OPERATING, MAINTENANCE & PARTS MANUAL

MODELS

850HH-NG

950H-NG

950L-NG

MANUAL PART NO. 250HPMAN.DOC

August 1996

COMPRESSOR SERIAL NUMBER RANGE

(Apply Serial No. Label Here)

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INGERSOLL-RAND®
Revised (10-12)

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OPERATING & MAINTENANCE,
PARTS MANUAL

IMPORTANT
SAFETY INSTRUCTIONS

This manual provides important information to familiarize you with safe operating and maintenance procedures for your Ingersoll-Rand Compressor. Even though you may be familiar with similar equipment you MUST read and understand this manual before operating this unit.

LOOK FOR THESE SIGNS WHICH POINT OUT POTENTIAL HAZARDS TO THE SAFETY OF YOU AND OTHERS. READ AND UNDERSTAND THOROUGHLY. HEED WARNINGS AND FOLLOW INSTRUCTIONS. IF YOU DO NOT UNDERSTAND, INFORM YOUR SUPERVISOR.

(Red background)

Indicates the presence of a hazard which WILL cause *severe* injury, death or property damage, if ignored.

(Orange background)

Indicates the presence of a hazard which CAN cause *severe* injury, death or property damage, if ignored.

(Yellow background)

Indicates the presence of a hazard which WILL or CAN cause injury or property damage, if ignored.

(Blue background)

Indicates important setup, operating or maintenance information.

STATEMENT CONCERNING THE USE OF THIS EQUIPMENT

FOR BREATHING AIR AND/OR AQUA LUNG SERVICE

If the model number on this air compressor contains the letters "BAP", the compressor is suitable for use in breathing air services. In the absence of such a designation, the compressor is not considered as capable of producing air of breathing quality. For a compressor to be capable of use in breathing air services, it must be fitted with additional specialized equipment to properly filter and/or purify the air to meet all applicable federal, state and local laws, rules, regulations and codes, such as, but not limited to, OSHA 29 CFR. 1910.134, Compressed Gas Association Commodity Specification G-7.1-19, Grade D Breathing Air, and/or Canadian Standards Association. Should the Purchaser and/or User fail to add such specialized equipment and proceeds to use the compressor for breathing air service, the Purchaser/User assumes all liability resulting therefrom without any responsibility or liability being assumed by Ingersoll-Rand Company.

The Purchaser is urged to include the above provision in any agreement for any resale of this compressor.

Never operate unit without first observing all safety warnings and carefully reading the operation and maintenance manual shipped from the factory with this machine.

DANGER

Air discharged from this machine may contain carbon monoxide or other contaminants which will cause severe injury or death. Do not breathe this air either directly or indirectly in a confined space.

Never operate the engine of this machine inside a building without adequate ventilation. Avoid breathing exhaust fumes when working on or near the machine.

WARNING

Ether (Starting Fluid, etc.) can EXPLODE in engine or compressor and cause severe injury. Do NOT spray ether into air cleaners.

A battery contains explosive gases and sulfuric acid. Can cause serious injury or blindness. NO sparks, open flames or smoking near battery. In event of accident, flush skin or eyes with water. Obtain medical attention immediately.

WARNING

This machine produces loud noise when operating. Extended exposure to loud noise can cause hearing loss. Always wear hearing protection when performing any work while the machine is operating.

This machine contains high pressure air which can cause severe injury or death from hot oil and flying parts.

Always relieve pressure before removing caps, plugs, covers or other parts from the pressurized air system.

Air pressure can remain trapped in an air supply line which can result in serious injury or death. Always vent air supply line at vent valve before performing any service.

Never inspect or service unit without first disconnecting battery cable(s) to prevent accidental starting.

Do not remove a pressure cap from a hot cooling system for the engine. The sudden release of pressure from a heated cooling system can result in a loss of coolant and severe personal injury. Allow system to cool before removing pressure cap.

Never run unit with guards, covers or screens removed. Keep hands, hair, clothing, tools, blow gun tips, etc. well away from moving parts.

Do not use petroleum products (solvents or fuels) under high pressure as this can penetrate the skin and result in serious illness. Wear eye protection while cleaning unit with compressed air to prevent debris from injuring eye(s).

CAUTION

Use extreme care to avoid contacting hot surfaces (engine exhaust manifold and piping, air receiver and air discharge piping, etc.).

An isolation valve should be installed at or near the unit discharge.

Do not connect the air discharge on this unit onto a common header with any other source of compressed air, without first making sure a check-valve is used between the header and the unit.

If this unit is connected in parallel with another unit of higher discharge pressure and capacity, a safety hazard could occur in a back-flow condition.

Never allow the unit to sit stopped with pressure in the receiver-separator system. As a precaution, open the vent valve.

Any unauthorized modification or failure to maintain this equipment may make it unsafe and out of warranty.

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SECTION 1 -- FOREWARD

During the preparation of this manual every effort was made to ensure the adequacy and accuracy of the contents. Only in this manner can the owner be provided with a tool that will aid him in obtaining maximum performance and trouble-free service from the compressor. Since all classes of equipment require a certain amount of attention, the purpose of this manual is to acquaint an operator with the functions, operation and lubrication of the compressor. This manual also provides the owner with the maintenance requirements applicable to the various components designed or selected for incorporation into this unit. Special attention has been given in an effort to make sure that only components built with the very best materials and the finest workmanship have been used, thus reducing the maintenance requirement to a bare minimum.

Before starting the compressor, the instructions should be carefully read to obtain a thorough knowledge of the duties to be performed. Take pride in the compressor, keep it clean, and in good mechanical condition.

For complete protection and minimum down-time to facilitate the maintenance effort that is required, it is suggested that a complete set of recommended spares be kept on hand during and after the first few months of operation. For recommended spares, replacement parts or information regarding the condition or operation of your unit or for major servicing not covered in this manual, consult your nearest sales office, autonomous company or authorized distributor. Be sure to specify the model and serial number of the compressor during any correspondence with a company representative.

In addition to preventive maintenance, the compressor airend may require overhauling to maintain maximum output and performance of the unit. Your Ingersoll-Rand Company Construction Equipment Group Sales Offices and authorized distributors as well as Ingersoll-Rand International autonomous companies and authorized distributors now have a compressor airend exchange program, therefore we do not recommend overhaul of the airend by the customer. However, we do recognize the fact that circumstances may warrant field overhaul of the airend. Prior to any disassembly or reassembly of the airend we strongly suggest the owner contact the Field Service Department, Ingersoll-Rand Company, Mocksville, North Carolina 27028 for their advice and suggestions.

SECTION 2 -- GENERAL DATA

SPECIFICATIONS

Unit Model:	850HH-NG	950H-NG	950N-NG
Rated Delivery:			
-- cfm	850	950	950
-- (litres/sec.)	(400)	(449)	(449)
Rated Pressure			
-- psi	150	125	100
-- (kPa)	(1050)	(875)	(700)

ENGINE -- CATERPILLAR (NATURAL GAS)

Model ..... Waukesha F11GSID

Fuel Pressure: Standard: 20 to 25 psi

Optional: 1.5 to 5 psi

Full Load Speed -- rpm 1850

No Load Speed -- rpm 1350

Electrical System -- volt 24

FLUID CAPACITIES

Compressor Lubricant, Initial Fill ..... 25 U. S. gallons (95 litres)

Service Refill ..... 23 U.S. gallons (87 litres)

Engine Crankcase Lubricant ..... 11 U.S. gallons (42 litres)

Engine Coolant ..... 20 U.S. gallons (76 litres)

UNITS MEASUREMENTS/WEIGHTS

Overall Length ..... 9.6 feet (2.92 meters)

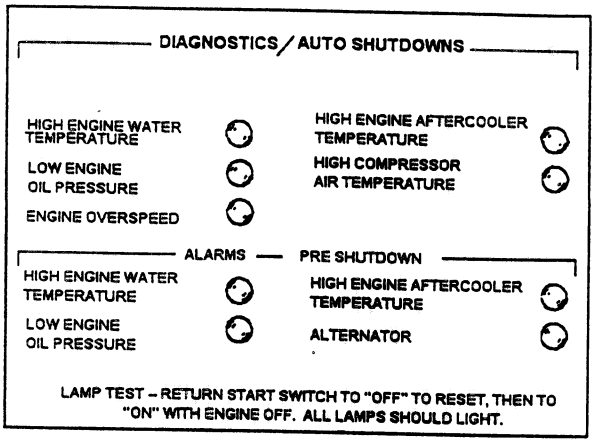
Overall Height ..... 5.5 feet (1.68 meters)

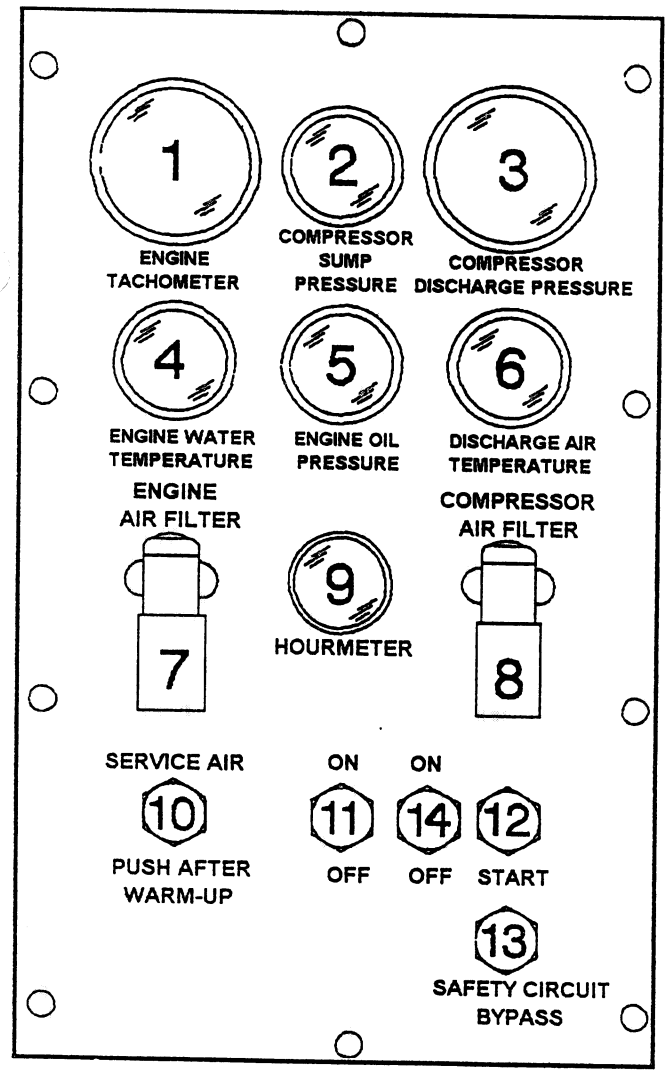
Overall Width ..... 5.0 feet (1.53 meters)

Weight (all fluids) ..... 8770 pounds (3978 kilograms)

NOTICE: Any departure from the specifications may make this equipment unsafe and out of warranty.

EXPENDABLE SERVICE PARTS	Part Number
Compressor Oil Filter Element (2)	35296920
Compressor Oil Separator Element	35856376
Compressor Air Cleaner Element, Inner	35355353
Outer	35355395
Engine Air Cleaner Element	(Waukesha P/N) 351568
Pre-cleaner	(Waukesha P/N) 351567





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OPERATING CONTROLS AND INSTRUMENTS (STANDARD)

A. **Auxiliary Compressor** -- Press and hold for 15 seconds before starting compressor if ambient temperature is less than 40°F (4°C).

1. **Engine Tachometer** -- Indicates engine speed in RPM from 0 when stopped to full speed.

2. **Compressor Sump Pressure** -- Indicates pressure at the discharge of the airend (inlet to receiver tank).

3. **Compressor Discharge Pressure Gauge** -- Indicates pressure at the service air connection, normally from 0 psi (kPa) to the rated pressure of the machine.

4. **Engine Water Temperature Gauge** -- Indicates coolant temperature, with normal operating range from 180°F (82°C) to 210°F (99°C).

5. **Engine Oil Pressure Gauge** -- See Engine Operation Manual for normal range.

6. **Discharge Air Temperature** -- Indicates in °F and °C. Normal operating range: WITH AFTERCOOLER, 10 to 15°F above ambient.

7/8. **Air Filter (Service) Indicator** -- Indicates acceptable (green flag) or excessive (red flag) restriction within air cleaners.

9. **Hourmeter** -- Records running time for maintenance purposes.

10. **Service Air Button** -- Push After warm up. provides full rated air pressure in the receiver tank.

11. **Toggle Switch** -- Flip "On" to operate, "Off" to stop.

12. **Start Button** -- Activates the engine starter.

13. **Bypass Button** -- Bypasses automatic shutdown circuit.

14. **Toggle Switch** -- Operates panel light.

15. **Panel Light** -- Illuminates panel.

16. **Engine Throttle Cable** -- (Not shown, Below Instrument Panel). Controls engine speed.

SECTION 3 -- OPERATING INSTRUCTIONS

INITIAL SET UP

WARNING

Improper grounding can cause severe injury or death. Comply with local electrical codes when installing this unit.

A grounding point is located on the top of the frame at the engine front mount.

- Before using your compressor for the first time, you must install the appropriate cooling water piping, engine exhaust and emissions control system and natural gas hookup connections.

NOTICE

The user is responsible to ensure the gas supply train, regulator and main gas supply components meet the requirements of NFPA 37 and any additional applicable local, state or federal codes.

- In addition, this machine contains manual and automatic drain connections for the engine oil, engine water jacket coolant, compressor oil, aftercooler condensate (automatic drain with manual override), auxiliary engine oil filter, natural gas moisture separator and natural gas filter.

NOTICE

The user is responsible for collecting and disposing of all liquids and particulates in an environmentally acceptable manner in accordance with applicable local, state, and federal regulations.

BEFORE STARTING UNIT

WARNING

No smoking, sparks, or open flame while operating or servicing unit.

- Check batteries for proper connections and condition.

WARNING

Exercise extreme caution when using a booster battery to start. To jump-start, connect the ends of one booster cable to the positive (+) terminals of each battery. Then connect one end of the other cable to the negative (-) terminal of the booster battery and the other end to the engine block. NOT TO THE NEGATIVE (-) TERMINAL OF THE WEAK BATTERY. After the engine starts:

a. Disconnect the negative (-) cable from engine block; then from booster battery.

b. Disconnect positive (+) cable from both batteries.

- Check the compressor lubricating oil level. The proper oil level is mid-way on the sight gauge. Add oil if the level falls to the bottom of the sight gauge when the unit is running at full load. Do not overfill. If necessary, refer to Section 5 -- Lubrication for recommended lubricant.

- Check the engine lubricating oil level. Add oil if low on dipstick. Refer to the engine Operator's Manual for recommended lubricant.

WARNING

Do not remove the cap from a HOT engine radiator. The sudden release of pressure from a heated cooling system can result in a loss of coolant and possible severe personal injury.

- Check the engine coolant level in the engine expansion tank. Fluid level should be to the top of the tank.

NOTICE

If the appropriate mixture of antifreeze is not used (during freezing temperatures), failure to drain the engine may cause costly damage. If water only is used, a corrosion inhibitor should be included.

- Check the air cleaner service indicators of both engine and compressor. If the flag in either indicator shows red, refer to Section 4 -- Maintenance for service instructions.

DANGER

Absolutely no smoking or open flames when draining fuel filter.

- Drain condensate from fuel filter by opening quarter turn ball valve at the bottom of the filter.

STARTING

- IMPORTANT: The following steps must be taken prior to beginning the start up procedure described below.

NOTICE

Ingersoll-Rand natural gas engine compressors are equipped with an automatic PRE-START FRESH AIR PURGE circuit. The first attempt to start the machine will automatically engage the starter for an adjustable period up to ten (10) seconds with the natural gas supply turned off. This allows any unburned gas in the intake manifold or cylinders to be purged and prevents engine backfiring which may damage engine emissions equipment.

NOTICE

The FRESH AIR PURGE cycle must be performed for each new startup and for each restart following a shutdown.

PRE-START FRESH AIR PURGE CYCLE:

1. Turn the main control POWER switch to ON.
2. Press and hold the SAFETY CIRCUIT BYPASS button.
3. Press the START button.

