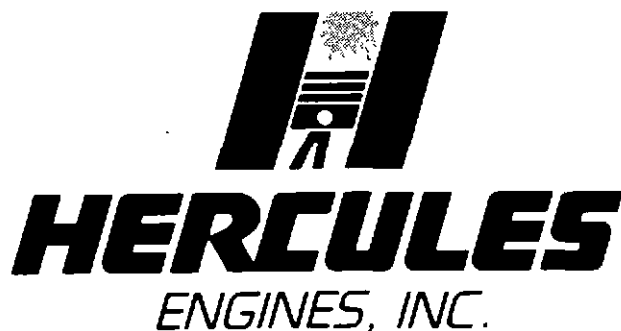


OPERATOR'S GUIDE

DIESEL ENGINES

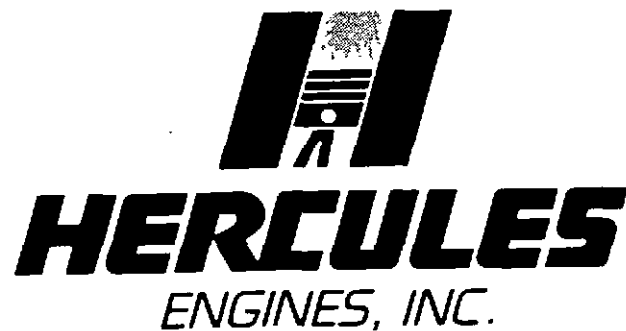
D-1500	—	3 ³ / ₄ "	x	4 ¹ / ₂ "
D-1700	—	4"	x	4 ¹ / ₂ "
D-2000	—	3 ³ / ₄ "	x	4 ¹ / ₂ "
D-2300	—	4"	x	4 ¹ / ₂ "
D-3000	—	3 ³ / ₄ "	x	4 ¹ / ₂ "
D-3400	—	4"	x	4 ¹ / ₂ "
D-4800	—	4-9/16"	x	4 ⁷ / ₈ "



OPERATOR'S GUIDE

DIESEL ENGINES

D-1500	—	3 ³ / ₄ "	x	4 ¹ / ₂ "
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OPERATION

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INTRODUCTION

This operation manual is intended for the guidance of the operator and furnishes necessary information for operation as well as for adjustments, lubrications, periodic checks, and maintenance of the engine.

Proper service practices save expensive down-time and costly repairs. When repairs or replacement parts are needed, always insist on genuine Hercules precision parts to insure the satisfaction and long lasting service to which you are entitled.

All parts are available through the nearest Hercules Engines, Inc. Distributor. The engine model and serial number should always be furnished to obtain the correct parts and assure fast and courteous service.

The manual is divided into the following major sections:

OPERATION

SERVICE AND MAINTENANCE

TROUBLESHOOTING

As an operator you owe it to yourself to read this manual carefully and fully.

NOTE: ENGINE OPERATION BELOW 1200 RPM REQUIRES FACTORY AUTHORIZATION.

OPERATION

This section covers those items which are of particular interest to the operator and does not necessarily cover such work as might be required of the maintenance man. Each operator should thoroughly acquaint himself with the various subjects covered in this book.

PRECAUTIONS — READ BEFORE STARTING THE ENGINE

Know how to stop the engine before attempting to start.

The following precautions, if followed, will help eliminate many operating difficulties and insure satisfactory service and engine life:

1. Do not start the engine until the lubricating oil, water, and fuel supplies have been checked.
2. Before attempting to start in cold weather read "COLD WEATHER STARTING."
3. Never run the starting motor longer than 15 seconds without a rest period of at least one minute before allowing it to run again.
4. Remember: Dirt, grit, water, lint, or any foreign matter is detrimental, and it is your duty to see that they do not get into the engine. Keep all filters clean and serviced regularly.
5. Fuel oil — keep it clean — use only clean containers and to insure maximum power and engine performance, use only No. 2 distillate fuels, summer and winter grades, which conform to ASTM Designation D-975.

