.010	.010	200	3600	.38
90T	.125	.012	.012	200	3600	.56
100T	.188	.012	.012	260	2440	.94
110T	.188	.012	.012	260	2250	1.1
120T	.250	.012	.012	650	2025	1.6
130T	.250	.012	.012	650	1800	2
140T	.250	.015	.015	650	1650	2.5

■ Align couplings within "Operating Alignment Limits" specified above. Exceeding these limits reduces coupling life.

PERIODIC LUBRICATION — Remove both lube plugs and insert lube fitting. Fill with recommended lubricant until an excess appears at the opposite hole. CAUTION: Make certain all plugs have been inserted after lubricating.

COUPLING DISASSEMBLY AND GRID REMOVAL

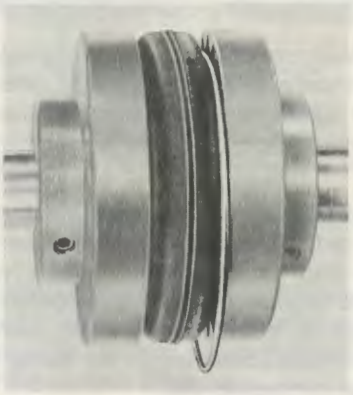
Whenever it is necessary to disconnect the coupling, remove the cover halves and grid. A round rod or screw driver that will conveniently fit into the open loop ends of the grid is required. Begin at the open end of the grid section and insert the rod or screw driver into the loop ends. Use the teeth adjacent to each loop as a fulcrum and pry the grid out radially in even, gradual stages, proceeding alternately from side to side.



WOOD'S SURE-FLEX COUPLINGS INSTALLATION INSTRUCTIONS TYPES J, S AND SC

Sure-Flex flanges (outer metallic parts) and sleeves (inner elastometric members) come in many sizes and types. All rubber sleeves (EPDM and Neoprene) have the same ratings for a given size and may be used interchangeably. Hytrel sleeves, however, has completely different ratings. **Rubber sleeves must not be substituted for Hytrel, or Hytrel for rubber.** First, determine the size and type of components being used. Remove all components from their boxes, and loosely assemble the coupling on any convenient surface. (Do not attempt to install the wire ring on the two-piece E or N sleeve at this time.)

1. Inspect all coupling components and remove any protective coatings or lubricants from bores, mating surfaces and fasteners. Remove any existing burrs, etc. from the shaft.
2. Slide one coupling flange onto each shaft, using snug-fitting keys.
3. Position the flanges on the shafts so that each shaft extends into each flange a minimum length equal to the shaft diameter. Tighten one flange in its final position. Slide the other far enough away to install the sleeve. With a two-piece sleeve, do not move the wire ring to its final position; allow it to hang loosely in the groove adjacent to the teeth, as shown.



4. Slide the loose flange on the shaft until the sleeve is completely seated in the teeth of each flange. Tighten all fasteners to the values given in Table 2.

TABLE 2 — FASTENER TORQUE VALUES (ft.-lbs.)

Coupling Size	TYPE J	TYPE S	TYPE SC	
	2 Setscrews at 90°	2 Setscrews at 90°	4 Hex Head Cap Screws Flange to Hub	1 Setscrew over Keyway in Hub
3	3	...	...	...
4	3	...	5½	13
5	7	13	4	13
6	13	13	9	13
7	13	13	9	13
8	23	23	18	23
9	...	23	31	23
10	...	23	50	50
11	...	23	75	50
12	...	50	150	100
13	...	100	150	165
14	...	100	150	165
16	...	100	150	165

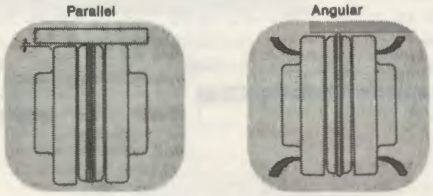
Coupling size is marked on flanges.

Different coupling sleeves require different degrees of alignment precision. Locate the earing failure
(D) Excessive coupling wear

(Continued next page)

SURE-FLEX COUPLINGS, continued

5. Check parallel alignment by placing a straightedge across the two coupling flanges and measuring the maximum off-set at various points around the periphery of the coupling. DO NOT rotate the coupling. If the maximum off-set exceeds the figure shown under "Parallel" in Table 3, realign the coupling.
6. Check angular alignment with a micometer or caliper. Measure from the outside of one flange to the outside of the other at intervals around the periphery of the coupling. Determine the maximum and minimum dimensions. DO NOT rotate the coupling. The difference between the maximum and minimum must not exceed the figure given under "Angular" in Table 3. If a correction is necessary, be sure to recheck the parallel alignment. (Note: For maximum life, keep misalignment values as near to zero as possible.)



NOTE: Periodically check elastomeric coupling sleeves for any visible evidence of deterioration. If deterioration is apparent, the coupling sleeve must be replaced.

TABLE 3 – MAXIMUM ALLOWABLE MISALIGNMENT

(Dimensions in inches)

SLEEVE SIZE	G DIMENSION	TYPES JES, JNS, E & N		TYPE H & HS*	
		PARALLEL	ANGULAR	PARALLEL	ANGULAR
3	3/8	.010	.035	–	–
4	5/8	.010	.043	–	–
5	3/4	.015	.056	–	–
6	7/8	.015	.070	.010	.016
7	1	.020	.081	.012	.020
8	1-1/8	.020	.094	.015	.025
9	1-7/16	.025	.109	.017	.028
10	1-5/8	.025	.128	.020	.032
11	1-7/8	.032	.151	.022	.037
12	2-5/16	.032	.175	.025	.042
13	2-11/16	.040	.195	.030	.050
14	3-1/4	.045	.242	.035	.060
16	4-3/4	.062	.330	–	–

NOTE: Values shown above apply if the actual torque transmitted is more than 1/4 the coupling rating. For lesser torque, reduce the above values by 1/2. *Type H sleeves (orange) should not be used as direct replacements for EPDM or Neoprene sleeves (black) or with J or B flanges.

7. If the coupling employs the two-piece sleeve with the wire ring, force the ring into its groove in the center of the sleeve. It may be necessary to pry the ring into position with a blunt screwdriver.
8. Check safety codes and install protective guards or shields as required.

Caution: Coupling sleeves may be thrown from the assembly when subjected to a severe shock load.

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SECTION III LUBRICATION

3-01. COUPLINGS. Couplings with elastomeric drive parts do not require lubrication. Most other couplings require some form of lubrication. After completion of installation and alignment, and before operating the unit, lubricate coupling in accordance with manufacturer's specific instructions contained in the pump installation packet or on an instruction tag.

3-1. BEARINGS. Reasonable care and proper lubrication of Peerless Pump bearings will result in many years of service. Lubricant is normally grease; oil is optional on some pump types. The lubricant provides a film between the rolling elements and races, giving low friction and preventing excessive temperature rise and corrosion.

3-2. The normal life of bearings is terminated only by fatigue. Improper lubrication practices are the primary cause of failure. Good practice includes the following:

(A) Keep lubricant clean. Provide, and use, a dust-tight cover on the storage container.
(B) Use the oldest lubricant first.
(C) Clean pump lubricant fittings before relubricating with grease.
(D) Use clean dispensing equipment.
(E) Use the proper amount of lubricant –
  1. Too much results in churning, unnecessary power consumption, rapid heating to a high temperature and inadequate lubrication.
(F) Use the correct lubricant –
  1. Grease, Lithium soap base, meeting National Lubricating Grease Institute Grade 2 specifications. This has a safe operating temperature up to 250°F.
  2. Oil, see Maintenance and Repair instructions.
  3. Some pumps are built with "Lifetime" sealed bearings, requiring no relubrication or maintenance. Such pumps are not provided with external lubrication fittings.

3-3. OPERATING TEMPERATURE. Use of the lubricants and procedures given in this bulletin will allow safe operation at bearing temperatures up to 250° F.

3-4. A high normal operating temperature is not a sign of bearing failure. Normal temperatures vary with the seasons and environment and may range from 0 to approximately 200° F. A continuous rise (determine as shown in Figure 6) from the **established, normal** operating temperature indicates trouble and probable failure of the bearing. Shut down the pump immediately. Disassemble, clean and inspect the bearing; replace if required. Refer to Maintenance and Repair instructions.

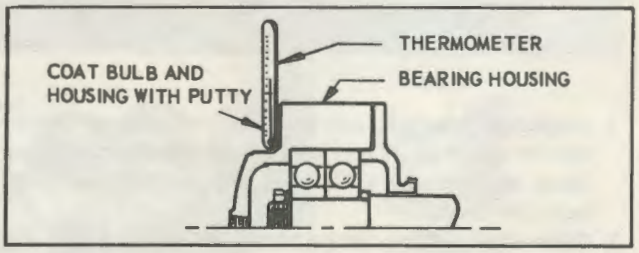

FIGURE 6. MEASURING BEARING TEMPERATURE

3-5. RELUBRICATION

(A) Grease – Grease that has been in service does not "wear away." It needs replacing only because of contamination by dust, metal particles, moisture or high temperature breakdown. Relubricate bearings as follows (with the pump shutdown): Pumps have been provided with the initial supply of grease in the bearings.

1. Thoroughly clean grease fittings and outside of bearing housing.
2. Inject clean, new grease, forcing out the old through the small opening between the shaft and the bearing housing.
3. Start and run the pump for a short time to eject any excess grease.
4. Wipe off all ejected grease.

(B) Oil – see Maintenance and Repair instructions.

3-6. STUFFING BOX. The function of a stuffing box is to limit or eliminate leakage of the pumped fluid and to prevent air from entering along the shaft. Pumps are equipped with packing or mechanical shaft seals. These instructions are intended for pumping units handling water.

3-7. Packed type seal. A packed type stuffing box must correspond to the suction conditions of the installation. The pump is shipped with the packing installed unless otherwise specified by the customer. Check the packing carefully, allowing a slight leakage for lubrication. Never force the packing into a leak-proof position since this will create excessive friction and cause damage to the packing or shaft sleeve. Maximum packing life can be expected when the leakage approximates a minimum of 40-60 drops per minute. A reduction of leakage considerably reduces the life of both the packing and shaft sleeve. If leakage is excessive, tighten the gland bolts evenly, about 1/6 of a turn at a time. Do not be confused if the leakage seems to increase after an adjustment of the packing has been made. The leakage will normally reduce after a period of time as the packing adjusts itself to its new position. It should be kept in mind that it takes time for newly installed packing to "run-in" and that during this initial period, frequent attention and adjustments are necessary. It sometimes takes several days to achieve the desired results. Peerless Pump recommends the use of lantern rings and water seal lines only when suction pressure is less than 30 psig.

Replacement packing can be obtained from Peerless Pump or from your local packing supplier.

3-8. Mechanical Shaft Seal. The mechanical shaft seal is adjusted at the factory and no further adjustment is required except for a short run-in period. Follow the recommendations made by the shaft seal manufacturer to obtain good performance and life.

3-9 Special Shaft Seal. A separate special instruction is included for any pumps completely describing any special shaft seals. This same instruction will specify any required system piping that is required by the shaft seal arrangement. The pump sectional drawing will completely describe the construction of any special shaft seal.

NOTE

The types of packing listed in Table 4 are for use with water pumps. Pumps handling other liquids may require special types other than those listed.

TABLE 4
RECOMMENDED STUFFING BOX PACKING ARRANGEMENTS

SUCTION PRESSURE RANGE	PACKING	SHAFT SLEEVE	LEAKAGE RATE
6.0 PSIA – 60 PSIG	1) Square Braid Non-Asbestos 2) Lattice Braid Non-Asbestos 3) Plastic with end rings of Non-Asbestos	SAE 40 Bronze or stainless steel	50 drops/min.
60 – 100 PSIG	Plastic with metallic or Non-Asbestos end rings	Hardened stainless steel*	1/3 pint/min.
100 – 250 PSIG	Combination plastic and metallic packing or Teflon impregnated packing	Hardened stainless steel*	1 pint/min.

*Metallic packing has an affinity for bronze, therefore, do not use brass or bronze shaft sleeves.

NOTE

All UL/ULC listed fire pumps will have water seal piping only when suction pressure is less than 30 psig.
All FM approved fire pumps will have water seal piping regardless of the suction pressure.

NOTE

See supplemental instruction 4850332 for high pressure fire pump applications.

SECTION IV OPERATION

NOTE

Pump cases of steel, cast iron, and especially all iron pumps must be thoroughly flushed prior to initial start-up to avoid contamination of piping systems.

4-1 PRIMING. A centrifugal pump must be primed before it can be operated. If run dry, damage can occur to close-clearance rotating parts. Also, if not primed properly, it will not deliver fluid. Prime in one of the following ways:
a. If the system has suction pressure, bleed all air from the pump casing and suction pipe by opening the petcock(s) at the top of the pump. Rotate the shaft a few times if possible to evacuate any air trapped inside the impeller passages.
b. If the system has a suction lift and there is a foot valve in the suction pipe, fill the pump casing and suction pipe with water from an outside source. At the same time, let the trapped air escape through the petcock(s) at the top of the pump.
c. If the system has a suction lift but no foot valve, use a vacuum pump or ejector operated by air, steam, water, engine exhaust, etc., to evacuate the air from the pump case and suction pipe by connecting the ejector to the priming connection on the top of the pump.

4-2. STARTING. When making an initial start, after installation or major maintenance, check the following:

(A) Correct installation and rotation of driver.
(B) Coupling alignment.
(C) Bearing lubrication on pump and driver.
(D) Proper lubrication for stuffing boxes. For pumps having mechanical shaft seals, make certain that the liquid temperature, pressure, cooling and lubrication of seal faces all meet the manufacturer's requirements.
(E) Gauges (if used) of correct range and in good condition.
(F) All foundation, pump and driver bolts properly tightened. All external fasteners (nuts, bolts, screws)

Peerless Pump
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2005 Dr. Martin Luther King Jr. Street Indianapolis, IN 46207 (317) 925-9661
1441 Peerless Way Montebello, CA 90640 (213) 726-1232

on pump checked against recommended torque values.

(G) Suction screens are in place.

(H) Recirculation orifice (or device), when installed, must be open during starting. It should be closed during normal operation.

4-3. Start the pump as follows:

a. When possible, turn the pump shaft by hand to make sure that parts do not bind.

b. Close the discharge valve. (Pumps started with an open valve require more starting torque.)

c. Open the suction valve (if used).

d. Prime the pump.

e. Start the driver. Open the discharge valve as soon as operating speed is reached.

Only brief periods of operation during start-up and shut-down are permissable with a closed discharge valve without piping provisions for the release of heat. Prolonged operation at less than 15 to 20% of the pump's rated capacity will cause heating of the fluid pumped, impeller erosion, short life of bearings and packing or mechanical seals due to stress or vibration. Some pumps may incur shaft damage and wear on stationary parts. Variable RPM drives may be unstable.

During new system tests, check out, early part load system operation, or when prolonged operation at less than about 15% of the rated capacity is possible, installation of a pump bypass is recommended as generally shown in Figure 7.

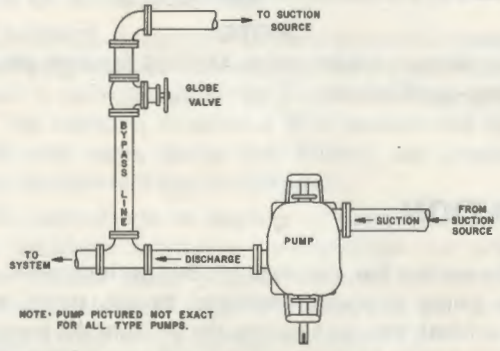

FIGURE 7. PUMP BYPASS ARRANGEMENT

CAUTION

OPERATION OF THE PUMP WITH FLOW ONLY THROUGH THE BYPASS PIPING IS NOT ALLOWABLE.

NOTE

Installation of the bypass piping back to the suction source is recommended; bypass must never be piped closer than 10 pipe diameters to the pump suction flange.

A thermostatic valve (or its automatic equivalent) can be substituted for the manual globe valve with its bulb located in the discharge pipe close to the pump.

With the bypass valve open, the pump can be operated above about 20% of its rated capacity and incur little or no erosion or other parts damage. When the pump operates at or near normal capacity, the bypass valve is to be closed. Important: Small volume closed systems may require special cooling arrangements, not just a pump bypass.

Operation for prolonged periods at flow rates higher than those given to the pump manufacturer at the time the pump was selected and purchased can cause cavitation, driver overload, noise and other problems.

CAUTION

Consult with the factory when operating conditions will be different than those for which the pump was purchased.

Important:
For systems with water over 180° F, use of a recirculation orifice (or device) piped all the way back to the suction supply source is mandatory to avoid flashing (caused by heating of the water) at low flow rates. The reliability of any automatic device must be high and monitors may be installed to warn of malfunction or to cause pump shut-down.

4-4. After the pump has run a reasonable time, measure the temperature of bearing and stuffing box housings (see Figure 6). The temperature of the stuffing box should approximate that of the pumped liquid. If it is too hot (over-heats), the packing is too tight. Stop the pump and repack. See Maintenance and Repair instructions.

4-5. Refer to Maintenance and Repair instructions for aid in overcoming trouble in operation.

4-6. SHUTDOWN. The pump may be stopped with the discharge valve open, as no damage results if water flows back through the casing. Electric motors are free to rotate and may safely run backwards at approximately 1.25 times the rated forward speed. The pump prime may be lost if shut down with an open discharge valve. It may be unwise to leave the discharge valve open on a pump in a manifold system, as short-circuiting may result. Shut down as follows:

a. Recirculation orifice (or device), when installed, must be open during shutdown.

b. Close the discharge valve.

c. Shut down the driver. If a motor, press the STOP button or open the switch; if an engine, follow the procedure recommended by the manufacturer in Operating instructions.

d. Turn off all cooling water lines.

4-7. If water in the lines or pump casing might freeze when shut down, drain completely.

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Printed in U.S.A.

INSTRUCTION
FOR
FIRE PUMP MAIN RELIEF VALVE
PILOT OPERATED TYPE

I. PURPOSE

The purpose of the "main relief valve" is to protect the discharge system from excessive pressure.

II. INTRODUCTION

The "main relief valve" is required for all horizontal and vertical pumps driven by an adjustable speed driver (engine or steam turbine). This valve may also be required for a pump driven by a constant speed driver (electric motor) if the shutoff pressure plus static suction pressure exceeds the pressure for which the system is designed to operate.

III. DESCRIPTION

The "main relief valve" must be adjusted on the job to meet job conditions.

Valves furnished for 175 PSI systems may be adjusted from 60 to 175 PSI.
Valves furnished for 300 PSI systems may be adjusted from 100 to 300 PSI.

IV. INSTALLATION

The "main relief valve" should be installed per the requirements of the current edition of NFPA Pamphlet 20 and as shown on our outline drawing.

V. APPLICATION

The water supply to the "main relief valve" must be clean. Sand, gravel, or other abrasives can prevent proper operation and cause damage to the bronze sealing parts.

VI. VALVE SETTING

The "main relief valve" must be set to job conditions. Most local insuring authorities will require the valve to start opening when the pump is operating at shutoff.

Operation

The pressure Relief Control is normally held closed by the force of the compression spring above the diaphragm; control pressure is applied under the diaphragm.

When the controlling pressure exceeds the spring setting, the disc is lifted off its seat, permitting flow through the control.

When controlling pressure drops below spring setting, the spring returns the control to its normally closed position.

Adjustment

The Pressure Relief Control can be adjusted to provide a relief setting at any point within the range stamped on the data plate.

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Pressure adjustment is made by turning the adjustment screw to vary the spring pressure on the diaphragm. Turning the adjustment screw clockwise increases the pressure required to open the valve. Counterclockwise decreases the pressure required to open the valve.

When pressure adjustments are complete the jam nut should be tightened and the protective cap replaced. If there is a problem of tampering, lock wire holes have been provided in cap and cover. Wire the cap to cover and secure with lead seal.

Peerless Pump
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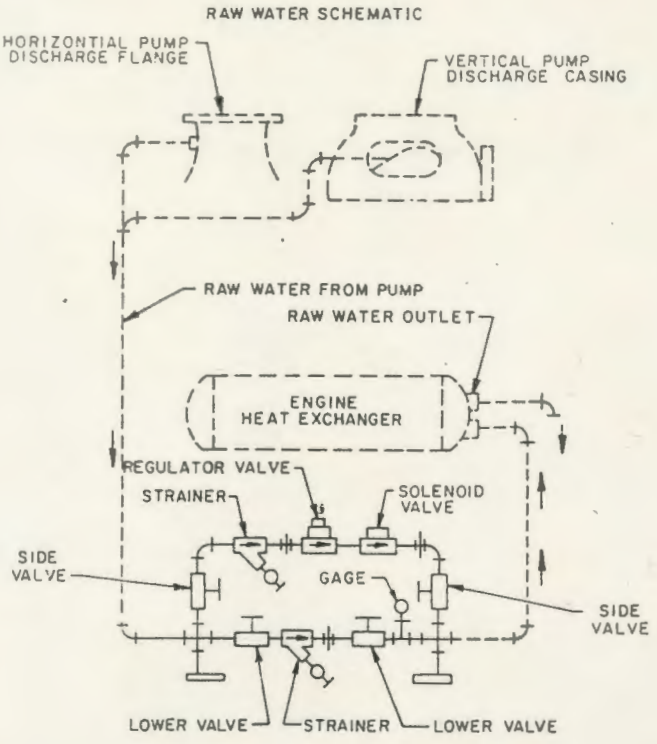
COOLING WATER INSTRUCTIONS

Horizontal and Vertical Engine Driven Fire Pump Cooling Water Piping Data For Caterpillar Diesel Engines Only



This instruction covers the installation and operation of the cooling water system for heat exchanger cooled fire pump engines. This instruction is a supplement to pump instructions and engine manufacturer's instructions.

I. INTRODUCTION

UL listed, FM approved fire pump engines employ a "heat exchanger" instead of a conventional "radiator" to maintain proper jacket water temperature. The engine water pump circulates jacket water around the tubes of the heat exchanger. Raw water from the fire pump is passed thru the tubes and discharged to waste. Since there is no mixing of jacket water and raw water, anti-freeze and rust inhibitors, as recommended by the engine manufacturer, should be used.

II. DESCRIPTION

In order to provide an adequate volume of raw water at the proper velocity and at the proper pressure, a raw water bypass system must be used. The various parts of this raw water bypass system are described below. Reference "Raw Water Schematic" drawing.

A. The "Strainer" is used to prevent foreign matter from entering the solenoid valve, the regulator valve and the heat exchanger tubes. A blow-off valve is located at the bottom of the strainer to allow cleaning while the engine is in operation.

B. The "Regulator Valve" controls volume and pressure of raw water.

C. A "Solenoid Valve", (furnished for horizontal pump application only), will automatically open when the engine is running and automatically close when the engine is stopped, thereby preventing the waste of raw water.

D. The "Lower Valves" are normally closed. These valves may be opened, in an emergency, to bypass the regulator valve and solenoid valve, and provide raw water to the engine. Note: Open "Lower Valves" in an emergency only.

E. The "Side Valves" are normally open. These valves may be closed should the regulator valve and solenoid valve ever require repair.

F. A "Gage" is provided to indicate back pressure on the raw water discharge. Most installations will produce approximately 3 PSI of back pressure. Back pressure must not exceed 30 PSI.

III. INSTALLATION

The raw water outlet, shown on outline drawing, must be piped to an open drain. Do not use a valve or other restriction in this line. Fill engine with clean coolant containing anti-freeze and rust inhibitor in accordance with the engine manufacturer's recommendations. Make up coolant may be required after the engine has been operated. Check position of the valve handles in the raw water bypass. The "lower valve" should be closed. The "side valves" should be open.

IV. OPERATION

Start the engine. Gradually increase the load until the engine is operating the pump at the maximum BHP condition. Maximum BHP condition is indicated by minimum engine speed. Observe engine block temperature. Temperature will continue to rise until the engine thermostat opens. Opening of the thermostat will occur at approximately 170°F and will be indicated by a leveling off of temperature and then a slight reduction of temperature. Observe this point and adjust the "regulator valve" to maintain this temperature within ± 5°F. Turn the regulator screw clockwise to reduce block temperature.

V. MAINTENANCE

A. Strainer must be checked frequently and kept clean at all times.

B. Regulator may require adjustment for seasonal changes in water temperature.

VI. LIMITATIONS

The raw water bypass is designed to maintain engine jacket water temperature at 170°F based on the following conditions.

A. Cooling water, from the pump, must be free of contamination.

B. Cooling water temperature, from the pump, must not exceed 70°F.

C. Pump House temperature must not exceed 115°F. Radiant heat not dissipated by air circulation is transferred to the engine jacket water and must be absorbed by the raw water bypass system.

D. Waste water, from the heat exchanger outlet, must be piped to an open waste.

If the above conditions cannot be provided, supplemental equipment or an alternate cooling method must be supplied locally to meet local conditions and to adhere to the requirements of local approval authorities.

CATERPILLAR®

SEBU5986-03
April 1989

Operation & Maintenance Manual

3208, 3306B, 3406B, 3408B and 3412 Fire Pump Engines

Supplement for Direct Injection Industrial Engines

Table of Contents and Foreword

Table of Contents

Foreword

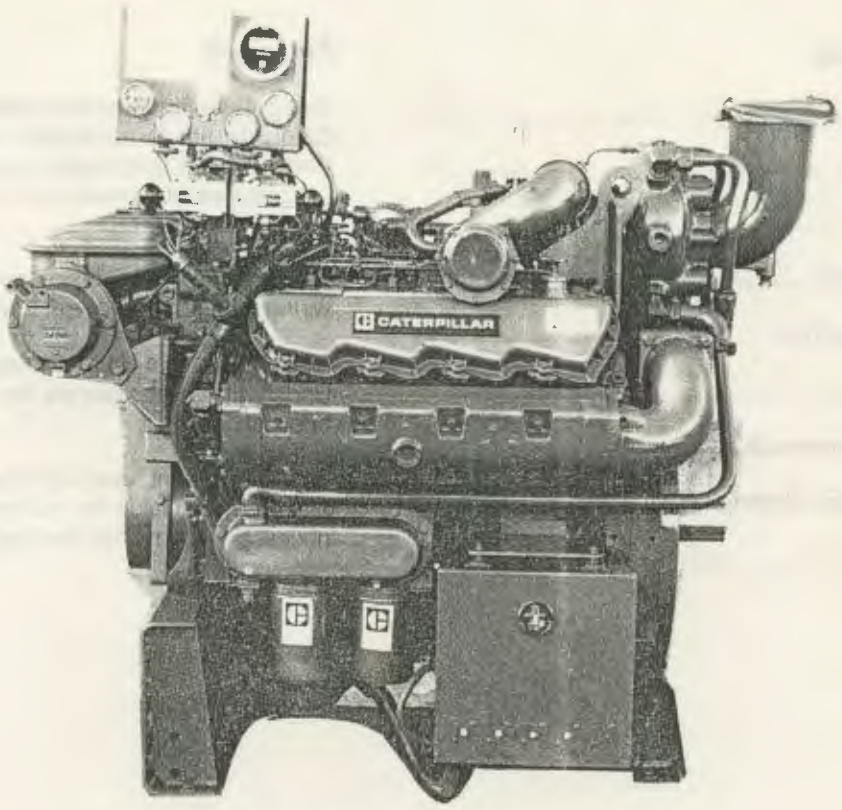
This publication provides supplemental information for Caterpillar fire pump engines, listed by the Underwriters Laboratories, Inc. (ULI), Underwriters Laboratories of Canada (ULC) and approved by Factory Mutual (FM).

This supplement contains operating procedures, a wiring diagram and coolant system flow schematics.

It also contains a list of accessories required by the Underwriters Laboratories, Inc. (ULI), for various engine applications.

This supplement, used with the Operation and Maintenance Guide for your engine, provides the necessary information for fire pump engines.