   The automatic timer will engage and crank the engine for the duration set [up to ten (10) seconds].
4. Release the START and SAFETY CIRCUIT BYPASS buttons.

IMPORTANT: After completing the FRESH AIR PURGE cycle the START SWITCH must remain in the ON position while attempting to start the machine.

When the START SWITCH on the instrument panel remains in the ON position, the gas supply valve will be open for any additional start attempts. When the START SWITCH is turned to the OFF position, the adjustable time delay will reset and the next attempt to start the machine will repeat the gas purge cycle.

Carefully read and understand the starting instructions before operating this equipment.

STARTUP PROCEDURE:

NOTICE

When the ambient temperature is below 40°F/4°C, push the Auxiliary Compressor Button located above the instrument/control panel or on top of the receiver/separator tank for fifteen (15) seconds. This operates the 24 volt compressor unit which pressurizes the unloader and thus keeps the inlet valve closed for easier start up.

1. Before starting, complete the Pre-start Fresh Air Purge cycles.

2. Ensure that the main engine power switch remains in the RUN position.

3. Turn the main control panel POWER switch to ON.

   All diagnostic panel lights should be ON for lamp test.

4. Press and hold the SAFETY CIRCUIT BYPASS button.

5. Press the START button.

   NOTE: Do not operate the starter motor for more than ten (10) seconds without allowing at least one (1) minute cooling time between start attempts.

6. Release the START button when the engine starts and sustains running. If the engine does not start after five (5) attempts, refer to Section 7 -- TROUBLESHOOTING.

7. Release the SAFETY CIRCUIT BYPASS button when the engine oil pressure exceeds 20 psi (140 kPa). If the engine oil pressure does not rise within five (5) seconds, stop the unit and refer to Section 7.

8. The Diagnostic Board lamps should now be OFF.

9. Watch the gauges while the unit warms up for five (5) to ten (10) minutes or until the engine coolant temperature reaches 140°F (60°C).

10. Push the SERVICE AIR button. The discharge pressure should rise to slightly over rated pressure. If there is no air being consumed, the compressor will unoad (intake will be throttled or closed).

STOPPING

- Allow the unit to run at "No Load" for 3 to 5 minutes to reduce the engine temperatures.

- Flip the toggle switch to "OFF".

NOTICE

Once the engine stops, the automatic blowdown valve will begin to relieve all pressure from the receiver-separator system.

CAUTION

Never allow the unit to sit stopped with pressure in the receiver-separator system. As a precaution, open the vent valve.

DANGER

Even after pressure is relieved from the receiver-separator system, any air supply line from the compressor to a plant air system or machine could remain under pressure and cause very serious personal injury or death. After the compressor stops, carefully open a vent valve to exhaust the pressure in any line prior to removal or servicing.

- Stop the cooling water flow in external circuit.

AUTOMATIC ALARM/SHUTDOWN

All units in this family of machines are protected by some thirteen (13) sensors or switches as listed in Table 1 in Section 3. As indicated, some of these problem situations will cause a lamp to glow on the DIAGNOSTICS panel.

Other problems will cause the unit to stop. A glowing lamp will remain on until the toggle (main power) switch is flipped to "Off". Before restarting the unit, check the problem area for low fluid level, evidence of excessive heat, etc. and take corrective action.

NOTICE

Do NOT wire around or bypass a shutdown sensor or switch.

Other possible causes for an unexpected shutdown may be found on the standard portable compressor Trouble Shooting Chart in Section 7.

TABLE 1 -- SENSOR LOCATIONS AND SET POINTS

ITEM (Schematic Ref. Designator)	ALARM	SHUTDOWN	LOCATION
1. Low Engine Aftercooler Flow* (S10)	YES	<25 gpm	Engine Aftercooler Outlet Line
2. High Engine Water Temp.* (S11)	>209° F/98°C**	>215° F/102°C**	Engine Water Out Manifold, Both Sides
3. Low Engine Oil Pressure * (S12)	<16 psi/109 kPa**	<10 psi/68 kPa**	Behind Engine Electrical Junction Box
4. Engine Overspeed* (K8)	YES	>1980 rpm	Module, Inside Engine Electrical Box
5. High Engine Aftercooler Temperature* (S7)	>120° F/49°C**	>130° F/54°C**	Main Water Inlet Manifold
6. High Compressor Air Temp.* (S8)	YES	>248° F/120°C > >280° F/138°C** >280° F/138°C**	a. Between Airend and Receiver Tank b. Top of Receiver Tank c. In air discharge pipe
7. Alternator* (K3)	Non Charging Alarm Only	NONE	Tachometer Terminal on Alternator
8. Low Oil Pressure to Compressor Bearings (S13)	NONE	>12 psi/83 kPa	At Rear Bearing Housing

*Lamp on "Diagnostics" Panel **Separate Sensor

SECTION 4 -- PREVENTIVE MAINTENANCE

GENERAL

In addition to periodic inspections, many of the components in these units require periodic servicing to provide maximum output and performance. Servicing may consist of pre-operation and post-operation procedures to be performed by the operating or maintenance personnel. The primary function of preventive maintenance is to prevent failure, and consequently, the need for repair. Preventive maintenance is the easiest and the least expensive type of maintenance. Maintaining your unit and keeping it clean at all times will facilitate servicing.

Refer to the engine Operator's Manual furnished with the unit for the specific requirements on preventive maintenance for the engine.

SCHEDULED MAINTENANCE

It is highly recommended that a written maintenance schedule (Table, etc.) be developed and followed, considering these guidelines and the site environment. In the event unusual environmental operating conditions exist, the schedule should be adjusted accordingly.

COMPRESSOR OIL LEVEL

The oil level is most consistent when the unit is RUNNING AT FULL LOAD and should be checked at this time. The optimum operating level is midway of the sight tube on the side of the receiver tank. See the decal beside the sight tube. If the oil level is not in the "OK" range, make appropriate corrections (Add or Drain). A totally filled sight tube in which the level is not visible indicates an over-full condition and requires that oil be drained.

AIR CLEANER

This unit is equipped with AIR FILTER service (restriction) indicators on the instrument panel, covering both the engine and the compressor. These should be check daily before starting and during operation. If the window shows red with the unit operating at full speed, and remains red after the unit is shut down, servicing of the cleaner element is necessary.

Also weekly squeeze the rubber valve (precleaner dirt dump) on each air cleaner housing to ensure that they are not clogged.

NOTICE

Holes or cracks downstream of the air cleaner housing will cause the restriction indicators to be ineffective.

After servicing, the restriction indicator should be reset by pressing down on the indicator's flexible top.

To service the air cleaners proceed as follows:

1. Loosen outer wing nut and remove with outer element. Inspect red window on special inner wing nut to find small dot. If dot is not visible, remove cotter pin and special wing nut and inner (safety) element.

2. Inspect cleaner housing for any condition that might cause a leak and correct as necessary.

3. Wipe inside of air cleaner housing with a clean, damp cloth to remove any dirt accumulation, especially in the area where the element seals against the housing.

4. Inspect element by placing a bright light inside and rotating slowly. If any holes or tears are found in the paper, discard this element. If no ruptures are found, the element can be cleaned by one of the following procedures.

5. If a new air filter element is to be used check it closely for shipping damage. To reset the signal indicator in the special wing nut, apply suction to the red window.

6. Install cleaned or new elements in the reverse order to the above. Tighten wing nuts firmly and replace cotter pin.

7. Inspect to ensure that the end cap seals tightly 360 degrees around the air cleaner body.

In the event that the filter element must be reused immediately, compressed air cleaning (as follows) is recommended since the element must be thoroughly dry. Direct compressed air through the element in the direction opposite to the normal air flow through the element.

Move the nozzle up and down while rotating the element. Be sure to keep the nozzle at least one inch (25.4 mm) from the pleated paper.

NOTICE

To prevent damage to the element, never exceed a maximum air pressure of 100 psi (700 kPa).

In the event the element is contaminated with dry dirt, oil or greasy dirt deposits, and a new element is not available, cleaning can be accomplished by washing using the air cleaner element manufacturer's recommendations.

NOTICE

It is highly recommended that new replacement elements be installed in the unit immediately in order that the unit be returned to service in the shortest possible time. In this manner the elements just removed for cleaning can be washed and stored as future replacements.

In addition, the air cleaner system (housing and piping) should be inspected every month for any leakage paths or inlet obstructions. Make sure the air cleaner mounting bolts and clamps are tight. Check the air cleaner housing for dents or damage which could lead to a leak. Inspect the air transfer tubing from the air cleaner to the compressor and the engine for holes. Make sure that all clamps and flange joints are tight.

INSTRUMENTS

The gauges and lamps are essential for safety, maximum productivity and long service life of the machine. Inspect the gauges and test the diagnostic lamps prior to start-up. During operation observe the gauges and lamps for proper functioning. Refer to Section 2, Operating Controls, for the normal readings and the procedure for testing the diagnostic lamps.

BATTERY

Heavy-duty, diesel cranking type batteries were installed at the factory and these should be inspected weekly. Keep the battery posts-to-cable connections clean, tight and lightly coated with a grease. Also the electrolyte level in each cell should cover the top of the plates. If necessary, top-up with clean distilled water.

FUEL SYSTEM

Once a month, check the fuel piping, joints for leaks. Spray a solution of soap and water on joints and inspect for bubbles. If bubbles appear take corrective action to eliminate the leak. Replace flexible metal hose once a year.

CONDENSATE DRAIN VALVE

Condensate from the aftercooler and air/water separator is drained from the system by an automatic solenoid valve. The valve is located below the aftercooler and air/water separator. The valve has adjustments for duration of valve opening and interval between valve openings. These adjustments may need to be changed from the factory settings to suit the site environment and/or seasonal humidity.

AUTOMATIC ALARM / SHUTDOWN SYSTEM

NOTICE

Do NOT wire around or bypass a shutdown sensor or switch. Do NOT short-circuit fuses.

The operation of this system is extremely important in order to protect personnel, the site environment, the engine and the compressor airend. The system should be checked every month, or whenever it appears to be operating improperly. The various sensors (both alarm and shutdown), their locations, and set points are listed in Table 1 in Section 3.

Once a month, simply remove a wire from the low engine oil pressure switch to check the shutdown solenoid for proper operation.

Once a year, the temperature switches should be tested by removing from the unit. The two (2) "fusible" (non-resettable) switches can be checked visually or with an ohmmeter (0 ohms = good). The other (resettable) temperature switches must be tested with an ohmmeter.

There should be 0 ohms between the wire terminals. When the sensor is placed in the heated oil bath and its contact open, the ohmmeter should indicate infinite ohms. Replace any defective sensor before continuing to operate the unit.

The low oil pressure sensors may be tested by removing and connecting to a source of controlled pressure while observing an ohmmeter connected to the switch terminals. As pressure is applied slowly from the controlled source, the sensors should close at the set points and show continuity through the terminals. Replace a defective sensor before continuing to operate the unit.

COMPRESSOR OIL COOLER

The compressor lubricating and cooling oil is cooled by means of a shell and tube type cooler. The oil flows through the shell and is cooled by the water which flows through the tubes.

The interior surfaces of the tubes can be cleaned in several ways. Many deposits can be removed by flushing a high velocity stream of water thru them. for more stubborn deposits, wire brushes or rods can be used. If the special air or water gun is available, rubber plugs can be forced thru the tubes.

Circulate the cleaning solution until exchanger is clean. Be sure to wash out all chemicals thoroughly with clean water before returning the exchanger to service. A final flush with oil is recommended for the shell side to remove any water.

ENGINE COOLING SYSTEM

WARNING

Do not remove the cap from a HOT engine expansion tank. The sudden release of pressure from a heated cooling system can result in a loss of coolant and possible severe personal injury.

The engine cooling system is filled at the factory with a 50/50 mixture of water and ethylene glycol. this permanent type antifreeze contains rust inhibitors and provides protection to -35°F (-37°C).

The use of such a mixture is recommended for both summer and winter operation. When using water alone, be sure to add a reputable brand of rust inhibitor to prevent internal corrosion.

It is recommended to test the freezing protection of the coolant every six months or prior to freezing temperatures. Replenish with a fresh mixture every twelve months. A remote drain for the system is located at the bottom right hand side of the unit.

The engine coolant is routed to the tube side of a heat exchanger. Plant or fresh water flowing through the shell side provides the cooling.

The interior surfaces of the tubes can be cleaned in several ways. Many deposits can be removed by flushing a high velocity stream of water thru them.

For more stubborn deposits, wire brushes or rods can be used. If the special air or water gun is available, rubber plugs can be forced thru the tubes.

Both shell and tube side can be cleaned chemically by circulating cleaning solutions thru the exchanger. For most deposits a mild oakite solution is satisfactory. If scale is very hard, a weak solution of inhibited hydrochloric acid may be used. Circulate the cleaning solution until exchanger is clean. Be sure to wash out all chemicals thoroughly with clean water before returning the exchanger to service.

HOSES

Each month it is recommended that all of the intake lines to and from the air cleaners, the engine cooling system hoses and all the flexible hoses used for air, oil, and fuel be inspected.

To ensure freedom from air leaks, all rubber hose joints and the screw-type hose clamps must be absolutely tight. Regular inspection of these connections for wear or deterioration is a definite "must" if regulator servicing of the air cleaners is not to prove futile.

Premature wear of both the engine and compressor is ASSURED whenever dust-laden air is permitted to enter the engine's combustion chamber or the compressor intake practically unfiltered.

The flexible hoses used in the fuel, oil and air lines on these units are primarily used for their ability to accommodate relative movement between components. It is extremely important they be periodically inspected for wear and deterioration. Clamps are used to prevent hose cover abrasion through vibration. This abrasion may occur when two hose lines cross, or when a hose line rubs against a fixed point; therefore, it is necessary that all clamps be replaced if missing.

It is also important the operator does not use the hoses as convenient hand hold or steps. Such use can cause early cover wear and hose failure.

NOTICE

Piping systems operating at less than 150 psi (1050 kPa) may use a special nylon tubing. The associated fittings are also of a special "push-in" design. If so, features are as follows:

Pulling on the tubing will cause the inner sleeve to withdraw and compress, thus tightening the connection. The tubing can be withdrawn only while holding the sleeve against the fitting. The tubing can be removed and replaced numerous times without losing its sealing ability.

To install the nylon tubing, make a mark (with tape or grease pencil) approximately 7/8 inch from the end of the tubing. Insert the tubing into the sleeve and "push-in" past the first resistance to the bottom.

The mark should be approximately 1/16 inch from the sleeve, for the 3/8 inch O.D. tubing; 1/8 inch for the 0.25 inch O.D. tubing. This will ensure that the tubing is fully engaged in the sealing mechanism.

COMPRESSOR OIL FILTERS

The compressor lubrication and cooling oil system includes dual, spin-on (throw away) type oil filters, each with an internal bypass valve. With a clean, new filter element, all of the oil flows through the full element area, from the outside to the inside.

As each element becomes contaminated with dirt, a pressure differential is created in the filter housing between the oil inlet and outlet ports. As this differential approaches 25 psi (175 kPa), the bypass valve starts to open, thus permitting a small quantity of oil to bypass the filter. As the contaminants continue to build up, more and more of the oil bypasses the filter media itself.

This does not provide any filtration but does allow a maximum flow of compressor lubricating and cooling oil to preclude any possible damage from loss of oil. Also the design of the filter prevents any washing-off of any dirt during oil bypass.

RECEIVER -- SEPARATOR SYSTEM

In the compressor lubricating and cooling system, separation of the oil from the compressed air takes place in the receiver-separator tank. As the compressed air enters the tank, the change in velocity and direction drop out most of the oil from the air.

Additional separation takes place in the oil separator element which is located in the top of the tank. Any oil accumulation in this separator element is continuously drained off by means of a scavenge tube which returns the accumulated oil to the system.

To add or drain oil:

WARNING

High pressure air can cause severe injury or death from hot oil and flying parts. Always relieve pressure before removing caps, plugs, covers or other parts from pressurized air system.

* Open manual blowdown valve on top of separator tank.

* Ensure pressure is relieved, with BOTH:
  -- Discharge air pressure gauge reads zero (0)

  -- No air discharging from blowdown valve.

* When draining oil, turn remote drain quarter-turn valve located in frame below instrument and control panel.

* When adding oil, remove and replace (make tight) plug on side of separator tank.