FUEL OIL SPECIFICATIONS

Flash point	125°F, minimum	NOTES: 1. The fuel oil must be clean, completely distilled, stable, and noncorrosive. 2. In cold weather, the cloud point (temperature at which wax crystals begin to form in the fuel oil) should be 10°F below the lowest expected fuel temperature to prevent clogging of the fuel filters by wax crystals. 3. The fuel filters are sensitive to water and care should be taken to keep the water content low. 4. Distillation range, sulphur content, and cetane number are three of the most important properties in the selection of fuel for optimum combustion and minimum wear.
Carbon residue	0.35 percent	
Water and sediment (see note 3)	0.10 percent by volume, maximum	
Ash	0.02 percent by weight, maximum	
Distillation, 90 percent point (see note 4)	640 maximum 540 minimum	
Viscosity at 100°F	2.0 centistokes, minimum 4.3 centistokes, maximum	
Sulphur (see note 4)	1.0 percent, maximum	
Cetane number (see note 4)	45 minimum	

OPERATION

6. Lubricating oil — keep it clean — drain the crankcase often. Use the best brands obtainable.
7. Oil level — maintain the level at the "Full" mark on the bayonet gauge; however, do not overfill. Never allow the engine to run without oil pressure showing on the gauge.

LUBRICATION

Lubricating oil recommendations are based on engine design, type of service, and ambient air temperature. High quality oils combined with necessary oil and filter changes are required to assure maximum performance, long engine life, and minimum operating cost.

RECOMMENDED LUBRICATING OIL SPECIFICATIONS

Ambient Air Temperature -10° to 30° F 30° to 60° F 40° and up	Viscosity Grade 10W 20 - 20W 30	Use single viscosity, low ash oil with API Classification as shown below. Select viscosity grade according to ambient temperature.
-10° F and up	15W - 40	NOTE: Multigrade oils with <u>CD Classification Only</u> are acceptable for Diesel engines.
API CLASSIFICATION Naturally Aspirated Diesel (MIL-L-2104B or C) ----- CC (Single Viscosity) or CD Turbocharged Diesel Engine (MIL-L-2104C) ----- CD		

8. Do not put cold water in an overheated engine. A cracked cylinder head or block may result. Add water slowly in radiator with engine

operating at a slow idle. Never operate with the water boiling. At temperatures below freezing use anti-freeze solutions.

9. Never allow your batteries to run low or dry of water. In cold weather do not fill the batteries with water when shutting down as this makes them more likely to freeze. Add water after starting engine for day's run.
10. Do not use the engine as a brake in intermediate or low gear unless the vehicle speed is held to that used in the same gears on the level, or serious damage may result from engine overspeeding.
11. Do not attempt to make repairs or adjustments to the engine or fuel injection equipment; rather, take it to the nearest authorized service station.
12. Do not operate the fuel injection pump with any lines shut off or blocked. The high pressure will ruin the pump. Correct fuel nozzle pressure is essential to efficient operation.
13. Keep the fan belts properly tightened. Loose belts allow slippage and wear rapidly. Overtightening can damage water pump or alternator bearings.
14. Loss of power, erratic running, and poor performance often result from air in the injection system. Be sure there are no leaks in the fuel lines and filters. See "PRIMING FUEL SYSTEM."
15. Do not permit oil, water, or fuel leaks to go uncorrected.

