Operator's Manual Table of Contents
For Darley HERCULES Fire Pump

Model: **HERCULES** Pump Serial Number: _____

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

HERCULES OPERATORS MANUAL
CONDENSED OPERATING PROCEDURE

WARNING: Do not use this pump for hose testing.

1. Check and correct engine fluid levels.
   A. Engine Coolant
   B. Large Oil Injection Reservoir
   C. Small Oil Injection Reservoir
2. Visually Inspect Unit
   A. Visually Inspect all flexible components
      - Throttle cables seated
      - Carburetor Shroud Undamaged
      - All fasteners tight
      - Priming belt in operable condition
3. Turn on ignition
      - Ignition light should be light.
4. Prime carburetors and/or activate choke(s).
5 Start unit.
6. Prime Pump and flush primer.
7. Raise pump pressure to 25 PSI and engage loss of water protection system.
8. Allow unit to warm up. (5 minute idle recommended)
9. Pump water as required.
10. After pumping, allow unit to cool down. (5 minute idle recommended)
11. Shut down unit.
12. Perform check #1 and #2 to ensure unit will be read for next use.

PREPARATION FOR PRIMING

Check coupling gaskets and connect hose lines with coupling properly tightened.

Any size of suction and discharge hose may be used, depending on the volume of water required.

Be certain that the suction hose (or pipe) is absolutely air tight. The pump will not lift water if the suction side of the pump has the slightest air leak.

A strainer with openings not larger than 1/4” mesh must always be used on the end of the suction line when pumping dirty water.

Avoid air traps in suction hose if possible.

Keep the suction intake strainer well above the bottom of stream or pond to prevent pickup of soil and other foreign matter. If the strainer must lie on the bottom, a metal plate or pan should be laid under it.

The suction intake should be submerged several inches to prevent sucking in air. A cover laid over the top of strainer will allow the pump to operate with a minimum of submergence.

Close drain valve and all other openings into pump casing.

Do not start the engine until everything is in readiness for pumping, with hose couplings properly tightened, and pump discharge valve partly open.

BEFORE OPERATING UNIT

Read and follow instructions given in your engine operators manual. The Rotax engine powering this pumping unit has features not commonly found on ordinary 2-cycle engines. Familiarize yourself with these features before starting the unit and follow Rotax's instructions at all times.

The Hercules pumping unit also has features not commonly found on other portable pump. Familiarize yourself with these features before starting the unit and follow W.S. Darley's instructions at all times.

STARTING THE PUMP

Before staring the pump, check and correct the engine fluid levels in the three reservoirs: the expansion tank, the injection oil tank, and the lubricating oil reservoir. Both oil tanks use high quality 2-cycle oil as specified in your engine operator's manual. Also, visually inspect unit, paying particular attention that all throttle cable are properly seated, all fasteners are tight and the priming belt is in operable condition. Also, inspect all hoses, lines, and flexible connections.

For a cold start, activate one or both chokes located on the carburetors, and/or use the fuel primer. Prime the carburetors by pumping the bulb on the fuel line. Set the throttle at its lowest setting and position the ignition switch in the "RUN" position. Ignition light must light. If it does not, inspect the fuse. If the fuse is blown it is possible to operate the unit, however, all safety systems will be deactivated and the battery will not charge. Do not operate unit with a blown fuse. Press the start button or pull the recoil rope starter to start the engine.

PRIMING THE PUMP

Make certain all hose lines and drains are tightly sealed. With the engine running at a moderate idle, open the priming valve and activate the primer by lifting the priming lever so that the priming belt tightens in its sheave. If you are unable to achieve a prime in 60 seconds, turn off the engine and check your hose connections for leaks. After the pump is primed, continue to operate the primer for about 5 seconds in order to flush out any oil residue that remains. Failure to flush primer may cause an oil build-up in the primer which will result in long prime times and difficulty at priming from high lifts. Before the primer handle is released, close the priming valve.

OPERATING THE PUMP

After the pump is primed and running, bring the discharge pressure above 25 PSI and put the loss of water protection circuit switch in the "ON" position and allow the unit to warm up for 5 minutes. The pump will run at any pressure form 10 to 250 PSI (200 PSI for models not equipped with electronic governor). Failure to place the loss of water protection switch in the "ON" position disables safety features and may result in engine failure.

Do not operate the pump when the "run" light is not lit, as this is an indication that the fuse is blown. Continued operation with a blown fuse will discharge and damage the battery, as well as disable all safety systems.

SHUTTING OFF THE PUMP

After pumping, lower the throttle down to idle and allow unit to cool down for 5 minutes. Place the ignition switch in the "OFF" position. Drain the pump completely to avoid freezing damage.

SPECIAL SAFETY SYSTEMS

TEMPERATURE RELIEF VALVE

The engine coolant is kept cool by passing it and cold pump water through the heat exchanger. If all the discharges are closed for a period of time, the pump water would heat rapidly and be ineffective at cooling the engine. If the engine coolant temperature reaches the maximum permissible temperature, the temperature relief valve will open, dump hot water, and pull cool water into the pump to the engine. If this occurs, a discharge valve should be opened to allow more effective circulation.

The temperature relief valve is designed as a safety feature to protect the engine from overheating if all discharges are left closed. If it activates under normal operating conditions, it indicates a serious cooling failure, such as loss of engine coolant, which could result in engine failure if engine is not shut down immediately.

PRIME LOSS PROTECTION SWITCH

In order to prevent the engine form overspeeding due to loss of water, the prime loss protection switch will shut off the engine when the discharge pressure drops below 10 PSI. This switch performs its function only when it is in the "RUN" position. Operating the pump with the prime loss protection switch in the "OFF" position will the engine and will cause engine failure if the water supply is interrupted. Always operate the pump with the prime loss protection switch in the "RUN" position.

GOVERNOR CIRCUIT

The engine speed of your unit is limited by either an electronic governor or a pressure switch governor. Operating the unit at the limiting speed of either device (approximately 200 PSI for the pressure switch or 250 PSI for the electronic governor) will result in pressure pulsation. Open a discharge valve or lower your throttle setting to reduce engine speed slightly if such a condition occurs.

INITIAL START/BREAK IN

Read all operating instructions before operating unit for the first time.

Your pumping unit has been tested and operated at the W.S. Darley Pump Factory; however in order to ensure the oil injection system was not damaged during shipment, and to ensure maximum engine life, the following break in procedure is recommended for the unit's initial run.

Fill the injection oil reservoir with 2-cycle oil and mark its level with a marker or piece of tape.

For this initial run only, fill the fuel tank with a 50:1 Gasoline/two-stroke oil mixture. This facilitates break in and protects the unit should the oil injection pump have been damaged.

Follow the break in procedure in your engine owner's manual. The following table approximately matches the engine speeds noted there with pump pressures on your gauge.

Table 1 - Approximate Speeds at Various Pressures

3500 RPM - 60 PSI	5000 RPM - 130 PSI
4000 RPM - 75 PSI	5500 RPM - 160 PSI
4500 RPM - 100 PSI	

After breaking in your unit, inspect the oil reservoir to ensure that the oil pump is pumping. An air bubble in the oil line, caused by shipping, may require the lines to be bled. See the engine owners manual.

After the break in procedure has been completed, the oil pump is determined to be in working order, inspect the spark plugs to ensure they have not become fouled by excessive oil. Clean or replace them is necessary.

FUEL & OIL

Your Rotax engine requires high quality fuels and lubricants. While it can run on regular fuel, the engine's life can be extended by using premium grade. Avoid fuels containing alcohol.

The oil should be designed for air cooled engines, such as high quality motorcycle oil. Oils designed for the boating industry can gum up the lower piston rings. Premium oils include Castrol SuperTT and Pennzoil air cooled (not outboard). Avoid synthetic oils unless unit is run very often.

Do not run your engine with a higher concentration of oil by adding extra oil to the gas mixture (except for initial start-up). Such operation will cause oil and residue build up in the muffler, shortening its life, as well as fouling spark plugs.

Once a fuel and oil have been chosen, continue to use them exclusively. Due to the reactions possible due to different fuels and oil additives, the number of different fuels and oils should be kept to a minimum.

MAINTENANCE INSTRUCTIONS

Regular maintenance will extend your pumping unit's life.

Rotax maintenance schedule for aircraft use is included in this manual. By following it, you will maintain the stringent aircraft reliability standards to which this engine was designed.

Following is a list of maintenance points for your pumping unit.

1. Engine maintenance as directed in you engine manual.
2. Fuel and oil lines - visually inspect for cracks or tears.
3. Priming belt - visually inspect for wear or glazing.
4. Throttle cables - inspect for smooth operation. Lubricate inner cable with WD-40 or equivalent if necessary.
5. Rubber carburetor manifold - inspect for tears.
6. Overheat protection system - inspect periodically for proper operation. While unit is pumping, manually ground out temperature switch located on side of heat exchanger. The solenoid valve should open and dump water.
7. Loss of water protection circuit - with unit pumping at an idle and protect circuit on, lift suction hose from water source so as to lose the pump's prime. Unit should shut down. DO NOT PERFORM THIS PROCEDURE ABOVE AN IDLE.

PUMP TORQUE SPECIFICATIONS

Engine repairs should be done by qualified mechanics and in accordance with procedures set by Rotax.

Pump repairs should be done by qualified mechanics, paying attention to the following points.

1. All fasteners on the pump and frame should be installed using Loctite 243 or equivalent.
2. The 1/2" - 20UNF x 4" Lg. Stainless Steel screw which holds down the pump impeller should be installed with Loctite 243 or equivalent and torque to 48 ft. lbs.