The life of the oil separator element is dependent upon the operating environment (soot, dust, etc.) and should be replaced whenever the restriction indicator on the separator tank cover shows "red".

To replace the element proceed as follows:

* Ensure the tank pressure is zero.
* Disconnect the hose from the scavenge tube.
* Remove scavenge tube from tank cover.
* Disconnect service line from cover.
* Remove cover mounting screws.
* Remove cover, element and inner shell.
* Remove any gasket material left on cover or tank.
* Install new gasket, inner shell and new element.

NOTICE

Do not remove staples from the element-to-gasket connection.

* Place a straightedge across top of element and measure from bottom of straightedge to bottom of element (See Fig. 4.1).
* Replace scavenge tube in cover (cover is still off of tank).
* Measure from bottom of cover to end of scavenge tube (see Fig. 4.2). Measurement should be from 1/8" to 1/4" less than the element measurement. If not, cut to size.
* Remove scavenge tube.
* Reposition cover (use care not to damage gaskets).
* Replace cover mounting screws; tighten in a crisscross pattern to 100 lbs.-ft.
* Reconnect service line. Replace scavenge tube. Reconnect hose.
* Close service valve. Start unit and look for leaks.

When replacing the element, the scavenge lines, orifice, filter, and check valve should be thoroughly cleaned and the oil changed.

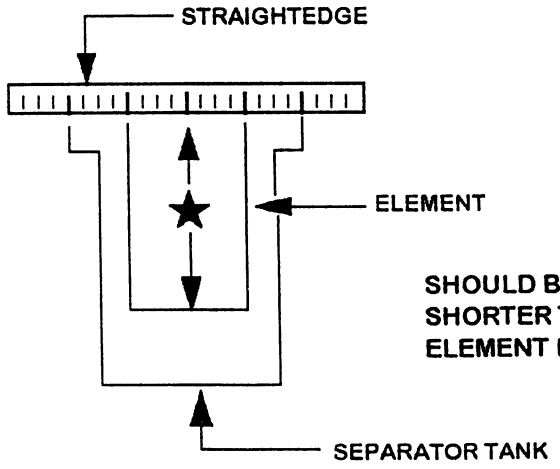


Figure No. 4.1
Element Measurement

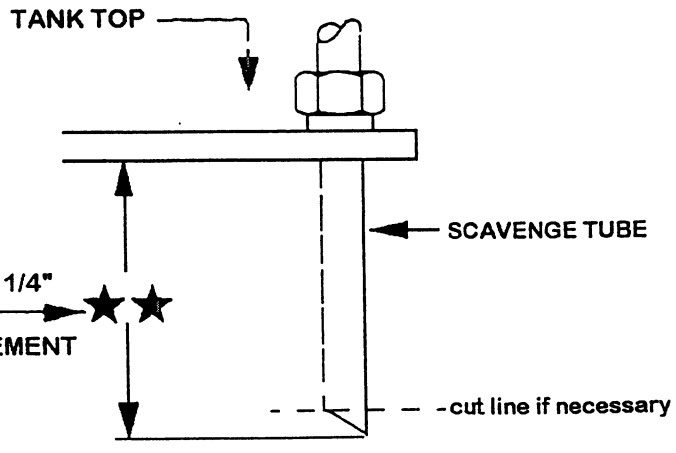


Figure No. 4.2
Tube Measurement

SCAVENGE LINE

WARNING

High pressure air can cause severe injury or death from hot oil and flying parts. Always relieve pressure before removing caps, plugs, covers or other parts from pressurized air system.

The scavenge line originates at the receiver-separator tank cover and terminates at the compressor airend through an orifice (.063 inch/1.6 mm).

Once a year or every 2000 hours of operation, whichever comes first, remove this line and any orifice, thoroughly clean, then reassemble.

NOTICE

Excessive oil carry-over may be caused by an oil-logged separator element. Do not replace element without first performing the following maintenance procedure:

1. Check oil level. Maintain as indicated earlier in this section.
2. Thoroughly clean scavenge line, any orifice and check valve.
3. Assure minimum pressure valve (if so equipped) has proper setting.
4. Run unit at rated operating pressure for 30 to 40 minutes to permit element to clear itself.

EXTERIOR FINISH CARE

This unit was painted at the factory with a high quality acrylic modified alkyd enamel. The following care will ensure the longest possible life from this finish.

1. Allow 30 days, if possible, before washing with anything but clean water. If necessary to remove dust, pollen, etc. from housing, rinse off with only a hose. Do not scrub with a rough cloth, pad, etc.
2. Do not use strong solvents or harsh abrasive cleaners to remove road film or tar. Use only mild tar removers or mild household detergents or detergents especially for automotive finishes.
3. If necessary to remove oxidized pigment and restore the gloss, do not use coarse rubbing compound. Use any automotive polish or wax.

SECTION 5 -- LUBRICATION

Contents **Page**

GENERAL INFORMATION

Lubrication is an essential part of preventive maintenance, affecting to a great extent the useful life of the unit. Different lubricants are needed and some components in the unit require more frequent lubrication than others. Therefore, it is important that the instructions regarding types of lubricants and the frequency of their application be explicitly followed. Periodic lubrication of the moving parts reduces to a minimum the possibility of mechanical failures.

The lubrication chart in Section 5 shows those items requiring regular service and the interval in which they should be performed. A regular service program should be developed to include all items and fluids. These intervals are based on average operating conditions. In the event of extremely severe (hot, cold, dusty or wet) operating conditions, more frequent lubrication than specified may be necessary. Details concerning lubrication of the package ventilation fan are in Section 4 - Maintenance.

All filters and filter elements for air and compressor lubricant must be obtained through Ingersoll-Rand to assure the proper size and filtration for the compressor.

COMPRESSOR OIL CHANGE

These units are normally furnished with an initial supply of oil sufficient to allow operation of the unit for 3000 hours. However, if for some reason the unit has been completely drained of oil, it must be refilled with new oil before it is placed in operation. Refer to specifications in the table in Section 5.

NOTICE

Some oil types are incompatible when mixed and result in the formation of varnishes, shellacs, or lacquers which may be insoluble. Such deposits can cause serious troubles including clogging of the filters. Where possible, do not mix oils of different types and avoid mixing different brands. A type or brand change is best made at the time of a complete oil drain and refill.

If the unit has been operated for 3000 hours, it should be completely drained of oil. If the unit has been operated under adverse conditions, or after long periods in storage, an earlier change period may be necessary as oil deteriorates with time as well as by operating conditions.

Complete replacement of the old oil with clean new oil every 3000 operating hours (or every six months, whichever comes first), depending upon operating conditions, is not only desirable, but is good insurance against the accumulation of dirt, sludge, or oxidized oil products.

WARNING

High pressure air can cause severe injury or death from hot oil and flying parts. Always relieve pressure before removing caps, plugs, covers or other parts from pressurized air system. Ensure the following conditions are met:

--Discharge air pressure gauge reads zero (0).

--No air discharging from manual blowdown valve.

Completely drain the receiver-separator, piping, and oil cooler. If the oil is drained immediately after the unit has been run for some time, most of the sediment will be in suspension and, therefore, will drain more readily. However, the fluid will be hot and care must be taken to avoid contact with the skin or eyes.

After the unit has been completely drained of all old oil, close the drain valve. Add oil in the specified quantity at the filler plug. Tighten the filler plug and run the machine to circulate the oil. Check the oil level WHEN RUNNING AT FULL LOAD. If not within the "OK" range, stop the unit and make corrections. DO NOT OVERFILL OR OPERATE IN THE "ADD" RANGE.

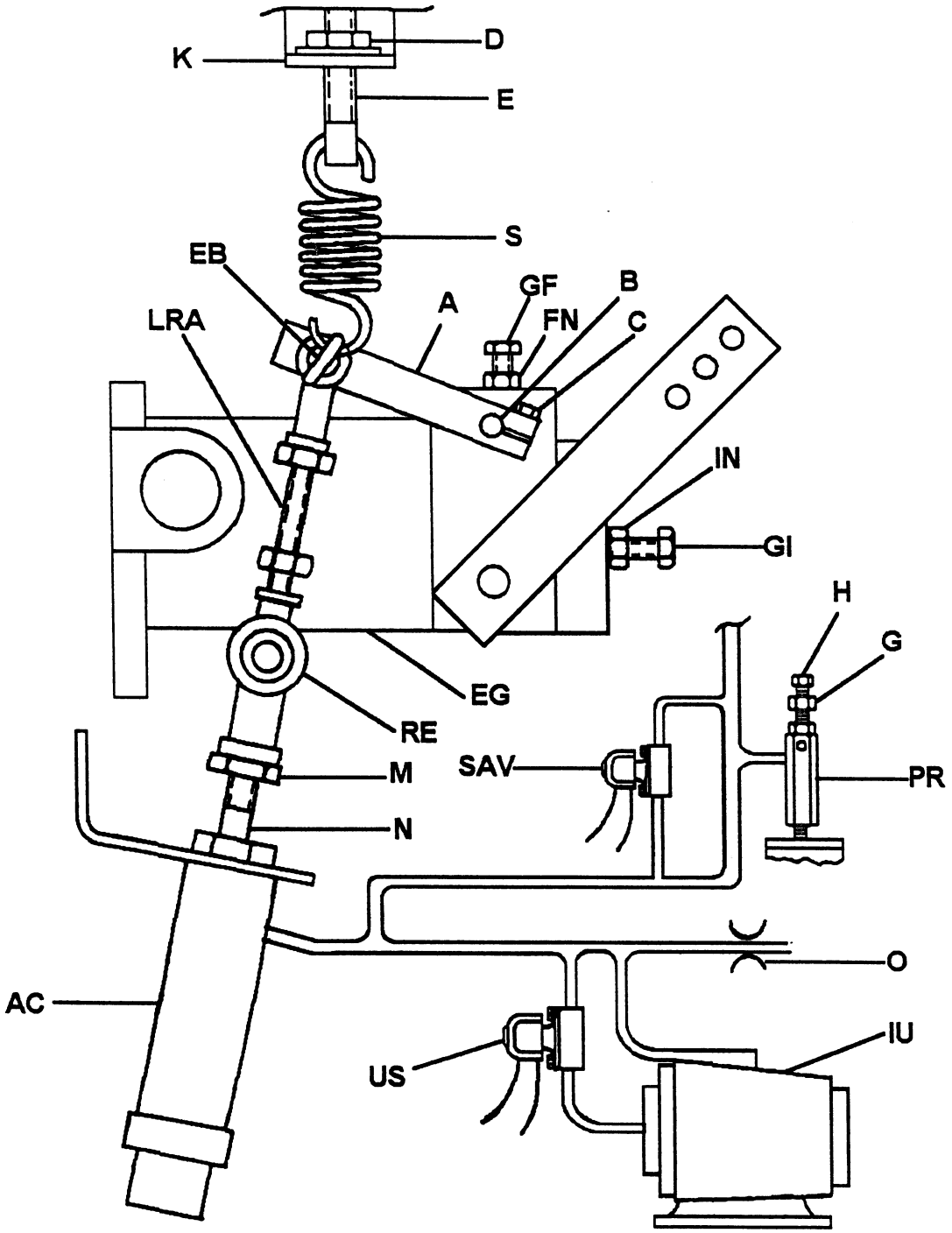
FLUIDS AND LUBRICANTS TABLE

ITEM	FLUID	AMBIENT TEMP.	SPECIFICATION	INTERVAL
Compressor	Lubricant	125°F to -10°F (52°C to -23°C)	• SSR ULTRA COOLANT	3000 hours
		-10°F to -50°F (-23°C to -46°C)	• MIL-L-23699B Synthetic	1000 hours
			• MIL-L-46167 Sub-Zero Arctic	1000 hours
Engine	• Oil • Coolant • Fuel	Refer to Engine Operator's Manual or Manufacturer's Representative		

DEXRON® -- Reg. T.M. of General Motors Corp.

*Or every six months, whichever comes first.

SECTION 6 -- PRESSURE REGULATION ADJUSTMENT



AC	= Air Cylinder	EG	= Engine Governor	RE	= Air Cyl. Rod End	FN	= Full Speed Jam Nut
US	= Unloader Solenoid	PR	= Pressure Regulator	EB	= Eye Bolt	FI	= Idle Speed Jam Nut
IU	= Inlet Unloader	LRA	= Link Rod Assembly	GF	= Governor Full Speed Screw		
SAV	= Start/Run Solenoid Valve			GI	= Governor Idle Speed		

Normally, regulation requires no adjusting, but if proper adjustment is lost, proceed as follows:

BEFORE STARTING UNIT

1. At engine governor, (EG), check the position of throttle arm (A) on governor shaft (B). This is done by loosening screw (C) that clamps the throttle arm (A) to the shaft (B).
2. Compress air cylinder (AC) shaft to the idle position (fully retracted). Attach link rod assembly (LRA) to air cylinder rod end (RE) with 1/4" screw, washers and nut.

3. Attach other end of link rod assembly (LRA) to throttle arm (A) with eye bolt (EB) using two (2) 1/4" washers and two (2) 1/4" - 20 nuts.

Note: Link rod assembly (LRA) should be adjusted to 4.50" long from center of rod end to center of rod end before assembly.

4. On top of separator tank at pressure regulator (PR) loosen jam nut (G) on adjustment screw (H). Turn screw counterclockwise until no tension is felt on screw. Now turn screw clockwise one full turn.

5. Start the unit following the steps listed in the operating instructions.

6. Allow unit to warm up, then push "service air" button on control panel.

7. Open and adjust service valve on outside of unit to obtain the rated operating pressure* on the discharge pressure gauge.

Note: If the rated operating pressure* cannot be maintained with engine at full load speed* and rod (N) fully extended, adjust regulator screw (H) clockwise until rated operating pressure can be obtained with engine at full speed.

8. Insure that pressure is maintained at 5 psig less than rated pressure*, then adjust regulator screw (H) until air just starts to flow out of the regulation orifice (O). It is normal for this to bleed air at unload and partial load.

Note: Adjusting regulator screw (H) clockwise will raise pressure at full speed.

9. Adjust jam nut (D) on throttle spring rod (E) to extend spring (S) until the spring is extended to a length of 5.75" overall from hook to hook.

10. Close service valve (engine will slow to no load or idle speed*). To obtain no load or idle speed adjust the governor idle screw (GI) in or out as required till the correct no load speed* is reached. Tighten jam nut (IN) when speed is set.

11. If necessary, repeat steps 7 and 8.

12. At pressure regulator (PR) tighten jam nut (G).

13. Limit full load engine speed* by adjusting the governor full load speed screw (GF). Clockwise decreases full load speed, counterclockwise increases speed. Tighten jam nut (FN) when speed is set.

    It is normal for the system to cycle 4 - 5 times after a step change in load (air demand). However, if more cycling occurs with a partial load, tighten jam nut (D) to further extend spring (S) until surging stops.

14. To obtain maximum cfm at any pressure between 80 psi (550 kpa) and the rated operating pressure*, change adjustment of screw (H) to obtain desired discharge pressure at full load engine speed. Always lock and protect pressure setting of adjusting screw (H) with jam nut (G).

15. Insure that unloader solenoid (US) acts to hold pressure in inlet unloader (IU) after shutdown. After start-up a pressure switch will open unloader solenoid (US).

* Refer to general data.

SECTION 7 -- TROUBLE SHOOTING

Contents **Page**

INTRODUCTION

Trouble shooting for this piece of machinery is an organized study of a particular problem or series of problems and a planned method of procedure for investigation and correction. The trouble shooting chart that follows includes some of the problems that an operator may encounter during the operation of an INGERSOLL-RAND rotary compressor.

The chart does not attempt to list all of the troubles that may occur, nor does it attempt to give all of the answers for correction of the problems. The chart does give those problems that are most apt to occur. To use the trouble shooting chart:

A. Find the "complaint" in the top horizontal line.
B. Follow down that column to find the potential cause or causes. The numbers (1, 2, 3 etc.) suggest an order to follow in trouble shooting.
C. A reference for most causes is indicated in the extreme right column and the footnotes. For example, "M" stands for Maintenance - Section 4 in this manual.

ACTION PLAN

A. Think Before Acting

Study the problem thoroughly and ask yourself these questions:

(1) What were the warning signals that preceded the trouble?
(2) Has a similar trouble occurred before?
(3) What previous maintenance work has been done?
(4) If the compressor will still operate, is it safe to continue operating it to make further checks?