PRIMING AND STARTING PROCEDURE

PRIMING FUEL SYSTEM

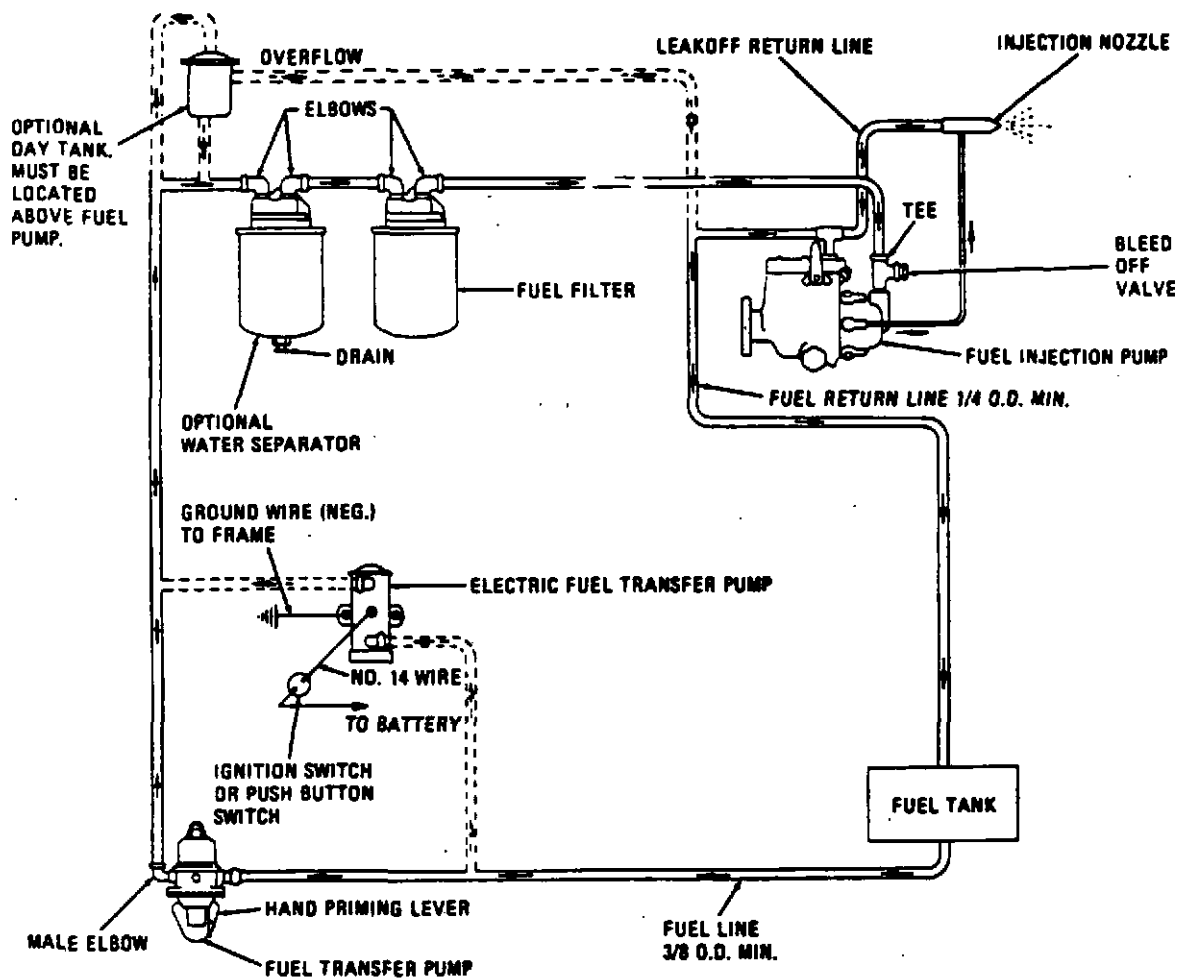
1. Open water separator drain sufficiently to eliminate water from the system.
2. On engines equipped with spin-on-filters (single or dual) and one of the following priming pumps:
 1. Electric fuel supply pump (optional)
 2. Diaphragm type pump with hand priming lever
 3. Hand priming pump

the following procedure should be used:

Open bleed valve at fuel injection pump inlet. Using hand lever primer on supply pump, purge system of air. The fuel system is sufficiently purged when air-free fuel flows from bleed valve. (See illustration).

NOTE: Electric fuel supply pump (optional) — energize pump until system is purged of air.

OPERATION



STARTING THE ENGINE

WARNING! Never operate engine in a closed building unless engine exhaust system has been vented outside.

BATTERY RECOMMENDATIONS

If a 12 volt battery is not furnished with the unit, procure only those of a good brand and with the following capacity: 210 ampere-hours, 12 volt, 25 plate.

NOTE: Some applications may call for 24 or 32 volt system. Correct batteries should then be obtained for these special applications.

CAUTION: The size and capacity of the wires and terminals used in all wiring circuits are as important as the electrical units themselves. Under size wires or terminals, poor insulation, loose or corroded connections etc., may cause severe troubles or failures in the system.

If the atmospheric temperature is 20°F or above, the following instructions should enable anyone to readily start the engine. If the air temperature is below 20°F, read "COLD WEATHER STARTING."

NORMAL STARTING

If the engine has been operated recently and nothing has been removed or repaired since it last operated, start as follows:

1. Check the fuel supply in the tank, lubeoil level in the pan, and cooling solution level in the radiator.
2. If in a vehicle, place drive lever in "Neutral" position.
3. Be sure the stop control is not in the "Shut Off" position.
4. Place the throttle at $\frac{3}{4}$ to full position.
5. Depress the clutch pedal, if in vehicle.
6. Start the engine by operating the starter switch.
7. After the engine starts, reduce the engine speed to a fast idle and observe oil gauge. If no pressure shows in a few seconds, shut engine down and determine the trouble. Oil pressure should show between 30 and 60 P.S.I. at full speed. As oil heats up, pressure will reduce.
8. Allow the engine to run for several minutes at fast idle or light load, if possible, before applying the load. Never attempt to pull loads that are beyond the power of the engine.