PRIMING BELT REPLACEMENT

Two methods exist for replacing the priming belt.

1. Remove 1/2-20UNF impeller screw and washer.
2. Remove (6) metric nuts from studs holding pump to engine.
3. *Using Darley tool X4062 inserted into impeller shaft, release impeller shaft form engine shaft taper, making sure to support pump.
4. *Pull pump and shaft off engine together. Continued pressure on shaft alone after it has released from the engine shaft will unseat stuffing box. After pulling pump away approximately 2", the old belt can be removed and the new one installed.

Alternate instructions for belt replacement without Darley Tool X4062.

3. Supporting pump carefully, pull entire unit off of impeller shaft, which will remain attached to engine shaft taper. This must be done in a straight line motion. As pump will need to travel approximately 6", gauge and cooling lines may require disconnecting.
4. After pump has been pulled away sufficiently to expose impeller shaft (approx. 6"), old belt can be removed and the new one installed.
5. Reassemble pump to engine. If pump has been disassembled from impeller shaft without using tool, extreme care must be used to line up pump shaft and stuffing box. Impeller will require reassembly to impeller shaft, also.
6. Using Loctite 243 or equivalent tighten (6) metric nuts onto studs, securing pump to engine.
7. Using Loctite 243 or equivalent assemble impeller washer and 1/2-20UNF screw to engine. Torque to 48 ft. Lbs.

8. Pull engine over by hand to ensure no parts are rubbing.
9. Replacement of belt without the use of tool X4062 may require extra packing adjustments on the following run.

WARRANTY INFORMATION

Your engine is warranted by Rotax through W.S. Darley & Co., for domestic sales or through your country's authorized dealer, if outside of North America. It extends for 6 months after you receive your unit.

All warranty claims must be reported to W.S. Darley & Co., or your country's authorized dealer (outside of North America). All warranty work must be done by an authorized engine service center.

Your pump is warranted by W.S. Darley & Co., and claims should be directed by them.

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

ROTAX SERVICE INFORMATION
DAILY AND PRE USE CHECK LISTS - MAINTENANCE PLAN
FOR ALL ROTAX UL - engines

	DAILY INSPECTION		PRE USE CHECK LIST
1	Check ignition switched off	*1	Check ignition switched off.
2	Drain water from fuel tank sump and/or water trap (if fitted).	*2	Check Fuel Content
3	Check carburetor rubber socket or flange for cracks and secure attachment.	3	
4	Check carburetor float chamber for water and dirt	4	
5	Check security and condition of intake silencer and air filter	5	
6	Check security of radiator mounting. Check radiators for damage and leaks	*6	Visual Check for coolant leaks.
7	Check coolant overflow bottle level and security of cap.	7	
8	Check coolant hoses for security, leaks and chafing	8	
9	Check engine for coolant leaks (Cylinder head, cylinder base and water pump).	9	
10	Check oil content for rotary valve gear lubrication and security of oil cap.	10	
11	Check oil hoses for security, leaks and chafing,	*11	Check oil tank content (oil injection engines).
	(Rotary valve gear lubrication system and oil injection system.)	*12	Check spark plugs caps for security.
12	Check ignition coils/electronic boxes for secure mounting.	13	
	Check ignition leads and all electrical wiring for secure connections and chafing.	14	
13	Check electric starter for secure mounting, check cover for cracks.	15	
14	Check engine to airframe mounting for security and cracks.	16	
15	Check fuel pump mounting for security. Check all fuel hose	*17	Visual check of engine and gearbox for oil leaks
	connections filters, primer bulbs, and taps for security, leakage, chafing and kinks.	*18	Visual check of engine and gearbox for loose or missing nuts,
16	Check fuel pump impulse hose for secure connections, chafing and kinks.		bolts and screws. Check security of gearbox to engine mounting.
17	Check wire locking of gearbox drain and level plugs.	19	
18	Check rubber coupling for damage and perishing (C type gearbox only).	*20	Check propeller for splits and chips. If any damage, repair and/or re-balance before use.
19	Rotate engine by hand and listen for unusual noises (Double check ignition OFF first).	21	Check security of propeller mounting.
20	Check propeller shaft bearing for play by rocking impeller.	*22	Check throttle, oil injection pump and actuation for free and full movement
21		23	Check cooling fan turns when engine is rotated (air cooled engines).
22	Check throttle choke and oil pump lever cables for damage (end fittings, outer casing, and kinks).	24	Check exhaust for cracks, security of mounting, springs and hooks
23			for breakage and wear, check wire locking of springs.
24		25	Start engine after ensuring area clear of bystanders.
25		26	Single ignition engines - check operation of ignition switch
26			(Flick ignition off and on again at idling).
27		27	Dual ignition engines - check operation of both ignition circuits.
28		28	Check operation of all engine instruments during warm up.
29		29	If possible, visually check engine and exhaust for excessive
30			vibration during warm up (indicates propeller out of balance.
		30	Check engine reaches full power RPM during take off roll.

MAINTENANCE PLAN
ROTAX SERVICE INFORMATION

	checks and work	2h	10h	every 12,5h	25h	50h	75h	100h	125h	150h	175h	200h	225h	250h	275h	300h
1	re-torque cylinder head nuts															
	(only air-cooled engines) 1)	x														
2	re-torque exhaust manifold screws 1)	x														
3	check rewind starter rope			x												
4	check electric starter gear					x		x		x		x		x		
5	inspect spark plugs			x												
6	replace spark plugs				x	x	x	x		x	x	x	x	x	x	
7	check and clean inside spark plug caps			x					x							
8	check ignition timing (only breaker ignition)		x2)				x						x			
9	check contact breaker gap		x2)				x						x			
10	check ignition damping box						x			x			x			
11	replace contact breakers and condenser									x						
12	check V-belt tension		x		x	x	x	x	x	x		x	x	x	x	
13	grease ball joints				x	x	x	x	x	x	x	x	x	x	x	
14	replace exhaust muffler springs						x			x	x		x			
15	oil control cables				x	x	x	x	x	x		x	x	x	x	
16	clean oil and air filter				x	x	x	x	x	x		x	x	x	x	
18	check fuel filter					x	x		x	x	x		x	x	x	
19	replace fuel filter							x			x	x				
20	check carburetor(s) and re-adjust	x			x		x		x							
	(idle speed, cable tension....)										x		x		x	
21	clean carburetor(s) and check for wear					x		x		x		x		x		
22	replace jet needle and needle jet									x						
23	clean and check fuel pump						x			x			x			
24	check gearbox oil level				x	x	x		x	x	x		x	x	x	
25	replace gearbox oil		x					x				x				
26	replace rotary valve lubrication oil							x				x				
27	inspect cylinder head and piston crown 5)					x		x		x		x		x		
28	inspect piston ring groove 6)					x		x		x		x		x		
29	check piston diameter 8)					x7)		x7)		x7)		x7)		x7)		
30	piston ring: check gap 8)					x7)		x7)		x7)		x7)		x7)		
31	piston ring: check axial play (rectang. ring) 8)					x7)		x7)		x7)		x7)		x7)		
32	check cylinder diameter 8)					x7)		x7)		x7)		x7)		x7)		
33	cylinder: check for roundness 8)					x7)		x7)		x7)		x7)		x7)		
34	replace cylinder head, cylinder base, and exhaust gasket 9)					x		x		x		x		x		
35	inspect piston pin and bearing									x						
36	inspect crankshaft and replace outer seals									x						
37	general overhaul of engine 10)															x

1) and after every replacement of gasket(s)
2) and after every replacement of contact breakers
3) also after any damage
4) according to instructions of manufacturer
5) if carbon layer is more and 0.5 mm thick, decarbonize
6) if piston rings stick, clean and replace if necessary
7) if used in very dusty atmosphere
8) wear limit see Service Information 5 UL / 91
9) if cylinders get dismantled
10) contact authorized ROTAX distributors or service centers

ROTAX SERVICE CENTERS

U.S.A.

ALASKA

ARCTIC SPARROW AIRCRAFT ,INC.
c/o Mike Jacober
7231 Rovenna Street
Anchorage, AK 99518
PH: (907) 349-4101
FAX: (907) 563-3971
Mike Jacober, President

CALIFORNIA

CALIFORNIA POWER SYSTEMS, INC.
790 - 139th Avenue, #4
San Leandro, CA 94578

PH: (415) 357-2403
Fax: (415) 357-4429
Mike Stratman, President

COLORADO

LEADING EDGE AIR FOILS, INC.
331 South 14th Street
Colorado Springs, CO 80904

PH: (719) 632-4959
Fax: (719) 632-2815
Order Desk: 1-800-LEAF INC
Bill Raisner, President

FLORIDA

LOCKWOOD AVIATION, INC.