Model Views



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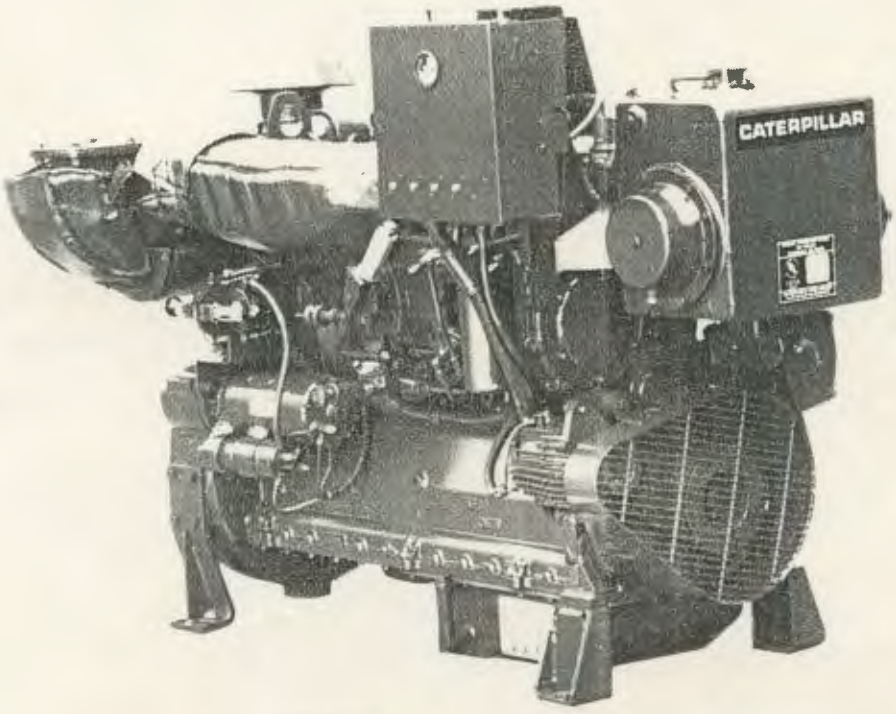

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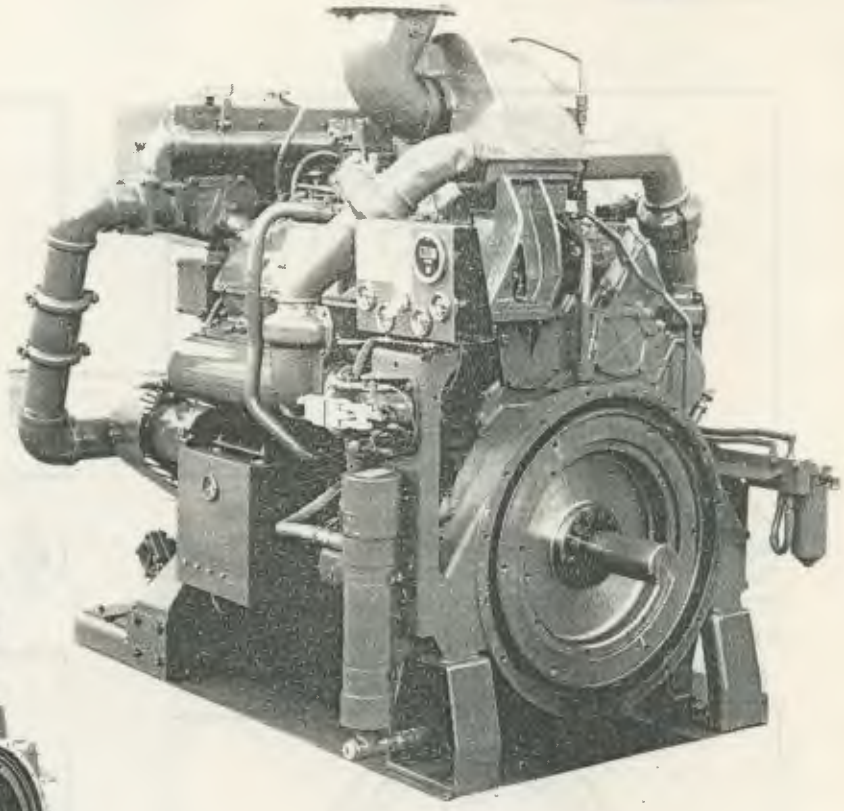
Model Views



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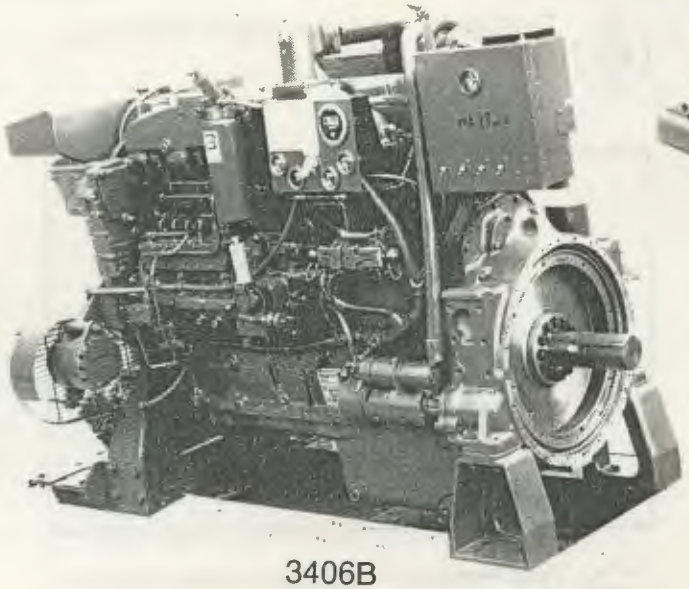

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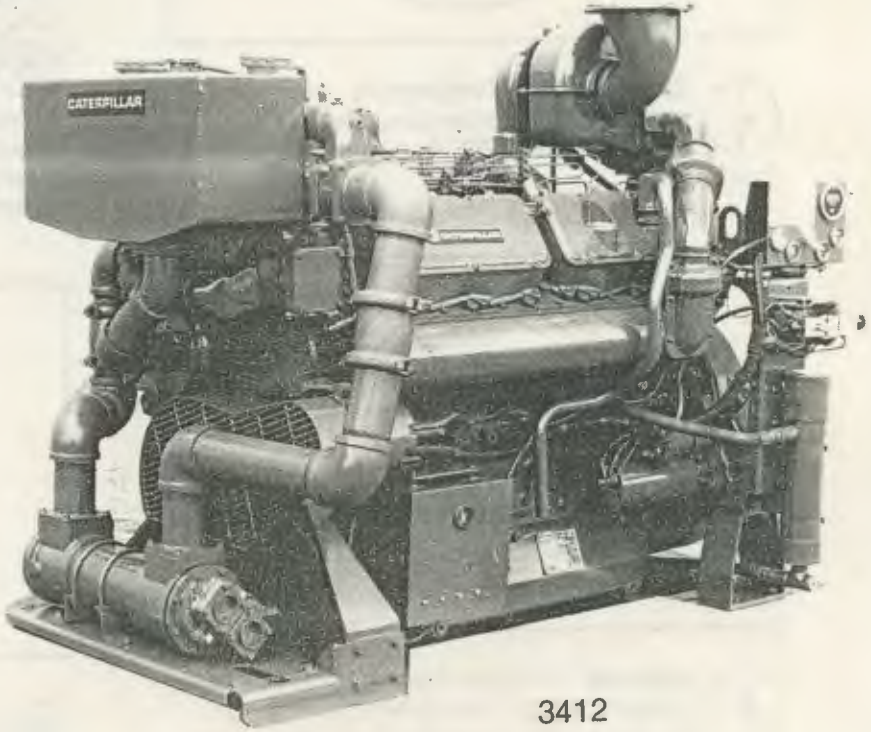

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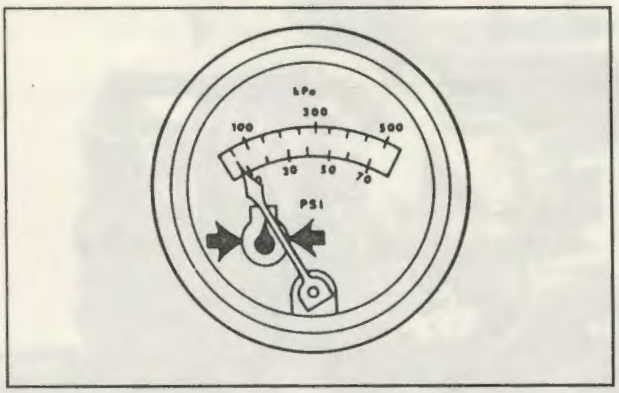
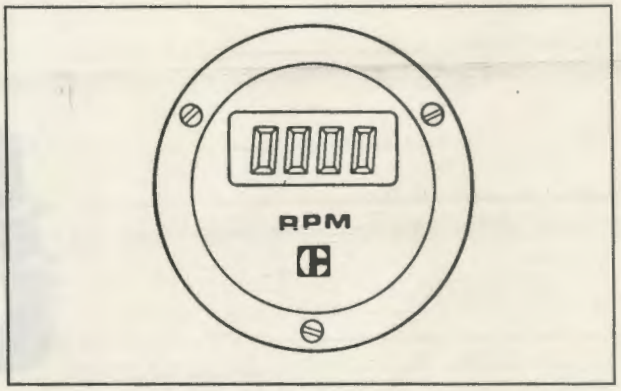
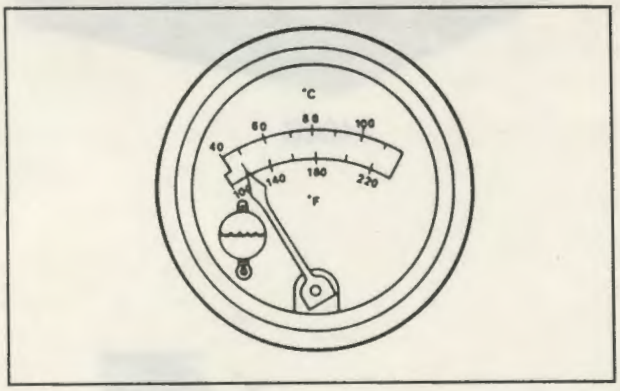
Gauges



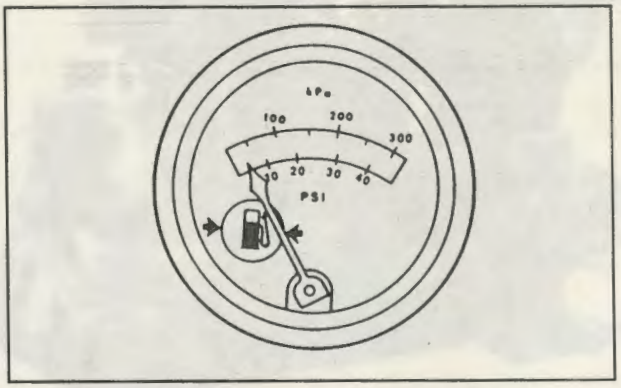
Engine Oil Pressure – Indicates engine oil pressure during operation. The indicator should be in the WHITE range at low idle engine speed or in the GREEN range at operating engine speed.



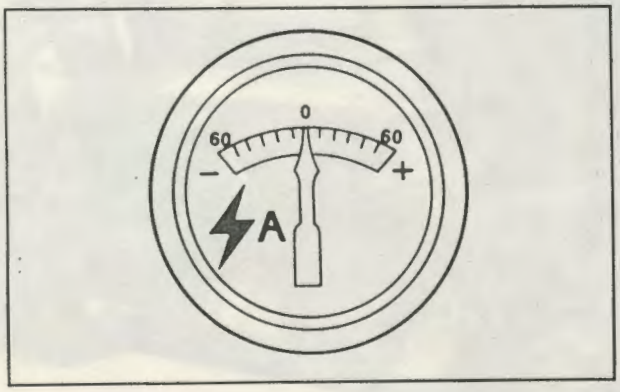
Tachometer – Indicates engine speed (rpm).



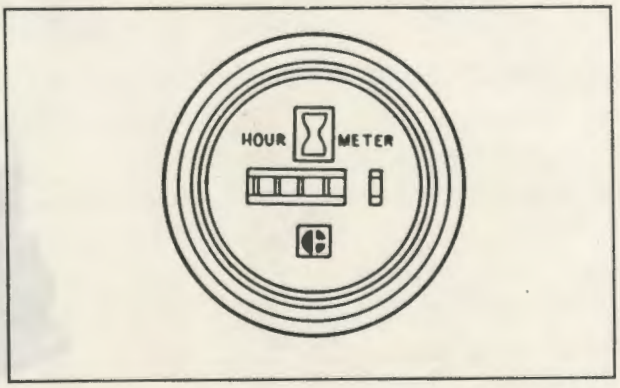
Engine Coolant Temperature – Indicates engine coolant temperature. The indicator should be in the GREEN range during engine operation.



Fuel Pressure – Indicates fuel pressure during operation and should register in the NORMAL (green) range. When the filter elements become clogged, the indicator moves to OUT. If the indicator registers below 140 kPa (20 psi), clean primary fuel filter and replace secondary fuel filter element.



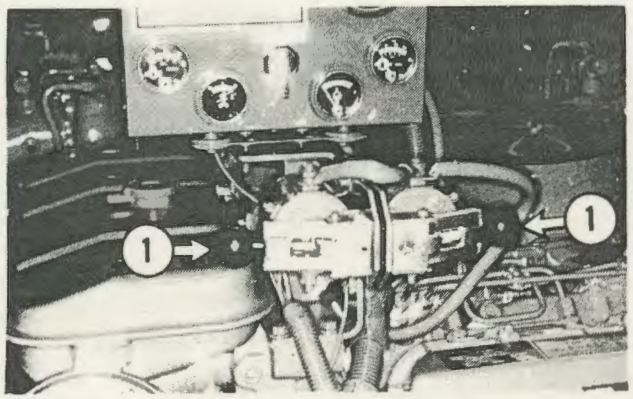
Ammeter – Indicates condition of the battery charging circuit. The indicator should be on the plus (+) side immediately after the engine starts and then the indicator should return to ZERO (0).



Service Meter – Indicates the total service hours on the engine. Use to determine service intervals.

Manual Operation

Emergency Starting



Manual Start Levers (1)
3208 Engine shown

Emergency Manual Starting Instructions

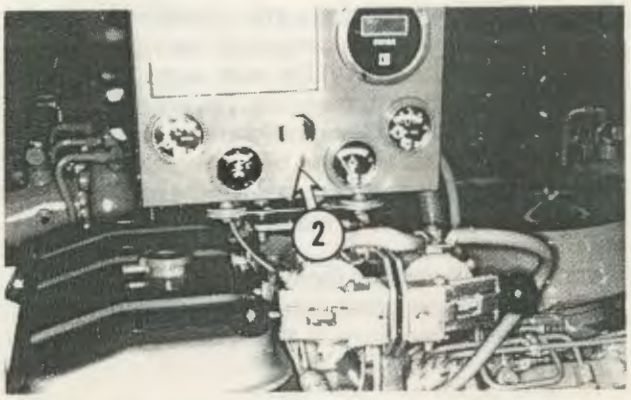
IMPORTANT: The control switch on this panel must be in the "MANUAL" position.

To Start Engine

1. Open the manual cooling bypass valve.

2. Pull and hold one of the two manual start levers (1) until engine starts; or for a cranking period of approximately 15 seconds. If engine fails to start – wait 15 seconds and repeat cycle with the alternate manual start lever (1).

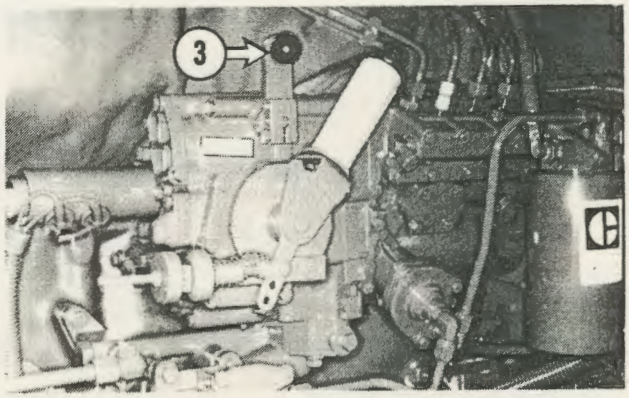
To Stop the Engine



Manual-Auto-Stop Switch (2)
3208 Engine shown

1. Turn the control switch (2) on this panel to "STOP" position and hold until engine comes to a complete stop.

2. Close the manual cooling bypass valve.



Manual Shutoff Lever (3)

The 3300B and 3400B Series Engines may be shut off using the manual shutoff lever (3).

Automatic Operation and Weekly Operation Test

Automatic Operation

The basic function of a fire pump controller for engine driven fire pumps is to automatically start the engine upon a drop in pressure in the water supply, or from a number of other demand signals. The controller provides automatic cycled cranking and alarm protection for various engine failures when running. Stopping the engine after the demand period is terminated may be either manual or automatic.

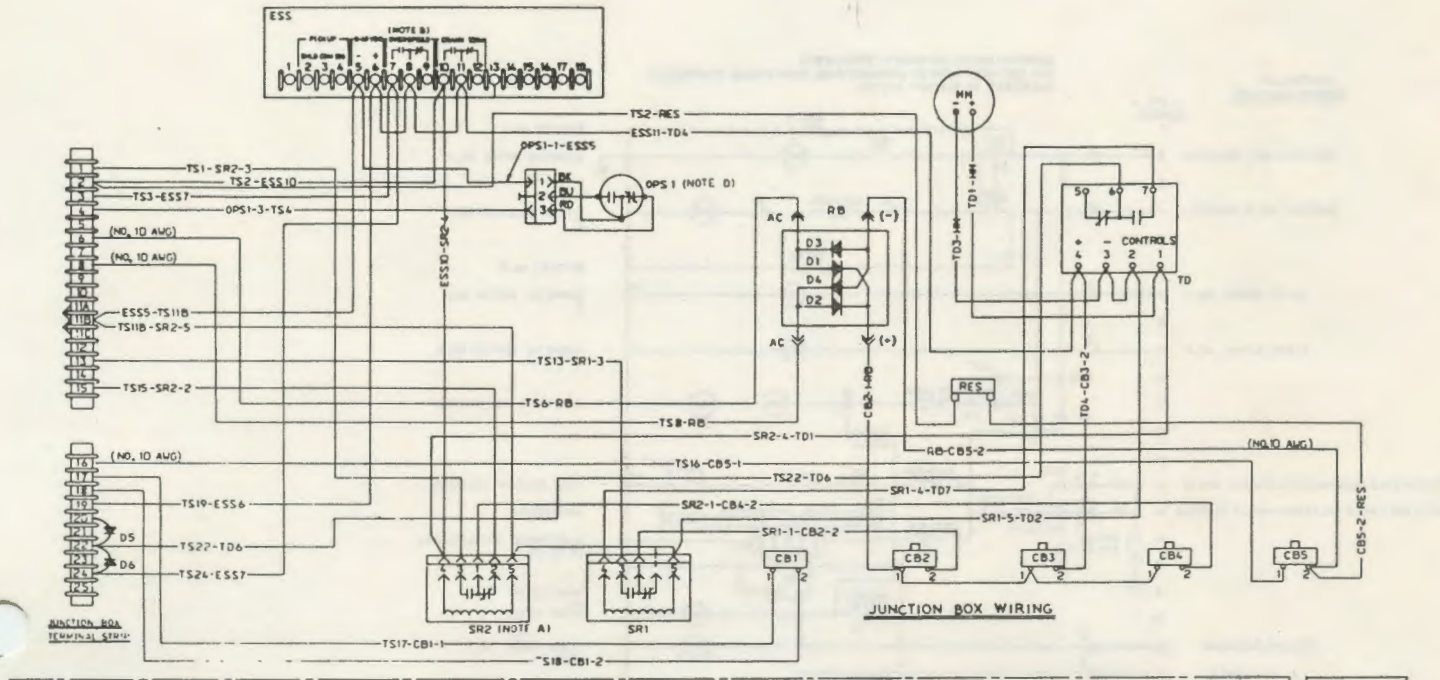
Recommended ambient room temperature is 20°C (70°F). The engine jacket water temperature must be maintained at a minimum of 49°C (120°F).

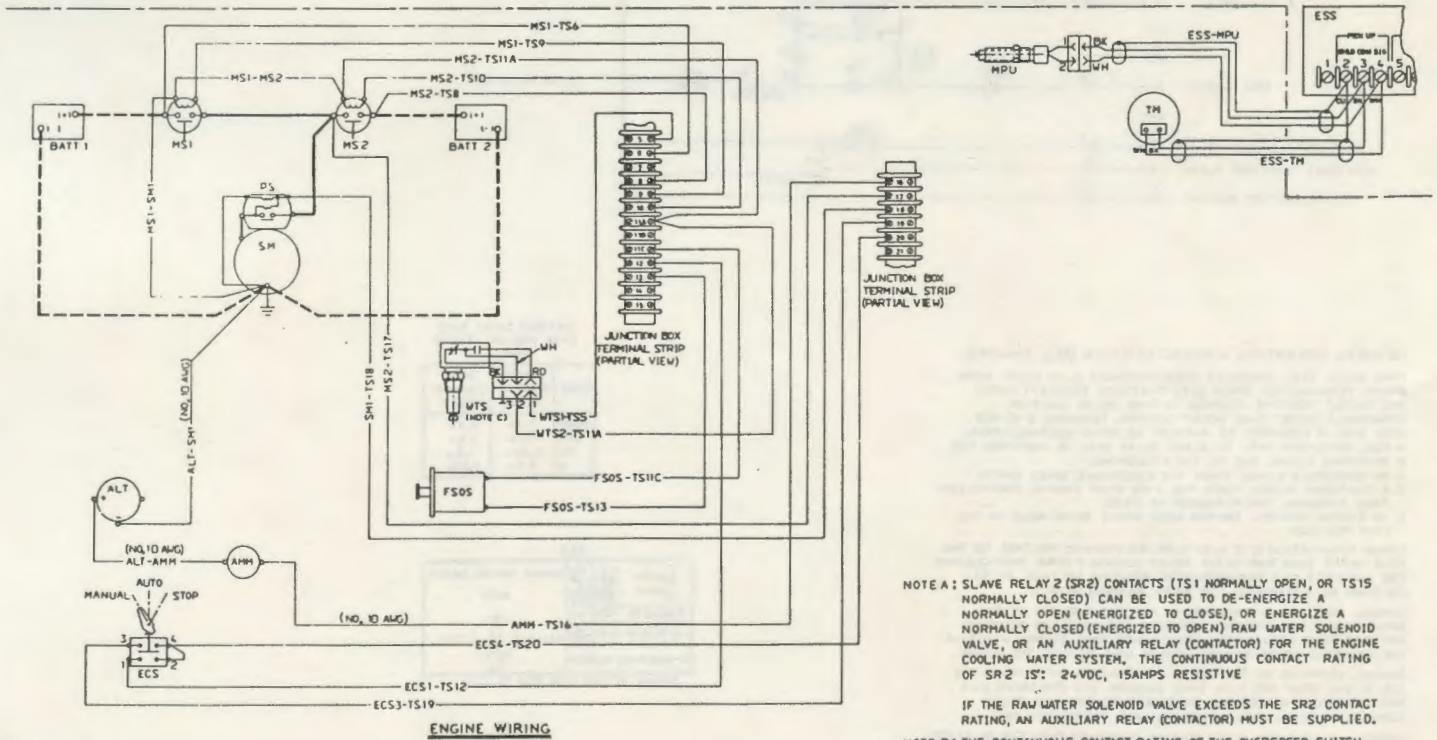
Weekly Operational Test

Once a week, in accordance with NFPA-20, start and run the engine for a minimum of 30 minutes to attain normal operating temperatures.

The Operation and Maintenance Guide for your engine provides the correct lubrication and maintenance procedures.

Wiring Diagram





NOTE A: SLAVE RELAY 2 (SR2) CONTACTS (TS1 NORMALLY OPEN, OR TS15 NORMALLY CLOSED) CAN BE USED TO DE-ENERGIZE A NORMALLY OPEN (ENERGIZED TO CLOSE), OR ENERGIZE A NORMALLY CLOSED (ENERGIZED TO OPEN) RAW WATER SOLENOID VALVE, OR AN AUXILIARY RELAY (CONTACTOR) FOR THE ENGINE COOLING WATER SYSTEM. THE CONTINUOUS CONTACT RATING OF SR2 IS: 24VDC, 15AMPS RESISTIVE

IF THE RAW WATER SOLENOID VALVE EXCEEDS THE SR2 CONTACT RATING, AN AUXILIARY RELAY (CONTACTOR) MUST BE SUPPLIED.

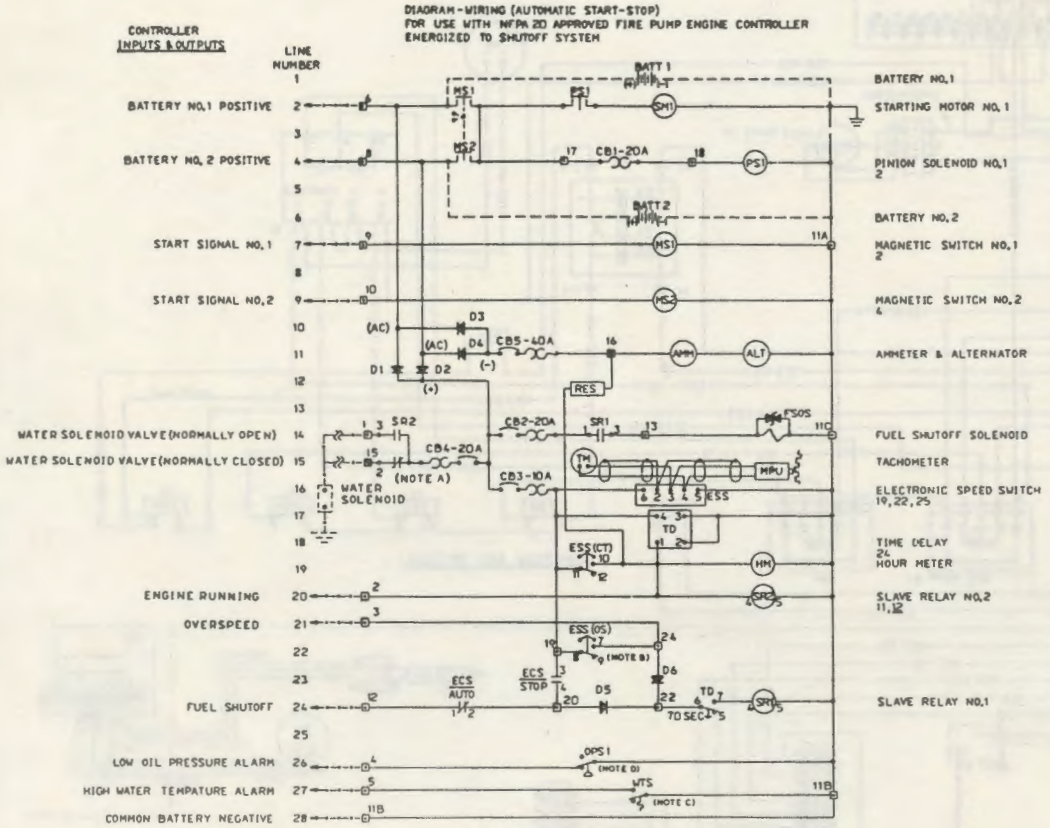
NOTE B: THE CONTINUOUS CONTACT RATING OF THE OVERSPEED SWITCH (OSS) IS: 24VDC, 3AMPS RESISTIVE
1.5AMPS INDUCTIVE

NOTE C: THE CONTINUOUS CONTACT RATING OF THE WATER TEMPERATURE SWITCH (WTS) IS: 24VDC, 10 AMPS RESISTIVE
10 AMPS INDUCTIVE

NOTE D: THE CONTINUOUS CONTACT RATING OF THE OIL PRESSURE SWITCH (OPS1) IS: 24VDC, 1.5AMPS RESISTIVE
1.5AMPS INDUCTIVE

ENERGIZED TO SHUTOFF SYSTEM FOR USE WITH A NFPA 20 APPROVED FIRE PUMP ENGINE CONTROLLER

Wiring Diagram



BATTERY CABLE SIZE
(MAX ONE-WAY LENGTH)
(25°C)

GAGE	SINGLE STARTING MOTOR	DUAL STARTING MOTORS
0000	5,0m	2,5m
000	4,0m	2,0m
00	3,25m	1,5m
0	2,5m	1,25m

GENERAL OPERATING CHARACTERISTICS (ALL ENGINES)

TIME DELAY (TD) NORMALLY OPEN CONTACTS (6-7) CLOSE WHEN CRANK TERMINATION SPEED (CT) CONTACTS ESS 10 & 11 CLOSE AND SUPPLY POSITIVE VOLTAGE TO TIME DELAY CONTROL TERMINAL 1. (NOTE: TIME DELAY CONTROL TERMINAL 2 IS NOT USED AND IS GROUNDED TO BATTERY NEGATIVE VOLTAGE.) THUS, A FUEL SHUTDOWN PATH TO SLAVE RELAY (SR1) IS PROVIDED FOR A SHUTDOWN SIGNAL DUE TO THE FOLLOWING:

1. AN OVERSPEED SIGNAL FROM THE ELECTRONIC SPEED SWITCH
2. A SHUTDOWN SIGNAL FROM THE FIRE PUMP ENGINE CONTROLLER THRU TERMINAL STRIP NUMBER 12 (TS 12)
3. AN ENGINE CONTROL SWITCH (ECS) WHILE BEING HELD IN THE STOP POSITION

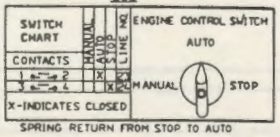
CRANK TERMINATION (CT) ALSO SUPPLIES POSITIVE VOLTAGE TO THE HOUR METER (HM) AND SLAVE RELAY NUMBER 2 (SR2) THUS CLOSING SR2 CONTACTS 1 & 3 AND PROVIDING POSITIVE VOLTAGE AT TS-1 (TO TURN ON A REMOTE ENGINE WATER SOLENOID VALVE).