COLD WEATHER STARTING — BELOW 20°F

1. Move the manual stop control to "Run" position and throttle to $\frac{3}{4}$ to full speed position, and start the engine.
2. After starting, reduce the speed to a moderate idle, then operate under light load until the engine is warm.

NOTE: A cold starting aid is desirable, if the engine does not start on the third attempt of 15-second bursts. In extremely low temperature, heating the lubeoil and cooling solution is beneficial.

In predominately cold climates starting aid kits should be installed permanently on the engine. The authorized White Engines, Inc. distributor has the proper one available for the engine.

STOPPING THE DIESEL ENGINE

NOTE: This procedure will differ somewhat with each application or vehicle.

1. Pull the throttle to idle position. A hot engine must be cooled before stopping. Reduce temperatures to normal by idling the engine a few minutes.
2. Move the manual stop control or electric shutoff to "Stop" position until the engine completely stops.

OPERATION

HIGH ALTITUDE OPERATION

At higher altitudes the engines may encounter difficulties such as loss of power, darker exhaust, and hard starting due to lower air pressures. The higher the operating altitudes the more noticeable these conditions become. When severe conditions are encountered, adjustments, such as reducing the fuel supply must be made by the authorized service dealer.

CAUTION: For altitudes above 5000 ft., fuel must be adjusted on turbo-charged engines to prevent turbocharger overspeeding and to control smoke.

To aid in starting it may be desirable to follow the "COLD WEATHER STARTING" instructions.

STORAGE OF ENGINES FOR LONG PERIODS AND RUST PREVENTIVE TREATMENT

If the engine is to be stored for an extended period, special preparations should be made to prevent RUST from forming on the wearing surfaces or in the fuel system.

Thorough "Rustproofing Preparation Instructions" may be obtained from the authorized service dealers.

NOTE: If the engine can be started and run each week until operating temperature is reached, rust treatment may not be required; however, it is recommended that a No-Rust type oil be used during these periods or until the equipment is put into regular service.

RUST PRESERVATIVE OILS

1. Viscor No. L-1487B — Viscosity Oil Company
2. Shell Oil Company Injector Oil — Code 66631
3. Gulf Rust "C"

SERVICE AND MAINTENANCE

This section covers a brief description of various parts of the engine with instructions covering their service and maintenance requirements under normal operating conditions.

SUGGESTED PREVENTIVE MAINTENANCE SCHEDULE

A. DAILY

1. Tighten loose clamps and replace damaged hoses promptly. All connections between air cleaner and intake manifold must be air-tight.
2. Check crankcase oil level and oil condition.
3. Check coolant level and condition of the solution in radiator. Also keep the external parts of the radiator clean.

SERVICE AND MAINTENANCE

4. Check the fuel supply in the fuel tank. To avoid water condensation, fill the fuel tanks at the end of the day's run.
5. Drain water separator (if used in system). See drawing, page 5.
6. Check battery solution level. Never allow it to run low.
7. Check all gauges to be sure they are functioning properly.
8. Check general condition of unit. Tighten, repair, or replace parts necessary.

B. 125 HOURS OR 3000 MILES IN ADDITION TO "A" SERVICES

1. Change crankcase oil and filter or element.
2. Clean crankcase breather system.
3. Tighten accessory drive belts to avoid slippage.
4. Check radiator air passages for air flow restrictions — dirt, chaff, etc. Clean, if dirty.
5. Replace primary and secondary fuel oil filters and reprime the fuel system. (For priming procedure see page 4.)

NOTE: If excessive water or materials are found, drain the filters more often.

6. Lubricate accessory items as needed.

C. 500 HOURS OR 12,000 MILES IN ADDITION TO "B" SERVICES MAJOR TUNE-UP:

1. Inspect engine for loose connections, leaks in oil, fuel and water system, cracks, and free action of all moving parts.
2. Check valve tappet clearance and reset, if necessary.
3. Adjust governor and throttle linkage.
4. Change air filter.
5. Clean, inspect and set injector nozzles if loss of engine performance is noted or exhaust smoke density indicates a problem.
6. Check fuel pump timing and adjust, if necessary.

TURBOCHARGERS

When turbochargers are specified they are of the self contained turbine and blower type requiring no separate controls. They operate entirely automatically to furnish all the pressurized air required by the engine to the intake manifold.