460 South Airport Road
Lake Wales, FL. 33853

PH: (813) 676-0344
Fax: (813) 676-5803
Phillip Lockwood, President

OHIO

GREEN SKY ADVENTURES, INC.
2377 Cream Ridge Road
Orwell, OH 44076

PH: (216) 293-6624
Fax: (216) 293-6321
Gerald Olenik, President

MISSISSIPPI

S. MISSISSIPPI LIGHT AIRCRAFT, INC.
Route 7, Box 337B
Lucedale, MS 39752
PH: (301) 947-4953
Fax: (601) 947-4953
Ronald Smith, President

CANADA

ALBERTA

A.C. ULTRA AVIATION LTD.
Box 541
Smoky Lake, AB
TOA 3C0
PH: (403) 656-4207
Fax: (403) 656-4206
Mark Paskevich, President

B. C.

REG'S AIR-COOLED ENGINES
9708 Princess Drive
Surrey, B.C.
V3V 2T4
PH: (604) 581-7414
Fax: (604) 581-7414
Reg Lumsden

ONTARIO

BUZZMAN MICROLIGHT AVIATION
P.O. Box 310
Holland Landing, ON
L0G 1H0
PH: (416) 836-2800
Fax: (416) 836-2800

Dave Loveman, President

ON PARLE FRANCAIS

QUEBEC

CENTRE d'AVIATION RECREATIF LEGER
C.A.R.L., INC.
1836 Rue Des Erables
St. Lambert de Levis, PQ
G0S 2W0
PH: (418) 889-0423
Fax: (418) 889-8219
John McDonald - English
Daniel Saseville - en Francais
- Treasurer

GLIDERS & SAILPLANES

WASHINGTON

EASTSIDE ULTRALIGHTS, INC.
4700 - 188th ST. N.E.
Arlington, WA 98223

PH: (206) 435-3737
Fax: (206) 435-6179
Jim Scott, President

CALIFORNIA

F. ROBERT MARSHALL
601 Sequoia Street
Brentwood, CA 94513

PH: (415) 422-9596 (days)
Fax: (415) 644-2310 (evenings)
Robert Marshall

TORQUE SPECIFICATIONS FOR HERCULES PUMP
STANDARD ER - E4
WARNING: FAILURE TO FOLLOW SPECIFICATIONS MAY VOID WARRANTY

GENERAL SPECIFICATIONS:

Unless otherwise specified, assemble all fasteners with Loctite 262r equivalent.

SPECIFICATIONS FOR IMPELLER SCREW:

Assemble Impeller and Impeller washer to engine with (1) 1/2 - 20 Stainless Steel Hex Head Cap Screw 4" long using Loctite 243 or equivalent. Torque to 48 ft. Lbs. (6.63 Kg-m).

SPECIFICATIONS FOR ELECTRIC STARTER COMPONENTS:

Assemble the Inner Spacer PA1592 and Harmonic Balancer to the magneto flywheel with (3) M8 Socket Head Cap Screws 25mm long using Loctite 680. Torque to 20 ft. Lbs. (240 in-lb., 2.77 Kg-m).

Assemble the outer spacer PA1589 and Ring Gear PA1590 to the Inner Spacer PA1592 with (4) 1/4-20 Socket Head Cap Screw 7/8" long using Loctite 680. Torque to 100 in.lbs. (1.15 Kg-m).

Assemble starter pulley PA1549 to outer spacer with (3) 5/16 -18 Socket Head Cap Screws 3/8" long using Loctite 680. Torque to 130 in. Lbs. (11.50 Kg-m).

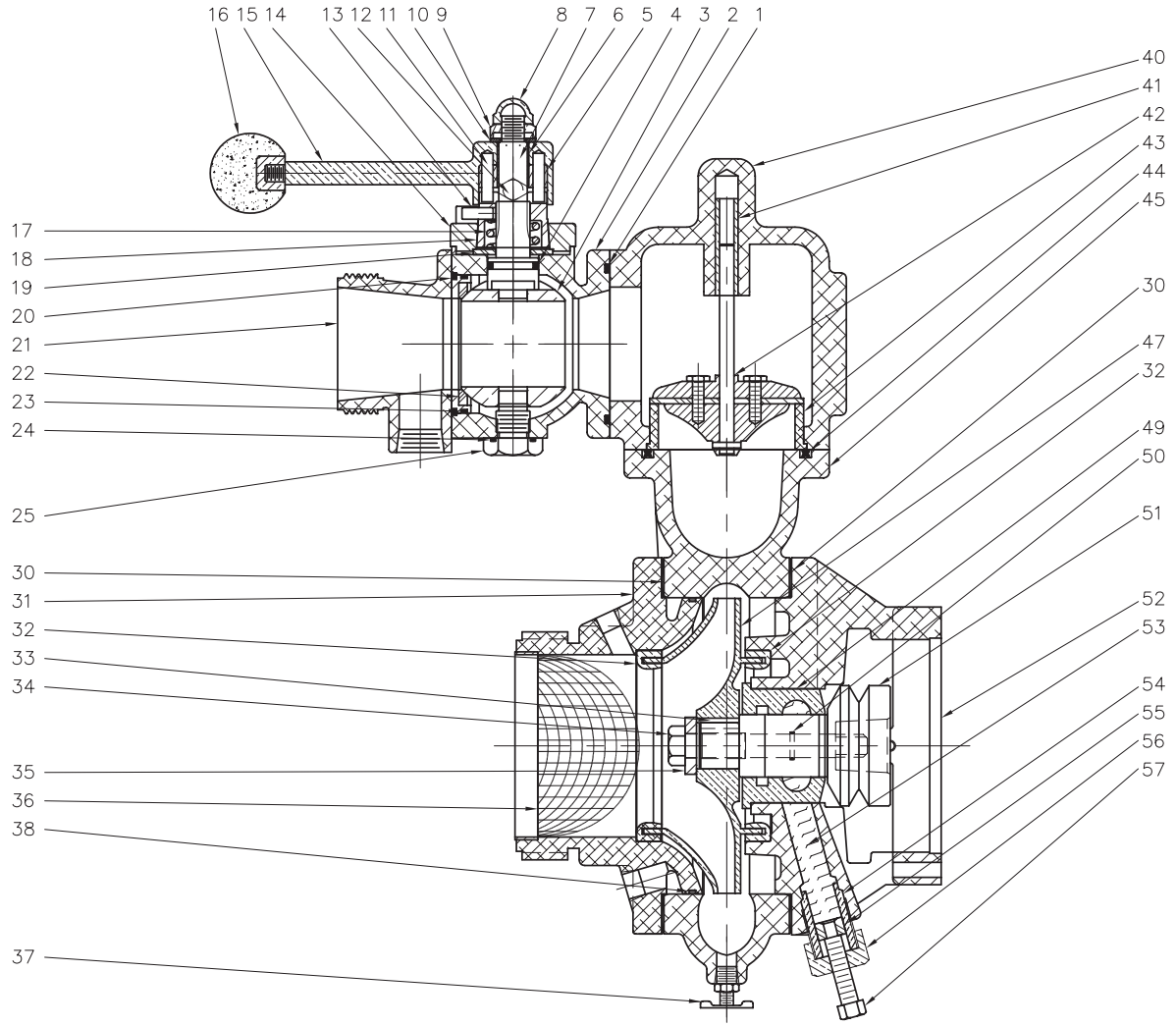
In the case of replacing Bendix Starter Gear on the starter motor, it may be necessary to apply heat to disassemble because Loctite 262 was used at assembly. Re-assemble using Loctite 262. Tighten nut using impact wrench.

It is generally required to apply heat to remove screw attached with Loctite 680 or Loctite 262.

In order to lock engine crankshaft and prevent engine form rotating while screws are torqued, remove the hose which runs from the engine crankcase to the bottom of the fuel pump. This hose barb is located on the upper half of the crankcase between the carburetors and the electric starter on the carburetor side of the engine. Place the rod form the engine took kit or a 1/4" drill rod 6 inches long into the hose barb and rotate the engine by hand until the rod locks and the crankshaft in place.

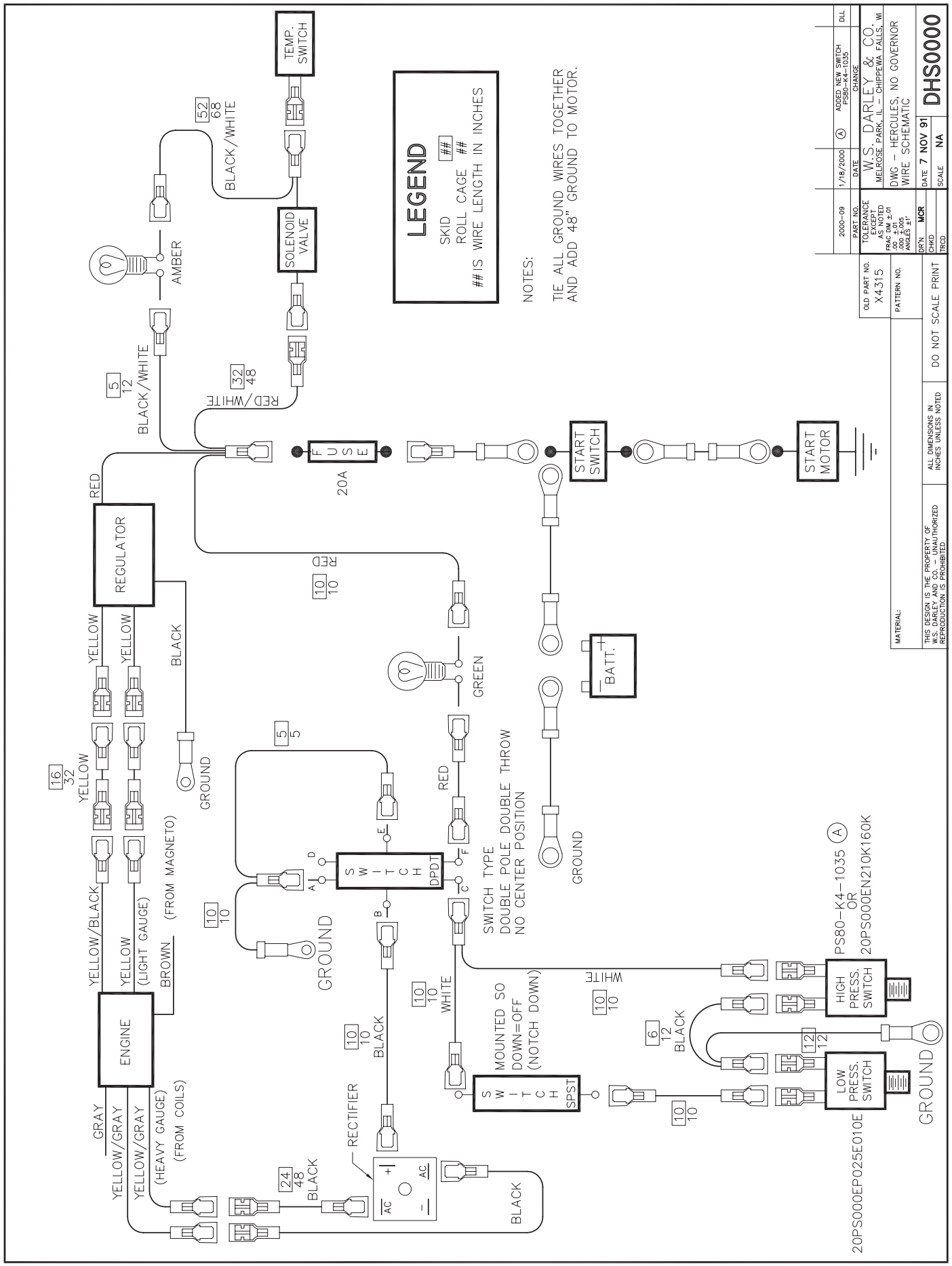
When torquing is completed, remove rod and replace hose on to hose barb.