B. Do The Simplest Things First

Most troubles are simple and easily corrected. For example, most complaints are "low capacity" which may be caused by too low an engine speed or "compressor over-heats" which may be caused by low oil level.

Always check the easiest and most obvious things first; following this simple rule will save time and trouble.

Note: For trouble shooting electrical problems, refer to the Wiring Diagram Schematic found in Section 9 - Parts List.

C. Double Check Before Disassembly

The source of most compressor trouble can be traced not to one component alone, but to the relationship of one component with another. Too often, a compressor can be partially disassembled in search of the cause of a certain trouble and all evidence is destroyed during disassembly. Check again to be sure an easy solution to the problem has not been overlooked.

D. Find and Correct Basic Cause

After a mechanical failure has been corrected, be sure to locate and correct the cause of the trouble so the same failure will not be repeated. A complaint of "premature breakdown" may be corrected by repairing any improper wiring connections, but something caused the defective wiring. The cause may be excessive vibration.

SAFETY AND SHUTDOWN SYSTEM THEORY OF OPERATION

Lowest Explosive Limit (LEL) DETECTOR SYSTEM -- A natural gas leak detector system has been incorporated into the Ingersoll-Rand control panel on compressor models with complete enclosure panels.

The detector module activates at 25% concentration of the lowest inflammable limit of methane which has a LEL of 5% by volume or 50,000 parts per million.

When the Main Engine Switch at the Engine Junction Box, located on the side of the engine, is "ON" the LEL detector is powered up and performs a 2 minute warmup period while its red LED is lit, transferring to a green LED when ready. At the same time, and when the fan box AC power cord is connected, the exhaust fan comes on. this fan air flow activates an air flow switch which is required for the LEL alarm system to be "reset" by the reset push button above the Ingersoll-Rand Control Panel.

This alarm condition must be reset before the engine can be started.

PRE-START FRESH AIR PURGE CYCLE

The natural gas engine is equipped with an automatic pre-start fresh air purge circuit which initiates an adjustable crank motor run period of 0.1 to 10 seconds each time the panel "ON-OFF" switch is turned from "OFF" to "ON" and the bypass and start push buttons are simultaneously depressed. During each purge cycle interval the main gas valve is "OFF" (de-energized) and the engine magneto is shorted to ground. The purge cycle is to be performed on each new startup and on restart from a shutdown. The fresh air purge on restart after running is also used to lower the inner surface temperatures of the exhaust piping to below auto ignition temperature of natural gas (approx. 900°F).

STARTING ENGINE

- Ingersoll-Rand control panel switches off. Main engine switch remains in "RUN" position. 120 VAC power connector to fan box, fan running, then reset LEL alarm light to "DARK" ("OFF") if triggered.

- At the Ingersoll-Rand control panel turn panel power switch to "ON".

Comments -- All diagnostic lights go "ON" for lamp test then fade out to only the alarming points displayed.
-- Condensate drain valve cycle timer is energized.

- When the ambient temperature is below 40°F (4°C), push the Auxiliary Compressor button located above the instrument/control panel or on top of the receiver/separator tank for fifteen (15) seconds. This operates the 24 volt compressor unit which pressurizes the unloader and thus keeps the inlet valve closed for easier startup.

- Press by-pass push button and hold

Comments:--By-pass push button resets diagnostic panel
-- Seals KSA to energize the normally open service air valve
-- Energizes K2 & K1D relays and supplies 24 VDC to the compressor safety switch series train
-- Interrupts 24 VDC power to OPS2 thus to the normally open unloader solenoid valve K6 TD to S15 by-pass contacts.
-- Low oil press, alternator, low flow lights should be "ON".

- Still holding by-pass push button down, press "START" push button to obtain crank function.

Comments -- Following the exclusive excursion of S1 from "OFF" to "ON" will initiate the purge time delay for the <u>first</u> crank command of this start cycle.
-- By-pass and start push buttons can be released during this auto purge crank time.

- Upon completion of purge crank time, again press by-pass, hold, then press "START" again for no more than 10 seconds. If not started allow a 30 second cooling period with buttons released. Then press by-pass with start again for up to 10 seconds. If engine does not start after 5 trials then search for the problem per Section 7 -- Troubleshooting.

TROUBLE SHOOTING I-R PORTABLE COMPRESSOR

CAUSE \ COMPLAINT	Short Air Cleaner Life	Excessive Oil In Air	Oil Seal Leak	Oil In Air Cleaner	Excessive Comp. Oil Temperature	Engine RPM Down	Will Not Unload	Safety Valve Relieves	Low CFM	Unit Shutdown	Unit Fails To Shutdown	Excessive Vibration	Won't Start/Run	Alternator Lamp Stays On	Alternator Lamp Stays Off	Engine Temp. Lamp Stays On	Engine Temp. Lamp Stays Off	Engine Oil Press. Lamp Stays Off	Engine Oil Press. Lamp Stays On	*REFER TO: SECTION
Dirty Operating Conditions	1		1		6				3						5					M
Wrong Air Filter Element	6					8			13											P
Defective Service Indicator	3																			P
Inadequate Element Cleaning	2								4											M
High Oil Level		1																		M
Out Of Level > 15°		2			2										7			3		O
Clogged Scavenge Orifice		3																		M
Defective Separator Element		8				9		7	12											P
Scavenge Tube Blocked		4																		M
Defective Scavenge Check Valve		5																		M
Defective Minimum Pressure Valve		7			14				11											P
Contaminated Lube Oil			2																	M
Malfunctioning Seal			6																	P
Scored Shaft			7																	P
Malfunctioning Inlet Unloader	5			3			5	6	9											P
Incorrect Stopping Procedure	4			1																O
Dirty Cooler					5										6					M
Low Oil Level					3													2		M
Clogged Oil Filter Elements					7													5		M
Wrong Lube Oil			3		4													4		L
Malfunctioning Thermostat					12															P
Defective Oil Cooler Relief Valve					13															P
Recirculation Of Cooling Air					10										11					RA
Operating Pressure Too High			5		9	2		1	8						9					O/A
Loose Or Broken Belts					8							1		1	8					M/P
Blocked Or Restricted Oil Lines			4		15													6		—
Incorrect Linkage Adjustment						5			5											A
Clogged Fuel Filters						1							5							EM
Incorrect Pressure Regulator Adjustment						3	3	3	6											A
Ruptured Inlet Unloader Diaphragm				2			2	5												P
Defective Discharge Air Temp. Switch										7	1		11							P/M
Defective Engine Belt Break Switch										8	2		12			3	4			P/M
Defective Engine Oil Pressure Switch										9	3		13					3		P/M
Defective Shutdown Solenoid										10	4		14							P/M
Malfunctioning Relay										11	5		15							P/M
Loose Wire Connection										6			10	2	2		2			W/P
Blown Fuse										1			3							P
Low Battery Voltage													2	3						—
Malfunctioning Start Switch													4							P
Defective Safety Bypass Switch											6		16							P
< 9 Volts At Shutdown Solenoid										12			1							—
Malfunctioning Alternator														4						P
Bulb Burnt Out															1		1	1		P
Broken Engine Fan Belt										4			8			1				M
Malfunctioning Circuit Board														5	3	2	3	2		P
Ambient Temp. >125°F (52°C)					1											4				RA
Ice In Regulation Lines/Orifice						10	6	8	14											RA
Sep. Tank Blown Down Too Quickly		6																		O
Dirty Air Filter						6			1											M
Malfunctioning Pressure Regulator						4	4	4	7											P
Malfunctioning Air Cylinder						7			10											P
Leaks In Regulator Piping							1	2	2											—
Compressor Oil Temp. Too High										3			7							TC
Engine Water Temp. Too High										4			8							TC
Engine Oil Pressure Too Low										5			9							TC
Out Of Fuel										2			6							—
Malfunctioning Fan					12							3						9		P
Rubber Mounts Damaged												2								P
Engine Malfunctioning						11				14		5	18					12	7	EM
Drive Coupling Defective												4								P
Airend Malfunctioning					17	12						6	19							P
Defective Safety Valve								9												P

Numbers (1, 2, 3, Etc.) Suggest Order To Follow In Cause Trouble Shooting

*M – Maintenance (5) O – Operating (4) RA – Review Application EM – Engine Manual TC – Trouble Complaint
P – Parts (10) L – Lubrication (6) A – Adjustments (7) W – Wiring Diagram (10)

SECTION 8 -- PARTS ORDERING INFORMATION

CONTENTS PAGE

General

This publication, which contains an illustrated parts breakdown, has been prepared as an aid in locating those parts which may be required in the maintenance of the unit. All of the compressor parts, listed in the parts breakdown, are manufactured with the same precision as the original equipment. For the greatest protection always insist on genuine Ingersoll-Rand Company parts for your compressor.

NOTICE

Ingersoll-Rand Company can bear no responsibility for injury or damages resulting directly from the use of non-approved repair parts.

Ingersoll-Rand Company service facilities and parts are available worldwide. There are Ingersoll-Rand Company Construction Equipment Group Sales Offices and authorized distributors located in the principle cities of the United States. In Canada our customers are serviced by the Canadian Ingersoll-Rand Company, Limited. There are also Ingersoll-Rand International autonomous companies and authorized distributors located in the principal cities throughout the free world.

All parts orders pertaining to your engine should be referred to your particular engine manufacturer's authorized distributor or dealer.

DESCRIPTION

The illustrated parts breakdown illustrates and lists the various assemblies, subassemblies and detailed parts which make up this particular air compressor. This includes the standard unit along with some of the options that are available. A series of illustrations show each part clearly and in its correct location relative to the other parts in the illustration. The part number, the description of the part, the quantity of parts required, and the part number of the next higher assembly in which a particular part is used are shown on each illustration. The quantities specified are the number of parts used per one assembly and are not necessarily the total number of parts used in the overall unit. Where no quantity is specified the quantity is assumed to be one.

Each description of a part is based upon the "noun-first" method, i.e., the identifying noun or item name is always the first part of the description. In the event the item is an assembly or sub-assembly, the abbreviation "assy" or "subassy" follows the noun name. If the previous conditions do not exist, the noun name is followed by a single descriptive modifier. The descriptive modifier may be followed by words or abbreviations such as upper, lower, inner, outer, front, rear, RH, LH, etc. when they are required to modify the part noun.

In referring to the rear, the front or to either side of the unit, always consider the flywheel end of the engine as the rear of the unit. Standing at the rear of the unit facing the flywheel end of the engine, will determine the right and left sides.

FASTENERS

Both SAE/inch and ISO/metric hardware have been used in the design and assembly of these units. In the disassembly and reassembly of parts, extreme care must be taken to avoid damaging threads by the use of wrong fasteners. In order to clarify the proper usage and for exact replacement parts, all standard fasteners have been identified by part number, size and description. This will enable a customer to obtain fasteners locally rather than ordering from the factory. These parts are identified in tables that will be found at the rear of the parts illustrations. Any fastener that has not been identified by both part number and size is a specially engineered part that must be ordered by part number to obtain the exact replacement part. Refer to Section 10 -- Common Fasteners.

MARKINGS AND DECALS

NOTICE

Do not paint over safety warnings or instructional decals. If safety warning decals become illegible, immediately order replacements from the factory.

Part numbers for sets of original-type exterior markings (IR logotype etc.) and warnings/instructional decals are listed on the index page of Section 9 - Parts List. Part numbers for original individual decals and their mounting locations are shown within Section 9 - Parts List. These are available as long as a particular model is in production.

Afterwards, service sets of exterior decals and current production safety warning decals are available. Contact the Product Support Group at Mocksville for your particular needs and availability.

HOW TO USE PARTS LIST

a. Turn to Section 9 - Parts List.

b. Locate the area or system of the compressor in which the desired part is used and find illustration page number.

c. Locate the desired part on the illustration by visual identification and make note of part number and description.

HOW TO ORDER

The satisfactory ordering of parts by a purchaser is greatly dependent upon the proper use of all available information. By supplying your nearest sales office, autonomous company or authorized distributor, with complete information, you will enable them to fill your order correctly and to avoid any unnecessary delays.

In order that all avoidable errors may be eliminated, the following instructions are offered as a guide to the purchaser when ordering replacement parts:

a. Always specify the model number of the unit as shown on the general data decal attached to the unit.

b. Always specify the serial number of the unit. THIS IS IMPORTANT. The serial number of then unit will be found stamped on a plate conspicuously attached to the unit. (This number is also stamped on a tag attached to the frame side rail.)

c. Always specify the number of the parts list publication.

d. Always specify the quantity of parts required.

e. Always specify the part number, as well as the description of the part, or parts, exactly as it is given on the parts list illustration.

In the event parts are being returned to your nearest sales office, autonomous company or authorized distributor, for inspection or repair, it is important to include the serial number of the unit from which the parts were removed.

TERMS AND CONDITIONS ON PARTS ORDERS

Acceptance: Acceptance of an offer is expressly limited to the exact terms contained herein. If purchaser's order form is used for acceptance of an offer, it is expressly understood and agreed that the terms and conditions of such order form shall not apply unless expressly agreed to by Ingersoll-Rand Company ("Company") in writing. No additional or contrary terms will be binding upon the Company unless expressly agreed to in writing.

Taxes: Any tax or other governmental charge now or hereafter levied upon the production, sale, use or shipment of material and equipment ordered or sold is not included in the Company's price and will be charged to and paid for by the Purchaser.

Delivery: Shipping dates are approximate. The Company will use best efforts to ship by the dates specified; however, the Company shall not be liable for any delay or failure in the estimated delivery or shipment of material and equipment or for any damages suffered by reason thereof.

Shipping dates shall be extended for delays due to acts of God, acts of Purchaser, acts of Government, fires, floods, strikes, riot, war, embargo, transportation shortages, delay or default on the part of the Company's vendors, or any other cause beyond the Company's reasonable control.

Should Purchaser request special shipping instruction, such as exclusive use of shipping facilities, including air freight when common carrier has been quoted and before change order to purchase order can be received by the Company, the additional charges will be honored by the Purchaser.

Warranty: The Company warrants that parts manufactured by it will be as specified and will be free from defects in materials and workmanship. The Company's liability under this warranty shall be limited to the repair or replacement of any part which was defective at the time of shipment provided Purchaser notifies the Company of any such defect promptly upon discovery, but no event later than three (3) months from the date of shipment of such part by the Company. The only exception to the previous statement is the extended warranty as it applies to the special airend exchange program.

Repairs and replacements shall be made by the Company F.O.B. point of shipment. The Company shall not be responsible for costs of transportation, removal or installation.

Warranties applicable to material and equipment supplied by the Company but wholly manufactured by others shall be limited to the warranties extended to the Company by the manufacturer which are able to be conveyed to the Purchaser.

THE COMPANY MAKES NO OTHER WARRANTY OR REPRESENTATION OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES, INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE HEREBY DISCLAIMED.

Limitation of Liability:

The remedies of the Purchaser set forth herein are exclusive, and the total liability of the Company with respect to this order whether based on contract, warranty, negligence, indemnity, strict liability or otherwise, shall not exceed the purchase price of the part upon which such liability is based.

The Company shall in no event be liable to the Purchaser, any successors in interest or any beneficiary of this order for any consequential, incidental, indirect, special or punitive damages arising out of this order or any breach thereof, or any defect in, or failure of, or malfunction of the parts hereunder, whether based upon loss of use, lost profits or revenue, interest, lost goodwill, work stoppage, impairment of other goods, loss by reason of shutdown or non-operation, increased expenses of operation or claims of customers of Purchaser for service interruption whether or not such loss or damage is based on contract, warranty, negligence, indemnity, strict liability or otherwise.

AIREND EXCHANGE PROGRAM

Your Ingersoll-Rand Company Construction Equipment Group Sales Offices and authorized distributors as well as Ingersoll-Rand International autonomous companies and authorized distributors now have an airend exchange program to benefit portable compressor users.

On the airend exchange program the exchange price is determined by the age and condition of the airend and may be classified by one of the following categories.

Category "A": The airend must not be over two years old and must have reusable rotor housing(s) and rotor(s).

Category "B": The airend must be between two and five years old and returned with two or more reusable major castings.

Category "C": The airend must be over five years old.