MANUAL STARTING IS PROVIDED BY PLACING THE ECS IN THE MANUAL POSITION OPENING CONTACTS ECS 1 & 2 AND REMOVING ANY FIRE PUMP ENGINE CONTROLLER SHUTDOWN SIGNAL AT TS-12. THE MAGNETIC SWITCHES MAY THEN BE USED TO START THE ENGINE.

MANUAL STOPPING OF THE ENGINE IS PROVIDED BY PLACING THE ECS IN THE STOP POSITION THUS CLOSING ECS CONTACTS 3 & 4 AND PROVIDING A POSITIVE VOLTAGE THRU THE TIME DELAY CONTACTS (CLOSED WHILE RUNNING) AND ENERGIZING SR1.

DURING ALL SHUTDOWN MODES VOLTAGE IS SUPPLIED THRU TIME DELAY (TD) CONTACTS 6-7 TO SLAVE RELAY 1 (SR1). TIME DELAY CONTACTS 6-7 AUTOMATICALLY OPEN 70 ± 10 SECONDS AFTER THE ENGINE REACHES 0 RPM. INSTANT RESTART IS AVAILABLE WHEN THE SHUTDOWN SIGNAL IS REMOVED.

ECS



SPRING RETURN FROM STOP TO AUTO

Wiring Diagram Nomenclature

NOTICE

Do not polarize alternator.

Do not operate alternator without a battery connected to the system.

Nomenclature

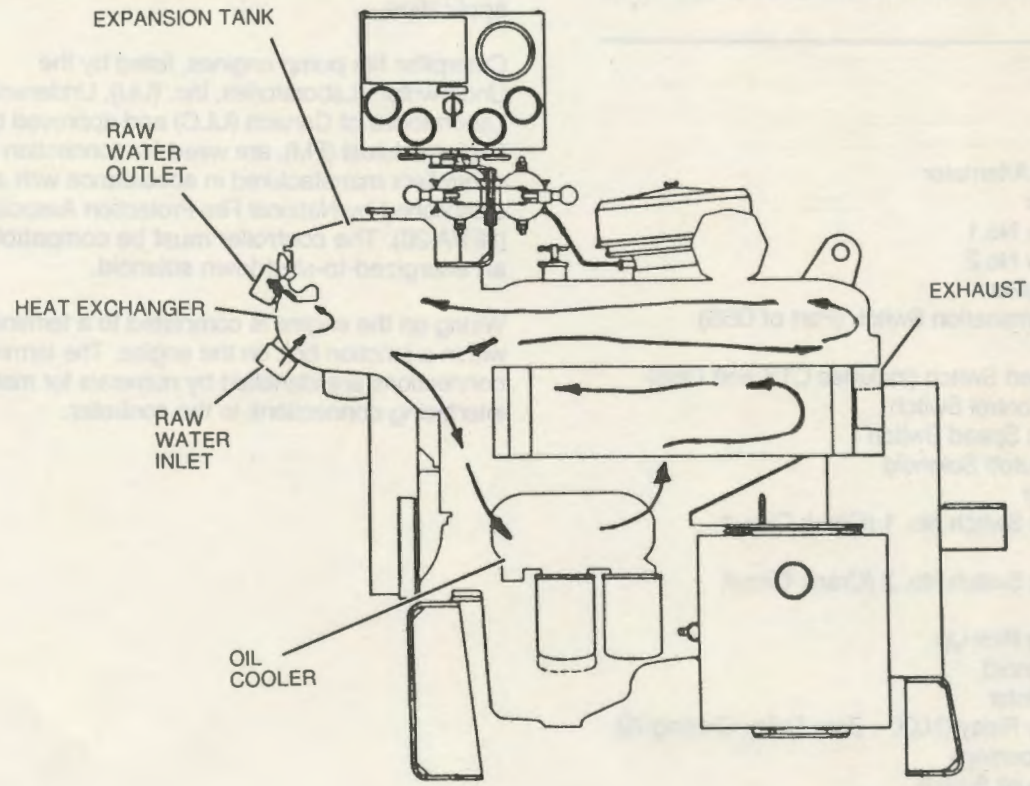
ALT – Charging Alternator
AMM – Ammeter
BATT 1– Battery No.1
BATT 2– Battery No.2
CB – Circuit Breaker
CTS – Crank Termination Switch (Part of DSS)
D – Diode
DSS – Dual Speed Switch (Includes CTS and OSS)
ECS – Engine Control Switch
ESS – Electronic Speed Switch
FSOS – Fuel Shutoff Solenoid
HM – Hour Meter
MS1 – Magnetic Switch No. 1 (Crank Circuit Contactor)
MS2 – Magnetic Switch No. 2 (Crank Circuit Contactor)
MPU – Magnetis Pick-Up
PS – Pinion Solenoid
SM – Starting Motor
TD – Time Delay Relay (N.O. – Zero Delay Closing-70 Second Delay Opening)
OPS – Oil Pressure Switch
OS – Overspeed Switch (Part of DSS)
RB – Rectifier Bridge
RES – Resistor
SM – Starting Motor
SR – Slave Relay
TM – Tachometer
TS 1-25 – Terminal Strip Point (Engine Junction Box)
WTS – Water Temperature Switch
——— Engine Battery Cable
– – – Customer Provided Battery Cable
-·-·-·- Customer Provided Wiring
——— Engine Wiring

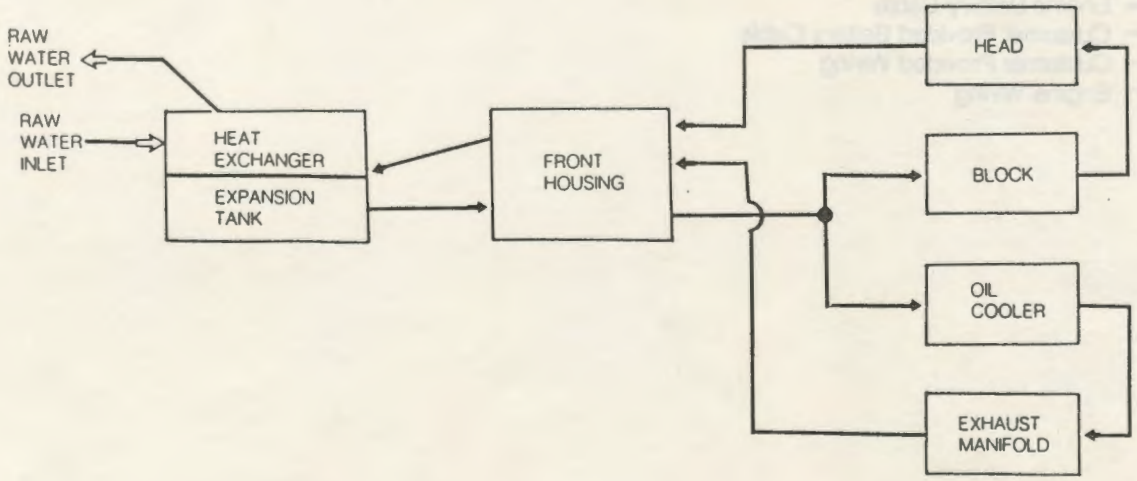
NOTE: The components listed are only a brief list of accessories that can be used on fire pump engines. Refer to the parts book for part numbers and accessories for your engine arrangement and application.

Caterpillar fire pump engines, listed by the Underwriters Laboratories, Inc. (ULI), Underwriters Laboratories of Canada (ULC) and approved by Factory Mutual (FM), are wired for connection to controllers manufactured in accordance with standards established by National Fire Protection Association (NFPA-20). The controller must be compatible with an energized-to-shutdown solenoid.

Wiring on the engine is completed to a terminal strip within a junction box on the engine. The terminal strip connections are identified by numerals for making interfacing connections to the controller.

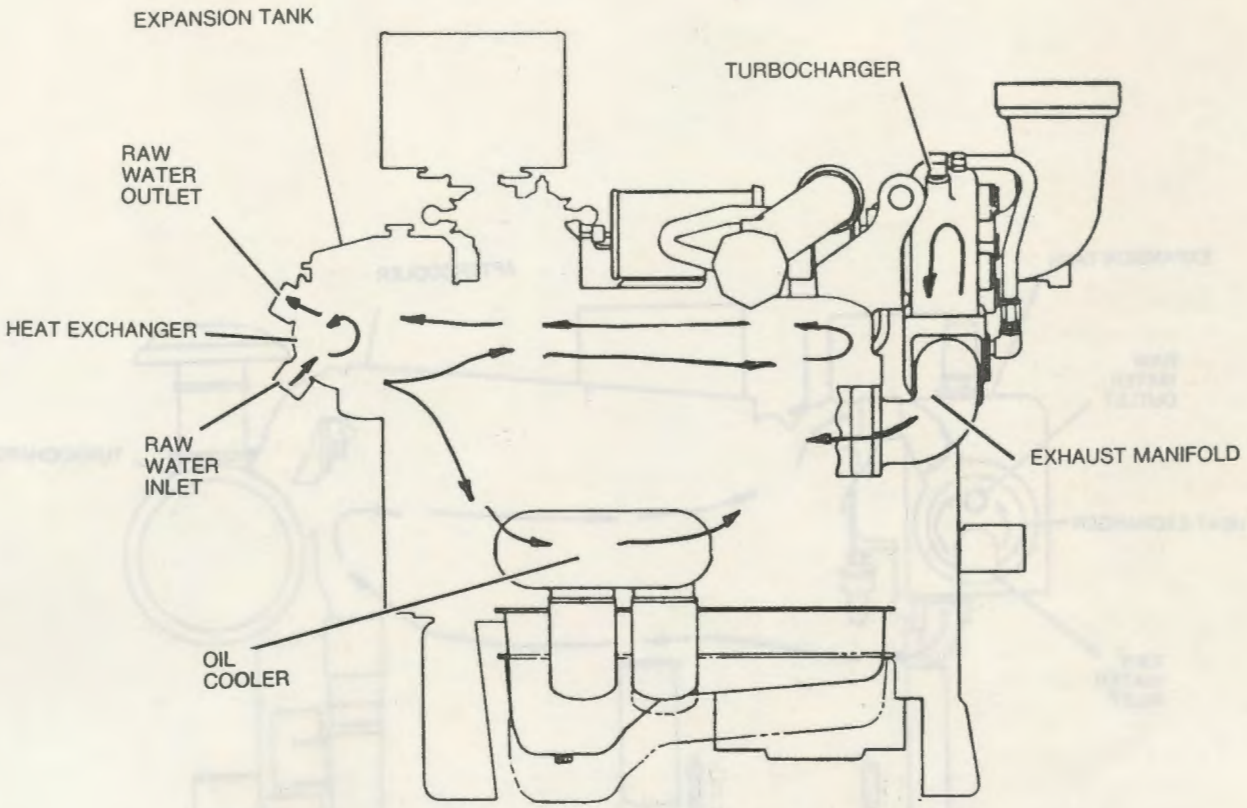
Coolant System Flow Schematics

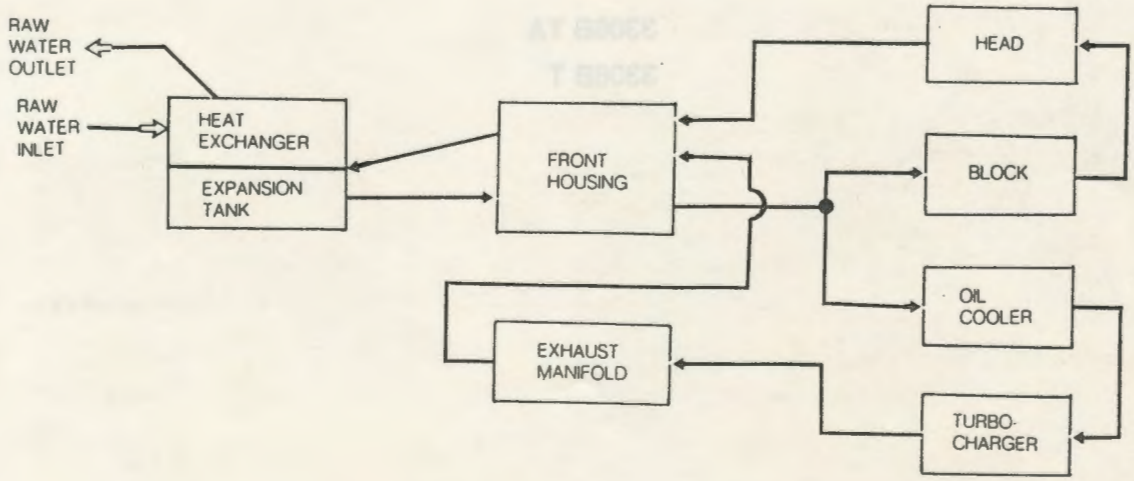




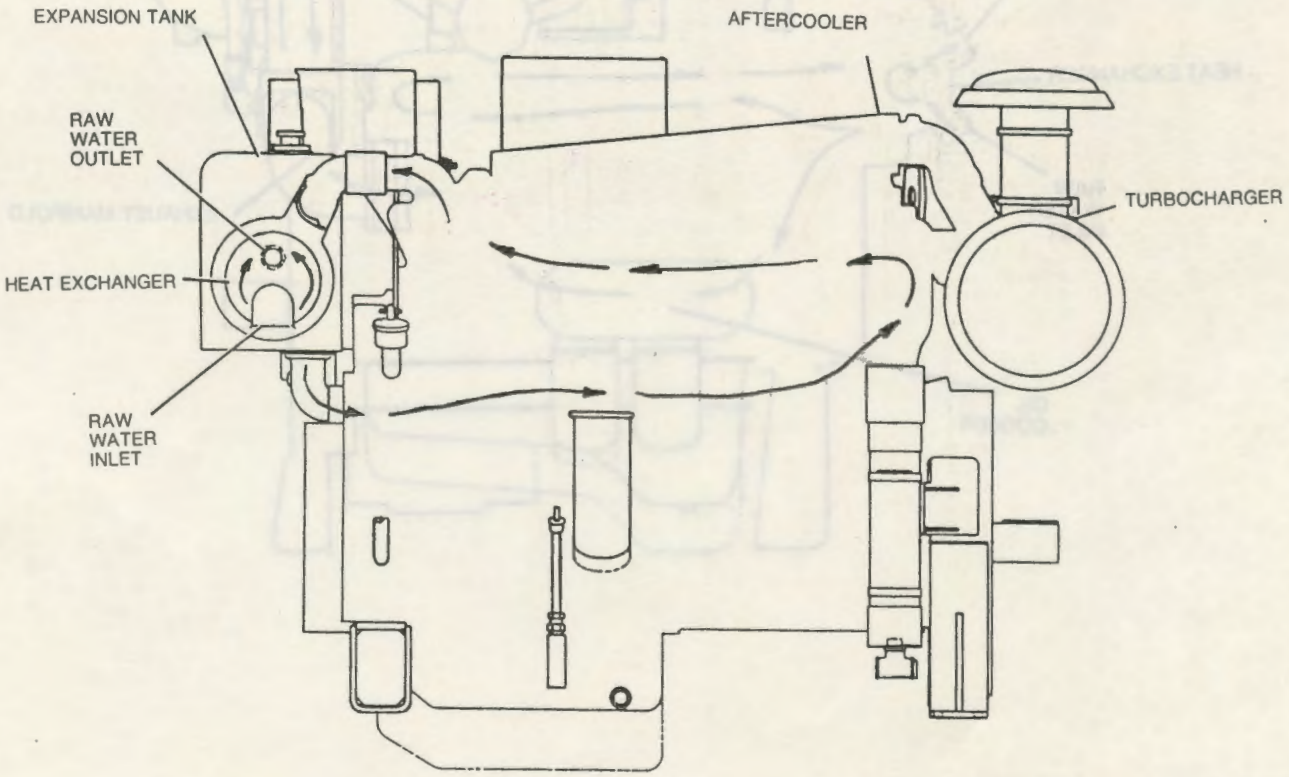
3208 NA

Coolant System Flow Schematics





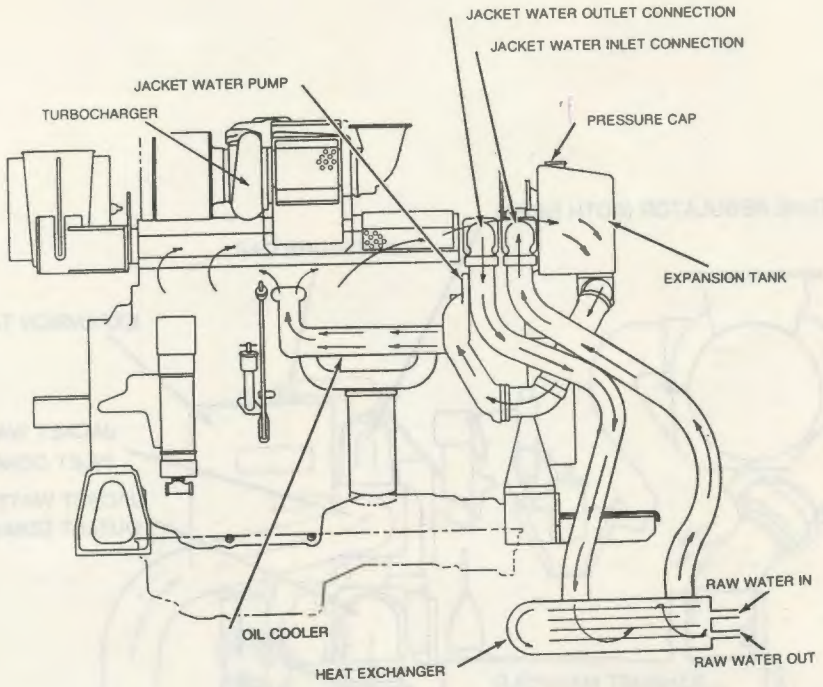
Coolant System Flow Schematics



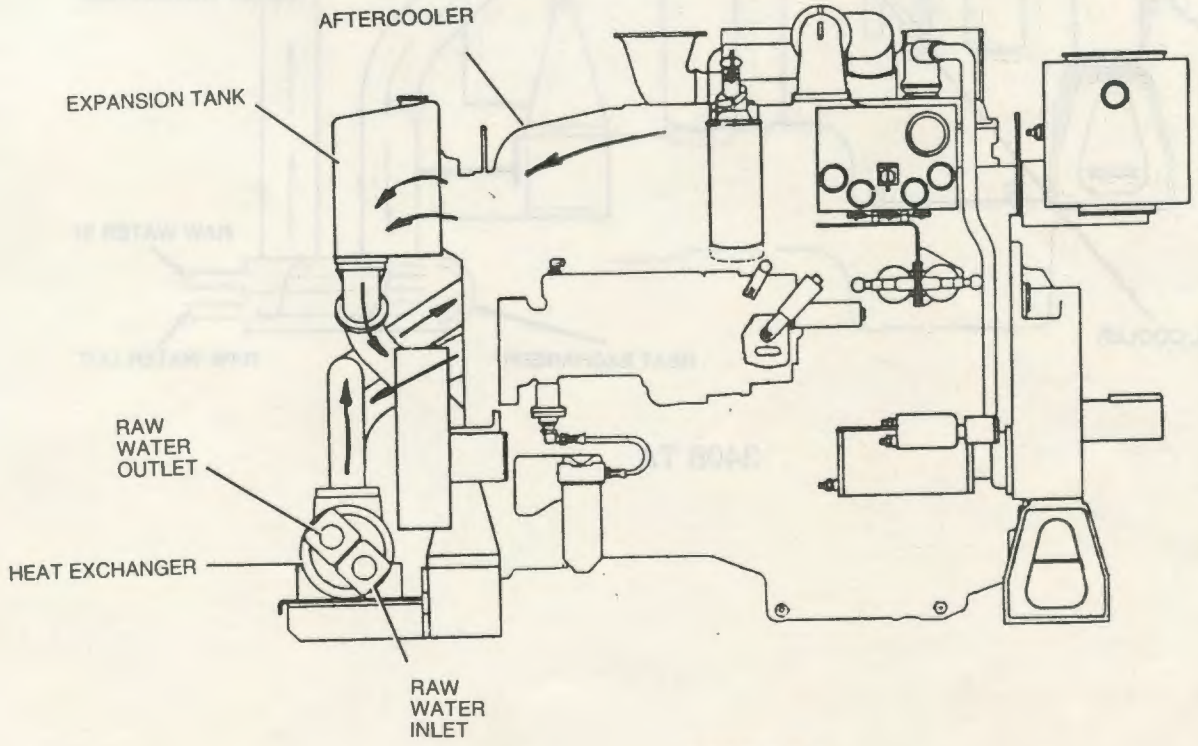
3306B TA

3306B T

Coolant System Flow Schematics

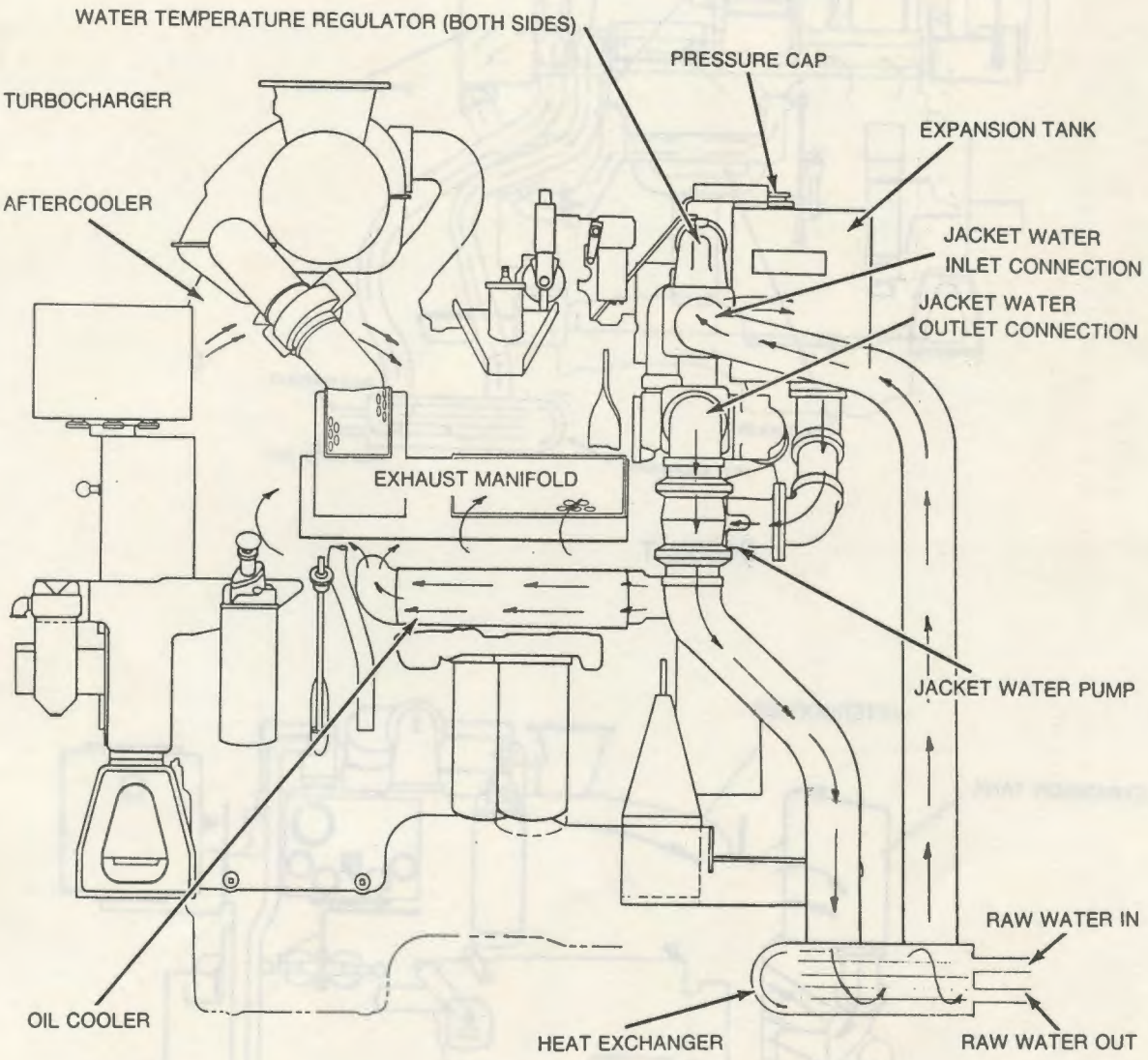


3406B T



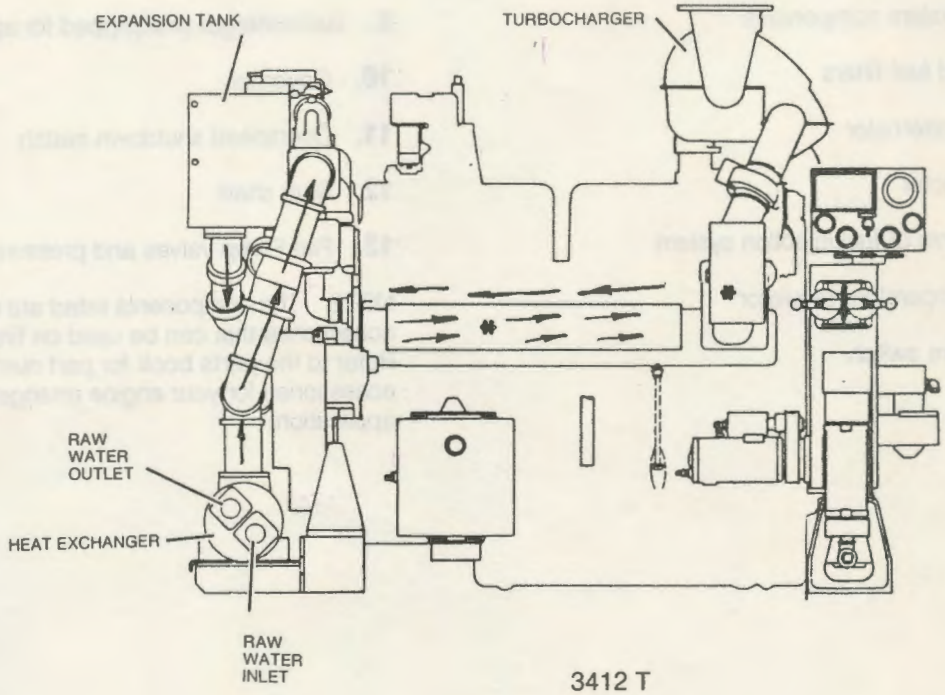
3406B TA

Coolant System Flow Schematics

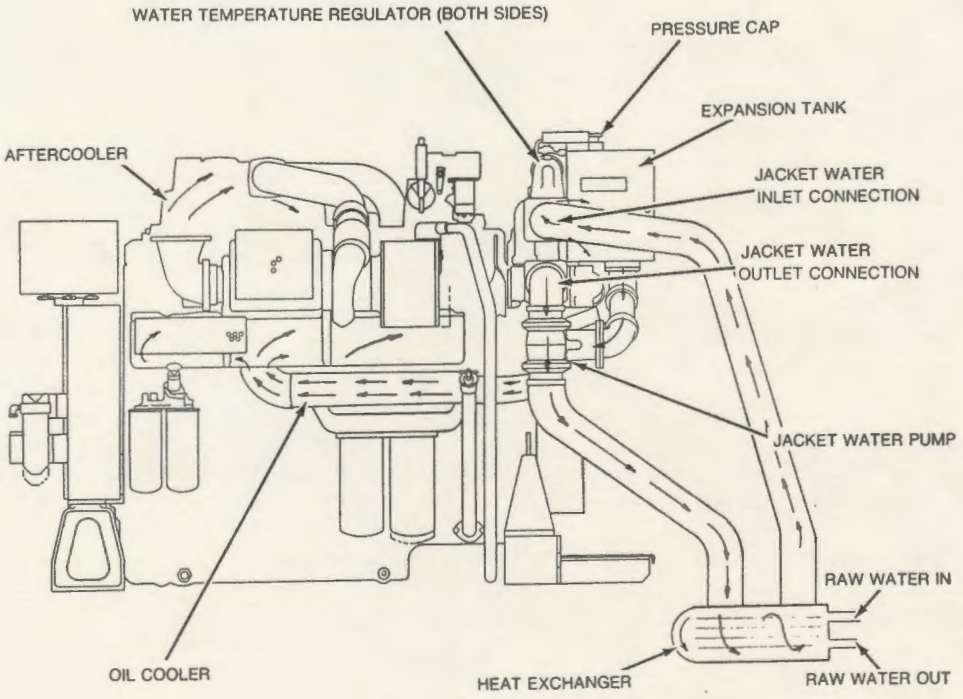


3408 TA

Coolant System Flow Schematics



3412 T



3412 TA

Accessories

Minimum Required Accessories

1. Cooling system components
2. Oil, air and fuel filters
3. Charging alternator
4. Starting motor
5. Components of fuel injection system
6. Engine temperature regulator
7. Oil pressure switch
8. Temperature switch
9. Turbocharger (if equipped for application)
10. Governor
11. Overspeed shutdown switch
12. Stub shaft
13. Fire Pump valves and pressure regulator settings

NOTE: The components listed are only a brief list of accessories that can be used on fire pump engines. Refer to the parts book for part numbers and accessories for your engine arrangement and application.