REP #	NAME OF PART	QTY
1	O–RING – VALVE FLANGE	2
2	VALVE BODY	2
3	VALVE BALL	2
4	O–RING – VALVE STEM	2
5	LEVER CAM	2
6	SLEEVE	2
7	VALVE STEM	2
8	CAP NUT	2
9	ADJUSTING NUT	2
10	WASHER	2
11	LEVER PIN	4
12	CAM BALL	4
13	STOP PIN	2
14	CLUTCH RING	2
15	LEVER	2
16	LEVER BALL	2
17	SPRING	2
18	CLUTCH SLEEVE	2
19	WASHER – VALVE STEM	2
20	QUAD RING – VALVE NIPPLE	2
21	VALVE NIPPLE	2
22	VALVE SEAT	2
23	O–RING – VALVE SEAT	2
24	O–RING – GUIDE SCREW	2
25	GUIDE SCREW	2
30	GASKET – PUMP BODY	2
31	HEAD – OUTBOARD	1
32	SEAL RING	2
33	KEY – IMPELLER	1
34	SCREW – IMPELLER	1
35	WASHER – IMPELLER	1
36	HYDRANT STRAINER	1
37	DRAINCOCK	2
38	O–RING	1
40	DISCHARGE HEAD	1
41	BUSHING – CHECK VALVE	1
42	CHECK VALVE ASS'Y	1
43	SEAT – CHECK VALVE	1
44	QUAD RING – DISCHARGE	1
45	PUMP CASING	1
47	IMPELLER	1
49	STUFFING BOX	1
50	O–RING – IMPELLER SHAFT	1
51	IMPELLER SHAFT	1
52	INBOARD HEAD	1
53	PACKING	
54	PACKING PLUNGER GUIDE	1
55	PACKING PLUNGER	1
56	PACKING PLUNGER CAP	1
57	PACKING PLUNGER STUD	1



INCH [MILLIMETER] THIRD ANGLE PROJECTION

MATERIAL DESCRIPTION: –	MATERIAL NO. –	OLD PART NO. H387 / PATTERN NO. –	TOLERANCE EXCEPT AS NOTED .00 ±.03 .000 ±.010 ANGLES ±1°	W.S. DARLEY & Co. MELROSE PARK, IL – CHIPPEWA FALLS, WI
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. – UNAUTHORIZED REPRODUCTION IS PROHIBITED	ALL DIMENSIONS IN INCHES UNLESS NOTED	DO NOT SCALE PRINT	DR'N MCR / CHKD / TRCD	DWG – HERCULES PORTABLE PUMP CROSS SECTION
			DATE FEB20,92 / SCALE 1/2	DHC0200


LEGEND
SKID
ROLL CAGE ##
##IS WIRE LENGTH IN INCHES
NOTES:
TIE ALL GROUND WIRES TOGETHER AND ADD 48" GROUND TO MOTOR.
TEMP. SWITCH
SOLENOID VALVE
AMBER
BLACK/WHITE
RED/WHITE
REGULATOR
ENGINE
RECTIFIER
FUSE 20A
START SWITCH
START MOTOR
BATT.
GROUND
SWITCH DPDT
SWITCH SPST
SWITCH TYPE DOUBLE POLE DOUBLE THROW NO CENTER POSITION
MOUNTED SO DOWN=OFF (NOTCH DOWN)
HIGH PRESS. SWITCH
LOW PRESS. SWITCH
PS80-K4-1035 (A) OR 20PS000EN210K160K
20PS000EP025E010E
RED
YELLOW
YELLOW/BLACK
YELLOW (LIGHT GAUGE)
BROWN (FROM MAGNETO)
GRAY
YELLOW/GRAY
YELLOW/GRAY (HEAVY GAUGE) (FROM COILS)
BLACK
GREEN
WHITE
BLACK
OLD PART NO. X4315
PATTERN NO.
MATERIAL:
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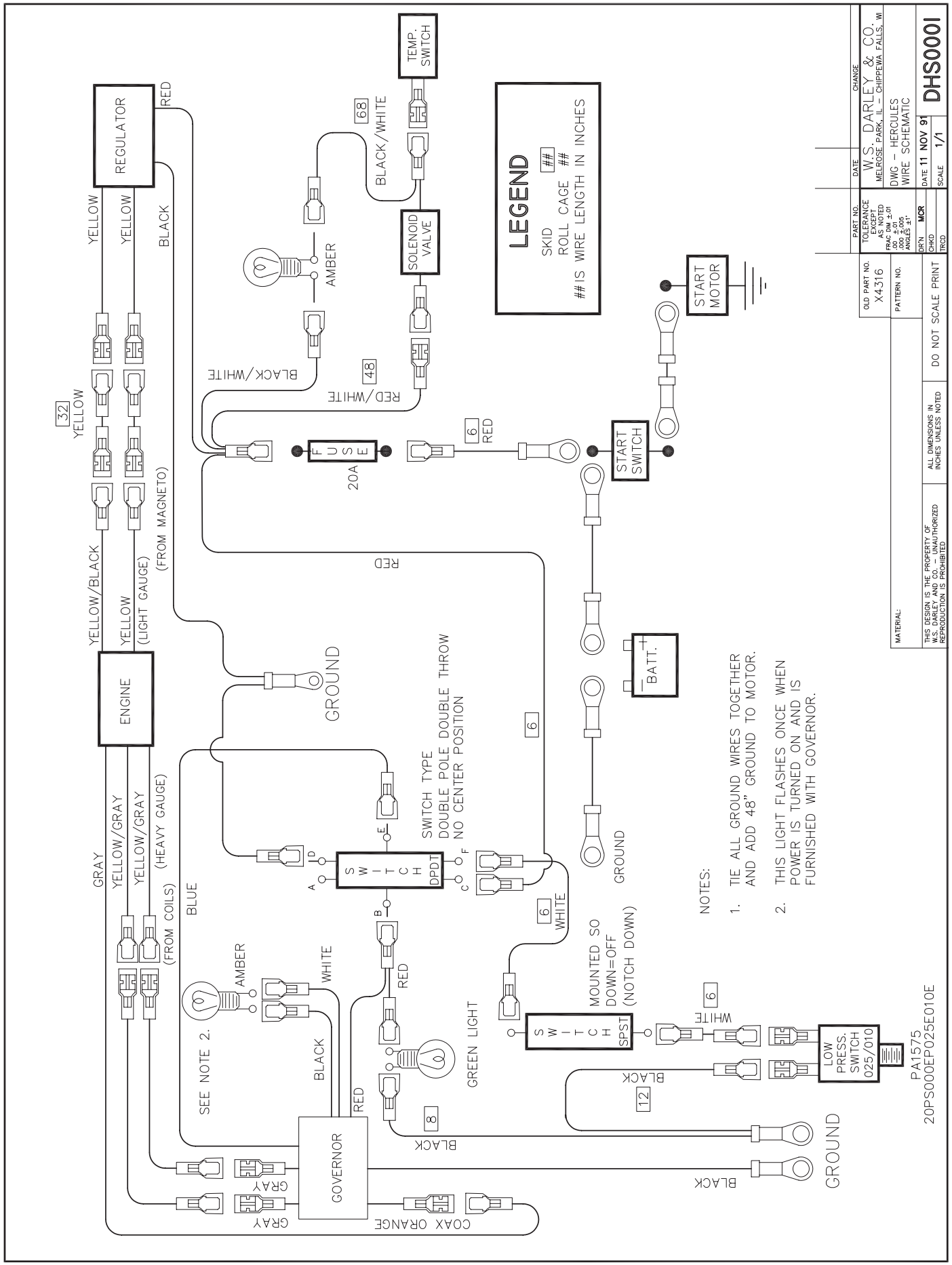
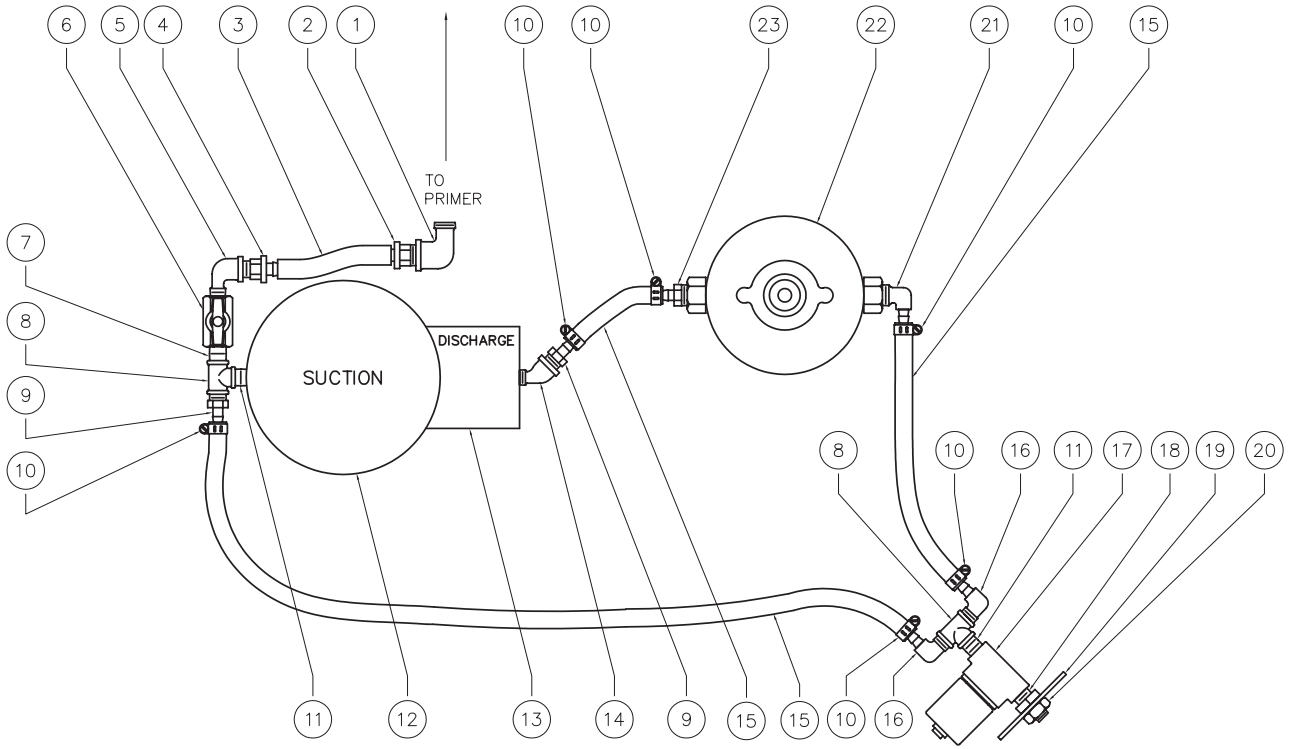
2000-09 PART NO.
1/18/2000 DATE
(A) ADDED NEW SWITCH PS80-K4-1035 CHANGE
DLL
TOLERANCE EXCEPT AS NOTED FRAC DIM ±.01 .00 ±.01 .0000 ±.0005 ANGLES ±1°
W.S. DARLEY & CO. MELROSE PARK, IL – CHIPPEWA FALLS, WI
DWG – HERCULES, NO GOVERNOR WIRE SCHEMATIC
DRN MCR
CHKD
TRCD
DATE 7 NOV 91
SCALE NA
DHS0000