They are lubricated, filtered and cooled under pressure from the main oil header of the engine.

When service repairs or parts are required the turbocharger should be taken to an Authorized Service Depot.

CAUTION: The turbocharger acts as an efficient muffler. Do not attempt to install an additional muffler on a turbocharged unit. This will decrease efficiency of the turbocharger.

TROUBLE SHOOTING

PREVENTIVE MAINTENANCE SCHEDULE FOR NORMAL OPERATING CONDITIONS

Operation	Hours Miles	Time Interval				Remarks
		8 Daily	50 1500	125 3000	500 12,000	
Lubrication system						
Engine oil		*		*		
Oil filter				*		Replace at every other oil change.
Cooling system						
Coolant		*				
Radiator			*			
Water pump						Inspect and lubricate at engine over-haul.
Hoses					*	
Fuel system						
Fuel filters				*		
Fuel nozzles					*	
Fuel tank		*			*	
Air system						
Air cleaner		*	*			
Crankcase breather			*			Clean breather cap at every oil change.
Electrical system						
Starting motor				*		Lubricate and service as directed in manufacturer's instructions.
Alternator				*	*	Lubricate and service as directed in manufacturer's instructions.
Battery			*		*	
Miscellaneous accessories						Lubricate and service as directed in manufacturer's instructions.
General condition		*				
Drive belts			*			Tighten new belts after 8 hours of operation.
Engine tuneup					*	As required by engine performance.

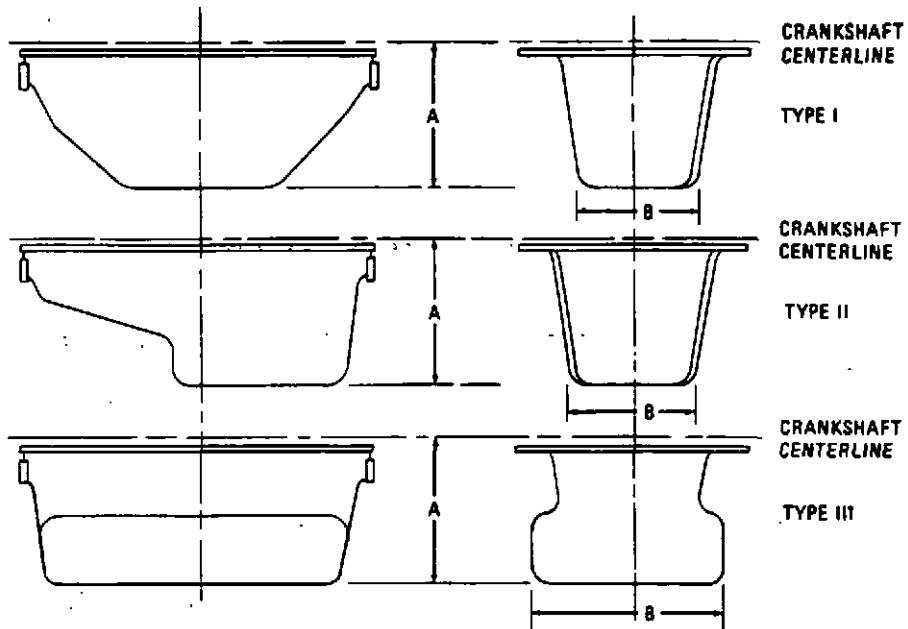
*Indicates that service or inspection is required.