SEBU6251-01
November 1989

Caterpillar's Engine and Marine Lubricant Recommendations

Caterpillar's Lubricating Oils

Introduction

The CAT Oils have been tested and selected by Caterpillar to provide the performance and life which has been designed and built into our engines and transmissions.

These CAT Oils are currently being used for factory fill for engines and machines and are offered by Caterpillar dealers for continued refill use. Consult your Caterpillar dealer for these CAT Oils.

CAT Oils are offered in a full line of appropriate single and multiviscosity oils to meet the ambient temperature requirements for each machine compartment. For additional lubricant information, refer to the "Caterpillar Reference Materials" section of this publication.

NOTE: All lubricant recommendations in this publication will be incorporated into the operation & maintenance manuals as they are revised.

CAT Lubricating Oils

The following oils have been blended, tested and selected for the various compartments:

- Caterpillar Engine Oils
CAT Diesel Engine Oil (DEO)
CAT Engine Oil (EO)

- CAT Transmission/Drive Train Oil (TDTO)

- CAT Lubricating Grease (MPGM)

Caterpillar Reference Materials

PEDP7122 ..... Question & Answer Booklet

PEHP7504 ..... CAT Engine Oil Spec Sheets

PEHP7505 ..... CAT Diesel Engine Oil Spec Sheets

PEHP7506 CAT Transmission/Drive Train Oil Spec Sheets

Your Caterpillar dealer can provide any literature required to maintain your machine and/or engine.

Lubricant Specifications

General Information

Certain abbreviations follow S.A.E. J754 nomenclature and some classifications follow S.A.E. J183 abbreviations. The MIL specifications are U.S.A. Military Specifications. The definitions other than Caterpillar's will be of assistance in purchasing lubricants. The recommended oil viscosities can be found in the "Lubricant Viscosities" chart in this publication.

The grease is classified by the National Lubricating Grease Institute (NLGI) based on the ASTM D217-68 Worked Penetration characteristics which are given a defined consistency number.

Engine Oils (DEO and EO)

Caterpillar has two oil formulations to provide maximum performance and life in your engines.

- CAT Diesel Engine Oil (DEO)
- CAT Engine Oil (EO)

The CAT Diesel Engine Oil (DEO) is blended with a diesel engine type additive with 14 TBN (Total Base Number) and 1.8% sulfated ash level.

The CAT Engine Oil (EO) is a lubricant meeting the industry standards for both gasoline and diesel requirements. This oil has 10 TBN and a 1.2% sulfated ash level.

The oil formulation will depend on the type of machine, fuel sulfur, customer machine usage and customer preference. But as a general reference, use the following chart:

CAT Engine	CAT Oil
3600	DEO
3500	DEO or EO
3400	DEO or EO
D-Series	DEO or EO
3300	EO or DEO
3200	EO or DEO
3114	EO
3116	EO
3176	EO

NOTE: For the 3600 Engines, use CAT Diesel Engine Oil (DEO) or other oils recommended by Caterpillar, contact Engine Division Engineering – phone U.S.A. (309) 578-3003.

Alternate Oils

If an oil other than the CAT oils is to be used, the following oil specifications provide selection guidelines.

When CAT DEO is listed for the engine:
- API specifications CD, CD/SF, CD/SG, CD/SD or CD/SE
- European oil specification CCMC D4 or D5
- Military specification MIL-L-2104E or MIL-L-2104D

When CAT EO is listed for the engine:
- API specifications CE, CE/SF or CE/SG

NOTE: Some 3200 Engines specify CD/SF, CD/SG, CE/SF or CE/SG oil because of slipper type valve cam followers which require a zinc additive for anti-wear. The CAT oils have the zinc additive and therefore, are acceptable for all 3200 Engines.

Oil with these specifications may require shortened oil change periods as determined by close monitoring of oil condition with Scheduled Oil Sampling (S•O•S) and infrared analysis.

NOTICE

Failure to follow these recommendations can cause shortened engine life due to carbon deposits or excessive wear.

Consult the "EMA Lubricating Oils Data Book", Form SEBU6310, for a listing of oil brands.

Additional Notes

NOTE: Consult the Caterpillar Operation and Maintenance Manual for the exact CAT or commercial oil specification for your specific engine or machine. Also consult with your Caterpillar dealer for the latest lubrication recommendations.

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PEHP7506 CAT Transmission/Drive Train Oil Spec Sheets

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CAT Engine	CAT Oil
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3500	DEO or EO
3400	DEO or EO
D-Series	DEO or EO
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3200	EO or DEO
3114	EO
3116	EO
3176	EO

NOTE: For the 3600 Engines, use CAT Diesel Engine Oil (DEO) or other oils recommended by Caterpillar, contact Engine Division Engineering - phone U.S.A. (309) 578-3003.

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- European oil specification CCMC D4 or D5
- Military specification MIL-L-2104E or MIL-L-2104D

When CAT EO is listed for the engine:
- API specifications CE, CE/SF or CE/SG

NOTE: Some 3200 Engines specify CD/SF, CD/SG, CE/SF or CE/SG oil because of slipper type valve cam followers which require a zinc additive for anti-wear. The CAT oils have the zinc additive and therefore, are acceptable for all 3200 Engines.

Oil with these specifications may require shortened oil change periods as determined by close monitoring of oil condition with Scheduled Oil Sampling (S•O•S) and infrared analysis.

NOTICE

Failure to follow these recommendations can cause shortened engine life due to carbon deposits or excessive wear.

Consult the "EMA Lubricating Oils Data Book", Form SEBU6310, for a listing of oil brands.

Additional Notes

NOTE: Consult the Caterpillar Operation and Maintenance Manual for the exact CAT or commercial oil specification for your specific engine or machine. Also consult with your Caterpillar dealer for the latest lubrication recommendations.

NOTE: The percentage of sulfur in the fuel will affect the engine oil recommendations. For fuel sulfur effects, the Infrared Analysis and the ASTM D2896 Procedure can be used to evaluate the residual neutralization properties of an engine oil. The sulfur products formation depends on the fuel sulfur content, oil formulation, crankcase blowby, engine operating conditions and ambient temperature. The Caterpillar 20 times rule for TBN versus fuel sulfur is a general requirement, but it can be modified by used oil analysis. The effectiveness of an oil formulation will depend on the additive package. A balanced additive package oil of a lower TBN can be as effective in fuel sulfur neutralization and overall performance as some oils with higher TBN values which have additives just for increased TBN. The used oil analysis can show these results.

For more information on oil and fuel sulfur content, refer to "Oil and Your Engine", Form SEBD0640.

CAT Transmission/Drive Train Oil (TDTO)

CAT Transmission/Drive Train Oils are balanced to give maximum friction material life in power shift transmissions and eliminate brake chatter in wet brake applications. We offer several viscosity grades, including a SAE 50 grade, for maximum gear and roller bearing protection at higher ambient temperatures.

Marine Transmission

Maximum transmission life and performance can be achieved, by using Caterpillar's:

- CAT Transmission/Drive Train Oil (TDTO)

NOTICE

This oil is formulated for Transmissions and Drive Trains only, and should not be used in engines. Shortened engine life will result.

NOTE: Multi-grade oils are not blended for use in transmissions. Multi-grade oils which use high molecular weight polymers as viscosity index improvers lose their viscosity effectiveness by permanent and temporary shear of the viscosity index improver.

If circumstances require the use of an oil other than CAT Transmission/Drive Train Oil, use an oil that meets API CD/TO-2 or military specification MIL-L-2104D.

NOTE: Failure to follow this recommendation can cause shortened transmission life due to material incapability and inadequate frictional requirements for disk materials.

CAT Lubricating Grease

Caterpillar has greases for all applications.

- CAT Multipurpose Molybdenum Grease (MPGM)

Use this MPGM for heavily loaded bearings and joints where an extreme pressure grease will maximize the life of Caterpillar equipment. This NLGI No. 2 grade is suitable for most temperatures.

If MPGM is not available, use a multipurpose type grease which contains 3 to 5% molybdenum.

- CAT Multipurpose Lithium Grease (MPGL) (non-extreme pressure)

This NLGI No. 2 grade is recommended for light duty automotive type applications where a high temperature [up to 175°C (350°F)] is required. This grease offers excellent mechanical stability, high resistance to oxidation, good rust protection and excellent breakaway torque.

If this grease is not available, use a similar multipurpose grease.

- CAT Special Purpose Grease (SPG)

This grease is recommended for high temperature anti-friction bearings in such applications as electric motors, alternators, fan drives, starters and generators. The grease is a NLGI No. 2 grade.

If this grease is not available, use a similar multipurpose grease suitable for anti-friction bearings.

Lubricant Viscosities

LUBRICANT VISCOSITIES[1] FOR AMBIENT (OUTSIDE) TEMPERATURE RANGES					
Compartment or System	Oil Viscosities	°C		°F	
		Min	Max	Min	Max
Diesel Engine Oil **DEO**	SAE 10W	−20	+10	−4	+50
	SAE 10W30	−20	+40	−4	+104
	SAE 15W40	−15	+50	+5	+122
	SAE 30	0	+40	+32	+104
	SAE 40	+5	+50	+41	+122
Engine Oil **EO**	SAE 10W30	−20	+40	−4	+104
	SAE 15W40	−15	+50	+5	+122
	SAE 30	0	+40	+32	+104
Marine Transmission "Cold Water Cooled" **TDTO**	SAE 30	+10	+80[2]	+50	+176[2]
	SAE 50	+20	+95[2]	+68	+203[2]
Marine Transmission "Cold Water Cooled"	SAE 30[3]	+10	+80[2]	+50	+176[2]
	SAE 40[3]	+15	+90[2]	+59	+194[2]
Marine Transmission "Engine Jacket Water Cooled" **TDTO**	SAE 50	+20	+95	+68	+203
Marine Transmission "Engine Jacket Water Cooled"	SAE 40[3]	+15	+90	+59	+194

[1] When operating below −20°C (−4°F) refer to the Operation and Maintenance Manual, for Cold Weather Recommendations, Form SEBU5898, available from your Caterpillar dealer.

[2] Choose oil grade based on maximum operating oil temperature. Start-up at oil temperatures below the minimum requires caution. Do not increase engine rpm or add load until oil temperatures are within the recommended range and oil pressures are normal. Stop engine if pressure is not normal within 15 seconds. Lower oil temperatures at start-up may require auxiliary oil heaters.

[3] Commercially available oils which meet performance requirements.

INSTRUCTION MANUAL

For

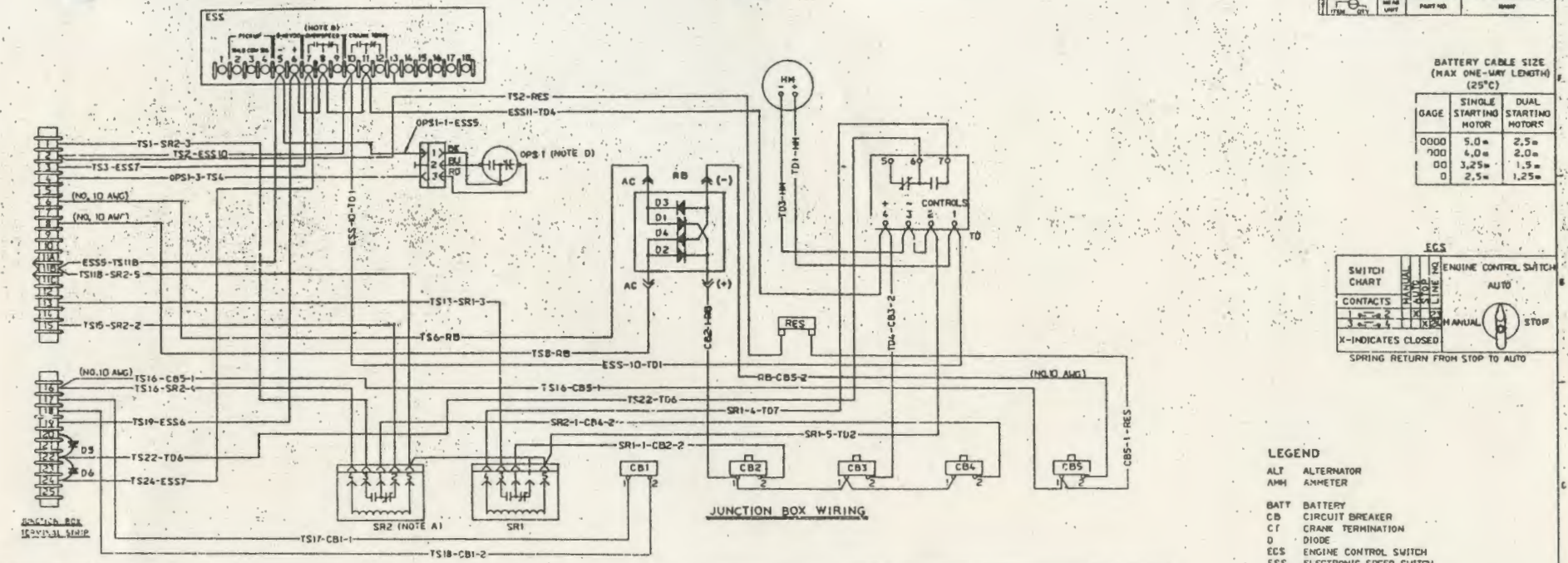
Fire Pump Controllers

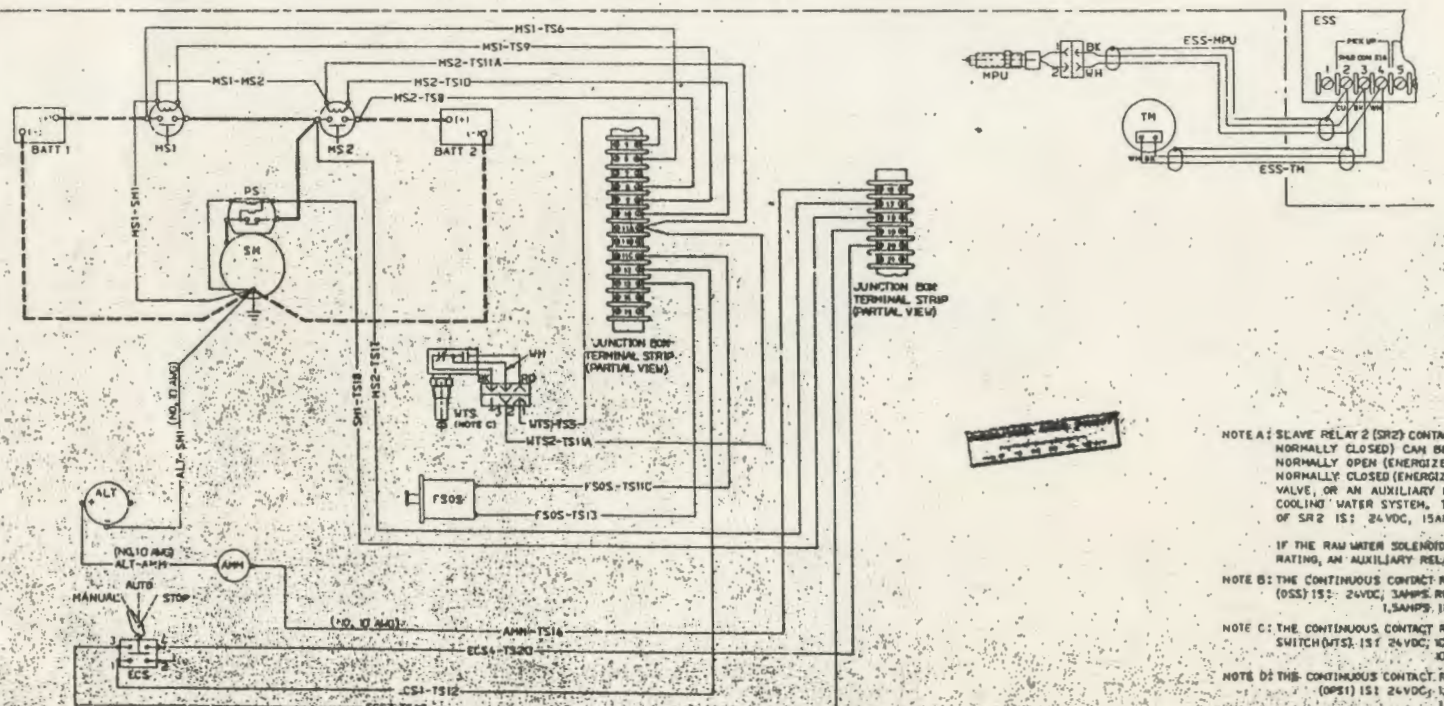
Model No. FD2-J

Serial No. _____

Metron

METRON, INC.
1051 SOUTH PLATTE RIVER DRIVE • DENVER, COLORADO 80223 • PHONE (303) 744-1781 • TELEX 4-5729
TELEFAX (303) 744-7503





BATTERY CABLE SIZE
(MAX ONE-WAY LENGTH)
(25°C)

GAGE	SINGLE STARTING MOTOR	DUAL STARTING MOTORS
0000	5.0m	2.5m
000	4.0m	2.0m
00	3.25m	1.5m
0	2.5m	1.25m

ECS

SWITCH CHART

CONTACTS	MANUAL	AUTO	STOP	NO LINE	NC
1 2		X		X	
3 4			X		X
5 6	X			X	

X-INDICATES CLOSED

ENGINE CONTROL SWITCH

AUTO

MANUAL

STOP

SPRING RETURN FROM STOP TO AUTO

LEGEND

ALT	ALTERNATOR
AMM	AMMETER
BATT	BATTERY
CB	CIRCUIT BREAKER
CT	CRANK TERMINATION
D	DIODE
ECS	ENGINE CONTROL SWITCH
ESS	ELECTRONIC SPEED SWITCH
FSOS	FUEL SHUTOFF SOLENOID
HM	HOUR METER
MPU	MAGNETIC PICK-UP
MS	MAGNETIC SWITCH
OPS	OIL PRESSURE SWITCH
OS	OVERSPEED SWITCH
PS	PINION SOLENOID
SM	STARTING MOTOR
SR	SLAVE RELAY
TD	TIME DELAY RELAY
TM	TACHOMETER
TS	TERMINAL STRIP
WTS	WATER TEMPERATURE SWITCH
RB	RECTIFIER BRIDGE
RES	RESISTOR

ENGINE BATTERY CABLE
CUSTOMER PROVIDED BATTERY CABLE
CUSTOMER PROVIDED WIRING
ENGINE WIRING

CERTIFICATION
NO DEVIATION OR CHANGE WITHOUT ENGINEERING APPROVAL

NOTE A: SLAVE RELAY 2 (SR2) CONTACTS (TS1 NORMALLY OPEN, OR TS15 NORMALLY CLOSED) CAN BE USED TO DE-ENERGIZE A NORMALLY OPEN (ENERGIZED TO CLOSE), OR ENERGIZE A NORMALLY CLOSED (ENERGIZED TO OPEN) RAW WATER SOLENOID VALVE, OR AN AUXILIARY RELAY (CONTACTOR) FOR THE ENGINE COOLING WATER SYSTEM. THE CONTINUOUS CONTACT RATING OF SR2 IS: 24VDC, 15AMPS RESISTIVE

IF THE RAW WATER SOLENOID VALVE EXCEEDS THE SR2 CONTACT RATING, AN AUXILIARY RELAY (CONTACTOR) MUST BE SUPPLIED.

NOTE B: THE CONTINUOUS CONTACT RATING OF THE OVERSPEED SWITCH (OSS) IS: 24VDC, 3AMPS RESISTIVE
1.5AMPS INDUCTIVE

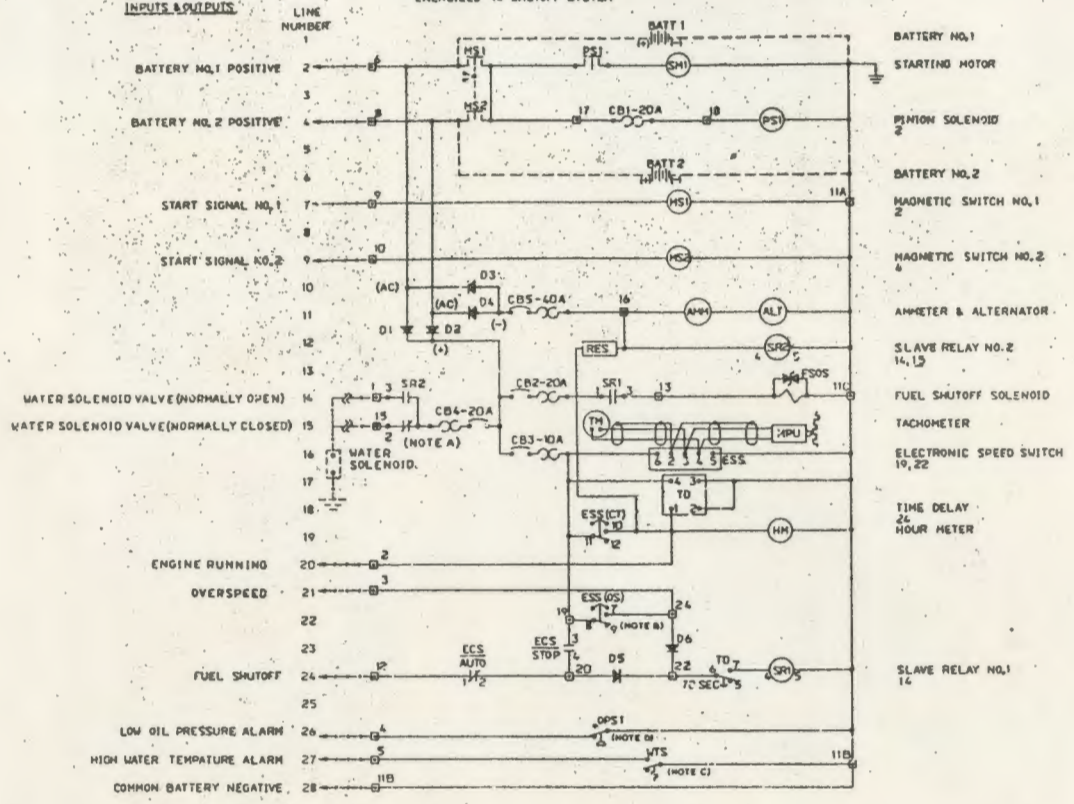
NOTE C: THE CONTINUOUS CONTACT RATING OF THE WATER TEMPERATURE SWITCH (WTS) IS: 24VDC, 10AMPS RESISTIVE
10AMPS INDUCTIVE

NOTE D: THE CONTINUOUS CONTACT RATING OF THE OIL PRESSURE SWITCH (OPS1) IS: 24VDC, 1.5AMPS RESISTIVE
1.5AMPS INDUCTIVE

FOR USE WITH: 3208, 3306, 3406, 3408, 3412

ENERGIZED TO SHUTOFF SYSTEM FOR USE WITH A NFPA 20 APPROVED FIRE PUMP ENGINE CONTROLLER

DIAGRAM-WIRING (AUTOMATIC START-STOP)
FOR USE WITH NFPA 20 APPROVED FIRE PUMP ENGINE CONTROLLER
ENERGIZED TO SHUTOFF SYSTEM



GENERAL OPERATING CHARACTERISTICS (ALL ENGINES)

TIME DELAY (TD) NORMALLY OPEN CONTACTS (6-7) CLOSE WHEN CRANK TERMINATION SPEED (CT) CONTACTS ESS 10 & 11 CLOSE AND SUPPLY POSITIVE VOLTAGE TO TIME DELAY CONTROL TERMINAL 1. (NOTE: TIME DELAY CONTROL TERMINAL 2 IS NOT USED / NO IS GROUNDED TO BATTERY NEGATIVE VOLTAGE.) THUS, A FUEL SHUTDOWN PATH TO SLAVE RELAY (SR1) IS PROVIDED FOR A SHUTDOWN SIGNAL DUE TO THE FOLLOWING:

1. AN OVERSPEED SIGNAL FROM THE ELECTRONIC SPEED SWITCH
2. A SHUTDOWN SIGNAL FROM THE FIRE PUMP ENGINE CONTROLLER THRU TERMINAL STRIP NUMBER 12 (TS12)
3. AN ENGINE CONTROL SWITCH (ECS) (I.E. BEING HELD IN THE STOP POSITION.

CRANK TERMINATION (CT) ALSO SUPPLIES POSITIVE VOLTAGE TO THE HOUR METER (HM). SLAVE RELAY NUMBER 2 IS ENERGIZED WHEN EITHER THE ALTERNATOR (ALT) IS RUNNING OR WHEN CRANK TERMINATION (CT) OCCURS. THIS CLOSES SR2 CONTACTS 1 & 3 AND PROVIDES POSITIVE VOLTAGE AT TS-1 TO TURN ON A REMOTE ENGINE WATER SOLENOID VALVE).

MANUAL STARTING IS PROVIDED BY PLACING THE ECS IN THE MANUAL POSITION OPENING CONTACTS ECS 1 & 2 AND REMOVING ANY FIRE PUMP ENGINE CONTROLLER SHUTDOWN SIGNAL AT TS-12. THE MAGNETIC SWITCHES MAY THEN BE USED TO START THE ENGINE.

MANUAL STOPPING OF THE ENGINE IS PROVIDED BY PLACING THE ECS IN THE STOP POSITION, THUS CLOSING ECS CONTACTS 3 & 4 AND PROVIDING A POSITIVE VOLTAGE THRU THE TIME DELAY CONTACTS (CLOSED WHILE RUNNING) AND ENERGIZING SR1.