LEGEND
SKID
ROLL CAGE
##IS WIRE LENGTH IN INCHES
REGULATOR
ENGINE
GOVERNOR
TEMP. SWITCH
SOLENOID VALVE
START MOTOR
START SWITCH
FUSE 20A
BATT.
SWITCH DPDT
SWITCH SPST
LOW PRESS. SWITCH 025/010
AMBER
GREEN LIGHT
GROUND
SWITCH TYPE
DOUBLE POLE DOUBLE THROW
NO CENTER POSITION
MOUNTED SO DOWN=OFF (NOTCH DOWN)
SEE NOTE 2.
(FROM COILS)
(HEAVY GAUGE)
(LIGHT GAUGE)
(FROM MAGNETO)
YELLOW
YELLOW/BLACK
YELLOW/GRAY
GRAY
BLUE
BLACK
RED
WHITE
BLACK/WHITE
RED/WHITE
COAX ORANGE
NOTES:
1. TIE ALL GROUND WIRES TOGETHER AND ADD 48" GROUND TO MOTOR.
2. THIS LIGHT FLASHES ONCE WHEN POWER IS TURNED ON AND IS FURNISHED WITH GOVERNOR.
PA1575
20PS000EP025E010E
W.S. DARLEY & CO.
MELROSE PARK, IL – CHIPPEWA FALLS, WI
DWG – HERCULES
WIRE SCHEMATIC
DHS0001
DATE 11 NOV 91
SCALE 1/1
DR'N MCR
CHK'D
TRC'D
PART NO.
CHANGE
DATE
TOLERANCE EXCEPT AS NOTED
FRAC DIM ±.01
.00 ±.01
.000 ±.005
ANGLES ±1°
OLD PART NO. X4316
PATTERN NO.
MATERIAL:
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. – UNAUTHORIZED REPRODUCTION IS PROHIBITED
ALL DIMENSIONS IN INCHES UNLESS NOTED
DO NOT SCALE PRINT

Prepared By: EAP
Revised By: EAP
Approved By: TED

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D



PARTS LIST		
REP. NO.	DESCRIPTION	QTY.
1	ELBOW – STREET 90° 3/8 NPT	1
2	CONN – PUSHLOK 3/8 H.B. X 3/8 NPT	1
3	HOSE – VACUUM 12"	1
4	CONN – PUSHLOK 3/8 H.B. X 1/4 NPT	1
5	ELBOW – STREET 90° 1/4 IP	1
6	VALVE – ON/OFF	1
7	NIPPLE – CLOSE 1/4 NPT	1
8	TEE – 1/4 NPT	2
9	FITTING – 5/16 H.BARB X 1/4 NPT	2
10	CLAMP – HOSE – 5/8 OD	6
11	NIPPLE – CLOSE 1/4 NPT BRASS	2
12	SUCTION	1
13	DISCHARGE	1
14	ELBOW – STREET 45° 1/4 NPT BRASS	1
15	HOSE – 5/16 ID X 5 FT LONG	1
16	ELBOW – 5/16 H.BARB X 1/4 NPT BRASS	2
17	SOLENOID VALVE – SKINNER	1
18	FITTING–MTG–1/4 NPT X 5/8 UNF BR HEX	1
19	BRACKET – VALVE MTG ALUM	1
20	JAM NUT – 5/8 UNF	1
21	ELBOW – 5/16 H.BARB X 3/8 NPT BRASS	1
22	HEAT EXCHANGER	1
23	FITTING – 5/16 H.BARB X 3/8 NPT BRASS	1