Your nearest sales office, autonomous company or authorized distributor must first contact the Parts Service Department at the factory at which your portable air compressor was manufactured for an airend exchange number. The airend must be tagged with this preassigned number and returned to the factory prepaid. The airend must be intact, with no excluded parts, otherwise the exchange agreement may be canceled. The warranty on an exchange or factory rebuilt airend is 365 days.

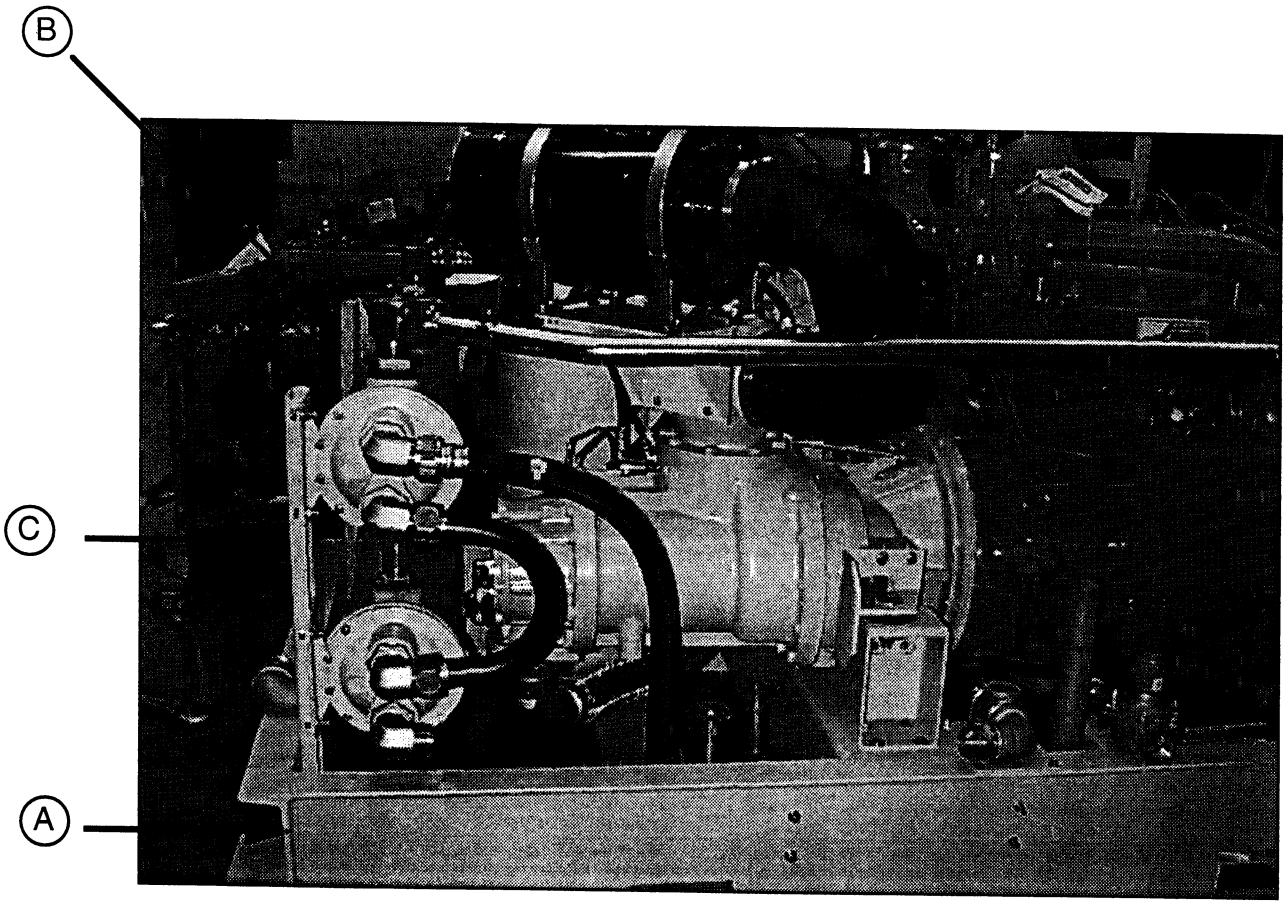
NOTICE

Airends being returned to the factory in connection with a WARRANTY CLAIM must be processed through the Customer Service Department. If returned without a Warranty MRR (Material Return Request) Number, no warranty claim will be considered.

SECTION 9 -- PARTS LIST

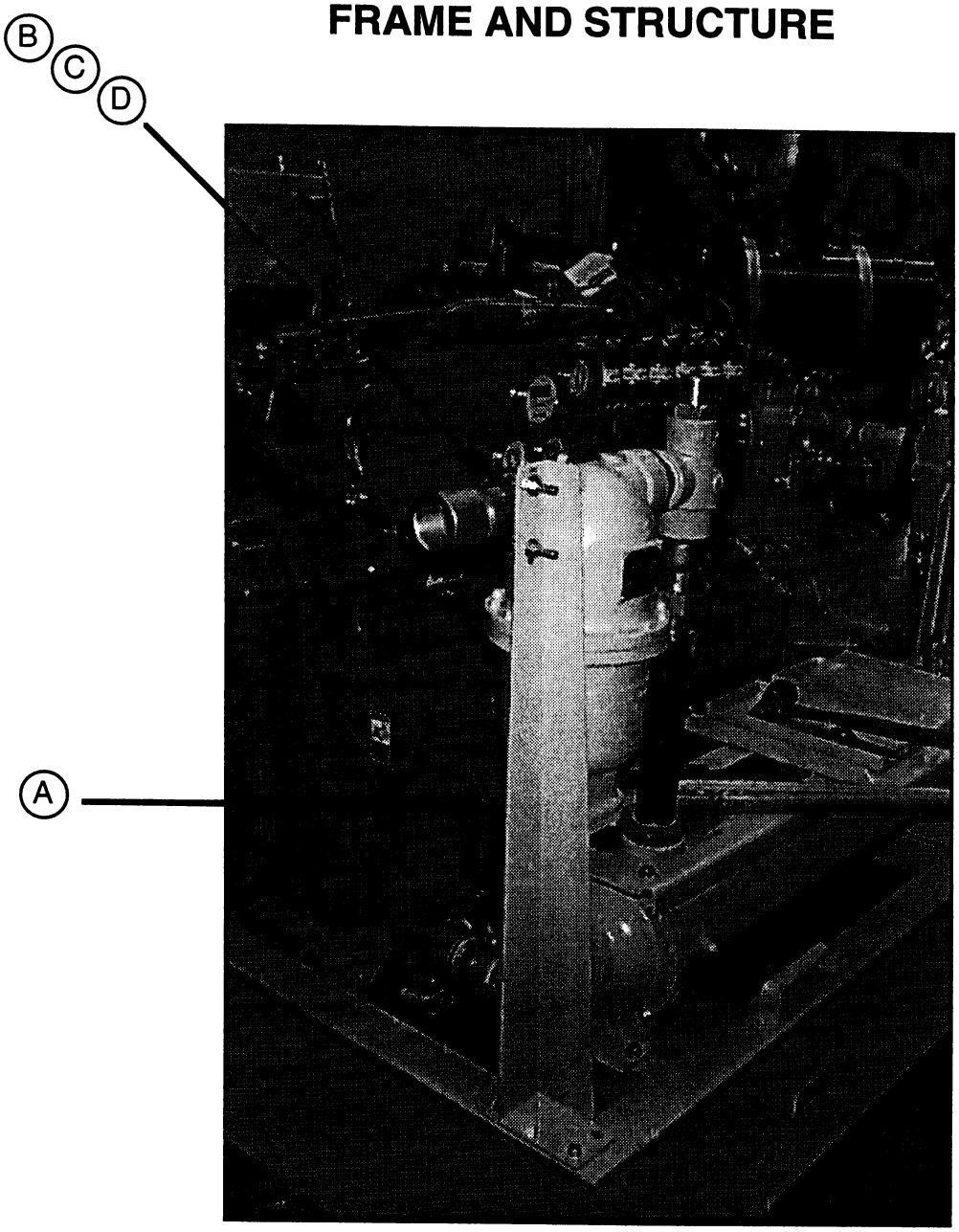
CONTENTS

FRAME AND STRUCTURE



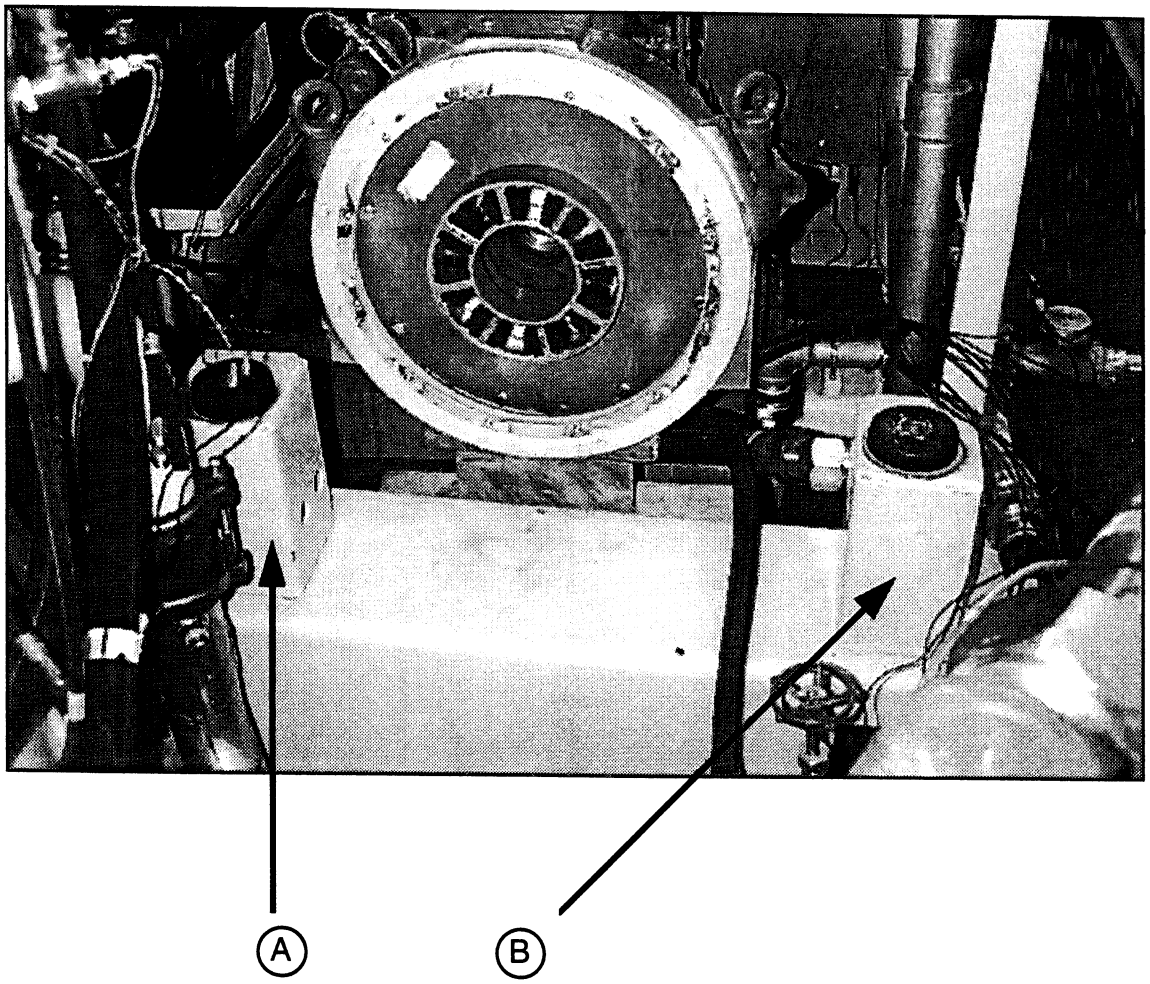
ITEM	PART NUMBER	DESCRIPTION
A	43200021	Mounting Base
B	43201789	Cooler Support, Left
C	43201797	Cooler Support, Right

FRAME AND STRUCTURE



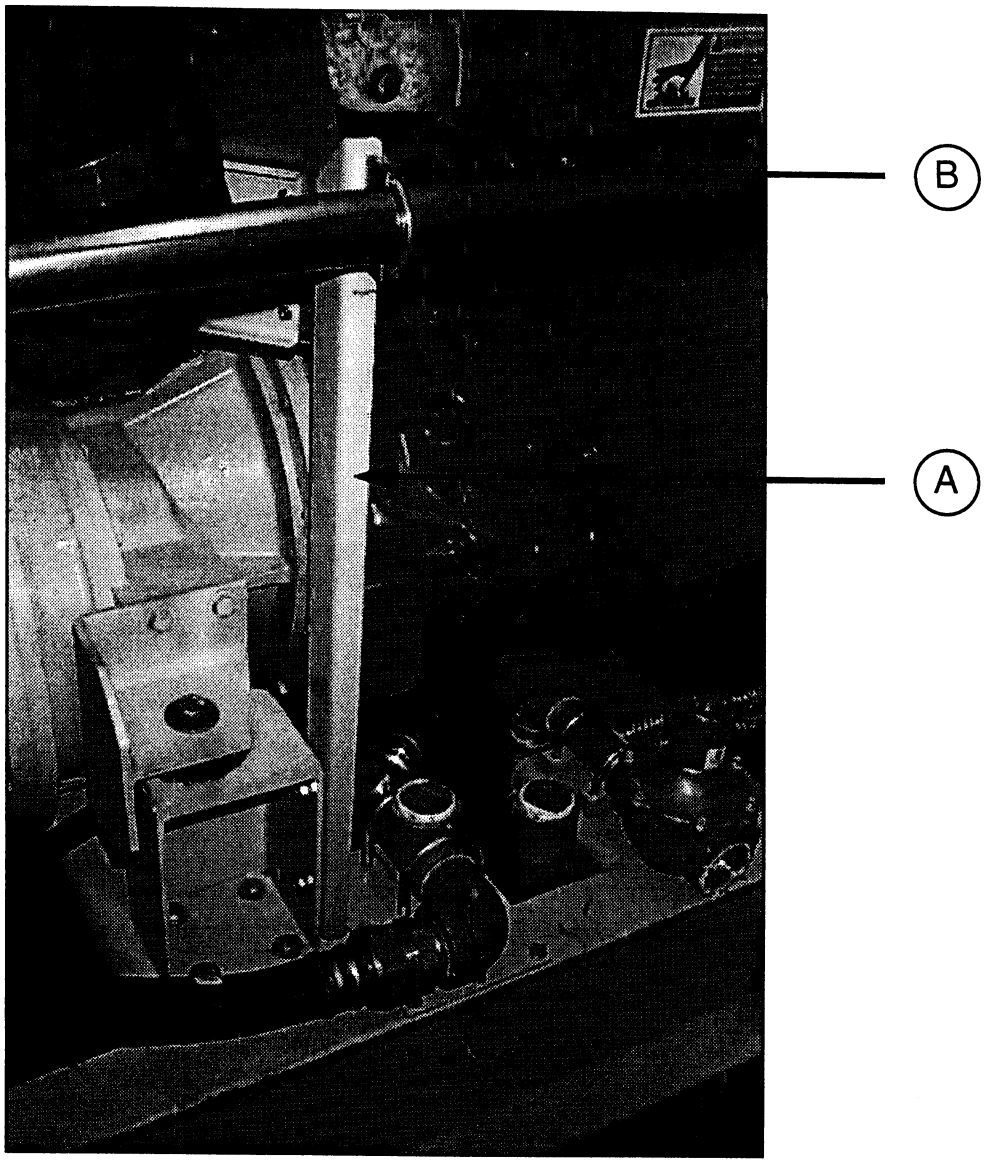
ITEM	PART NUMBER	DESCRIPTION
A	43200039	Pipe Support
B	35586288	U Bolt, 1/2 -13
C	95922902	Nut, 1/2 - 13 (2 Req'd)
D	95934931	Washer, 1/2 (2 Req'd)