DURING ALL SHUTDOWN MODES VOLTAGE IS SUPPLIED THRU TIME DELAY (TD) CONTACTS 6-7 TO SLAVE RELAY 1 (SR 1). TIME DELAY CONTACTS 6-7 AUTOMATICALLY OPEN 70 ± 10 SECONDS AFTER THE ENGINE REACHES 0 RPM. INSTANT RESTART IS AVAILABLE WHEN THE SHUTDOWN SIGNAL IS REMOVED.

FOR GENERAL NOTES AND SPEC, SEE SHEET 1

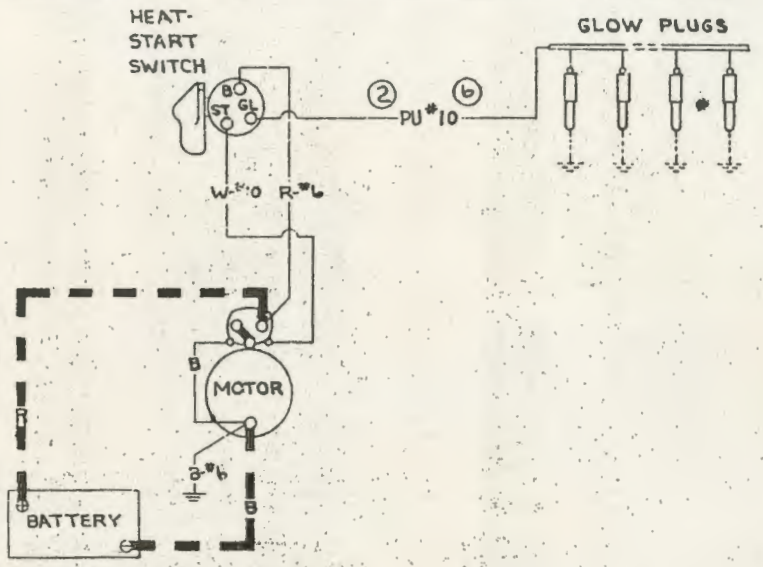


FIG.A SINGLE MOTOR DIRECT ELECTRIC STARTING WITH GLOW PLUGS

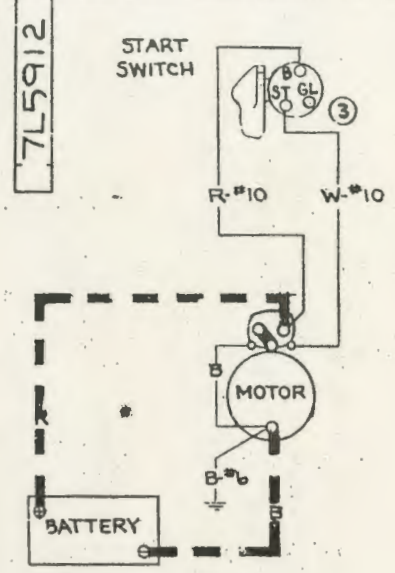


FIG.B SINGLE MOTOR DIRECT ELECTRIC STARTING

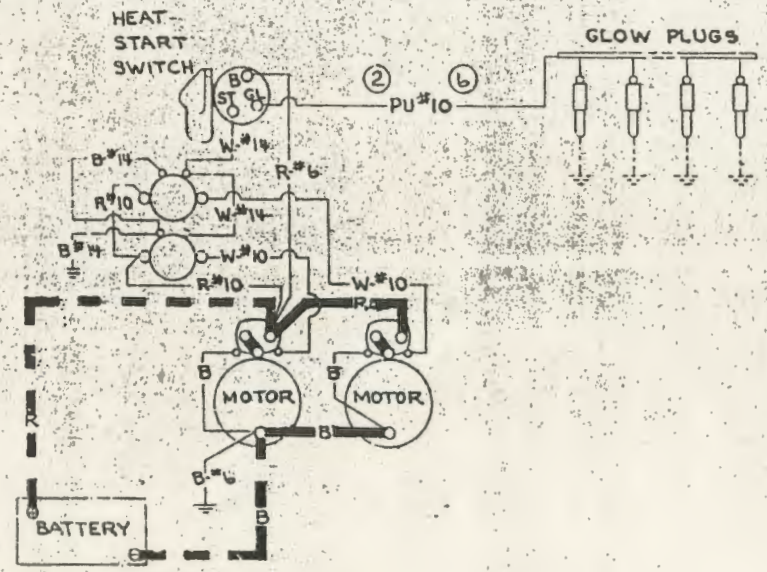


FIG. C DUAL MOTOR DIRECT ELECTRIC STARTING WITH GLOW PLUGS

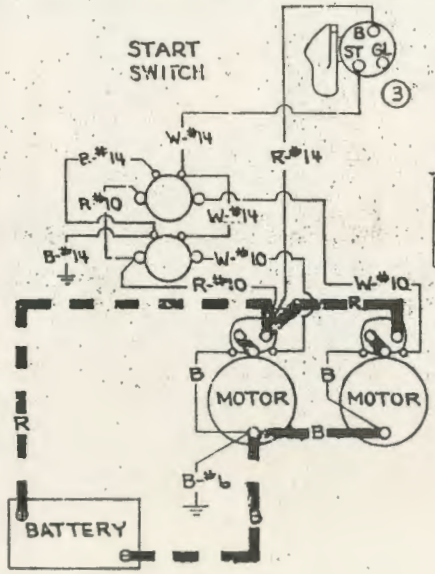


FIG.D DUAL MOTOR DIRECT ELECTRIC STARTING

COLOR CODE

B - BLACK
W - WHITE
R - RED
O - ORANGE
BR - BROWN
LTGN - LIGHT GREEN
PU - PURPLE
W/B - WHITE WITH BLACK STRIPE

MAXIMUM RECOMMENDED TOTAL BATTERY CABLE LENGTH

CABLE SIZE	DIRECT ELECTRIC STARTING 12 VOLT	24-32 VOLT
0	4.0 FEET	15.0 FEET
00	5.0 "	18.0 "
000	6.0 "	21.0 "
0000	7.5 "	27.0 "

WIRE AND CABLE SHOWN DOTTED FURNISHED BY CUSTOMER.

NUMBER FOLLOWING COLOR DESIGNATION INDICATES RECOMMENDED WIRE SIZE.

NOTE: THIS DIAGRAM NOT REQUIRED WHEN A CHARGING GENERATOR IS USED.

(1)

7L5912

REDUCED SIZE PRINT
INCHES 0 1 2 TENTHS
EIGHTHS 0
10 20 30 40 50 MILLIMETRES

HEAT TREATMENT

MATERIAL

CHG	DATE
6	28 MAR 77
5	27 JAN 77
4	24-6201
3	14 JUL 77
2	APR 27 74
1	SEP 26, 72

UNLESS OTHERWISE SPECIFIED
THIRD ANGLE PROJECTION
DIMENSIONS IN INCHES
3 PLACE DIM. ±.010
2 PLACE DIM. ±.
ANGULAR DIM. ±1°
SCALE =

DATE JAN 25, 66
DRN C.A. PAPE
CHK
APPD. A.M. Lasko
PROVE DES | PROD. X

CATERPILLAR

WIRING DIAGRAM-
GROUNDED SYSTEM (SEE NOTE)

7L5912

DES CONTROL 1K126

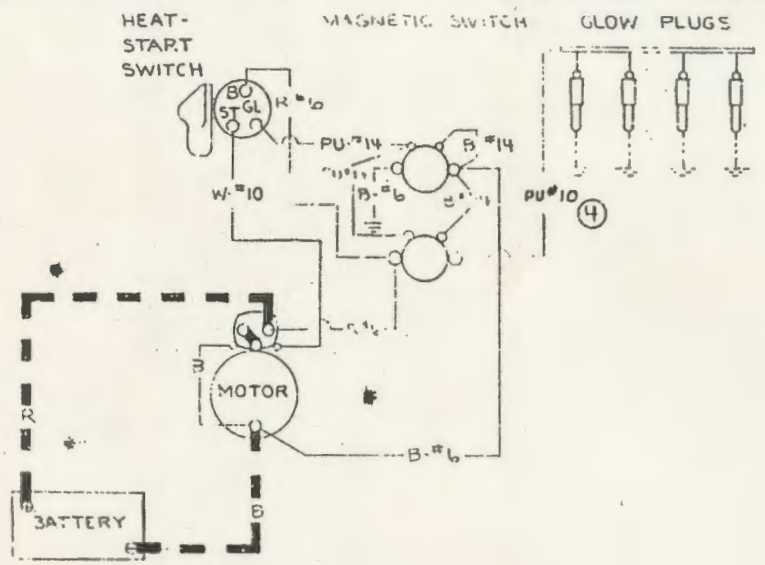


FIG. A SINGLE MOTOR DIRECT ELECTRIC STARTING WITH GLOW PLUGS.

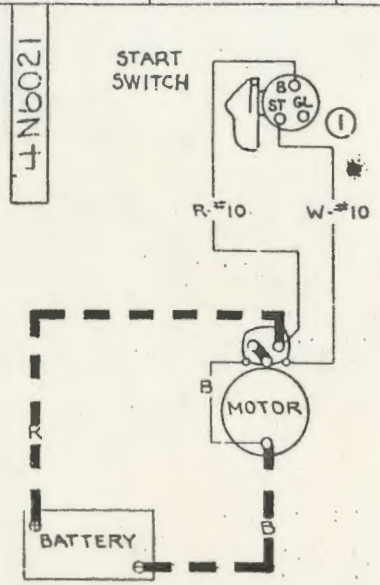


FIG. B SINGLE MOTOR DIRECT ELECTRIC STARTING

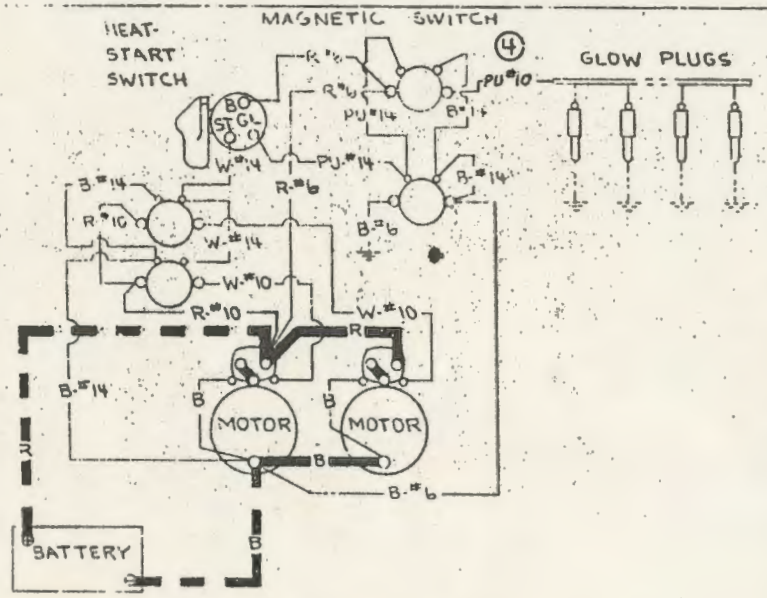


FIG. C DUAL MOTOR DIRECT ELECTRIC STARTING WITH GLOW PLUGS

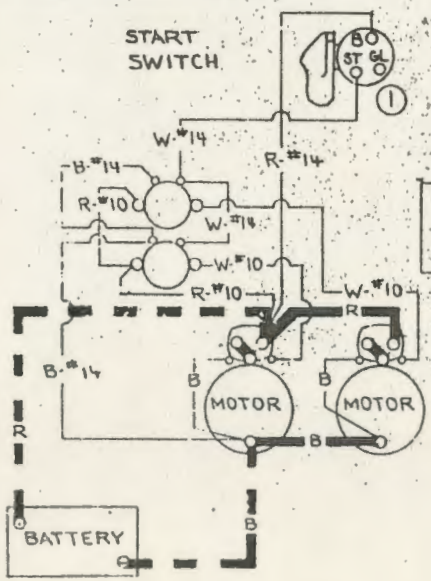


FIG. D DUAL MOTOR DIRECT ELECTRIC STARTING

COLOR CODE

B - BLACK
W - WHITE
R - RED
O - ORANGE
BR - BROWN
LTGN - LIGHT GREEN
PU - PURPLE
W/B - WHITE WITH BLACK STRIPE

MAXIMUM RECOMMENDED TOTAL BATTERY CABLE LENGTH

CABLE SIZE	DIRECT ELECTRIC STARTING	
	12 VOLT	24-32 VOLT
0	4.0 FEET	15.0 FEET
00	5.0 "	18.0 "
000	6.0 "	21.0 "
0000	7.5 "	27.0 "

WIRE AND CABLE SHOWN DOTTED FURNISHED BY CUSTOMER

NUMBER FOLLOWING COLOR DESIGNATION INDICATES RECOMMENDED WIRE SIZE

THIS DIAGRAM NOT REQUIRED WHEN A CHARGING GENERATOR IS USED.

4N6021

REDUCED SIZE PRINT
INCHES EIGHTHS TENTHS
0 10 20 30 40 50
MILLIMETRES

HEAT TREATMENT

MATERIAL

4	28MAR79	
3	29JAN79	X
2	2W-3201	X
1	11JUL77	
0	7DEC71	X
CHG	DATE	

UNLESS OTHERWISE SPECIFIED
THIRD ANGLE PROJECTION
DIMENSIONS IN INCHES
3 PLACE DIM. ±.010
2 PLACE DIM. ±.—
ANGULAR DIM. ±1°
SCALE — = —

DATE DEC 7, 71
DRN W.D. MILLER
CHK R Long
APPD
PROVE DES PROD X

CATERPILLAR

WIRING DIAGRAM-
INSULATED SYSTEM

4N6021

F.S. CONTROL K126

FIRE PUMP CONTROLLER

For Engine Driven Fire Pumps

SERIES FD2

For over 30 years Metron has manufactured automatic control equipment for all types of engine applications. Our policy has always been to stress dependable operation in field use because of the inherent vital nature of these installations.

Metron Fire Pump Controllers are listed by Underwriters Laboratories Inc., Underwriters' Laboratories of Canada, as well as approved by the Factory Mutual Engineering Corp. These controllers are for use with all approved types of engine driven fire pumps. Manufactured in accordance with the standards established by the National Fire Protection Association, Pamphlet 20, they are designed and constructed to provide the highest measure of reliability.

The basic function of a Fire Pump Controller for engine driven fire pumps is to automatically start the engine upon a drop in pressure in the water supply, or from a number of other demand signals. The controller provides automatic cycled cranking and alarm protection for various engine failures when running. Stopping the engine after the demand period is terminated may be either manual or automatic. Several optional features are available which may be required by the local authority having jurisdiction. These options are described further in this bulletin.

Metron

METRON, INC.
1051 SOUTH PLATTE RIVER DRIVE, DENVER, COLORADO 80223
PHONE 303 744-1791 TELEX 4-5729 TELEFAX (303) 744-7503

Optional Features

Supplied Only When Specified

OPTION A. INDIVIDUAL ALARM CONTACTS. Provides dry contacts (N.O. and N.C.) for remote indication of any failure. This option allows the five failure alarms which are common under "System Failure" to be brought out individually. In addition, other individual pump room alarm contacts can be supplied. The number of combinations is limited, if more than seven, consult factory. Metron can supply a remote alarm panel for indication of any combination of the above failure alarms.

OPTION B. PRESSURE RECORDER. A recording pressure gauge with 7 day chart, provides a permanent record of water pressure fluctuations which may also indicate engine starts. Standard chart drive is spring wound requiring wind up once each 7 days. Optional electric drive with automatic spring back up available. Standard range is 0 to 300 PSI.

OPTION E. ENGINE LOCKOUT CIRCUIT. This option is used with multiple pump installations when more than one pump should not run simultaneously. Upon receipt of an external signal this option will prevent the engine from starting, or will stop it if running. It is also used with Low Suction Cutoff Panels when authorized. When used for this purpose, power to the Low Suction Cutoff Panel is provided by the controller (this power circuit is fused).

OPTION F. LOW FUEL LEVEL ALARM. This option provides an alarm in event the fuel in the storage tank reaches a low level. A light and audible alarm will provide indication at the controller, and the "System Failure" contacts will operate for remote alarm. A float switch is supplied with this option which must be mounted in a threaded two inch opening on the top of the tank. The dimensions of the tank must be specified so that the depth of the float switch in the tank can be determined. This switch will be factory set to alarm when the fuel level drops to 60% of tank capacity unless otherwise specified.

OPTION H. SPACE HEATER. If the ambient atmosphere is especially damp, a space heater rated at 150 watts may be supplied to reduce moisture in the cabinet. A thermostat is supplied as standard with this option. A humidistat may be supplied if specified.

OPTION J. INTEGRAL BATTERY CHARGER. This option provides an integral dual battery charger for simultaneously charging both sets of batteries. This is an all solid state charger which continuously monitors both batteries. Rate of charge, up to 25 amperes, is dependent on the state of charge of the batteries, and tapers to less than 500 milliamperes at full charge. The charger is line voltage regulated and current limited to provide full protection during engine cranking. Two ammeters in the front of the cabinet indicate rate of charge. Two voltmeters are also supplied as standard.

OPTION K. PUMP ROOM ALARMS. NFPA Pamphlet 20 allows additional alarms to be provided in the controller to monitor various pump room conditions. Typically these alarms can be noted as follows: Low Pump Room Temperature, Reservoir Low, Reservoir Empty, Low Suction Pressure, Relief Valve Open, Flow Meter On. These alarms will automatically reset. An Alarm Silence pushbutton is provided for these alarms only.

OPTION L. STAINLESS STEEL PLUMBING. All water bearing parts and piping may be supplied made of stainless steel. This option is available 10-300 PSI or 10-600 PSI. This option may be used for Salt Water or for High Pressure.

OPTION N. STEP-DOWN TRANSFORMER. When 120 V.A.C./ single phase is not available, a transformer may be provided for operations from 208 to 600 V.A.C. 50/60 Hz input. Exact voltage and frequency must be specified when ordering.

OPTION P. AUTOMATIC START ON LOSS OF D.C. OUTPUT OF CHARGER. This option serves a dual purpose since either a charger failure or loss of A.C. will start the engine. The time delay is adjustable to 5 minutes.

OPTION R. AUTOMATIC STOP. After a specified minimum run time (field adjustable from 0 to 60 minutes, factory set for 30 minutes) the engine will stop automatically if starting causes have returned to normal. Controllers are shipped with a jumper wire installed on a convenient terminal block which bypasses this automatic stop feature. To activate the automatic stop in the field, requires the simple removal of the jumper wire.

OPTION S. SEQUENTIAL START. This option is for use on multiple pump installations to keep all pumps from starting simultaneously. It is accomplished by use of an adjustable timer supplied in all controllers except the one for the lead pump. Standard time is adjustable from 0.3 to 30 seconds. Time delay up to 300 seconds is available. These timers should be adjusted to 5 to 10 second intervals in order to allow a preceding pump to start. Failure of a preceding pump to start will not prevent a subsequent pump from starting.

OPTION U. This option provides for engine shutdown during automatic weekly test should a Low Oil Pressure or High Water Temperature failure occur. However if a demand such as low water pressure or deluge valve exists or occurs during the run, the shutdown will be overridden and the engine will continue to run. The "Test" position of the selector switch is not affected by this option.

OPTION W. OMIT LEGS. For systems where the controller is mounted on a common skid with the pump and engine, the legs of the controller may be omitted, and 3" mounting channels or wall mounting brackets can be supplied. If specified, lifting eyes may also be supplied.

Controller Dimensions—26"W x 72"H x 12"D
Shipping Dimensions—30"W x 80"H x 20"D
(Standard Carton)

Shipping Weight—12 Volt—280 Pounds
(Standard Carton) 24 Volt—300 Pounds

PRINTED IN U.S.A.
JANUARY, 1986

Metron

SUGGESTED SPECIFICATION
DIESEL ENGINE FIRE PUMP CONTROLLER

The fire pump controller shall be listed by Underwriters Laboratories and approved by Factory Mutual Research for fire pump service. The controller shall meet the requirements of NFPA 20. It shall be completely factory wired, assembled and tested prior to shipment.

The controller shall be housed in a NEMA 3R Raintight and Weatherproof enclosure, fabricated from heavy gauge cold rolled steel per the requirements of UL 508. All controller components shall be UL listed or UL recognized, shall be front mounted and wired allowing the controller to mount flush against a wall. The controller shall feature a swing-out relay panel allowing access to all wiring for easy repair or additions. All relays shall be dust-tight and of the plug-in type for long life and easy maintenance.

The controller shall be of the combined automatic manual type. Automatic starting shall be via an internally mounted pressure switch or remote deluge valve switch or manual start pushbutton station. Local manual starting shall be via panel mounted pushbuttons.

The controller shall have a four position selector switch for "Test", "Auto", "Off", and "Manual". This selector switch shall be mounted inside the controller cabinet to prevent unauthorized operation. The selector switch and engine crank pushbuttons shall be located such that they can be operated when the door is closed thru a break glass in the door in the case of an emergency.

The pressure switch shall be of the bourdon tube type with adjustable independent high and low set points and a range of 10-300 psi. The pressure switch shall be capable of being sealed to prevent unauthorized adjustment. The pressure switch shall be mounted inside the controller cabinet and piped to an external coupling for field connection.

The controller shall be capable of cycle cranking the engine. Crank timing shall consist of six fifteen second cranks with a fifteen second rest between each crank cycle. The controller shall alternate between the two battery sets on each successive crank cycle. Should the voltage of the battery being used to start the engine drop below approximately sixty percent of nominal, the controller shall lockout this battery and continue to crank on the other good battery. This lockout shall remain in effect until manually reset. Should the engine fail to start after six fifteen second crank cycles, the controller shall cease any further attempt to start and cause a visual and audible Overcrank (Failure-to-Start) alarm. This alarm shall not be capable of being silenced until the selector switch has been turned to the OFF position.

The controller shall have an externally mounted stop pushbutton which will stop the engine if all automatic start conditions have returned to normal. When the controller is stopped via this pushbutton it shall return to the automatic mode.

A weekly test timer shall be supplied which will automatically start the controller at predetermined time each week. This timer shall be capable of being field adjustable. The timer shall energize an externally mounted solenoid valve which will momentarily drop the water pressure to the pressure switch and initiate an automatic start of the engine. The controller shall continue to run until the weekly timer has timed out. Should a subsequent drop in water pressure occur due to a fire condition the controller shall remain running.

Dry contacts shall be provided for remote annunciation of the following conditions: Pump Running (two sets), System Failure, Selector Switch in Off or Manual, and Battery Failure. System Failure contacts shall be a common alarm for Overcrank, Low Oil Pressure, High Water Temperature, Overspeed, and Loss of Charger Output.

The controller shall have front mounted indicating lights for the following: Battery 1 On (green), Battery 2 On (green), Switch in Auto (green), Loss of A.C. or Charger (red), Low Oil Pressure (red), High Water Temperature (red), Overcrank (red), and Overspeed (red).

The controller shall have light emitting diode type pilot lights above each field wiring terminal point which is used for interconnection to the engine. These indicating lights shall make it possible to verify proper operation of signals to the engine without special tools or meters.

The controller shall be completely tested at the factory prior to shipment. This test shall verify proper operation of all normal automatic and manual functions along with the continuity of all dry contacts for remote alarms. The test shall also include a megohm test of all field wiring terminal points and associated circuitry.

The controller shall be manufactured by Metron Inc.

Metron

SK-860214JW

MANUAL FOR MODEL FD-2 FIRE PUMP CONTROLLERS

Starting Serial No. BD-84786

This manual provides General Information, Installation, Operation, Maintenance, and Trouble-Shooting Information for METRON Model FD-2 Engine Driven Fire Pump Controllers

TABLE OF CONTENTS

External Hookup, Schematic, and Engine Wiring drawings are in the back of the Manual

GENERAL INFORMATION

The basic function of the model FD-2 Fire Pump Controller for diesel engine driven fire pumps is to automatically start the engine upon a drop in pressure in the water main, or from a number of other demand signals. This controller provides automatic cycled cranking and alarm or shutdown protection for various engine failures. Stopping of the engine after the demand period is over may be either manual or automatic. This controller includes an automatic weekly test starting feature. Sixteen standard approved options may be provided.

FUNCTIONS

Equipment is provided in the Controller to provide the following functions:

1. Automatic starting from:
   a. Drop in water line pressure
   b. Loss of battery charger output (Option P)
   c. Operation of optional remote start switches, such as remote start switch, deluge valve switch, fire alarm switch, etc.
   d. Weekly test timer

2. Control Switch - A four (4) position switch is provided marked "Test-Automatic-Off-Manual".

3. Automatic cranking - A solid state crank control provides six (6) fixed crank periods separated by five (5) rest periods each of approximately 15 seconds duration.

4. Alarms and signal lights - Eight (8) to fifteen (15) lights are provided to give visual signals for Overcrank, Low Oil Pressure, High Water Temperature, Loss of Charger Output, Low Fuel Level (Option F), control switch in "Automatic" position, two (2) lights for "Battery On", Overspeed, and one (1) to six (6) additional pump room alarms (Option K). In addition, an alarm bell is mounted on the side of the cubicle to give audible alarm in event of failure. Terminals are provided for remote failure alarms, indicating "Switch in Off or Manual", "System Failure", "Engine Running", and "Battery Failure". Option A provides individual alarm contacts for remote indication of each alarm.

5. A recording instrument with 7-day chart is provided when specified as Option B. This records continuously the line water pressure.

6. A weekly test timer is supplied to automatically start the engine any set day of the week, at a set time of day, and let it run for the time set (Option R).

7. Stop Pushbutton - A pushbutton switch is provided to stop the engine only after starting causes have returned to normal. This returns the controller to the automatic position.

8. Integral Battery Charger (Option J). This is a fully automatic solid state charger for maintaining full charge on the dual sets of engine batteries. Charging current ammeters and battery voltage voltmeters are included.

9. Cabinet - A heavy gauge steel cubicle encloses the controller. The lights, stop button and meters are mounted on the front of the cubicle. The control switch, battery circuit breakers, and manual start pushbuttons are mounted behind a break-glass in the door of the cabinet.

OPERATION OF THE CONTROLLER

A. When the four (4) position control switch is in the "Automatic" position and both circuit breakers are in the "On" position, the controller is in standby condition ready to start the engine automatically. A green pilot light marked "Auto" will light in this position. Also, Battery No.1 and Battery No.2 green light will light indicating that battery power is available. If both battery lights are not on, push "Battery Reset" button.

When water pressure drops below a level which is preset on the internal water pressure switch, the pressure switch contacts will close, and the Controller will actuate the starter motor and the cranking cycle will commence. If the engine starts and runs, cranking will cease and the protective circuits will be operative. If the engine fails to start after six (6) crank periods, cranking will cease, the Overcrank light will light, and alarm bell will sound. The battery alternating circuit alternates batteries on each crank attempt unless one battery is in a discharged state and incapable of cranking the engine. In this instance, the control will lock onto the other battery for the remaining cranking attempts. This non-operative battery locking circuit is reset by pushing the "Battery Reset" pushbutton. Dry contacts for remote indication of "Battery Failure" are provided.

After an overcrank or overspeed failure, it is necessary to turn the control switch to "Off" to reset.

The panel is wired so that optional remote start switches may be used, such as Deluge Valve switches, Remote Start pushbutton, Fire Alarm switches, etc. In addition, when Option P is provided, the Controller will automatically start the engine upon loss of Battery Charger output after a time delay of fifteen (15) seconds. The loss of charger light and bell are energized without delay.

While the engine is running all protective circuits are operative. If the engine stops while running, the control will attempt to restart the engine. Failing in this, the Overcrank light will be lit and alarm sounded. If, while the engine is operating, the oil pressure drops below a safe limit, the oil light will light immediately. After fifteen (15) seconds the alarm will sound. Should the engine temperature exceed a safe limit while running, the alarm will sound and the water light will light to indicate overheating.

In case of Overspeed, the engine will be stopped and the overspeed light and alarm energized. It will remain energized until the engine speed switch is manually reset and the Overspeed alarm in the controller is reset by turning the switch to "Off".