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

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

DWG – HERCULES
PLUMBING SCHEMATIC

DR'N DLW
CHKD
TRCD

DATE JAN19,98

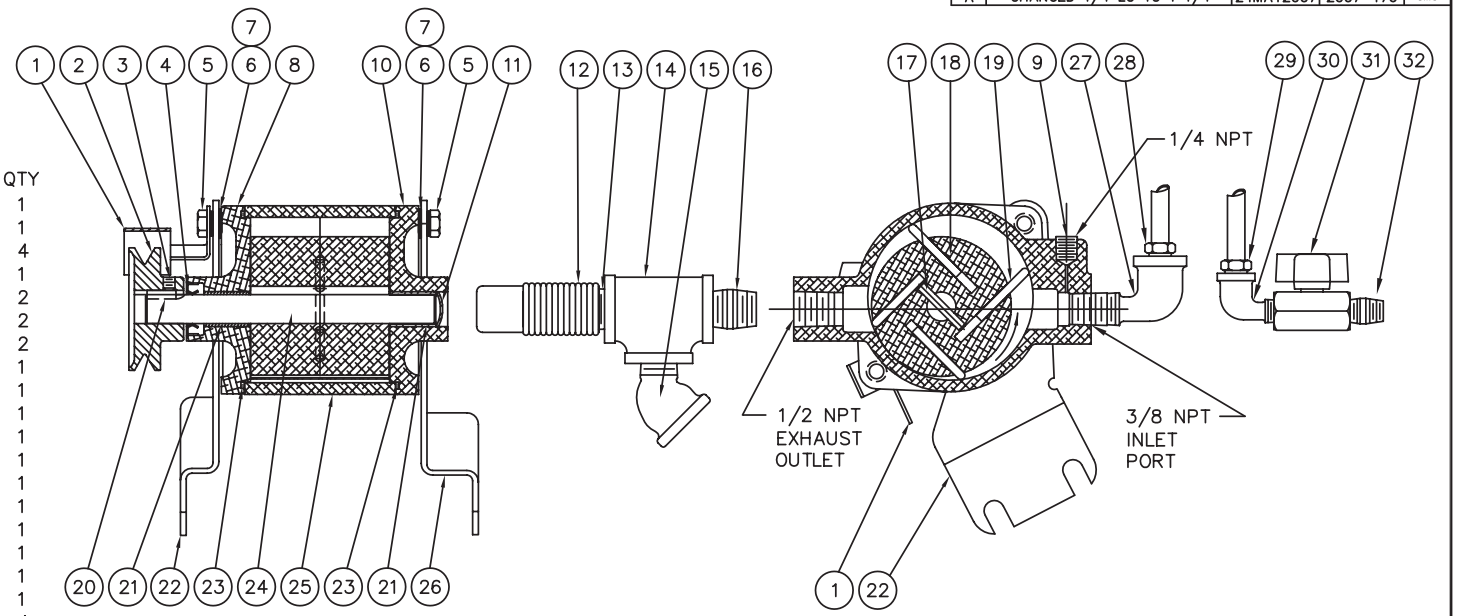
SCALE 1/4

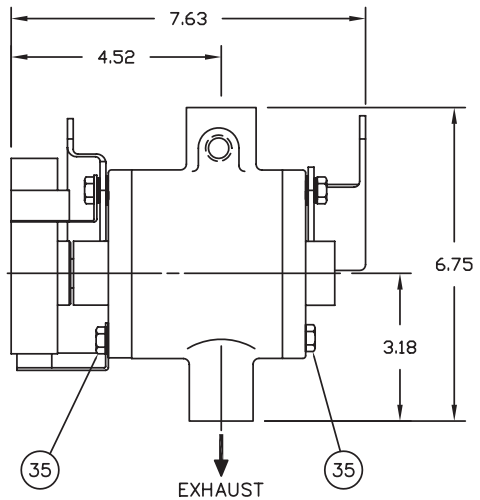
DHS0002

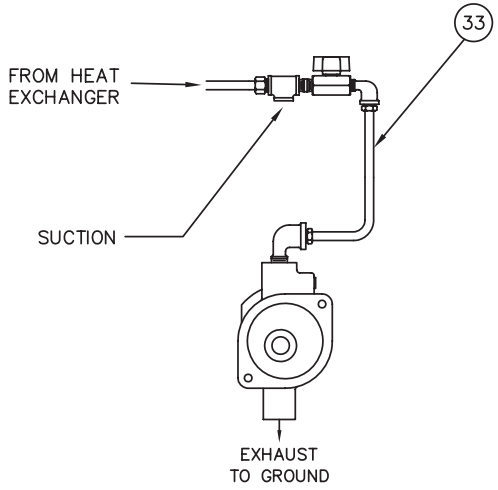
Rev. 7
Date: 01/31/06
Rev Date: 08/01/07
1200554.doc

REVISIONS				
LTR	DESCRIPTION	DATE	CHG NO.	APPR'D
A	CHANGED 1/4 LG TO 1 1/4	24MAY2007	2007–176	SMS

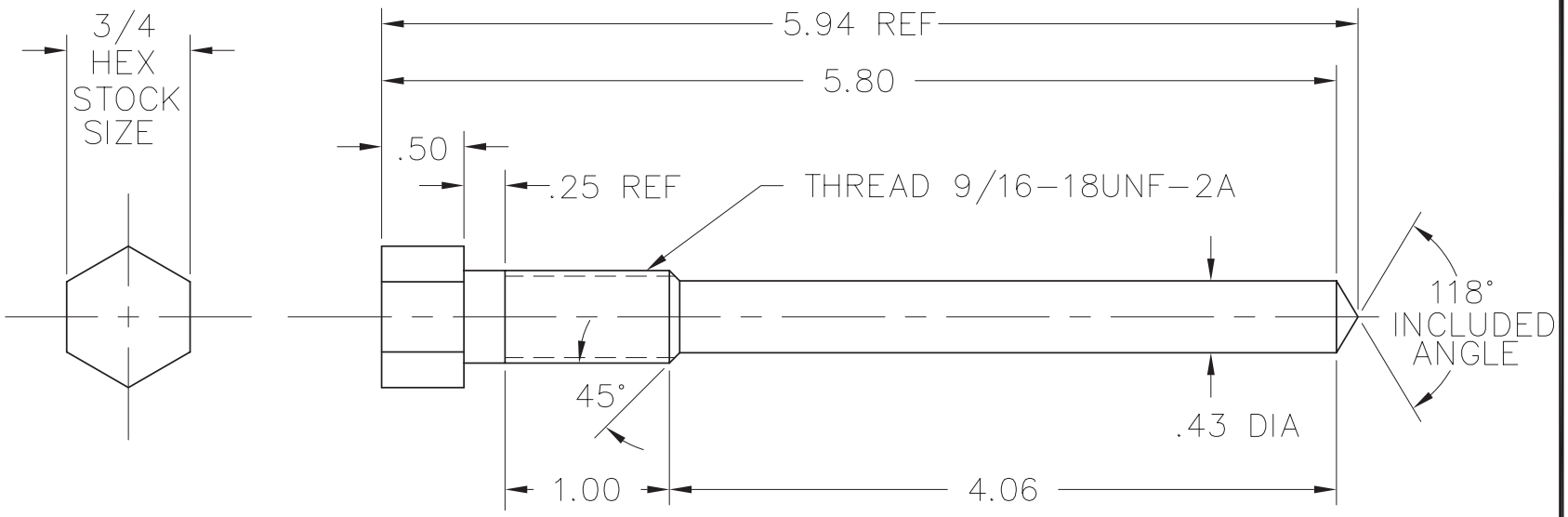
REP NO.	DESCRIPTION	QTY
1	GUARD BELT	1
2	SHEAVE	1
3	SCREW – 1/4NC X 3/8 LG	4
4	OIL SEAL	1
5	HHCS – 5/16NC X 1 1/4 LG Ⓐ	2
6	BEARING – NYLINER	2
7	PIVOT BUSHING	2
8	COVER	1
9	PIPE PLUG – .025 SOC HEAD	1
10	COVER	1
11	FREEZE PLUG – 3/4 DIA.	1
12	HANDLE COVER	1
13	HANDLE – PRIMER	1
14	TEE – 1/2 NPT	1
15	ELBOW – STREET 45°, 1/2 NPT	1
16	NIPPLE – CLOSE, 1/2 I.P.	1
17	DRIV–LOK PIN	1
18	ROTOR ASSY – FOUR VANE	1
19	VANES – ROTOR, LAM. PLASTIC	4
20	KEY – ROTOR SHAFT	1
21	BUSHING – OILITE	2
22	PIVOT BRACKET, INBOARD	1
23	O–RING	2
24	ROTOR SHAFT	1
25	CYLINDER	1
26	PIVOT BRACKET, OUTBOARD	1
27	ELBOW – STREET 90°, 3/8 NPT	1
28	CONN. – 3/8 H.B. X 3/8 NPT	1
29	CONN. – 3/8 H.B. X 1/4 NPT	1
30	ELBOW – STREET 90°, 1/4 I.P.	1
31	VALVE – ON/OFF	1
32	NIPPLE – CLOSE, 1/4 NPT	1
33	HOSE – VACUUM, 12"	1
35	HHCS – 5/16NC X 1 LG	2







MATERIAL:	MATERIAL NO. –	OLD PART NO.	PART NO.	DATE	CHANGE
		PATTERN NO.	TOLERANCE EXCEPT AS NOTED FRAC DIM ±.01 .00 ±.01 .000 ±.005 ANGLES ±1°	W.S. DARLEY & CO. MELROSE PARK, IL – CHIPPEWA FALLS, WI	
THIS DESIGN IS THE PROPERTY OF W.S. DARLEY AND CO. – UNAUTHORIZED REPRODUCTION IS PROHIBITED	ALL DIMENSIONS IN INCHES UNLESS NOTED	DO NOT SCALE PRINT	DR'N CKE CHKD SJL TRCD	BELT–DRIVEN PRIMER, 4 VANE FLUIDLESS, CROSS SECTION	
			DATE 01JUL,05 SCALE 1/2	DVC0202	



THREAD DATA:
9/16-18UNF-2A
MAJOR DIA: .5611/.5524
PITCH DIA: .5250/.5205
MINOR DIA: .4950 MAX (REF)

NOTE:
1) UNLESS INDICATED OTHERWISE, FINISH ALL OVER $\sqrt{}^{125}$.

PART NO.	DATE	CHANGE

PRICE SAME AS G1593

OLD PART NO. X4062

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

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

MATERIAL: LLYH75 – 0.75 HEX LEDLOY x 6.06 LG.

MATERIAL NO. 1101513

PATTERN NO.

TOOL – IMPELLER REMOVAL
–

DR'N MCR
CHKD
TRCD

DATE 5-22-90

SCALE 1/1

4406600

ALL DIMENSIONS IN INCHES UNLESS NOTED

DO NOT SCALE PRINT

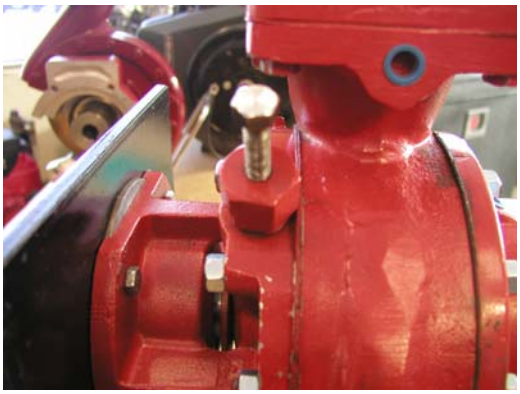
W. S. DARLEY & CO.

DARLEY INJECTION TYPE STUFFING BOX ADJUSTMENT

Prop 65 Warning: This product contains lead, a chemical known to the State of California to cause cancer, birth defects, and other reproductive harm. Wash hands after handling.