TROUBLE SHOOTING

ENGINE TROUBLESHOOTING

CAUSE	SYMPTOM											
	ENGINE WILL NOT START	HARD STARTING	ENGINE STOPS	ERRATIC ENGINE PERFORMANCE	BLACK EXHAUST SMOKE	BLUE EXHAUST SMOKE	WHITE EXHAUST SMOKE	LOW POWER	ENGINE OVER-HEATING	ENGINE OVER-COOLING	LOW OIL PRESSURE	BEARING FAILURES
Air Cleaner Dirty Air Inlet Restricted	X	X	X	X	X	X	X					
Exhaust System Restricted			X	X	X		X	X				
Battery Weak or Discharged Battery Cables - Loose Connections	X	X	X	X								
Foreign Matter on Pistons Low Cylinder Compression Worn Pistons, Rings, Etc. Scored Pistons	X	X	X	X	X	X	X	X	X			X
Valves Leaking Valves Sticking Valves Incorrectly Adjusted	X	X	X	X	X	X	X	X	X			
Luboil Level Too Low Luboil Level Too High Wrong Type of Luboil		X			X	X		X	X	X		X
Oil Pump Inlet Screen Plugged Pressure Regulator Not Functioning Luboil Contaminated Rocker Arm Shaft Upside Down Oil Header Plug Missing or Loose. Bearings Failed - Main, Rod, Cam					X	X	X	X	X	X	X	X
Excessive Angle Operations Excessive Thrust Pressure On Shafts	X	X	X		X			X	X	X		X
Fuel Tank Empty Fuel Tank Valve Closed Fuel Tank Vent Plugged	X	X	X	X								
Fuel Transfer Pump Worn Fuel Contamination Fuel Incorrect For Conditions	X	X	X	X	X	X	X		X			
Engine Too Cold to Ignite Fuel Properly Stop Control In Stop Position Electric Fuel Shutoff Not Functioning	X	X	X	X		X	X					
Throttle Linkage Adjustment Incorrect or Sticking			X				X					
Fuel Filters Dirty or Plugged Air Leaks In Fuel System Fuel Pump Incorrectly Timed Sticking or Fouled Nozzle Fuel Return Plugged or Restricted Incorrect Fuel Setting Nozzle Opening Pressure Incorrect Nozzle Incorrectly Torqued	X	X	X	X	X	X	X	X	X	X		
Fan Belt Loose Or Slipping Radiator Fins or Tubes Dirty or Restricted Water System Piped Incorrectly Low Coolant Level Coolant In Cylinders Inoperative Thermostat Thermostat Missing	X	X	X	X	X	X	X	X	X	X		
Engine Overloaded Engine Overspeeded			X	X	X	X	X	X	X	X		X

CRANKCASE OIL CAPACITIES



Engine Type	Oil Pan Type	Oil Pan Dimensions (Inches)		Crankcase Capacity (Quarts) (Not Including Oil Filter)
		A	B	
D-3 Cylinder	I	7-9/16	8-9/16	5
	III	11-5/8	11-3/4	5
D-4 Cylinder	I	9	7-1/2	5-1/2
	III	10-7/8	12-1/4	8
D-6 Cylinder	I	10	7-3/16	7
	I	9	7-7/16	6
	I	12	8-7/16	8
	II	11	7-5/8	8
	III	12-5/8	11-7/8	7
D-4800				18

HERCULES ENGINES, INC.

CANTON, OHIO 44707

LIMITED WARRANTY - INDUSTRIAL ENGINE

Hercules Engines, Inc. warrants each new engine or component thereof, sold by it to the original owner-user as follows:

For eighteen (18) months from date of shipment from the factory, or for twelve (12) months of service, or for 2,000 hours of service, whichever shall first occur, (or for such other period of time as may be agreed upon in writing by Hercules Engines, Inc. in respect to the application in which the engine is used) that said engine and component shall be free from defects in material and workmanship.

For any engine or component which is, or becomes defective within the period set forth above, Hercules Engines, Inc. shall furnish to the original owner-user, without charge, parts to replace those parts which upon inspection are determined by Hercules Engines, Inc. to have been defective in material or workmanship.

This warranty does not obligate Hercules Engines, Inc. for the cost of labor or transportation charges in connection with the replacement of defective parts or repair of the engine.

The foregoing warranty does not apply to normal maintenance services or adjustment or to an engine upon which repairs or alterations have been made unless the repairs or alterations were authorized in writing by Hercules Engines, Inc.

Hercules Engines, Inc. makes no warranty in respect to trade accessories. Trade accessories are subject to the warranties of their respective manufacturers.

Other than as set forth above, **SELLER MAKES NO WARRANTY OF ANY KIND WHATEVER, EXPRESS OR IMPLIED; AND ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, OTHER THAN AS CONTAINED HEREIN AND HEREBY LIMITED AS TO DURATION IS HEREBY DISCLAIMED.**

Owner is responsible for communication expense, meals, lodging and incidental costs incurred by owner or employees of owner as a result of warrantable failure.

Owner is also responsible for any loss of productivity, and all business costs and losses resulting from warrantable failure.

THIS WARRANTY SUPERSEDES ANY PREVIOUS WARRANTIES AND TAKES EFFECT June 6, 1988.



HERCULES ENGINES, INC.

101 Eleventh St., S.E., Canton, Ohio 44707-3802

Parts (216) 438-1025

FAX: (216) 438-1030

Service (216) 438-1035