FRAME AND STRUCTURE



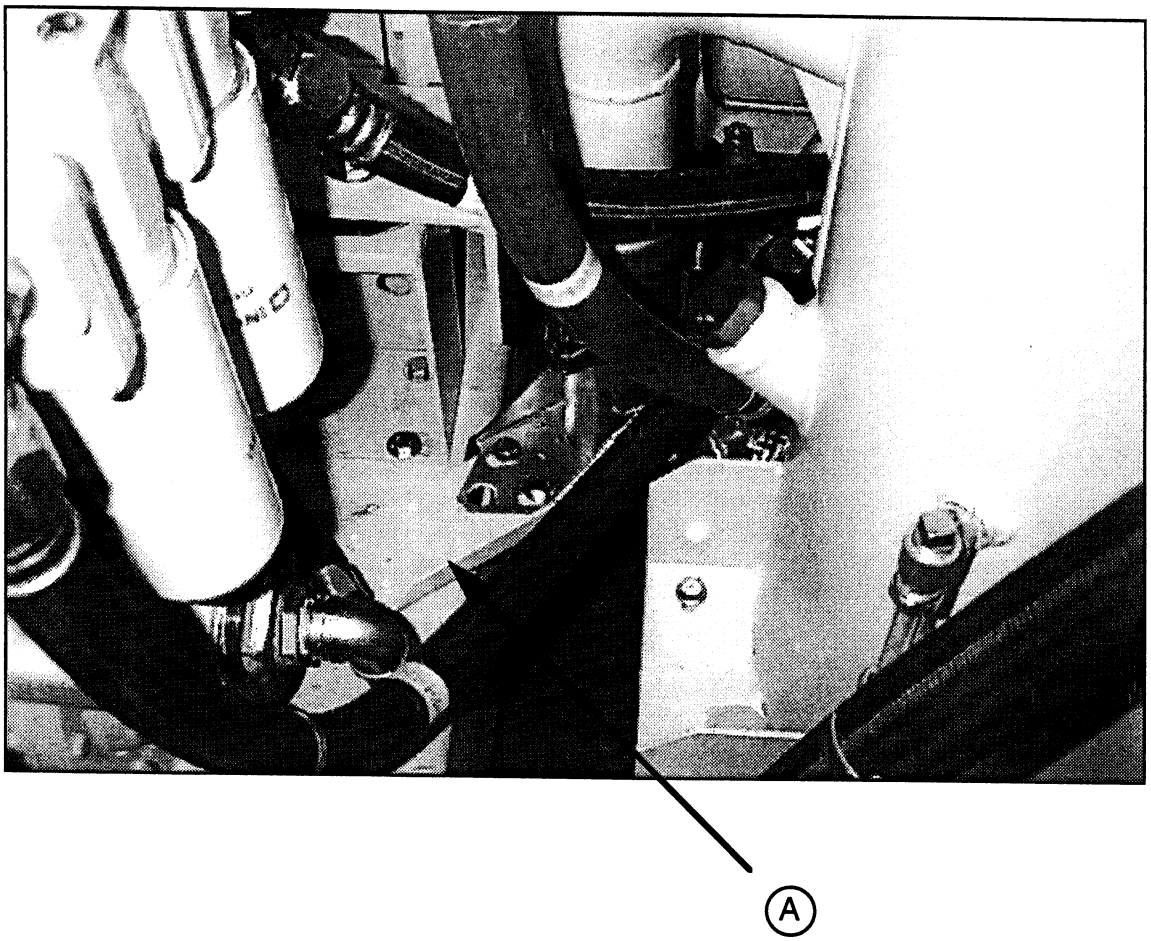
ITEM	PART NUMBER	DESCRIPTION
A	36840718	Air End Support, LH
B	36840726	Air End Support, RH

FRAME AND STRUCTURE



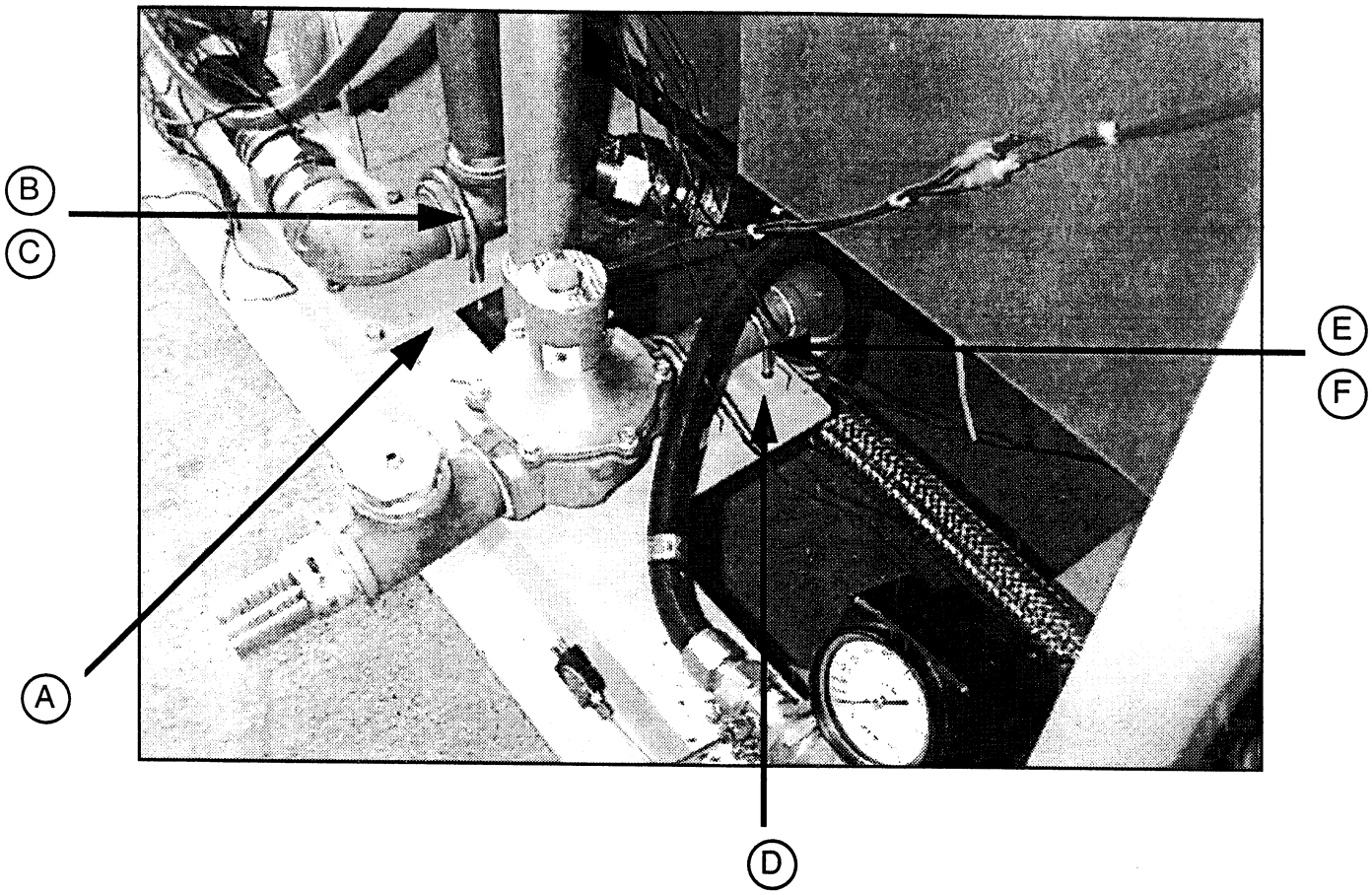
ITEM	PART NUMBER	DESCRIPTION
(A)	43201425	Tube Support
(B)	35192178	Tube Clamp

FRAME AND STRUCTURE



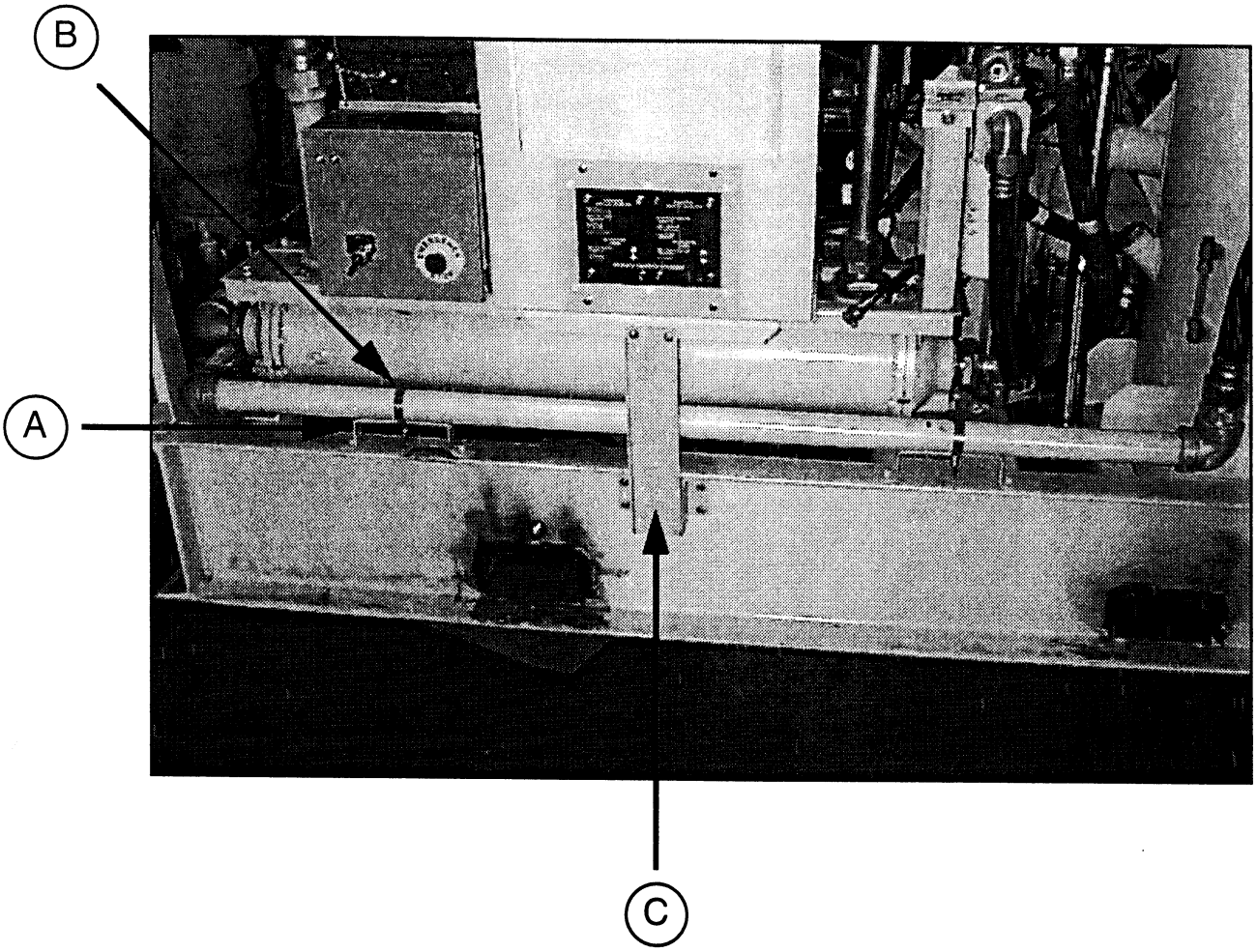
ITEM	PART NUMBER	DESCRIPTION
A	43201045	Discharge Pipe Support

FRAME AND STRUCTURE



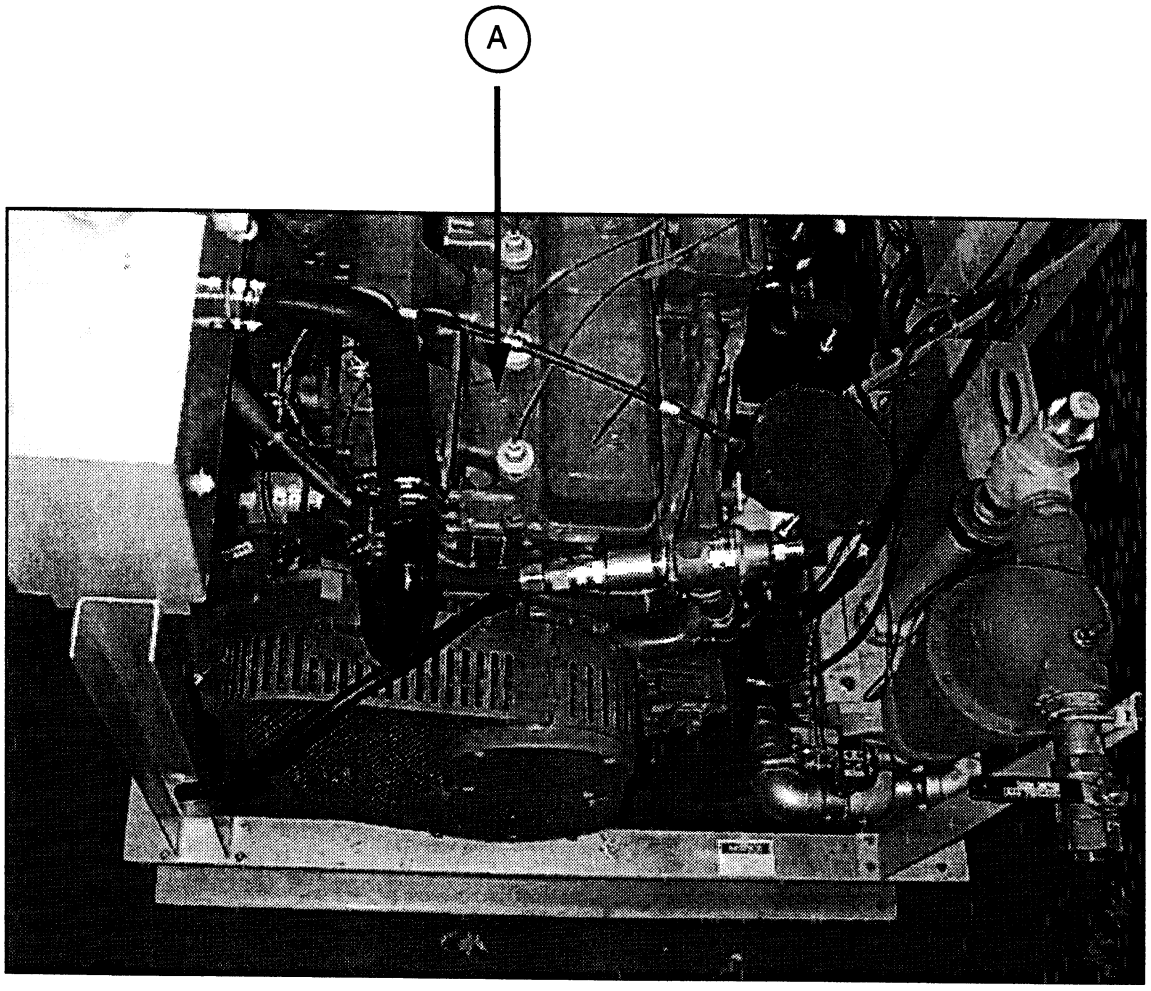
ITEM	PART NUMBER	DESCRIPTION
A	43201144	Inlet Tee Base
B	35586288	U Bolt, 1/2 - 13 (2 Req'd)
C	35252618	Nut, 1/2 - 13 (4 Req'd)
D	43200559	Spacer Block (4 Req'd)
E	43200542	U Bolt, 3/8 - 16 (2 Req'd)
F	35145077	Nut, 3/8 - 16 (4 Req'd)