The Controller may be provided with either "Manual" or "Automatic" stop (Option R) as required. If "Automatic" stop is provided, terminals T3-1 and T3-2 on the relay panel must be jumpered for manual stop. With "Manual" stop, the engine will continue to run even though the pressure switch or other remote starting switch returns to its normal position. The control will be stopped only by pressing the stop button or moving the control switch to "Off", at which time the engine stops immediately. If set up for "Automatic" stop, the engine will be stopped automatically upon restoration to normal of whatever demand switch started the engine providing it has run at least 30 minutes or for the period of time set on the Engine Run Timer. If the demand period was less than the time set on the timer, the engine will continue to run until the timer times out and will then stop.

B. When the control switch is in the "Test" position, the engine will be started and operated throughout the Controller by causing a drop in water pressure. Failure circuits will be operative in the "Test" position. This method of starting provides a test of the Controller, thereby assuring proper operation when required. The engine will run continuously in this position until the switch is moved to "Off".

C. Placing the control switch in the "Off" position stops the engine when running, as explained in preceding paragraphs. It also prevents the engine from starting when stopped. The switch should always be placed in this position when servicing the engine.

D. The Manual position of the control switch is for manually starting the engine from either battery. The throttle solenoid is energized in this position, and the engine must be cranked by pushing one of the buttons above the control switch. Manual Crank 1 cranks from Battery 1 and Manual Crank 2 cranks from Battery 2. Pressing both buttons will result in cranking from both batteries simultaneously.

E. Periodic Self Testing - The program clock can be set to give test runs on any day of the week and time of day desired. A timing element is incorporated in the controls so that when the engine starts in this manner, it will run for a definite time before it shuts down. This time is controlled by the Program Clock and should be set for a minimum of thirty (30) minutes.

F. The water pressure recorder is provided when specified as Option B. Its purpose is to provide a permanent chart recording of fluctuations of water main pressure. A record of engine starts is shown by a sharp rise in pressure each time the engine starts. A 1/2 inch pipe connection is brought out the side of the cubicle for connection of the water line.

G. Provision for sequential starting (Option S) is accomplished by the use of adjustable time delay relays installed in each controller except the leading pump. These timers, set sequentially and progressively longer in time, prevent more than one (1) pump from starting simultaneously with another pump. Failure of a leading pump to start will not prevent subsequent pumps from starting.

INSTALLATION AND TEST PROCEDURE

INSTALLATION

The Fire Pump Controller has been assembled and wired at the factory in accordance with the highest workmanship standards. All circuits and functions have been thoroughly tested to assure correct operation when properly installed. The installer should completely familiarize himself with the external hookup of the engine components to the terminal bar in the Controller. Engines of different make may not always be wired to the engine junction block alike, and it is very important that the various engine components be wired to the proper terminal in the Controller, using the correct size stranded wire. The cubicle and chassis are not grounded, and a ten (10) gauge wire must be run from the proper terminal on the terminal bar to a good ground on the engine.

In most cases, the engines are furnished by the manufacturer with all accessories installed and wired to the connection box in which case it is only necessary to wire from the engine connection box to like numbered terminals in the Controller. Note proper wire size. All wires must be stranded.

A drain valve is provided to relieve water pressure to the pressure switch, thus closing its contacts and starting the engine. This system simulates an actual demand start. Since the drain valve is actuated only momentarily by the Controller, a small amount of water is drained off. If adequate floor drainage is provided in the pump room, the drain valve outlet may be left open.

The water pressure line to the Controller from the pump must be thoroughly flushed before connection to the Controller in order to remove chips, particles, or other matter which could enter the Controller. Controllers provided with "Automatic" stop (Option R) may be changed to "Manual" stop by connecting a jumper between T3-1 and T3-2.

Terminals 13 and 14 have a jumper installed at the factory. If deluge valve switches are to be used for starting, remove the appropriate jumper and sire to normally closed contacts of the deluge start switch.

TEST PROCEDURE

After all external wiring is completed, install the plug-in relays and component packages which have been shipped loose. These units are packed in a separate carton inside the cubicle. They are numbered and should be plugged into the corresponding numbered socket in the panel.

All of the following tests should be made on each unit after installation. If each test is satisfactory, the operator may place the control switch in "Auto" position and depend upon the panel operating properly when the occasion arises. Also, any one of all of these tests may be carried through at any time after installation, if so desired.

NOTE: If 115 Volts A.C. is not connected to Controller, remove 18CR to prevent Loss of Charger Output light and alarm from being energized.

ENGINE TERMINAL (terminals 1-12) STATUS INDICATOR LIGHTS

On controllers built starting in 1982, L.E.D. (light emitting diodes) lights have been installed above each engine wiring Terminal 1 through 12, except 11, to indicate the status of each terminal

Status indication is given below:

Terminal Number	L.E.D.(light) "ON" Indication
1	Power available to fuel and water solenoids
2	Speed switch has operated into crank disconnect mode
3	Speed switch has operated into overspeed mode
4	Oil Pressure switch contacts closed (Low Oil Pressure)
5	Water temperature switch contacts closed (High Water Temperature)
6	Battery #1 voltage present
7	Battery and/or alternator voltage present
8	Battery #2 voltage present
9	Crank #1 voltage present (while cranking on #1 Battery)
10	Crank #2 voltage present (while cranking on #2 battery
12	Caterpillar - Rack solenoid voltage present

Status indicator lights above Treminals 6 and 8 should be on at all times when both batteries are connected. No light on Terminals 6 or 8 indicates no battery power to that terminal.

I. Battery Lockout Test:

A. Turn on Battery #1 switch, Battery #1 light should be on.

B. Turn on Battery #2 switch, nothing should happen.

C. Press the Battery Reset Button. Battery #2 lights should come on.

D. Turn Battery #1 switch off for a couple of seconds and back on. Battery #1 light should go off and remain off.

E. Press Battery Reset. Battery #1 light should come on.

II. Cranking Cycle Test:

This test simulates a condition where the engine refuses to start.

A. Disconnect Terminal No.1 on engine panel.

NOTE: Disconnecting Terminal No.1 is for the purpose of removing power from the fuel solenoid so engine will not start. On engines where fuel solenoid is not used (Caterpillar), or is connected other than through Terminal #1 (Clarke-G.M.), other means must be used to stop fuel flow to the engine to prevent starting.

B. Place control switch in "test" position to crank engine. Time crank and rest periods, count number of cranks. There should be six (6) crank periods separated by five (5) rest periods each of approximately 15-second duration. The overcrank light should come on and the alarm bell should ring.

Status indicator light #1 should come on as soon as selector switch is moved to Test and pressure switch operates. Status lights 9 and 10 should come on alternately to indicate cranking cycle.

C. Turn Control Switch to "Off" and properly reconnect all leads.

NOTE: In order to prevent discharging the starting batteries this same test can be made without actually cranking the engine by disconnecting the starter cable and observing the action of the starter contactors and/or status indicator lights 9 and 10.

III. Checking Starting Motor Release:

A. Place control switch in "Test" position. Engine should start promptly and starting motor should release at approximately 1/3 of engine speed. Status indicator light #2 should come on to indicate speed switch has operated to disconnect cranking.

NOTE: A convenient method of determining the exact instant the starter releases is to connect a battery test light or voltmeter across the starter terminals and observe when circuit goes dead.

B. Return switch to "Off" to stop engine.

IV. Oil Pressure Failure Test:

A. Place control switch in "Test" position to start engine.

B. When engine is starting and oil pressure is not yet up to full pressure, the Oil Pressure light will light, but the bell will not ring. When pressure builds up, and the switch opens, the light will go out. This feature provides indication that the pressure switch contacts are actually operating in a normal manner.

C. After the engine is running, connect temporary jumper between terminal of oil pressure switch and ground.

D. Oil light should come on immediately. Wait approximately fifteen (15) seconds. Alarm bell should ring. Status indicator light #4 should come on with oil light.

E. Turn control switch to "Off" to stop engine and remove jumper from oil switch.

F. Wait at least 30 seconds for elements to reset before making any further tests.

V. Water Temperature Failure Test:

A. Place control switch in "Test" position to start engine.

B. Jumper contacts on water temperature switch on engine.

C. Alarm bell rings and water light on controller comes on immediately. Status indicator light #5 sould come on with water termperature light.

D. Turn control switch to "Off" to stop engine, and remove jumper on water switch.

VI. Overspeed Failure Test:

A. Turn control switch to "Test" to start engine.

B. Momentarily short contacts on engine speed switch.

C. Alarm bell rings and Overspeed light comes on immediately. Engine comes to stop. Status indicator light #3 should come on with overspeed light.

D. Turn control switch to "Off".

VII. Automatic Starting Tests:

A. If program clock is in running position, turn dial to an off setting.

B. Place control in "Auto" position.

C. Bleed off pressure in system until pressure switch closes.

D. Engine should start automatically and continue to run after switch has opened if arranged for manual stop. If arranged for automatic stop, engine will continue to run for time set on engine run timer and then stop.

E. Turn control switch to "Off" to stop engine.

F. Repeat tests for each demand switch such as deluge valve, etc.

VIII. Periodic Starting Test:

A. Pressure must be up and pressure switch open and all other demand switches closed.

B. 110 V.A.C. power must be alive to panel.

C. Place control switch in "Auto" position.

1. If drain valve operates and if engine starts at once, the program clock is tripped to the operating position, and engine will run for the remaining time on the program clock.

2. If engine does not start immediately, turn dial of program clock until it trips on. The drain valve will relieve pressure, the engine will start and then run for the time setting of the program clock and stop.

IX. Adjust setting of Engine Run Timer (Option R only)

Turn pointer on front of Engine Rune Timer. Set to desired time. Do not reset while timer is operating. Never set time less than thirty (30) minutes.

X. Setting Program Clock:

See manufacturers instructions for setting clock.

XI. Remote Start Switch Circuits:

Field wiring terminals are provided on this panel so that optional remote start switches such as Remote Pushbutton Stations, Deluge Valve Switch, the Fire Alarm Switch, etc., may be used to start the engine. Two (2) sets of terminals are provided. Terminals #15 and #16 are used for remote manual start pushbuttons. Terminals #13 and #14 are used for remote Deluge Valve Switch or other remote automatic start switches. Upon automatic start from this type of switch, the engine will be stopped either automatically after the demand switch closes and Engine Run Timer times out, or manually at the Controller. If remote Deluge switch is not to be used, the terminals must be jumpered. When shipped from the factory, jumpers are installed.

XII. Power Failure Starting (Option P)

To test this optional feature, disconnect normal 120 V.A.C. to the Controller. After the set time delay, the Controller will commence cranking the engine. The "Loss of Charger Output" lamp will light and alarm sound without delay.

XIII. Normal Operation - Automatic

Place control switch in "Auto" position. Green Auto light will burn and engine will automatically start upon drop in pressure or operation of other start switches. If provided with manual stop feature engine must be turned off at Controller. The engine will also start periodically from the Program Clock and run for length of time set on the Program Clock, then stop. On Automatic stop Controllers, upon termination of the demand signal, the engine will overrun for the length of time left on the Engine Run Timer and then will stop automatically.

XIV. Adjust Sequence Start Timers When Option S is Supplied for Multiple Pump Installation

Normally, the leading pump Controller will not have a delay timer and will commence cranking the engine immediately upon operation of a demand signal (other than Power Failure which is time delayed). The subsequent Controllers will have a solid state time delay relay adjustable from 3 to 300 seconds. The dial in the top of each delay relay should be set with progressively longer times on each subsequent pump. The recommended time interval is ten (10) to fifteen (15) seconds; however, this may be extended or shortened as required by the local authorities having jurisdiction. If the length of adjustment time required is other than 3 to 300 seconds, a suitable timer will be supplied as required.

NOTE: If time delayed power failure starting (Option P) is also supplied in addition to sequential start (Option S) all of the power failure timers will add an additional delay before the sequence timers start functioning. Upon power failure, all of these timers will begin and end timing at the same time. However, the pumps will not start at the end of this time, but will be delayed in accordance with the time set on the sequential start timers. If power is restored before all pumps are started, the pumps which are running will continue to run until stopped in the normal manner. Those pumps which have not started will not start.

XV. Low Fuel Supply (Option F)

Field terminals have been provided for low fuel level contacts. The Controller is arranged so the alarm will sound and the low fuel light will come on when the low fuel contacts close.

XVI. Pump Room Alarms (Option K)

Field terminals may be provided for up to seven (7) pump room alarms. These alarms include: Low Fuel, Low Pump Room Temperature, Reservoir Low, Reservoir Empty, Low Suction Pressure, Relief Valve Discharge and Flow Meter On. The Controller is arranged so that the alarm will sound, and the light will come on when alarm sensor contacts close.

TROUBLE SHOOTING HINTS

This Controller has been carefully engineered and built to give years of dependable, trouble-free service. However, sometimes due to various reasons, dificulty may be encountered in the operation. For this reason, the following information is submitted as a guide for locating troubles which are easily corrected. If the trouble proves to be beyond scope of this book, consult the factory before proceeding further.

NOTE: Check to see that all relays are firmly seated in their sockets. Check to see that status lights Numbers 6, 7, and 8 are on.

I. Engine Refuses to Crank

A. Check status lights 9 and 10 to see if controller is applying power to crank terminals. If lights operate, problem is in the engine, or engine to controller wiring. If not, proceed to B.

B. Check to see if status light #2 is on. If #2 is "hot", the crank termination speed switch is closed. Check or replace speed switch.

C. If there is no voltage at Terminal No.2 and engine still does not crank, the crank relay, engine running relay, or auto start relay may be defective. Replace.

D. Check batteries to be sure they are fully charged. VOLTAGE MEASUREMENTS WITHOUT ACTUAL CRANKING LOAD IS NOT A SUFFICIENT CHECK FOR BATTERY CONDITION.

E. Check all battery and ground connections from battery to junction box to panel. Also, check circuit breakers to be certain they are turned on. Also, check starting motor cables and contactor connections.

II. Engine Cranks But Does Not Start

A. Check to see that status light #1 is on (Terminal #1 is "hot"). If not, Fuel Solenoid Relay may be defective. Replace. On Caterpillar engines, check to see that status light #12 is "Off".

B. Check fuel and throttle solenoid.

C. When engine does not start, cranking time is limited as previously described. If cranking does not stop and overcrank signal does not come on, check Solid State Crank Control.

III. Engine Starts But Starter Does Not Release

A. Check status light #2. Light should indicate no voltage (Light Off) while the engine is cranking and should come up to a full battery value (Light On) when engine starts and before it reaches 1/2 normal speed. The speed switch used for starter disconnect should close contact at about 1/3 engine speed to put battery into Terminal No.2. If not, replace switch.

B. If the above test indicates voltage on Terminal No.2 is satisfactory, engine running relay may be defective. Replace.

C. If starter does not release, check contacts to make sure the main contacts have not welded together.

IV. Engine Will Not Start on Weekly Test Runs

NOTE: On these test runs, the engine starts from the program clock. Instructions for setting and operating are covered under installation and test procedures.

A. Make sure clock is set for day engine is to start.

B. Turn Clock Dial until switch trips on and drain valve operates.

1. If drain valve does not operate, the Program Clock, Relays 4CR or 6CR or 3DP could be defective. If drain valve operates but the engine does not start, check to see if pressure switch trips. Also, check auto start relay.

V. Engine Will Not Stop On Test Runs or Starts Every Time Control Switch is Placed in "Auto" Position.

A. Stop engine by turning control switch to "Off".

B. Check pressure switch making certain that its contacts are open and that all other demand switches are closed.

C. Check to be sure A.C. voltage is on.

D. Be sure Program Clock is not tripped on.

E. If Solenoid Drain Valve opens each time, the Program Clock may be defective.

F. If Remote Start Switches are used to make sure they are in correct position. Check to see if Terminals #13 and #14 are jumpered.

VI. Low Oil Pressure Alarm Does Not Operate

A. Simulate oil pressure by shorting Oil Pressure switch. Oil light should come on immediately. Wait approximately fifteen (15) seconds for time delay to operate alarm. If oil light does not come on, but status light #4 comes on, the problem is in the Controller. If status light #4 does not come on, the problem is in the engine or engine to Controller wiring.

B. Check wire from control panel to oil pressure switch on engine and also from switch to ground on two-wire switches.

VII. High Water Temperature Alarm Does Not Operate

A. Simulate high water temperature by shorting terminals of temperature switch. If high water temperature light and/or alarm does not come on and status light #5 does not come on, the problem is in the engine or engine to Controller wiring.

B. Check wire from panel to water temperature switch and also from switch to ground on two-wire switches.

C. If operation is secured on this test but not under actual high water temperature conditions, replace water switch.

VIII. Overspeed Alarm and Shutdown Does Not Operate

A. Simulate Overspeed by momentarily shorting terminals of speed switch. If status light #3 is on but engine does not shutdown and alarm does not operate, problem is in Controller. If status light #3 does not come on, problem is in engine or engine to Controller wiring.

B. Check wire from panel to Overspeed switch.

C. If engine stops, light and alarm operate on this test, but not under actual conditions by overspeeding engine, replace overspeed switch.

D. If Controller is at fault, check relay 15CR and diode pack 3DP.

IX. Circuit Breaker in Controller Tripped

A. Check to see if Voltage Regulator is sticking.

B. Check to see if engine generator or alternator is charging above the capacity of the breaker - 20 amperes.

C. Check for external short circuits to ground in all wires from panel.

D. Check conditions of status lights. See - **TEST PROCEDURE.**

X. Loss of Battery Charger Output

A. Check A.C. voltage to charger.

B. Check charger input and output fuses.

C. Check connections to charger

SEQUENCE OF OPERATION

Introduction

Refer to schematic wiring diagram. All relay contacts are shown in the de-energized position. Control relays are designated as CR. Diodes designated DP are located in one of four (4) diode packages; diodes designated D are stud mounted on the chassis or on the relay sockets; and time delay relays are designated TR. Circles with numbers designate field wiring terminals and those with letters designate terminals for connections within the Controller.

Controller Battery Power

Power to operate thller comes from the two engine batteries. Battery No.1 connected to Field Terminal 6 and is fed through Circuit Breaker 1CB to Diode 1D, the Voltage Sensing Circuit (VS-7), the Manual Crank Pushbutton (1PB), and the Battery Switching relaperate ty 5CR-1. Battery No.2 is connected to Field Terminal 8 and is fed through 2CB to 2D, VS-8, the Manual Crank 2 Pushbutton (2PB) and 5CR-4. Diodes 1D and 2D allow the Controller to receive battery power from the battery with the higher potential.

Relays 10CR and 11CR are battery failure relays and are energized through a solid state Voltage Sensing switch (VS). If both batteries are fully charged 10CR and 11CR are held energized through the VS and both battery lamps 1B and 2B will be lighted. The voltage sensing circuit allows the battery failure relay to drop out when the battery potential drops below a level of about 60 percent of nominal for a period of several seconds. If a low battery voltage is sensed, the appropriate battery failure relay will drop out and lock the other one in.

If Battery No.1 goes low or fails 10CR will drop out. Its N.C. contacts close and keep 11CR energized independent of the VS circuit. Also, 10CR N.C. contacts close and lock the battery switching relay 5CR in the energized position. With 5CR held energized its N.O. contacts will be held closed so that cranking power can be provided only by Battery No.2 through 7CR contacts to Field Terminal 10. 10CR N.C. contacts 1, 7 energizes the Alarm Relay 13CR through 2DP-4, 5 sound the alarm. If Battery No.2 fails, 11CR drops out and locks in 10CR and 11CR N.O. contacts 9, 6 open and keep 5CR from energizing. The N.C. contacts of 5CR remain closed so that cranking power can be provided only by Battery No.1 through 7CR contacts to Terminal 9. 11CR N.C. contacts 1, 7 energizes the alarm relay 13CR through 2DP-2, 5 and sounds the alarm.

When the two batteries are turned on, the first one on will energize its battery failure relay and lock out the other one. Pressing the Battery Reset pushbutton, 3PB, will pull in the second battery failure relay if the battery voltage is high enough. Any time a battery failure is sensed and one of the relays drop out, the Battery Reset pushbutton must be pressed to reset the circuit.

Diodes 2DP-1,2 and 2DP-3, 4 are used to isolate the voltage sensing circuit from the alarm circuit.

Automatic Operation

For automatic operation, the selector switch is in the "Auto" position. The Controller is then in a standby mode and all automatic functions ready for operation. The "Auto" light and both battery lights should be on. The Controller will start from any of the following demand signals:

1. Closing of pressure switch contacts due to drop in water pressure.
2. Remote start switches.
3. Deluge switch.
4. Power Failure start (Option P).

All automatic starting is accomplished through the auto start relay 8CR. In sequential start controllers, auto starts from the pressure switch and deluge switch are delayed by the Sequential Start Timer (3TR).

I. Drop in Water Pressure

On drop in water pressure, the pressure switch contacts close, applying power to the coil of auto start relay 8CR. In sequential start controllers, the pressure switch contacts apply power to the coil of the Sequential Start Time delay relay (3TR), and the contacts of 3TR operate the coil of 8CR, after the time delay set on 3TR. 8CR locks in through its own N.O. contacts. 8CR is locked in and remains energized even after the pressure switch contacts open until either the "Stop" pushbutton contacts are open, the ERT contacts open or the selector switch is turned to off. If the pressure switch contacts remain closed, turning the selector switch to "Off" is the only means to de-energize 8CR and stop the engine.

With 8CR energized, its N.O. contacts 7, 4 close to apply power to the Fuel Solenoid relay 6CR, to the Crank Control unit through 9CR N.C. contacts and to the Crank Relay, 7CR. At this time the Crank Control Unit starts timing the first crank period and 7CR energizes closing its contacts 7, 4 to apply Battery power through 5CR N.C. or N.O. contacts to Field Terminal 9 or 10 depending on whether or not 5CR in energized. Battery power on Terminals 9 or 10 energize the engine starting contactor and thus cranking of the engine starts as soon as the pressure switch closes.

After a period of approximately 15 seconds, if the engine has not started, the Crank Control unit energizes 1CR. When 1CR energizes, its N.C. contacts open and 7CR de-energizes, thus stopping the crank cycle. Relay 2CR is a latching relay and is activated momentarily when 7CR is de-energized. 2CR contacts close or open to energize or de-energize 5CR. 5CR contacts transfer to switch to Battery 2 (Battery 1) power and to Field Terminal 10 (Field Terminal 9). After approximately 15 seconds rest, 1CR de-energizes and 7CR energizes, thus completing the circuit from the other Battery to Field Terminal 9 or 10. The engine now cranks on the alternate battery power. If the engine fails to start, this cycle repeats for a total of six (6) crank periods alternating batteries each time.

After six (6) crank periods the Overcrank relay 3CR is energized. Its N.O. contacts 9, 6 close to energize the alarm relay 13CR through diode 2DP-7, 5. One set of N.C. contacts 7, 1 opens to stop the cranking and another set 3, 9 opens to drop out the Fuel Solenoid relay 6CR. A set of N.C. contacts 7, 4 closes to light the Overcrank light (OC).

If the engine starts, the engine speed switch applies battery voltage to Field Terminal 2 and energizes Engine Running relay 9CR. 9CR N.C. contacts 1, 7 open and cut off power to the cranking circuits. 9CR contacts connected to Field Terminals 20, 21, 22, 23, 24, and 25 are used for remote indications of the engine running.

The engine oil pressure light is powered only when the Controller is in the run mode and 6CR contacts 9, 6 are closed or when the selector switch is in the Manual position. This prevents the oil pressure light from coming on when the Controller is in Auto and in the standby mode with the engine not running. It also allows the light to come on during the cranking while the oil pressure switch is still closed, thus giving an indication that the oil pressure switch is working. When the engine starts, battery power is applied to one side of the Oil Pressure Alarm Delay Timer, 1TR. If the oil pressure is low, the oil pressure switch is closed and completes the circuit through Terminal 4 and 3DP-4, 5 to 1TR. If the oil pressure remains low 1TR will time out and its N.O. contacts will close and energize the alarm relay 13CR through Diode 1DP-2, 5. The oil pressure light will remain on as long as the oil pressure switch is closed. Normally the oil pressure comes up as soon as the engine starts so 1TR does not remain energized long enough to time out.

The water temperature switch is N.O. and closes on high engine water temperature. When it closes it operates the water temperature light on the Controller through Field Terminal 5 and energizes the alarm relay through Diode 1DP-4, 5.

If an overspeed condition should develop while the engine is running, a speed switch on the engine closes and puts battery voltage on Field Terminal 3. This energizes the Overspeed relay 15CR through Diode 3DP-6, 7. 15CR locks in on its own N.O. contacts and thus remains energized until reset by switching the Controller to "Off". 15CR N.O. contacts 6, 9 close to turn on the Overspeed light and energize 13CR through Diode 1DP-8, 5. 15CR N.C. contacts 3, 9 open to de-energize the auto start relay and disable the cranking circuits and shutdown the engine.

If the Controller is wired for "Automatic Stop" and the water pressure has returned to normal, 8CR will drop out after the ERT times out and its contacts open. The ERT starts timing when 8CR is energized by the closure of N.O. contacts 5, 8 to the ERT motor. If the Controller is wired for "Manual Stop" 8CR will remain locked in until the control switch is turned to "Off" or the stop pushbutton is pressed. The ERT is installed to assure that the engine runs for a minimum time and should be set to at least 30 minutes. If the pressure switch remains closed for a longer period than set on the ERT, the ERT will time out but 8CR will remain energized through the pressure switch until the pressure switch contacts open.

The alarm circuit consists of a bell mounted on the outside of the enclosure and is controlled by 13CR N.O. contacts 6, 9. 13CR is energized by one of the following failures:

a. Engine Overspeed
b. Low Oil Pressure
c. High Water Temperature
d. Loss of Battery Charger Output
e. Overcrank
f. Battery Failure
g. Low Fuel Level (Option F)
h. Pump Room Alarm (Option K)

The diodes in the alarm circuit are used to isolate the various alarm contacts so that one of the contacts may be used for more than one function.

II. Remote Start

The remote start switch or switches are N.O. momentary contact switches. Depressing a remote start switch energizes 8CR which is then locked in through its N.O. contacts 6, 9.

III. Deluge Switch

The deluge switch or switches are N.C. switches and keep the deluge relay 14CR energized. Opening a deluge switch contact de-energizes 14CR to allow its contacts to close and energize 8CR. The remaining sequence of operation is the same as for a start from water pressure drop described above.

IV. Power Failure Start (Option P)

This option automatically starts the engine after a delay time upon loss of battery charger output. Relay 18CR is held energized by an alarm output of the battery charger. If the battery charger ouput should fail, 18CR will drop out and its N.C. contacts will energize 2TR. When 2TR times out its N.O. contacts will close and energize 8CR. The remaining sequence of operation is the same as for a start from water pressure drop described above.

V. Weekly Test Start

The weekly test is initiated by a 7-day Program Clock (PC) operated from the A.C. line. At the time and day of week programmed, its N.O. contacts close and energize a Solenoid Drain Valve (SDV) through 6CR and 4CR. The SDV is normally closed and is connected to the water line and to the pressure switch. When it is energized it opens and drains the water line to the pressure switch causing a drop in pressure. This in turn causes an automatic start as described above. When the Fuel Solenoid relay 6CR energizes its N.C. contacts 1, 7 open and de-energize the SDV. These contacts also keep the SDV from energizing while the engine is running. The SDV is open just long enough to drop the pressure and initiate the start sequence, minimizing the amount of water discharged.

When the crank relay 7CR energizes its N.O. contacts close to energize 4CR, the weekly test relay, which locks in on its own N.O. contacts. 4CR N.C. contacts 3, 9 open to keep 8CR from locking in on those controllers wired for manual stop. 8CR is held energized by the P.C. contacts through 3DP-1, 2 for the duration of time set on the P.C. The purpose of 3DP-1, 2 is to isolate 4CR contacts from the SDV. When the P.C. contacts open 4CR drops out and if all starting causes are normal 8CR also drops out and the engine stops.

VI. Test Start

Switching the controller selector switch to the Test position initiates an automatic start by energizing the solenoid drain valve as described above to drop the water pressure to the pressure switch. The starting sequence is the same as described above. The engine will continue to run until the selector switch is switched to OFF.