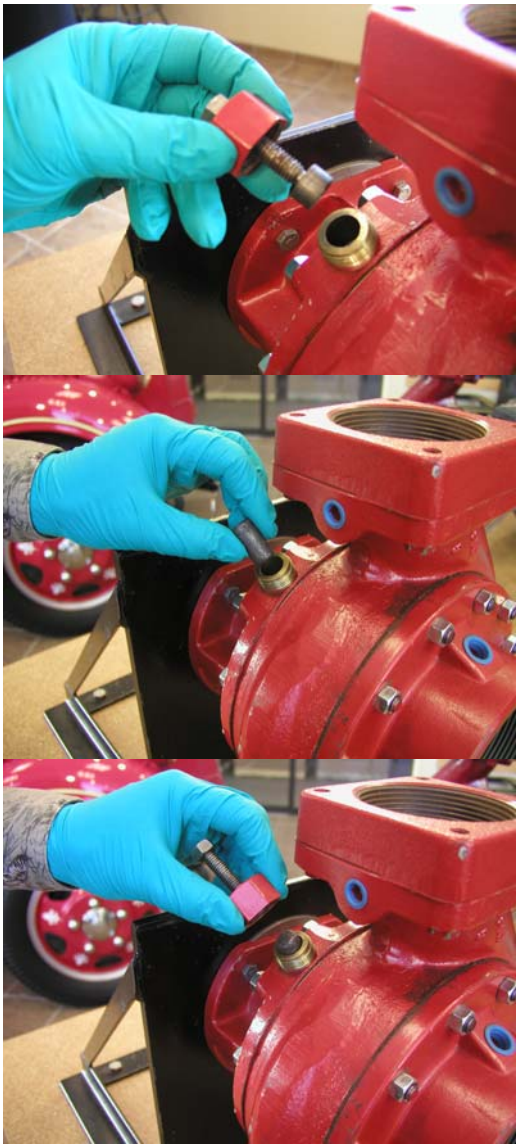
Attention: Prop 65 Warning does not apply to white packing, which does not contain lead.

Caution: Do not attempt to use anything but Darley injection packing. Using the wrong packing material in your pump may cause catastrophic failure of the pump shaft sealing components.



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

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



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

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

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

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

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

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

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

DEFINITIONS

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

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

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

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

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

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

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

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

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

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

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

BRAKE HORSEPOWER -- Actual power as delivered by a motor or engine to a driven machine.

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

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

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

OPERATING CHARACTERISTICS OF PUMPS

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

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

A centrifugal pump is an extremely simple mechanism mechanically, but rather complex hydraulically; in that many factors enter into the design of the impeller and water ways which will affect the pump's efficiency.

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

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

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

CONVERSION FACTORS

One pound per square inch	=	2.31 feet of water
	=	2.04 inches of mercury
	=	27.7 inches of water
One foot of water	=	0.43 pounds per square inch
One inch of mercury	=	1.13 feet of water
	=	0.49 pounds per square inch
One cubic foot of water	=	62.4 pounds
	=	7.5 gallons
One gallon of water	=	231 cubic inches
	=	0.13 cubic feet
	=	8.34 pounds
	=	3.8 liters
One Imperial Gallon	=	1.2 U.S. gallons
Atmospheric Pressure (Sea Level)	=	14.8 pounds per square inch
	=	29.9 inches of mercury
	=	34 feet of water

TABLE NO. 2
DISCHARGE FROM SMOOTH BORE NOZZLE
Pressures measured by Pitot gage.

Nozzle Pressure PSI	1/4	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	2	2 1/4	2 1/2
	GALLONS PER MINUTE DELIVERED															
5	4	9	16	26	37	50	66	84	103	125	149	175	203	266	337	415
6	4	10	18	28	41	55	72	92	113	137	163	192	223	292	369	455
7	4	11	19	30	44	59	78	99	122	148	176	207	241	315	399	491
8	5	11	21	32	47	64	84	106	131	158	188	222	257	336	427	525
9	5	12	22	34	50	67	89	112	139	168	200	235	273	357	452	557
10	6	13	23	36	53	71	93	118	146	177	211	248	288	376	477	587
12	6	15	25	40	58	78	102	130	160	194	231	271	315	412	522	643
14	7	15	27	43	63	84	110	140	173	210	249	293	340	445	564	695
16	7	16	29	46	67	90	118	150	185	224	267	313	364	475	603	743
18	7	17	31	49	71	95	125	159	196	237	283	332	386	504	640	788
20	8	18	33	51	75	101	132	167	206	250	298	350	407	532	674	830
22	8	19	34	54	79	105	139	175	216	263	313	367	427	557	707	871
24	8	20	36	56	82	110	145	183	226	275	327	384	446	582	739	909
26	9	21	37	59	85	115	151	191	235	286	340	400	464	606	769	947
28	9	21	39	61	89	119	157	198	244	297	353	415	481	629	799	982
30	10	22	40	63	92	123	162	205	253	307	365	429	498	651	826	1017
32	10	23	41	65	95	127	167	212	261	317	377	443	514	673	854	1050
34	11	23	43	67	98	131	172	218	269	327	389	457	530	693	880	1082
36	11	24	44	69	100	135	177	224	277	336	400	470	546	713	905	1114
38	11	25	45	71	103	138	182	231	285	345	411	483	561	733	930	1144
40	11	26	46	73	106	142	187	237	292	354	422	496	575	752	954	1174
42	11	26	47	74	109	146	192	243	299	363	432	508	589	770	978	1203
44	12	27	49	76	111	149	196	248	306	372	442	520	603	788	1000	1231
46	12	28	50	78	114	152	200	254	313	380	452	531	617	806	1021	1259
48	12	28	51	80	116	156	205	259	320	388	462	543	630	824	1043	1286
50	13	29	52	81	118	159	209	265	326	396	472	554	643	841	1065	1313
52	13	29	53	83	121	162	213	270	333	404	481	565	656	857	1087	1339
54	13	30	54	84	123	165	217	275	339	412	490	576	668	873	1108	1364
56	13	30	56	86	125	168	221	280	345	419	499	586	680	889	1129	1389
58	13	31	56	87	128	171	225	285	351	426	508	596	692	905	1149	1414
60	14	31	57	89	130	174	229	290	357	434	517	607	704	920	1168	1437
62	14	32	58	90	132	177	233	295	363	441	525	617	716	936	1187	1462
64	14	32	59	92	134	180	237	299	369	448	533	627	727	951	1206	1485
66	14	33	60	93	136	182	240	304	375	455	542	636	738	965	1224	1508
68	14	33	60	95	138	185	244	308	381	462	550	646	750	980	1242	1531
70	15	34	61	96	140	188	247	313	386	469	558	655	761	994	1260	1553
72	15	34	62	97	142	191	251	318	391	475	566	665	771	1008	1278	1575
74	15	35	63	99	144	193	254	322	397	482	574	674	782	1023	1296	1597
76	15	35	64	100	146	196	258	326	402	488	582	683	792	1036	1313	1618
78	15	36	65	101	148	198	261	330	407	494	589	692	803	1050	1330	1639

TABLE NO. 2
DISCHARGE FROM SMOOTH BORE NOZZLE
Pressures measured by Pitot gage.

Nozzle Pressure PSI	1/4	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	2	2 1/4	2 1/2
	GALLONS PER MINUTE DELIVERED															
80	16	36	66	103	150	201	264	335	413	500	596	700	813	1063	1347	1660
82	16	37	66	104	152	204	268	339	418	507	604	709	823	1076	1364	1681
84	16	37	67	105	154	206	271	343	423	513	611	718	833	1089	1380	1701
86	16	37	68	107	155	208	274	347	428	519	618	726	843	1102	1396	1721
88	16	38	69	108	157	211	277	351	433	525	626	735	853	1115	1412	1741
90	17	39	70	109	159	213	280	355	438	531	633	743	862	1128	1429	1761
92	17	39	70	110	161	215	283	359	443	537	640	751	872	1140	1445	1780
94	17	39	71	111	162	218	286	363	447	543	647	759	881	1152	1460	1800
96	17	40	72	113	164	220	289	367	452	549	654	767	890	1164	1476	1819
98	17	40	73	114	166	223	292	370	456	554	660	775	900	1176	1491	1838
100	18	41	73	115	168	225	295	374	461	560	667	783	909	1189	1506	1856
105	18	42	75	118	172	230	303	383	473	574	683	803	932	1218	1542	1902
110	19	43	77	121	176	236	310	392	484	588	699	822	954	1247	1579	1947
115	19	43	79	123	180	241	317	401	495	600	715	840	975	1275	1615	1991
120	19	44	80	126	183	246	324	410	505	613	730	858	996	1303	1649	2033
125	20	45	82	129	187	251	331	418	516	626	745	876	1016	1329	1683	2075
130	20	46	84	131	191	256	337	427	526	638	760	893	1036	1356	1717	2116
135	21	47	85	134	195	262	343	435	536	650	775	910	1056	1382	1750	2157
140	21	48	87	136	198	266	350	443	546	662	789	927	1076	1407	1780	2196
145	21	49	88	139	202	271	356	450	556	674	803	944	1095	1432	1812	2235
150	22	50	90	141	205	275	362	458	565	686	817	960	1114	1456	1843	2273

TABLE NO. 3
Approximate Discharge Flow From Different Nozzles
At the end of Fifty Feet of Average, 2 1/2"
Rubber Lined Fire Hose, for Various
Pump Pressures with Discharge
Valve Wide Open

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

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

TABLE NO. 4

Pump or Hydrant Pressure required to give Effective Nozzle Pressure through various Lengths of Rubber Lined Hose.