FRAME AND STRUCTURE



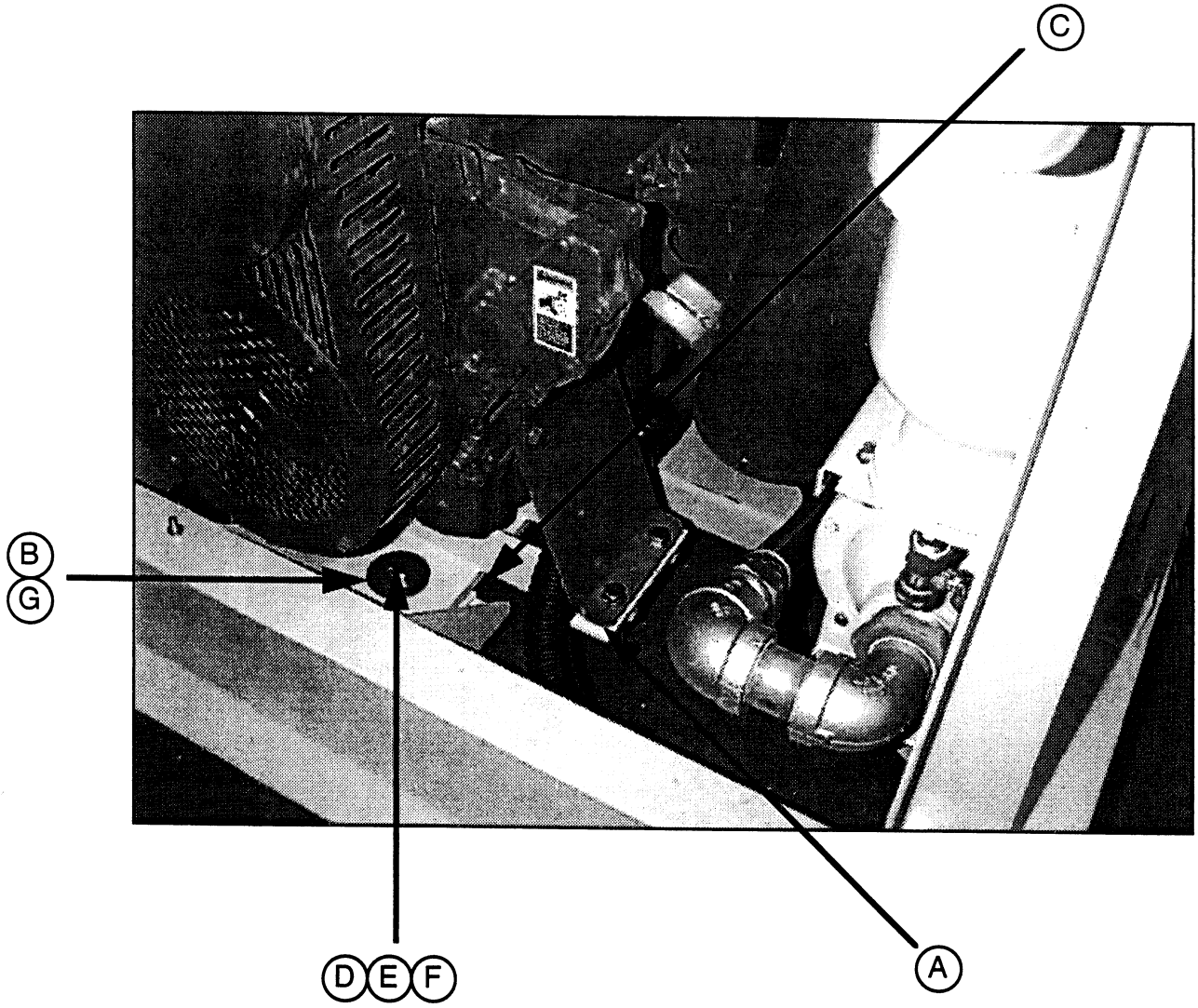
ITEM	PART NUMBER	DESCRIPTION
A	35209865	Pipe Support (2 req'd)
B	35314996	T Bolt Clamp (2 req'd)
C	43201573	Front Brace

ENGINE ASSEMBLY



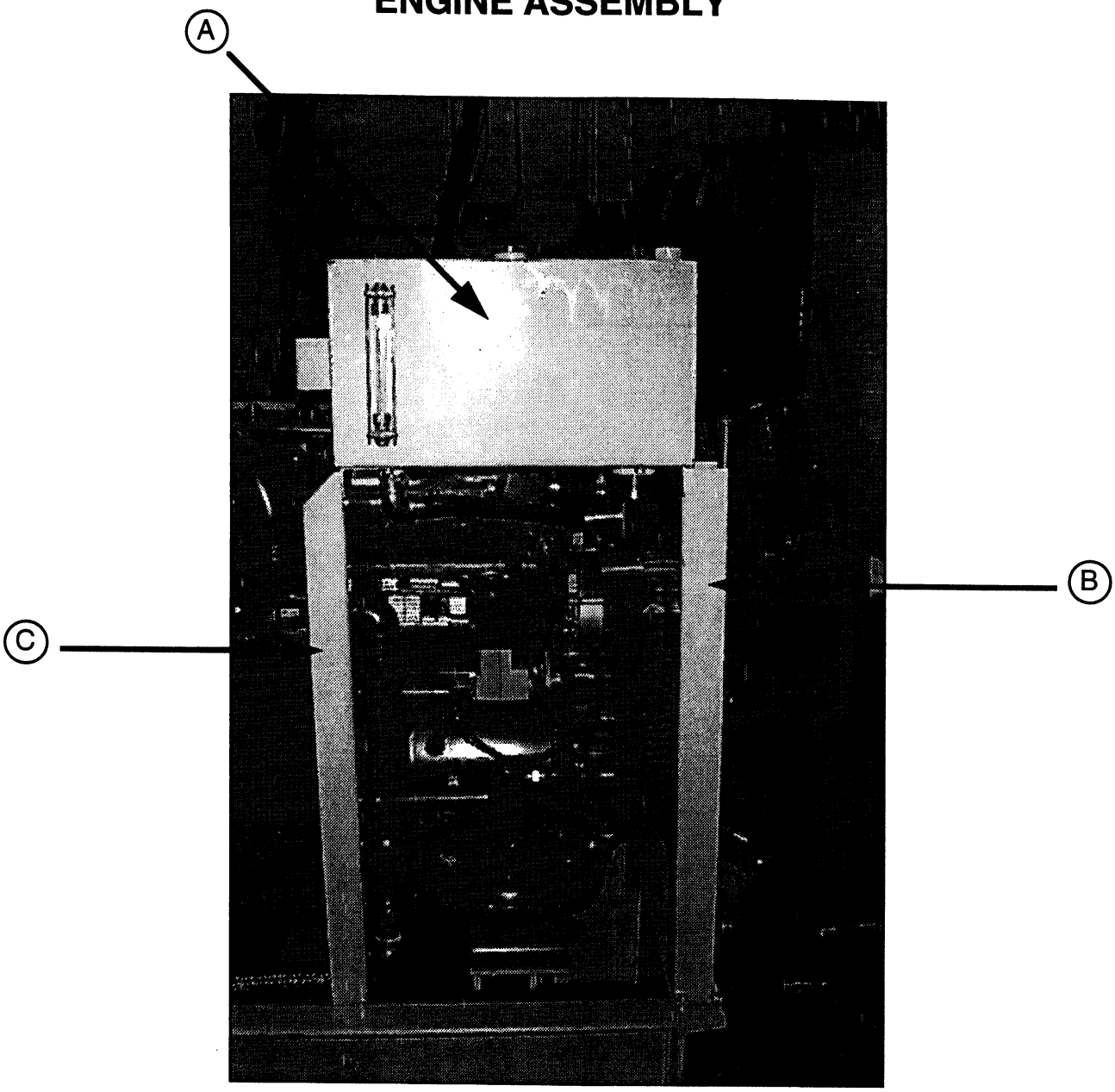
ITEM	PART NUMBER	DESCRIPTION
A	SP96-038	250 HP Waukesha Natural Gas Engine

ENGINE ASSEMBLY



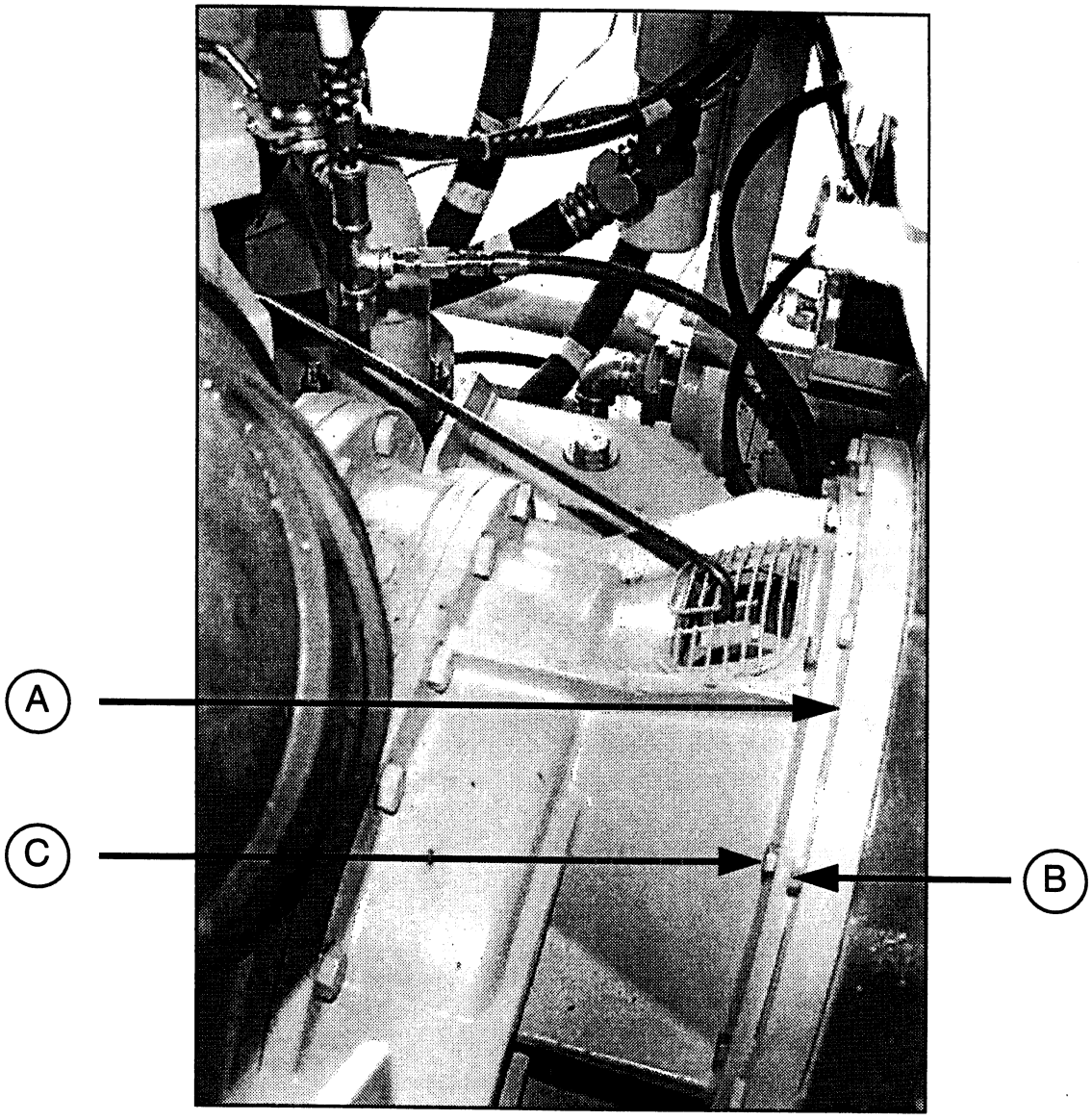
ITEM	PART NUMBER	DESCRIPTION
A	43200187	Front Engine Mount
B	35306133	Rubber Mount (Not Visible)
C	43201052	Engine Mount Spacer (Barely Visible)
D	96700919	Screw, M20 - 2.50 x 90 mm
E	35356526	Nut, M20 - 2.50
F	35101468	Washer, M20
G	35273937	Washer, Oversize

ENGINE ASSEMBLY



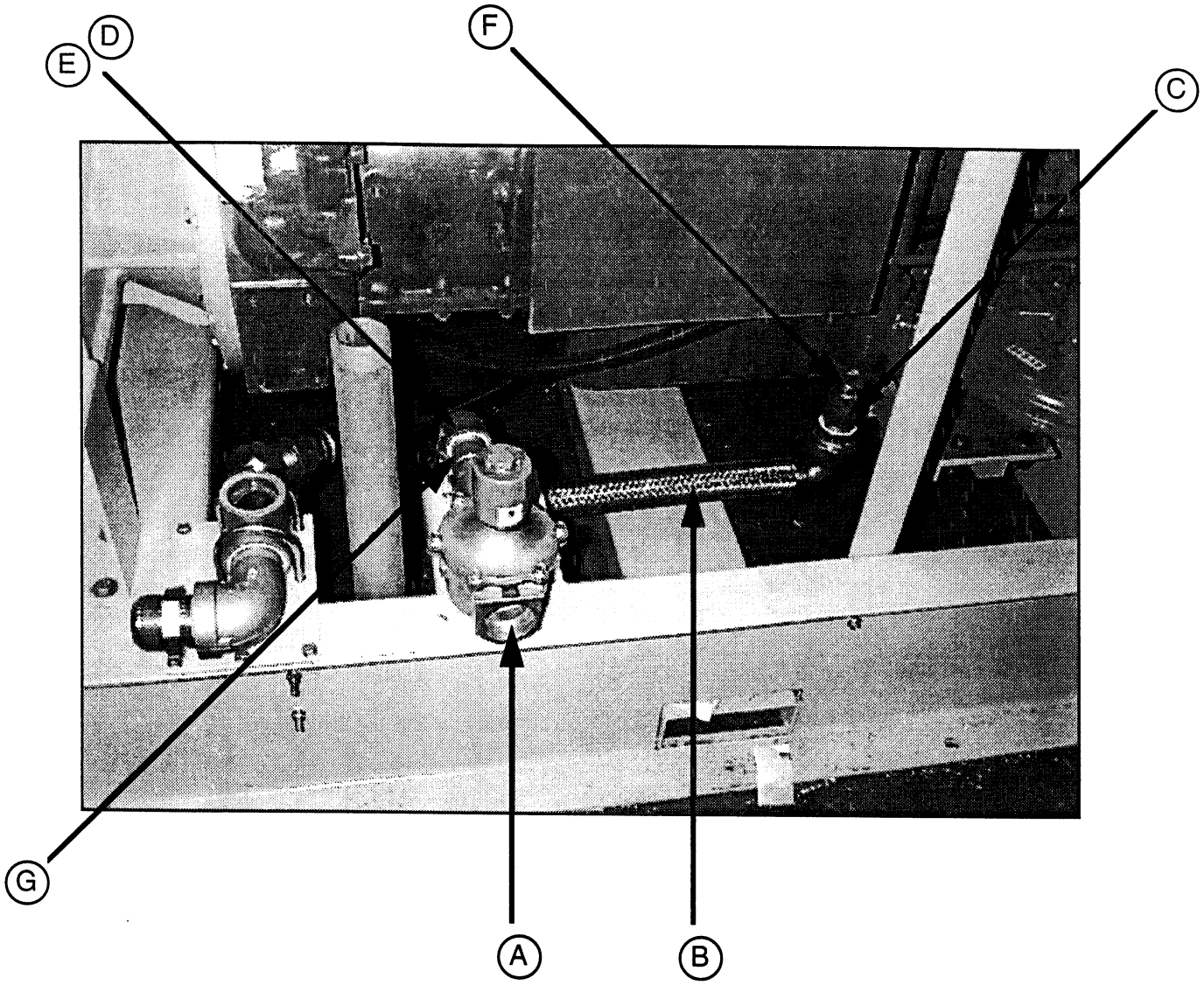
ITEM	PART NUMBER	DESCRIPTION
A	43200658	Expansion (Surge) Tank
B	43201367	Espansion Tank Support
C	43200526	Expansion Tank Support