VII. Manual Start

The Manual position of the controller disconnects all automatic start circuits of the controller and permits manual starting of the engine on either or both batteries by pressing the appropriate crank pushbutton. All alarms are functional in the manual position. The engine will continue to run until the selector switch is switched to OFF.

VIII. Additional Features

A. Engine Lockout (Option E)

Relay 19CR is an Engine Lockout relay which when energized will keep the engine from starting or stop the engine that is already running. This feature may be used to lock out one pump in a two-pump system, when the other is running or to lock out the pump in case of low suction pressure when this is a requirement.

B. Energize to Stop

This is provided for Caterpillar engines. With this circuit Field Terminal 12 is hot (battery power applied) at all times except while engine is running.

C. Remote Alarm Contacts

Terminals 17, 18, and 19 provide contacts for a remote indication that the switch is not in Auto position.

Terminals 20, 21, and 22, and 23, 24, and 25 provide two (2) sets of Engine Running contacts. One set can be used for remote alarm indications and the other for any other required control function.

Terminals 26, 27, and 28 provide a set of contacts for a remote indication of a system failure.

Terminals 29, 30, and 31 provide a set of contacts for remote indication of the failure of either battery.

Terminals 34 through 41 are used to provide for an alarm signal in case of low fuel level (Option F), or any other pump room alarm conditions (Option K). These alarm functions require N.O. contacts that close to represent an alarm condition. Terminal 34 is a common terminal for all alarm sensor contacts. Terminal 35 through 41 connects to one side of the pump room alarm sensor contacts. Relay 20CR is an alarm silence relay energized by Alarm Silence Push Button 5PB. 20CR is held energized by its own N.O. contacts as long as the alarm condition is present. 20CR N.C. contacts 1, 7 open and let 13CR drop out.

D. Individual Alarm Contacts (Option A)

Contacts for individual indication of each alarm condition may be provided by Relays CR51 through CR60 and one pole of 15CR and 18CR. These contacts are wired to Terminals 51 through 86.

E. Pressure Recorder (Option B)

A pressure recorder may be furnished to provide a 7-day continuous recording of the water pressure. This recorder will have either a 300 or 600 psi full scale rating and will operate from a hand wound spring meter of AC voltage with spring wind backup. It is designated CD on the Schematic.

F. Battery Charger Operation (Option J)

The Battery Charger is mounted in the engine controller and is factory wired to the controller terminal block from which it obtains its 120 volt, 50-60 hz. supply voltage and through which it provides charging current to the batteries. The charging current to the two (2) batteries is monitored by means of two (2) ammeters mounted in the controller light panel. Voltmeters are also provided to monitor the two (2) battery voltages.

The battery charger is line voltage regulated and will operate over a voltage range of 102 volts to 132 volts at 50-60 hz. Below about 110 volts the charger output will be slightly reduced. The charger output is current limited and provides full protection during the engine cranking cycle. The charger input and output are fused for protection in case of a failure of the control circuit or other internal component.

The battery charger is fully automatic and will simultaneously charge two (2) batteries at a rate of up to 25 amperes total current to the two (2) batteries. The current will be distributed to the two (2) batteries according to the battery demands. As the batteries approach full charge, the current will taper off to a predetermined level at which time the charge automatically switches to the float mode of operation. In the float mode the charger maintains the batteries at the float potential (approximately 13 volts for a 12-volt battery or 26 volts for the 24-volt battery).

There are two (2) adjustments available on the battery charger. One is the float voltage adjustment, and the other is for high rate adjustment. If charger does not trip into the float mode when batteries are fully charged, the high rate adjustment must be turned counter-clockwise. The float voltage adjustment may have to be altered for older batteries or for high or low temperatures. If, with no load on the batteries, the charger draws current in excess of 0.5 amps when in the float mode, the float potential should be decreased (counter-clockwise adjustment). If the charger does not maintain the batteries at a full charge, the float potential should be increased (clockwise adjustment). High rate adjustment must be made after float voltage adjustment.

The charger provides a means of monitoring the charger output to sound an alarm in case of loss of charger output on the output side of the fuse. This also provides a means of monitoring the A.C. power since a loss of A.C. power results in a loss of charger output.

Commercial: 12 Volt
BCI Group Size: 4D
Cranking Amps: 1280 CA
8½W x 10⅛H x 20¾L
Weigh 100#

IMPORTANT

BATTERIES/BATTERY CHARGER

INSPECT FOR:

1. Engine starting batteries have been inspected for proper: electrolyte (acid) level, location (battery rack), ventilation, adequate cable size and correct electrical/mechanical connections to engine and controller.

2. Integral battery charger has been connected to proper A.C. supply voltage. It is preferable that an external circuit breaker/disconnect means rated at least twenty (20) amps be utilized for A.C. supply voltage.

3. Under normal conditions energizing integral battery charger the panel mounted ammeter will indicate a high rate of charge (10-15 amps/meter).

The integral battery charger is designed to meet the requirements of NFPA-20 and bring a "good" battery (discharged only) back to a full charge within a continuous 24 hour period under normal conditions.

Upon energizing the integral battery charger the panel mounted controller ammeters will indicate a high rate of charge (10-15 amps/meter). Voltmeters should indicate proper voltage 12/24 volts D.C. depending on system voltage.

Generally, when all conditions are normal the batteries will come to a full charge prior to the 24 hour period. If, for some reason, batteries appear to be "gassing excessively" refer to BATTERY CHARGER FIELD ADJUSTMENT in this manual. However, should the batteries require a longer period of time due to some undetected abnormal condition, do not panic and refer to Paragraph 1 & 2 above of this controller manual.

As batteries begin to charge, the controller ammeters will indicate a gradual decrease in current draw. When these ammeters indicate a total (both meters combined) of approximately ten (10) amps (Example: 6a on one; 4 on other), the charger should drop to a trickle charge (approximately 0.5 amps).

In order to insure that charger is definitely adjusted properly momentarily disconnect the A.C. supply. When A.C. supply is returned the controller ammeters should once again indicate a high rate of charge but returning to "trickle rate" in a short period (10 minutes of less).

It is suggested that the A.C. be disconnected momentarily 3 or 4 times to insure compatibility.

Check batteries daily for a few days after initial installation has been made and weekly thereafter.

NOTE: As batteries age, the charger setting may have to be charged to keep the batteries charged. If a charge in setting is required due to age, it is probable that the batteries are deteriorating and should be replaced.

In some cases when controllers are installed in extermely warm atmospheres (95° of above) and ammeters are indicating continuous "high rate" requirements that the battery charger be turned off periodically allowing a cool down time for batteries.

CAUTION

Under no circumstances should new electrolyte (acid) be added to a battery that has been previously filled. Only water designated battery water (distilled) is recommended for maintenance purposes.

BATTERY CHARGER FIELD ADJUSTMENT

NOTE: Batteries must be fully charged before making charger adjustments.

1. Turn both potentiometers on battery charger printed circuit board fully counter-clockwise.

2. Turn Fire Pump Controller selector switch to "OFF".

3. Turn float mode, or low rate, potentiometer (*inboard) clockwise, while watching ammeters, until ammeters just begin to indicate current flow. Then turn potentiometer counter-clockwise approximately ten (10) degrees.

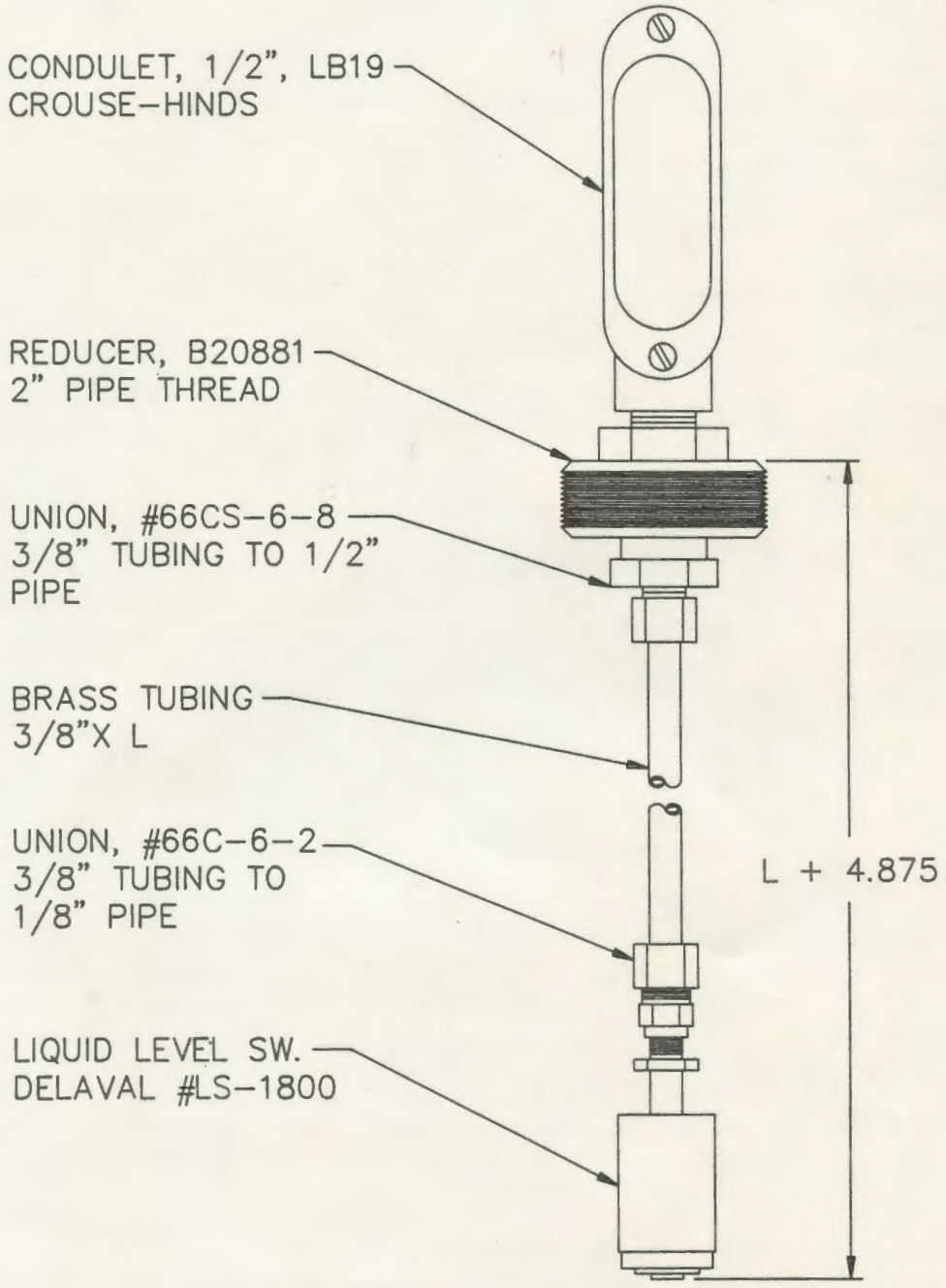
4 Turn equalize, or high rate, potentiometer (*outboard) fully clockwise. If charger has not switched to high rate turn A.C. power to charger off and back on again. This will set the charger to high rate.

5. Turn equalize potentiometer (outboard) counter-clockwise until charger switches from high to low rate. Turn potentiometer an additional 10° (approximately) counter-clockwise.

6. Turn A.C. power off and then on again to check 4 & 5.

* Inboard potentiometer is that potentiometer closest to printed circuit board connector.

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVED
A	REDRAWN ECO 1677	8-12-87	J.I.



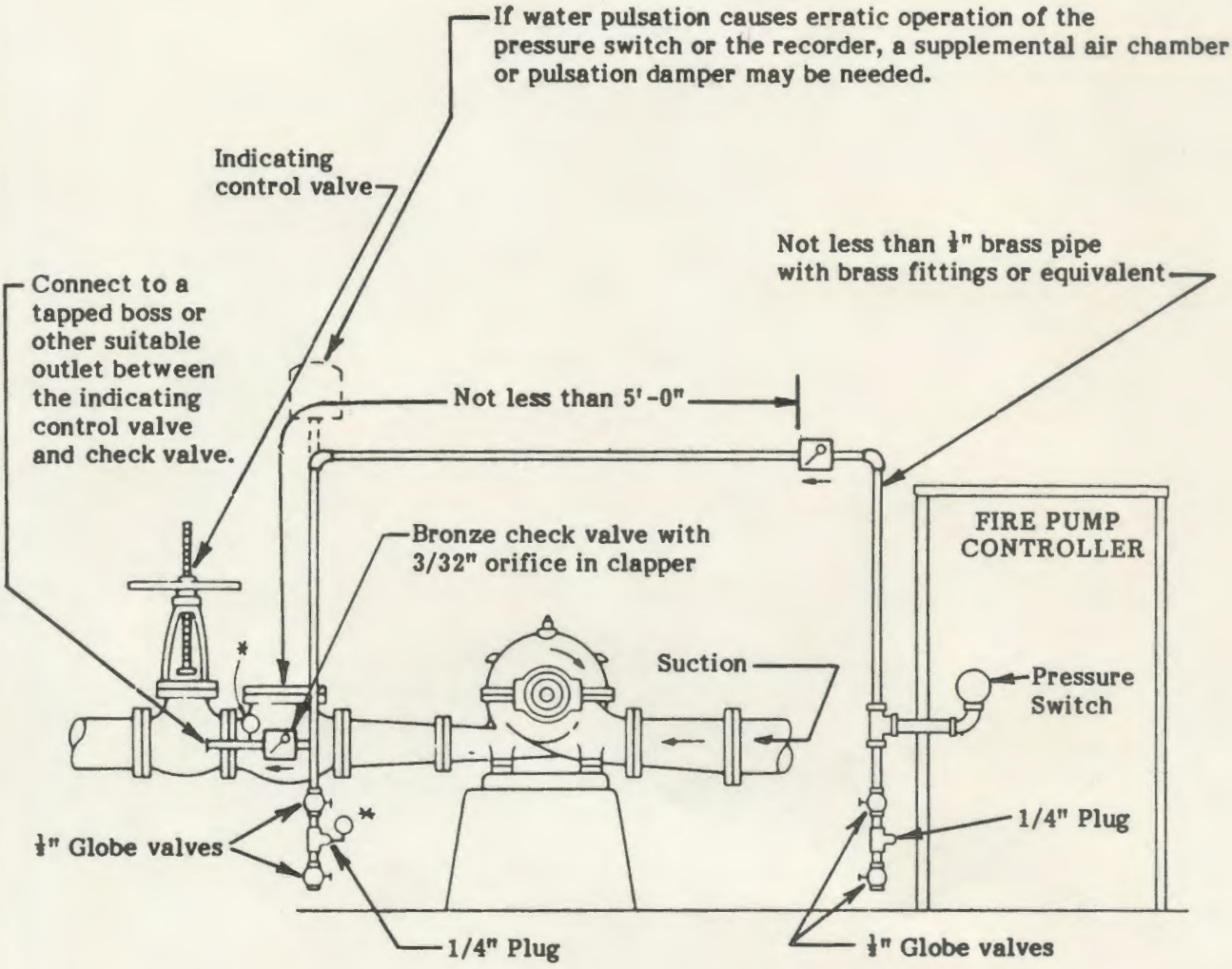
DRAWN	J.I. 12-Aug-87
CHECK	8-18-87
APPD	

METRON, INC.

LIQUID LEVEL SWITCH ASSEMBLY
OPTION F
ENGINE FIRE PUMP CONTROLLER

AA10519A

SCALE 1/2 | SHEET



*Recommended location of pressure gages (either location)

If water is clean, ground face unions with noncorrosive diaphrams drilled for 3/32" orifices may be used in place of the check valves.

DRAWN REDRAWN PGH 6-4-86	Metron	METRON, INC.
CHECK KMS 6-4-86		
APPD		

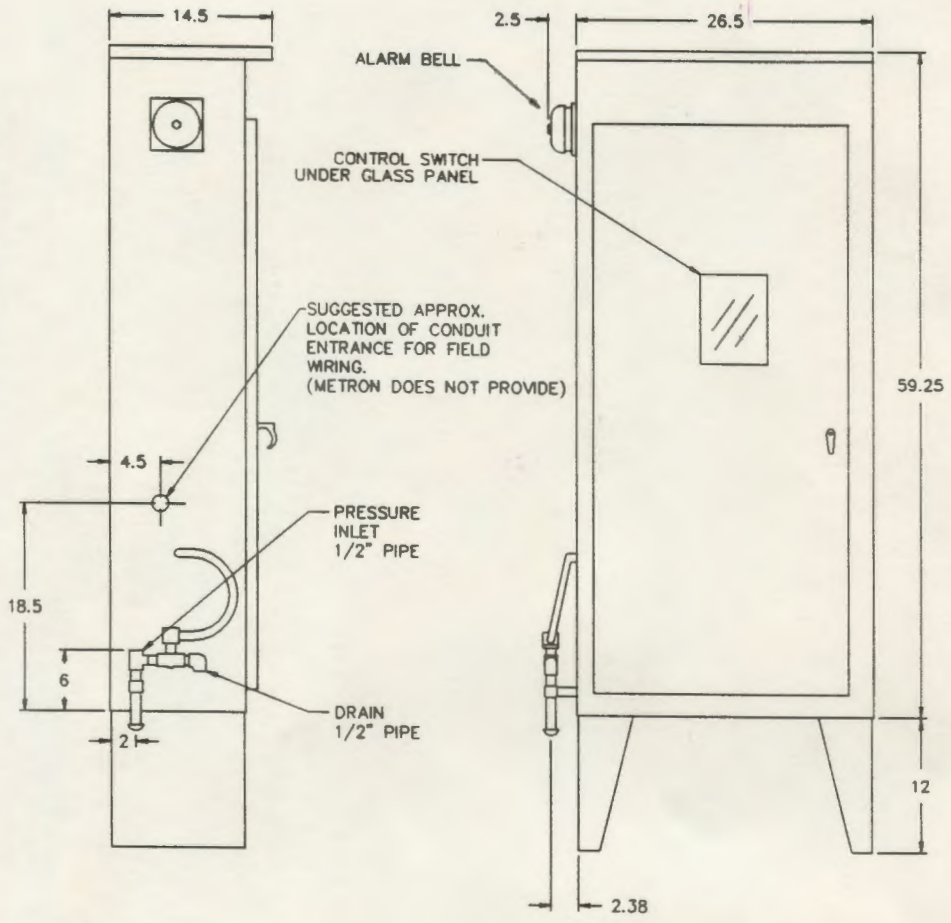
PLUMBING FOR FIRE PUMP CONTROLLERS

Reference - from NFPA Pamphlet 20, 1980
Fig. A-7-5.2.1

OPTIONS:

SIZE	
A	10761
SCALE	SHEET

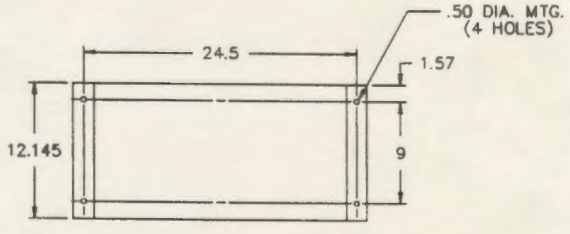
REVISIONS	SYM	DESCRIPTION	DATE	APPROVED
	C	ADD ALARM BELL ECO1863	4-11-89	



SIDE VIEW

FRONT VIEW

SIDE VIEW



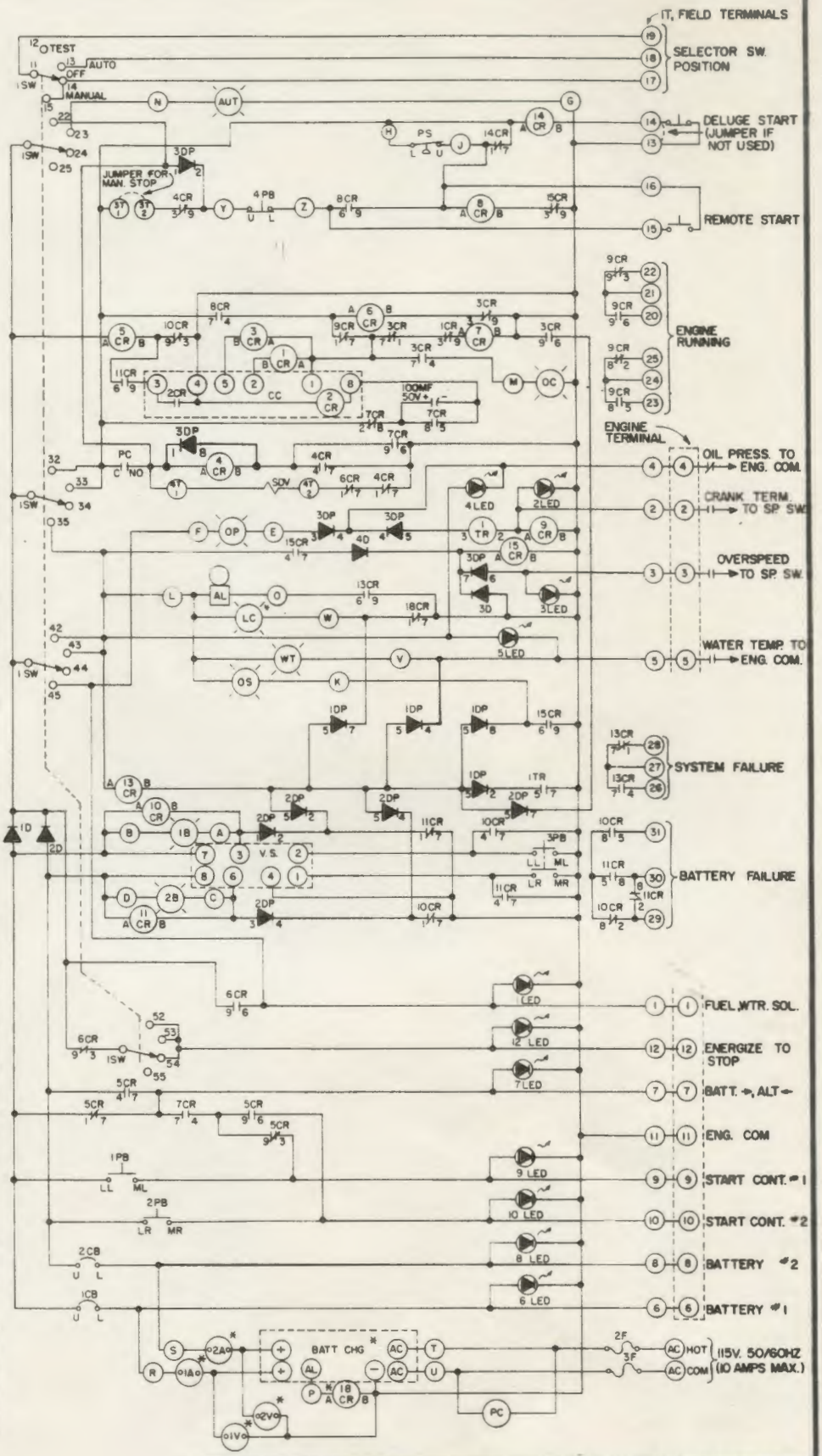
BOTTOM VIEW

DRAWN	4-11-89	METRON, INC. DENVER, CO
CHECK	4-18-89	
APPD	4-18-89	
OUTLINE DIMENSIONS MODEL FD2 ENGINE FIRE PUMP CONTROLLER		OPTIONS: CD30921C SCALE 1/8 SHEET

COMPONENTS		FUNCTION	LOCATION	CONTACTS
1CR		CRANK TIMING	17	16
2CR		BATT. LATCH	19	19
3CR		OVERCRANK	16	15,16,17
4CR		WEEKLY TEST	22	10,22,23
5CR		BATT. SWITCH	16	5,52,53
6CR		FUEL SOL.	15	23,47,49
7CR	3P	CRANK	16	20,21,52
8CR		AUTO START	10	10,15
9CR	3P	ENG. RUNNING	25	13,15,16,17,19
10CR	3P	BATT. #1 FAILURE	38	16,39,43
11CR	3P	BATT. #2 FAILURE	43	18,39,41,42
13CR		ALARM	37	28,35,37
14CR		DELUGE START	6	7
15 CR		OVERSPEED	26	10,26,34
18CR	*	LOSS OF CHARGER	65	29
1TR		OIL. PRESS.	25	37
1D		ISOLATION DIODE	39	
2D		ISOLATION DIODE	39	
3D		DAMPING DIODE	28	
4D		ISOLATION DIODE	26	
1DP		DIODE PACK	34,37	
2DP		DIODE PACK	38,39,43	
3DP		DIODE PACK	8,21,25,27	
1A	*	AMMETER	64	
2A	*	AMMETER	63	
1V	*	VOLTMETER	67	
2V	*	VOLTMETER	66	
AUT		AUTO LIGHT	5	
1B		BATT.#1 LIGHT	39	
2B		BATT.#2 LIGHT	42	
WT		WATER TEMP. LT.	31	
OC		OVERCRANK LT.	18	
OP		OIL PRESS. LT.	25	
OS		OVERSPEED LT.	32	
LC	*	LOSS CHRG. LT.	29	
1-12 LED		ENG. TERM. STAT LT.		
1PB		MAN. CR.#1	55	
2PB		MAN. CR.#2	57	
3PB		BATT. RESET	40,41	
4PB		STOP	10	
PS		PRESSURE SW.	7	
1SW		SELECTOR SW.	4,7,23,31,49	
1CB		BATT.#1 C.B.	61	
2CB		BATT.#2 C.B.	59	
PC		PROGRAM CLOCK	66	22
SDV		SOL. DRAIN VALVE	23	
VS		BATT. VOLT SENSE	4D	
AL		ALARM BELL	28	
CC		CRANK CONTROL	18	
BC		BATT. CHARGER	63	
2F		FUSE 30A	63	
3F		FUSE 30A	64	

NOTES:

1) * DESIGNATES OPTIONS
2) THERE IS A DIODE AND RESISTOR IN SERIES WITH EACH LED, NOT SHOWN ON SCHEMATIC.



DRAWN		12-6-83
CHECK		12/7/83
APPD		12-8-83

METRON INSTRUMENTS, INC.
DENVER, COLORADO

ENGINE DRIVEN FIRE PUMP CONTROLLER
SCHEMATIC WIRING

OPTIONS: J

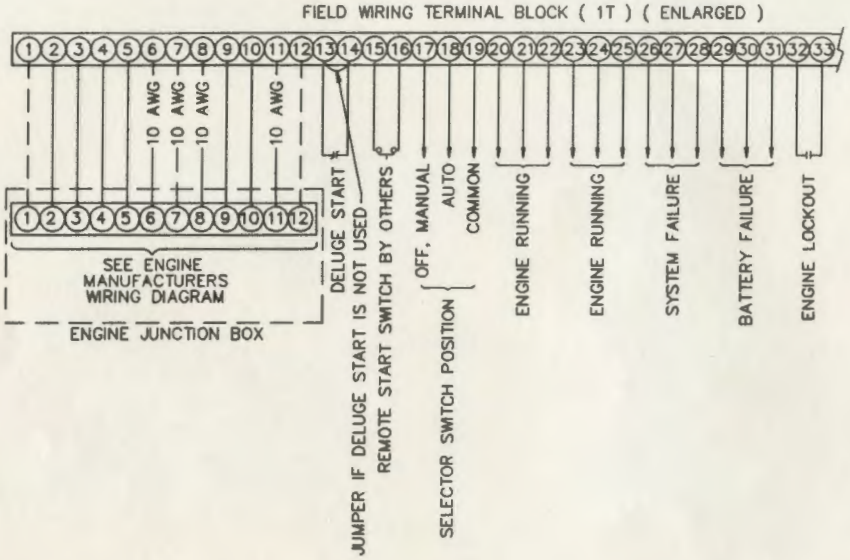
SIZE C | R 30883G

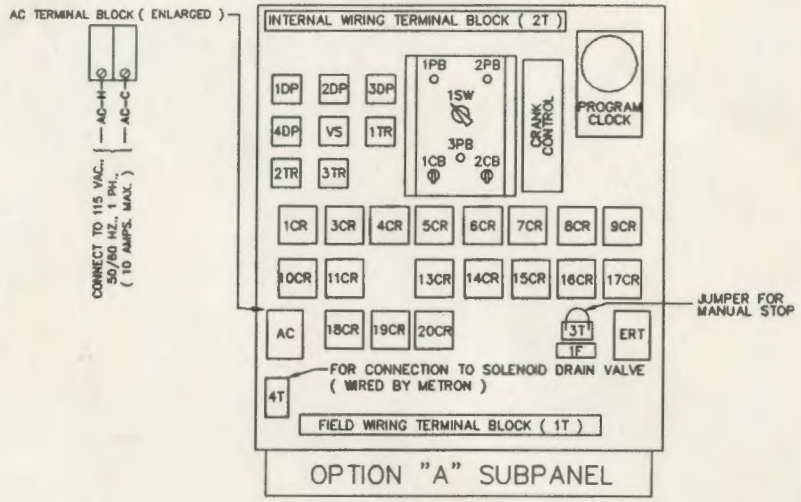
SHEET OF

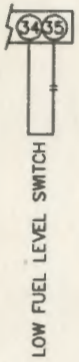
REVISIONS	SYM	DESCRIPTION	DATE	APPROVED
	F	REDRAWN ECO 1864	4-12-89	

NOTES:

1. ALL INCOMING FIELD WIRING TO BE STRANDED AND SIZED 14 AWG. MIN. EXCEPT AS NOTED.
2. ALL DRY CONTACTS SUPPLIED BY METRON ARE RATED AT 10 AMPS, 28 VDC/115 VAC.
3. TERMINAL 12 USED ON CATERPILLAR ENGINES ONLY.
4. TERMINAL 1 NOT USED ON CATERPILLAR ENGINES.
5. TERMINAL 7 NOT USED ON MOST ENGINES AFTER 1987, REFER TO ENGINE WIRING.