Size of Hose		1	1 1/2			2		2 1/2					3	
Size of Nozzle		1/4	3/8	1/2	5/8	5/8	3/4	3/4	7/8	1	1 1/4	1 1/2	1 1/4	1 1/2
Nozzle Press PSI	Length of Hose Feet	PUMP OR HYDRANT PRESSURE - PSI												
40	100	45	43	48	60	42	50	44	46	51	64	88	51	62
	200	49	46	56	79	43	60	47	52	60	86	130	59	78
	400	58	51	73	118	46	79	53	62	79	129	212	75	110
	600	67	57	89	158	50	99	59	74	97	172		92	143
	800	76	62	106	196	53	119	65	85	116	215		108	176
	1000	85	68	122	235	56	138	72	96	134	258		124	208
	1500	108	72	142		64	187	87	118	181			165	
	2000	130	96	204		72	226	103	151	227			205	
60	100	67	64	72	89	63	73	65	69	75	95	132	76	92
	200	74	68	84	117	65	86	70	78	89	126	196	88	115
	400	87	76	107	173	69	112	79	94	116	188		111	161
	600	101	85	131	231	74	138	88	111	143	250		135	208
	800	114	93	153		79	164	98	127	170			158	
	1000	127	101	178		83	190	107	143	197			182	
	1500	161	122	237		95	155	130	184	264				
	2000	195	142			106		153	225					
80	100	88	85	96	117	83	99	87	92	99	126	175	101	103
	200	97	91	112	154	86	117	93	103	115	167		116	154
	400	115	102	143	228	92	154	105	125	148	249		147	
	600	132	112	174		98	191	117	147	181			178	
	800	150	123	206		104	228	129	167	214			209	
	1000	167	134	238		110		141	191	247				
	1500	211	161			125		171	245					
	2000	254	188			140		201						
100	100	111	107	120	146	104	123	108	115	125	157		126	152
	200	122	113	139	192	108	145	116	128	150	209		146	190
	400	143	127	177	284	115	190	130	154	200			184	
	600	165	140	217		123	235	145	180	250			223	
	800	186	154	256		131		159	206					
	1000	208	167			138		174	232					
	1500	262	200			157		211						
	2000		234			175		253						

TABLE NO. 5
REACH OF FIRE STREAMS

Size of Nozzle	1/4"	3/8"	1/2"	5/8"	3/4"	7/8"	1"	1-1/4"	1-1/2"
NOZZLE PRESSURE	**EFFECTIVE VERTICAL REACH - Feet**								
40	30	35	40	50	59	62	64	65	69
60	35	40	45	60	74	77	79	84	87
80	38	42	48	65	81	85	89	94	96
100	40	44	50	68	84	89	94	100	102
NOZZLE PRESSURE	**MAXIMUM VERTICAL REACH - Feet**								
40	60	65	70	75	78	79	80	80	80
60	70	75	85	95	105	106	108	110	110
80	78	83	95	105	117	125	132	140	140
100	80	88	100	110	122	135	145	155	155
NOZZLE PRESSURE	**EFFECTIVE HORIZONTAL REACH - Feet**								
40	20	25	30	40	44	50	55	62	66
60	25	32	37	50	54	61	67	75	80
80	28	35	40	57	62	70	76	84	88
100	30	37	42	60	66	76	84	93	95
NOZZLE PRESSURE	**MAXIMUM HORIZONTAL REACH - Feet**								
40	65	80	90	100	108	120	125	138	140
60	80	95	95	120	127	142	156	176	183
80	90	105	105	135	143	160	175	201	210
100	95	110	110	140	153	180	205	215	223

TABLE NO. 6
Friction Loss in Fire Hose
Loss in PSI per 100 Feet of Hose

SIZE HOSE	LINEN HOSE			BEST RUBER LINED HOSE							
G.P.M.	1 1/2	2	2 1/2	3/4	1	1 1/2	2	2 1/2	3	3 1/2	(2)-2 1/2
10	1.0			13.5	3.5	0.5	.1				
15	2.2			29.0	7.2	1.0	0.3				
20	3.6			50.0	12.3	1.7	0.4				
25	5.5			75.0	18.5	2.6	0.6				
30	8.0	1.9		105.0	26.0	3.6	0.9				
40	13.0	3.2		180.0	44.0	6.1	1.5				
50	20.0	4.9	1.6		67.0	9.3	2.3				
60	28.0	7.0	2.2		96.0	13.5	3.3				
70	37.0	9.0	3.1		131.0	17.0	4..3				
80	47.0	11.5	3.8		171.0	23.0	5.6				
90	59.0	14.5	5.0		217.0	29.0	7.0				
100	72.0	17.5	5.9		268.0	33.0	8.4				
120		25.0	8.3		386.0	47.0	11.7				
140		34.0	11.0			62.0	16.0	5.2	2.0	0.9	1.4
160		43.0	14.0			78.0	20.0	6.6	2.6	1.2	1.9
180		53.0	17.7			97.0	25.0	8.3	3.2	1.5	2.3
200		63.0	21.5			121.0	30.6	10.1	3.9	1.8	2.8
220						146.0		12.0	4.6	2.1	3.3
240						173.0		14.1	5.4	2.5	3.9
260						204.0		16.4	6.3	2.9	4.5
280						237.0		18.7	7.2	3.3	5.2
300						272.0		21.2	8.2	3.7	5.9
320								23.8	9.3	4.2	6.6
340								26.9	10.5	4.7	7.4
360								30.0	11.5	5.2	8.3
380								33.0	12.8	5.8	9.2
400								36.2	14.1	6.3	10.1
425								40.8	15..7	7.0	11.3
450								45.2	17.5	7.9	12.5
475								50.0	19.3	8.7	13.8
500								55.0	21.2	9.5	15.2
525									23.2	10.5	16.6
550									25.2	11.4	18.1
575									27.5	12.4	19.6
600									29.9	13.4	21.2
650									34.5	15.5	24.8
700									39.5	17.7	28.3
750									45.0	20.1	32.2
800									50.5	22.7	36.2
850									56.5	25.4	40.7
900									63.0	28.2	45.2
1000									76.5	34.3	55.0

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

TABLE NO. 7
Friction Loss in 15-year-old Steel Pipe
Loss in PSI per 100 Feet of Pipe

PIPE SIZE / G.P.M.	1/8	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6	8
1	52.0	12.0	2.8	0.9										
2		45.0	10.0	3.2	4.0									
5			55.0	18.0	4.5	1.4	0.4							
10				64.0	16.0	5.0	1.3	0.6						
15				135.0	34.0	11.0	2.7	1.3	0.5					
20					59.0	18.0	4.7	2.2	0.8					
25					89.0	27.0	7.1	3.4	1.2					
30					125.0	39.0	10.0	4.7	1.7	0.6				
35						51.0	13.0	6.3	2.2	0.7				
40						66.0	17.0	8.0	2.9	0.9				
45						82.0	21.0	10.0	3.6	1.2				
50						99.0	26.0	12.0	4.3	1.4	0.6			
60						140.0	38.0	17.0	6.1	2.0	0.8			
70							49.0	23.0	8.0	2.7	1.1			
80							63.0	29.0	10.0	3.4	1.5			
90							78.0	36.0	13.0	4.3	1.8			
100							96.0	44.0	15.0	5.1	2.2	0.5		
125							144.0	66.0	24.0	7.8	3.3	0.8		
150								93.0	33.0	11.0	4.6	1.1		
175								125.0	44.0	15.0	6.1	1.5		
200									56.0	19.0	7.8	1.9		
250									84.0	28.0	12.0	2.9		
300									114.0	40.0	16.0	4.0	0.6	
350										53.0	22.0	5.4	0.8	
400										68.0	28.0	6.9	1.0	
450										84.0	35.0	8.6	1.2	
500										102.0	42.0	10.0	1.4	0.4
600											60.0	15.0	2.1	0.6
800												25.0	3.5	1
1000												37.0	5.2	1.3
1500													11.0	2.7
2000													19.0	4.7
2500													29.0	7.1
3000														10

TABLE NO. 8
Resistance of Fittings
Equivalent Lengths of Straight Pipe - Feet

PIPE SIZE	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	5	6	8
Gate Valve	0.4	0.6	0.8	1.1	1.4	1.8	2.2	2.8	4.1	5.3	6.7	9.4
Global Valve	3.0	4.5	6.0	8.5	10.5	14.0	17.0	22.0	32.0	42.0	53.0	75.0
Angle Valve	1.4	2.0	2.7	3.8	4.8	6.3	7.9	10.5	14.5	18.5	23.0	33.0
Std. Elbow	1.1	1.5	2.0	2.8	3.5	4.7	5.8	7.5	11.0	14.0	18.0	24.0
45 Elbow	0.6	0.8	1.0	1.4	1.6	2.1	2.5	3.1	4.2	5.2	6.3	8.5
Long Sweep EI Str Run Tee	0.5	0.8	1.0	1.4	1.7	2.3	2.8	3.7	5.3	7.0	9.0	12.5
Std. Tee Thru Side Outlet	2.1	2.9	3.9	5.5	6.9	9.1	11.6	14.8	21.0	27.0	34.0	49.0
SuddenEnlarg or contraction	1.8	2.5	3.2	4.2	5.0	6.5	7.5	9.5	13.0	16.0	19.0	25.0
Entrance to Pipe	1.0	1.3	1.6	2.2	2.6	3.3	3.9	4.9	6.5	8.2	10.0	13.0

TABLE NO. 9
To Convert Pounds per Square Inch to
Feet Elevation of Water

2.308ft head = 1.0 psi
1ft head = .433psi

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

Table NO. 10
American National Fire Hose Connection Screw Thread - NH

Size of Hose	4-Mar	1	1 1/2	2 1/2	3	3 1/2	4	4 1/2	5	6	8
Thr'ds per inch	8	8	9	7.5	6	6	4	4	4	4	4
Thread Designation	0.75-8 NH	1-8 NH	1.5-9 NH	2.5-7.5 NH	3-6 NH	3.5-6 NH	4-4 NH	4.5-4 NH	5-4 NH	6-4 NH	8-4 NH
Max. O.D. Male	1.375	1.375	1.99	3.0686	3.6239	4.2439	5.0109	5.7609	6.26	7.025	9.05

Ref. NFPA 1963

Underwriters Nozzle Tip Thread: 2.1875 O.D. - 12 threads per inch.

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