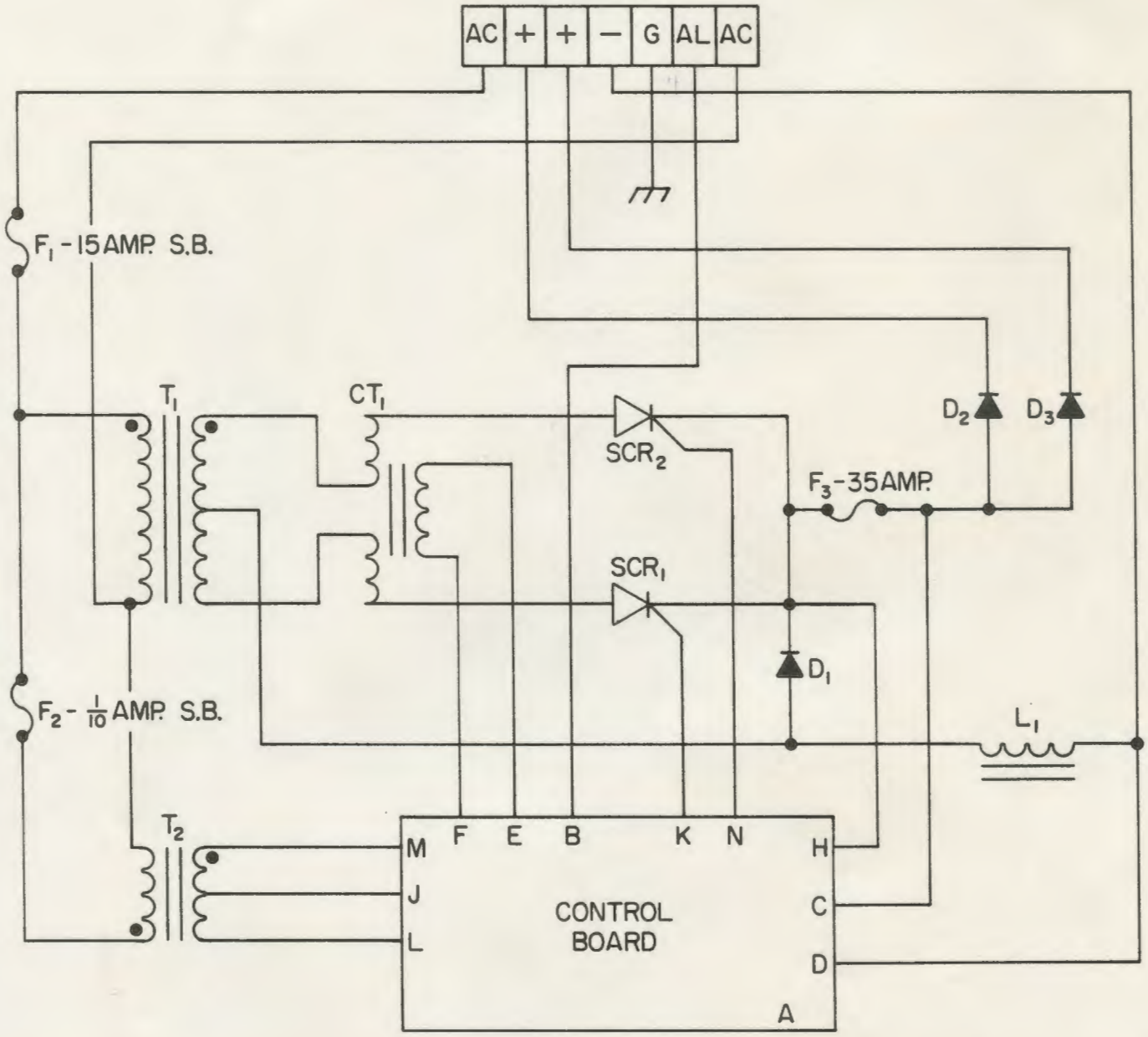




				TOLERANCES ARE: X ±.030 XX ±.015 XXX ±.005 ANGLES ±.0° 30' REMOVE BURRS & SHARP CORNERS	DRAWN J.I. 4-12-89	METRON, INC. DENVER, CO
					CHECK Ra 4-12-89	
					APPD [illegible] 4-13-89	
				EXTERNAL CONNECTION DIAGRAM MODEL FD2 ENGINE FIRE PUMP CONTROLLER		CH30923F
NEXT ASSY	FINAL ASSY	NEXT ASSY	FINAL ASSY			SCALE 1/4 SHEET
APPLICATION		QTY REQD				

REVISIONS

SYM	DESCRIPTION	DATE	APPROVED



QTY	PART NO.	DESCRIPTION	MATERIAL	ITEM

LIST OF MATERIAL

DRAWN	SR	REDRAWN	1-7-86
CHECK			1/7/86
APPD			1-7-86

METRON INSTRUMENTS, INC.
COLORADO, USA

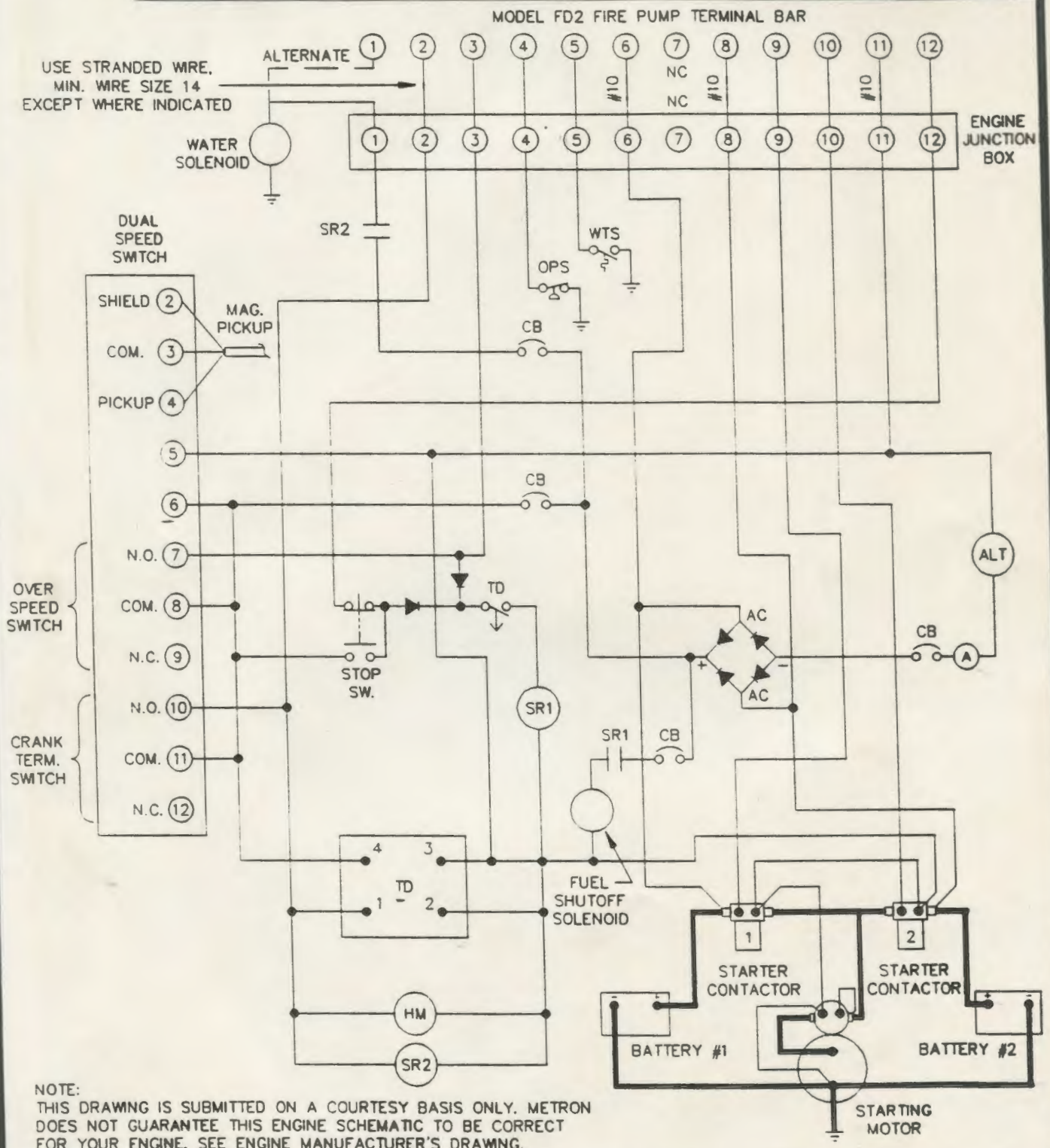
24 VOLT BATTERY CHARGER
BASIC WIRING DIA.
NEGATIVE GROUND

CODE IDENT NO. 40021

SIZE	
A	10481B

SCALE	SHEET

REVISIONS	SYM	DESCRIPTION	DATE	APPROVED
	A	REVISE WIRING AT STARTER ECO1848	2-22-89	SR / DY



NOTE:
THIS DRAWING IS SUBMITTED ON A COURTESY BASIS ONLY. METRON DOES NOT GUARANTEE THIS ENGINE SCHEMATIC TO BE CORRECT FOR YOUR ENGINE. SEE ENGINE MANUFACTURER'S DRAWING.

DRAWN	SR	9-21-87
CHECK	DY	9-24-87
APPD	DY	9-24-87

METRON, INC.
DENVER, CO

HOOKUP
CATERPILLAR DIESEL TO FD2

AH11064A

SCALE | SHEET

Metron

Effective March 9, 1989

Parts list for FD-2 Engine Fire Pump Controllers **12V System**

The following information must be supplied to METRON with every inquiry or parts order:

CONTROLLER MODEL No.: _____

CONTROLLER SERIAL No.: _____

SYSTEM VOLTAGE: _____

*SYSTEM GROUND POLARITY: _____

The following parts list is effective for controller serial numbers prefixing beginning with DD-89- starting (March 9, 1989).

DESCRIPTION	PART NUMBER	REC. SPARES	LIST PRICE
Bell	435-4E1,Edwards		48.00
Lamp Bulb	756,Norelco Chicago Miniature or equivalent	10	1.50
Relays: 1CR, 3CR thru 6CR, 13CR thru 15CR	W388CPX-6,Magnecraft Elect.	3	12.00
Relays: 7CR thru 11CR	W388CPX-10,Magnecraft Elect.	1	14.00
Sockets for Sigma Relays	SR3B51,IDEC	1	5.00
Octal Sockets	SR2P51,IDEC	1	2.00
*Crank Control & Battery Switching Unit	C30917-12,Metron	1	224.00
*1TR (Oil Pressure)	A10843-12(MTR100-12-7), Metron	1	52.00
*Voltage Sensing Unit (VS)	B20876-12,Metron	1	100.00
*1DP & 2DP Diode Modules	B20877,Metron	1	26.00
*3DP Diode Module	B20880,Metron	1	27.00
Circuit Breaker (1 & 2 CB)	JA1-B3-20-50-2A, Heinemann	1	19.00
Selector Switch (1SW)	3100-5A,5 Deck, Electro-Switch	1	97.00

NOTE: All prices subject to change without notice.

Metron

Parts list for FD-2 Engine Fire Pump Controllers **12V System**

DESCRIPTION	PART NUMBER	REC. SPARES	LIST PRICE
Crank Pushbuttons (1 & 2 PB)	81087J,Arrow Hart-Hagerman	1	13.00
Reset Pushbutton (3 PB)	81087J,Arrow-Hart Hagerman	1	13.00
Stop Pushbutton (4 PB)	XA2B-MET-3 Telemecanique	1	20.00
Pressure Switch (PS)	DA31-2,Rg.9,Mercoid	1	165.00
Program Clock (PC)	2410/120/60,Zenith 2410/120/50,Zenith	1	115.00 124.00
Diodes (1D & 2D)	1N3209,Motorola	2	5.00
Solenoid Drain Valve (SDV)	2LC2LB4250-12V,Skinner	1	142.00
Fuse (30 amp) (2F,3F)	BAF30,Bussman	1	2.00
Lamp Assy. with Lens (Red)	41-1310-0111-301,Dialco	1	14.00
Lamp Assy. with Lens (Green)	41-1310-0112-301,Dialco	1	14.00
Lens (Red)	41-0111-300,Dialco	2	7.00
Lens (Green)	41-0112-300,Dialco	2	7.00
Oil Tight Lamp Assy. (Red) Nema Enclosure	80-0410-1331-303,Dialco	1	18.00
Oil Tight Lamp Assy. (Green) Nema Enclosure	80-0410-1332-303,Dialco	1	18.00
Oil Tight Lens (Red) Nema Enclosure	80-1331-300,Dialco	2	7.00
Oil Tight Lens (Green) Nema Enclosure	80-1332-300,Dialco	2	7.00
Door Handle with Keys	50072, Hansen		25.00
Break Glass	6-3/4" x 8-3/4"	1	2.00
Option "A" Relays: 3CR & 15CR	W388CPX-10,Magnecraft, Elect.	1	14.00

NOTE: All prices subject to change without notice.

Parts list for Options,when applicable,for FD-2 Controllers **12V System**

DESCRIPTION	PART NUMBER	REC. SPARES	LIST PRICE
Relays: 51CR thru 60CR	W388CPX-6,Magnecraft Elect.	1	13.00
Relays: 18ACR	W388CPX-9,Magnecraft Elect.	1	14.00
Option "B"			
Pressure Recorder (CD)	06P1-1BM4,Weksler AC-313-603,Dickson	1	596.00 1075.00
Weksler Charts	W7-300-0-6	100	25.00/c
Dickson Charts	603		30.00/c
Option "E"			
Fuse (1 amp) (F1)	KTK-1 amp,Limitron	1	11.00
Relay 19CR	W388CPX-6,Magnecraft Elect.	1	12.00
Option "F"			
Level Switch only	LS-1800		72.00
Complete Assy. with tank fitting hardware ,etc. (Specify tank Dia.)	A10519		130.00
Option "H"			
Heater(Specify wattage)	PT-615,150w Emerson-Chromalox	1	47.00
Thermostat	WR65,Emerson-Chromalox	1	31.00
Humidstat (instead of Thermostat)	H46-C,Honeywell	1	109.00
Circuit Breaker	JA1-A3-2-250VAC-3, Heinemann		19.00
Switch Box	C30534,Metron		25.00
*Option "J"			
Battery Charger	1808-12-25,Metron		900.00
* Battery Charger P.C. Board	C30683-12,Metron	1	186.00
Relay 18CR	W388CPX-6,Magnecraft Elect.	1	12.00
Diodes	1N1183,Motorola	1	5.00
SCR	2N3897 or S2035H	1	14.00

NOTE: All prices subject to change without notice.

Parts list for Options,when applicable,for FD-2 Controllers **12V System**

DESCRIPTION	PART NUMBER	REC. SPARES	LIST PRICE
Fuse (35 amp)	NON35, Bussman	2	2.00
Fuse (.1 amp)	MDA.1,Bussman	2	3.00
Fuse (10 amp)	MDA10,Bussman	2	2.00
Ammeter (30 amp)	440D5,Electro-Mechanical	1	17.00
Voltmeter (0-30 volt)	445D5-30,Electro Mechincal	1	21.00
Option "K" Alarm Silence Pushbutton (5PB)	81087J,Arrow-Hart Hagerman		13.00
Relay (20CR)	W388CPX-6	1	12.00
*4DP Diode Module	B20885,Metron	1	30.00
Option "L" Pressure Recorder (CD) stainless steel	(0-300psi) 06P1-4BM4, Weksler	1	750.00
	(0-600psi) 06P1-4BM40, Weksler	1	964.00
Solenoid Drain Valve (SDV) stainless steel	R2H6LX7-12V, Skinner	1	230.00
Pressure Switch (PS) S.S.	DA521-2,Mercoid		
	Range 9S 0-300psi	1	360.00
	Range 10S 0-600psi	1	360.00
Option "N" Step Down Transformer 240/480V-120/240V 1KVA, 50/60hz.	Cat No. 9T51B510,GE		310.00
380/400/416V-120/240V 1KVA, 50/60hz.	Cat.No. 9T51B170,GE		380.00
Option "P" 2TR	RTE-PN1-DC-12(Specify time range),IDEC	1	78.00
Option "R" Engine Run Timer	2520-831922 Syracuse	1	92.00
Option "S" 3TR	RTE-PN1-DC-12(Specify time range),IDEC	1	78.00

METRON,INC.
1051 South Platte River Drive
Denver, Colorado 80223
Telephone: (303)744-1791 Telex: 45-729 Telefax: (303)744-7503

NOTE: All prices subject to change without notice.

Effective March 9, 1989

Parts list for FD-2 Engine Fire Pump Controllers **24V System**

The following information must be supplied to METRON with every inquiry or parts order:

CONTROLLER MODEL No.: _____

CONTROLLER SERIAL No.: _____

SYSTEM VOLTAGE: _____

*SYSTEM GROUND POLARITY: _____

The following parts list is effective for controller serial numbers prefixing beginning with DD-89- starting (March 9, 1989).

DESCRIPTION	PART NUMBER	REC. SPARES	LIST PRICE
Bell	435-4G1,Edwards		48.00
Lamp Bulb	757,Norelco Chicago Miniature or equivalent	10	1.50
Relays: 1CR, 3CR thru 6CR, 13CR thru 15CR	W388CPX-7,Magnecraft Elect.	3	12.00
Relays: 7CR thru 11CR	W388CPX-11,Magnecraft Elect.	1	14.00
Sockets for Sigma Relay	SR3B51,IDEC	1	5.00
Octal Sockets	SR2P51,IDEC	1	2.00
*Crank Control & Battery Switching Unit	C30917-24,Metron	1	224.00
*1TR (Oil Pressure)	A10843-24(MTR100-24-7), Metron	1	52.00
*Voltage Sensing Unit (VS)	B20876-24,Metron	1	100.00
*1DP & 2DP Diode Modules	B20877,Metron	1	26.00
*3DP Diode Modules	B20880,Metron	1	27.00
Circuit Breaker (1 & 2 CB)	JA1-B3-20-50-2A, Heinemann	1	19.00
Selector Switch (1SW)	3100-5A,5 Deck, Electro-Switch	1	97.00
Crank Pushbuttons (1 & 2 PB)	81087J,Arrow Hart-Hagerman	1	13.00

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Metron

Parts list for FD-2 Engine Fire Pump Controllers **24V System**

DESCRIPTION	PART NUMBER	REC. SPARES	LIST PRICE
Reset Pushbuttons (3PB)	81087J, Arrow Hart-Hagerman		13.00
Stop Pushbutton (4PB)	XA2B-MET-3 Telemecanique	1	20.00
Pressure Switch (PS)	DA31-Rg.9,Mercoid	1	165.00
Program Clock(PC)	2410/120/60,Zenith 2410/120/50,Zenith	1	115.00 124.00
Diodes (1D & 2D)	1N3209,Motorola	2	5.00
Solenoid Drain Valve(SDV)	2LC2LB4250,24V, Skinner	1	142.00
Fuse (30 amp) (2F,3F)	BAF30,Bussman	1	2.00
Lamp Assy. with Lens (Red)	41-1310-0111-301,Dialco	1	14.00
Lamp Assy. with Lens (Green)	41-1310-0112-301,Dialco	1	14.00
Lens (Red)	41-0111-300,Dialco	2	7.00
Lens (Green)	41-0112-300,Dialco	2	7.00
Oil Tight Lamp Assy. (Red) Nema Enclosure	80-0410-1331-303,Dialco	1	18.00
Oil Tight Lamp Assy. (Green) Nema Enclosure	80-0410-1332-303,Dialco	1	18.00
Oil Tight Lens (Red) Nema Enclosure	80-1331-300,Dialco	2	7.00
Oil Tight Lens (Green) Nema Enclosure	80-1332-300,Dialco	2	7.00
Door Handle with Keys	50072, Hansen		25.00
Break Glass	6-3/4" x 8-3/4"	1	2.00
Option "A" Relays: 3CR & 15CR	W388CPX-11,Magnecraft Elect.	1	14.00

NOTE: All prices subject to change without notice.

Part list for Options,when applicable,for FD-2 Controllers **24V System**

DESCRIPTION	PART NUMBER	REC. SPARES	LIST PRICE
Relays: 51CR thru 60CR	W388CPX-7,Magnecraft Elect.	1	13.00
Relays: 18ACR	W388CPX-9,Magnecraft Elect.	1	14.00
Option "B"			
Pressure Recorder (CD)	06P1-1BM4,Weksler	1	596.00
	AC-313-603,Dickson		1075.00
Weklser Charts	W7-300-0-6	100	25.00/c
Dickson Charts	603		30.00/c
Option "E"			
Fuse (1 amp) (F1)	KTK-1 amp,Limitron	1	11.00
Relay 19CR	W388CPX-7,Magnecraft Elect.	1	12.00
Option "F"			
Level Switch only	LS-1800		72.00
Complete Assy. with tank fitting Hardware,etc. (Specify tank Dia.)	A10519		130.00
Option "H"			
Heater (Specify wattage)	PT-615-150w Emerson-Chromalox	1	47.00
Thermostat	WR65,Emerson Chromalox	1	31.00
Humidstat (instead of Thermostat)	H46-C,Honeywell	1	109.00
Circuit Breaker	JA1-A3-2-250VAC-3, Heinemann		19.00
Switch Box	C30534,Metron		25.00
*Option "J"			
Battery Charger	1808-24-25,Metron		1050.00
*Battery Charger P.C. Board	C30683-24,Metron	1	186.00
Relay 18CR	W388CPX-7, Magnecraft Elect.	1	12.00
Diodes	1N1183,Motorola	1	5.00
SCR	2N3897 or S2035H	1	14.00
Fuse (35 amp)	NON35,Bussman	2	2.00
Fuse (.1 amp)	MDA.1,Bussman	2	3.00

Notes: All prices subject to change without notice

Parts list for Options,when applicable,for FD-2 Controllers **24V System**

DESCRIPTION	PART NUMBER	REC. SPARES	LIST PRICE
Fuse (15 amp)	MDA15,Bussman	2	2.00
Ammeter (30 amp)	440D5,Electro Mechanical	1	17.00
Voltmeter (0-30 volt)	445D5-30, Electro-Mechanical	1	21.00
Option "K" Alarm Silence Pushbutton (5PB)	81087J,Arrow Hart-Hagerman	1	13.00
Relay (20 CR)	W399CPX-11, Magnacraft,Elect.	1	12.00
*4DP Diode Module	B20885,Metron	1	30.00
Option "L" Pressure Recorder (CD) stainless steel	(0-300psi) 06P1-4BM4, Weksler	1	750.00
	(0-600psi) 06P1-4BM40, Weksler		964.00
Solenoid Drain Valve (SDV) stainless steel	R2H6LX7-24V, Skinner	1	230.00
Pressure Switch (PS) S.S.	DA521-2,Mercoid		
	Range 9 0-300psi	1	360.00
	Range 10 0-600psi	1	360.00
Option "N" Step Down Transformer 240/480V-120/240V 1KVA,50/60hz.	Cat. No. 9T51B510,GE		310.00
380/400/416V-120/240V 1KVA,50/60hz.	Cat. No. 9T51B170,GE		380.00
Option "P" 2TR	RTE-PN1-DC-24 Idec	1	78.00
Option "R" Engine Run Timer	2520-831922 Syracuse	1	92.00
Option "S" 3TR	RTE-PN1-DC-24 Idec	1	78.00

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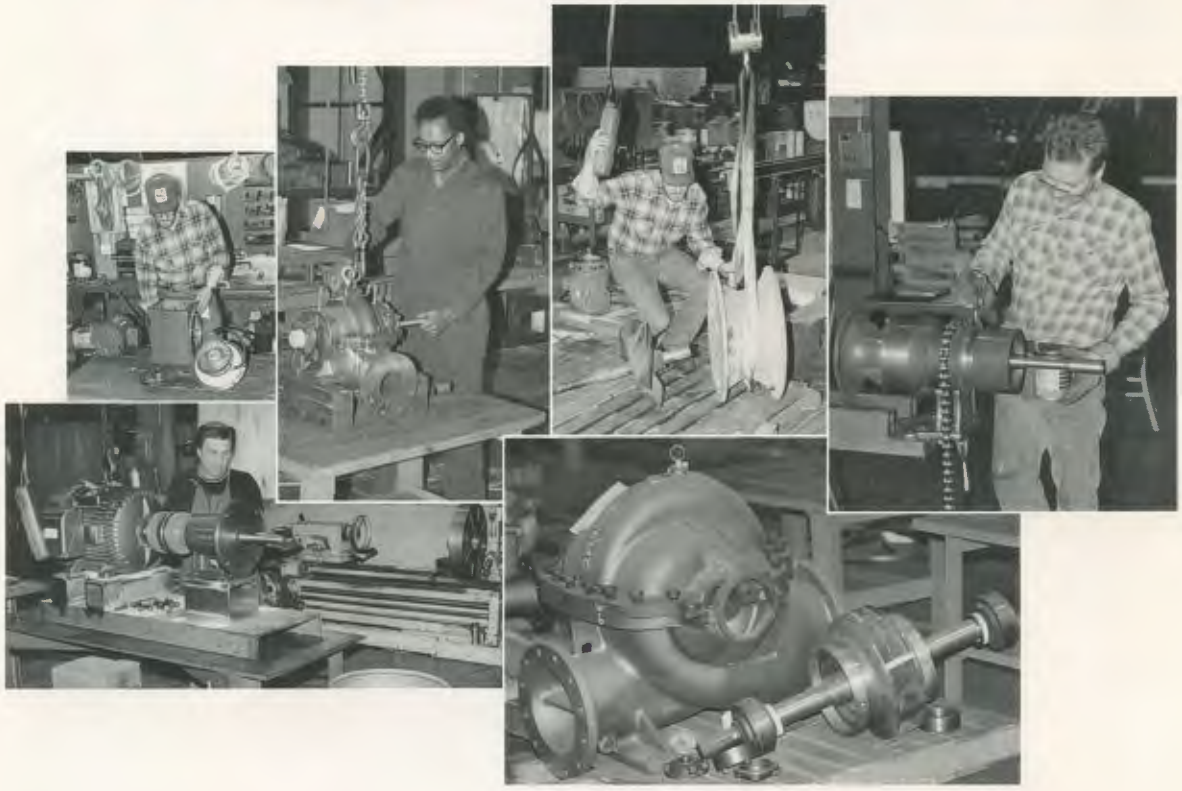

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