ENGINE ASSEMBLY



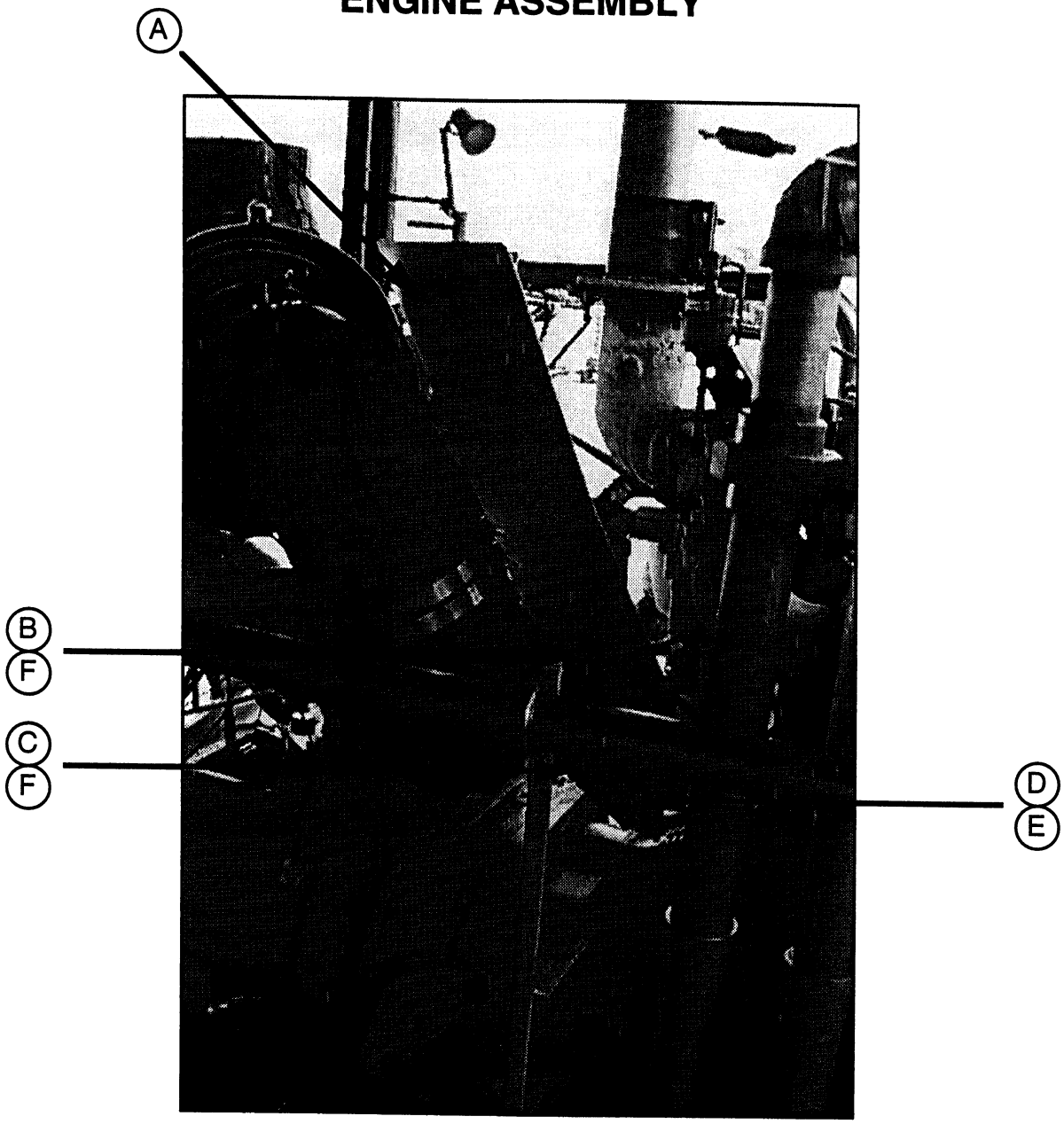
ITEM	PART NUMBER	DESCRIPTION
A	43200112	Flywheel Housing Adapter
B	36781722	Screw, M14 - 2.0 x 45 mm (12 Req'd)
C	96715693	Screw, M10 - 1.5 x 45 mm (12 Req'd)

ENGINE ASSEMBLY



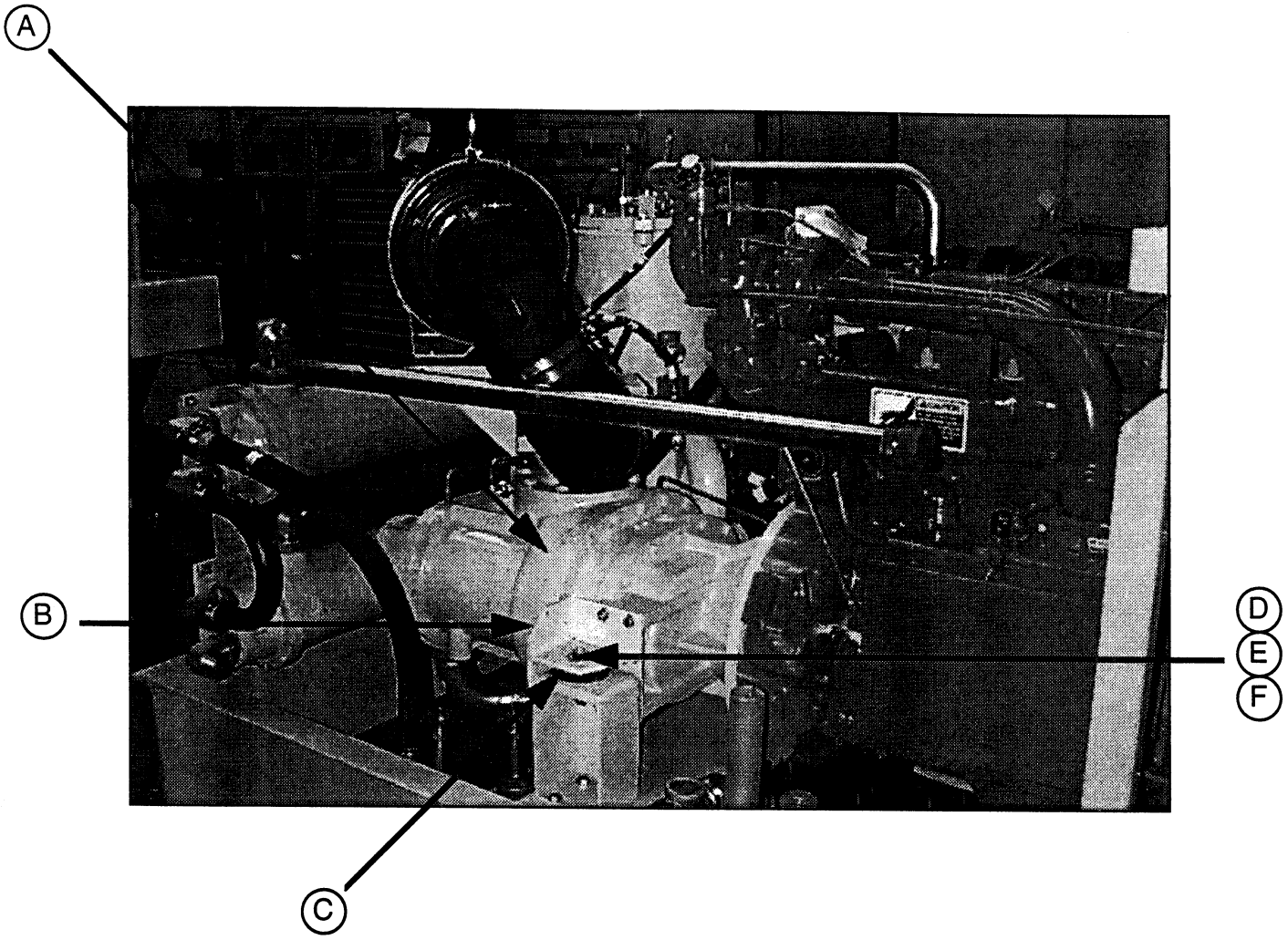
ITEM	PART NUMBER	DESCRIPTION
A	36846004	Solenoid Valve, Gas Inlet
B	43200856	Hose Assy., NG
C	95243259	Nipple, 1 1/2 NPT x 4.50
D	95932828	Elbow, 1 1/2 NPT
E	95487773	Close Nipple, 1 1/2 NPT
F	95953832	Hex Bushing, 2" to 1 1/2 NPT
G	95953535	Nipple 1 1/2 NPT x 6.00

ENGINE ASSEMBLY



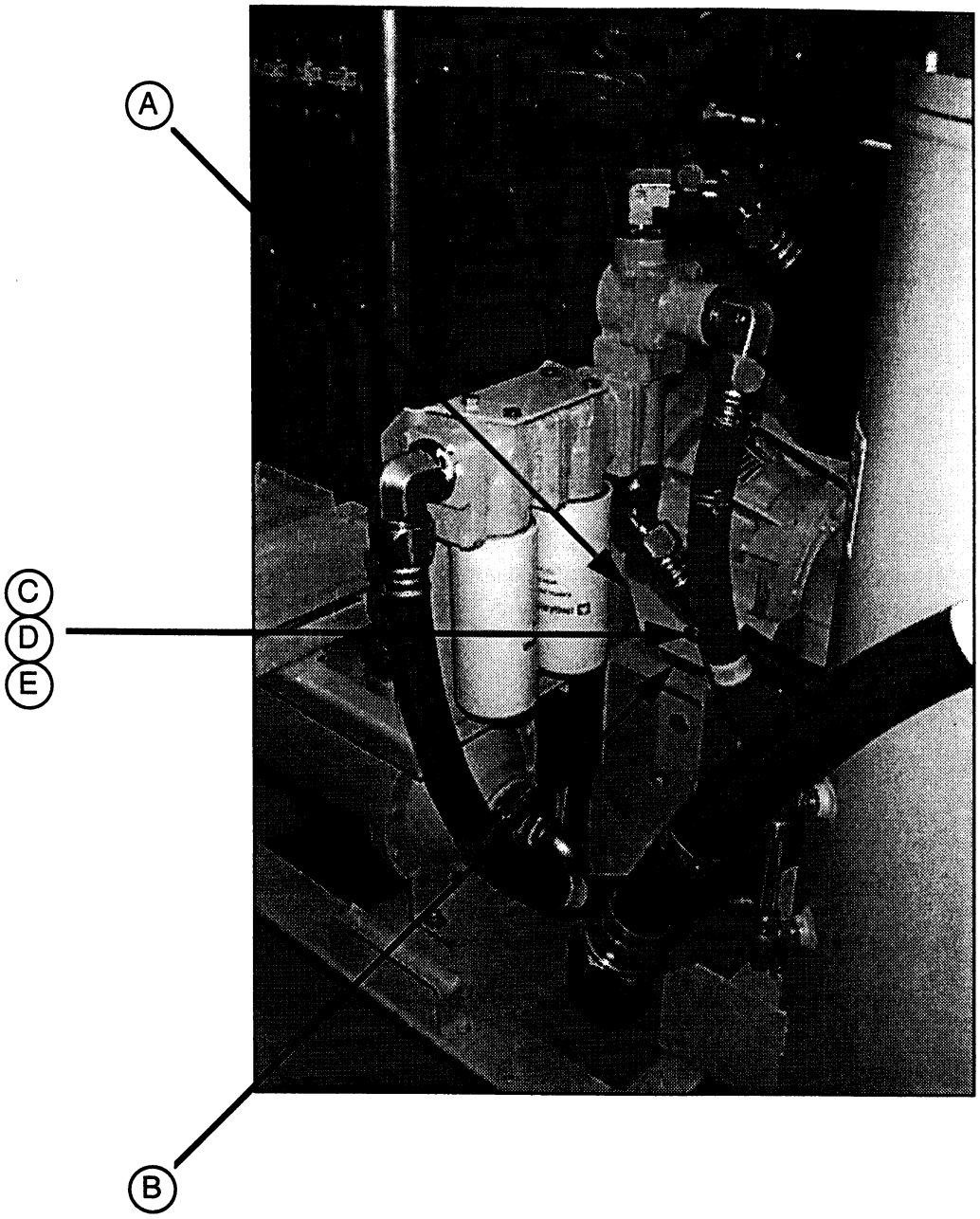
ITEM	PART NUMBER	DESCRIPTION
A	43201706	Heat Shield
B	43201714	Heat Shield Arm, Upper
C	43201722	Heat Shield Arm, Lower
D	35252451	Screw, 1/4 - 20 x 1.00 (4 Req'd)
E	35144492	Nut, 1/4 - 20 (8 Req'd)
F	35295757	Screw, M12 - 1.75 x 20 mm (Not Visible)

AIR END ASSEMBLY

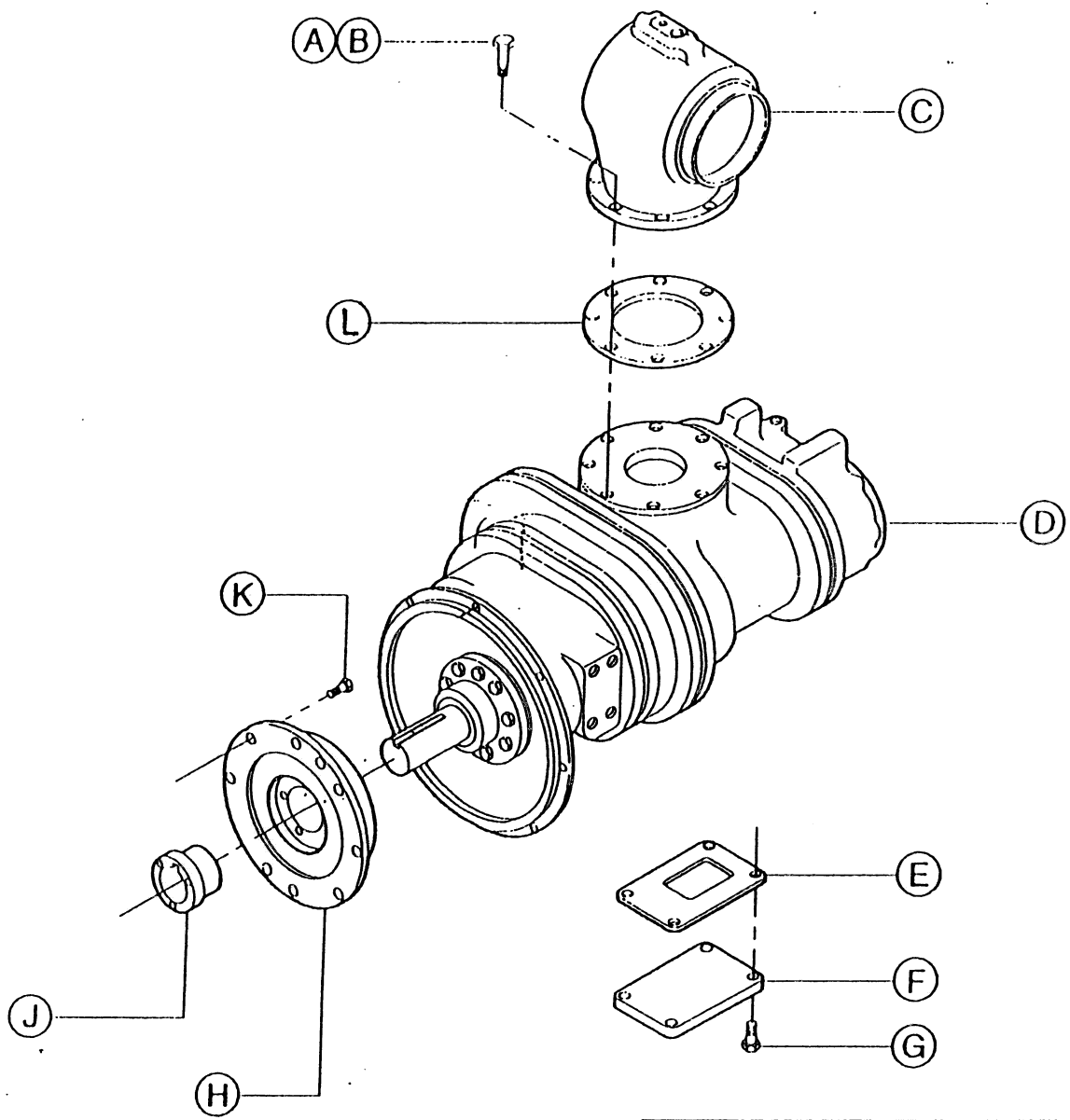


ITEM	PART NUMBER	DESCRIPTION
A	36032084	Air End Assembly
B	35853548	Air End Bracket, RH
C	35584556	Bonded Mount
D	35356518	Screw, M20 - 2.50
E	35273937	Washer, Oversize
F	35356526	Nut, M20 - 2.50

AIR END ASSEMBLY



ITEM	PART NUMBER	DESCRIPTION
A	43201029	Air End Bracket, LH
B	35584556	Bonded Mount
C	35356518	Screw, M20 - 2.50
D	35273937	Washer, Oversize
E	35356526	Nut, M20 - 2.50



WEIGHT (EST.)	____ LBS. ____ KGS.
	THIRD ANGLE PROJ.
DRAWN	DKG 12AUG96
CHECKED	
APPROVED	
REF.	

INGERSOLL-RAND COMPANY
AIR COMPRESSOR GROUP
PORTABLE COMPRESSOR DIVISION
MOCKSVILLE, NC 27028

TITLE: AIR END COMPLETE

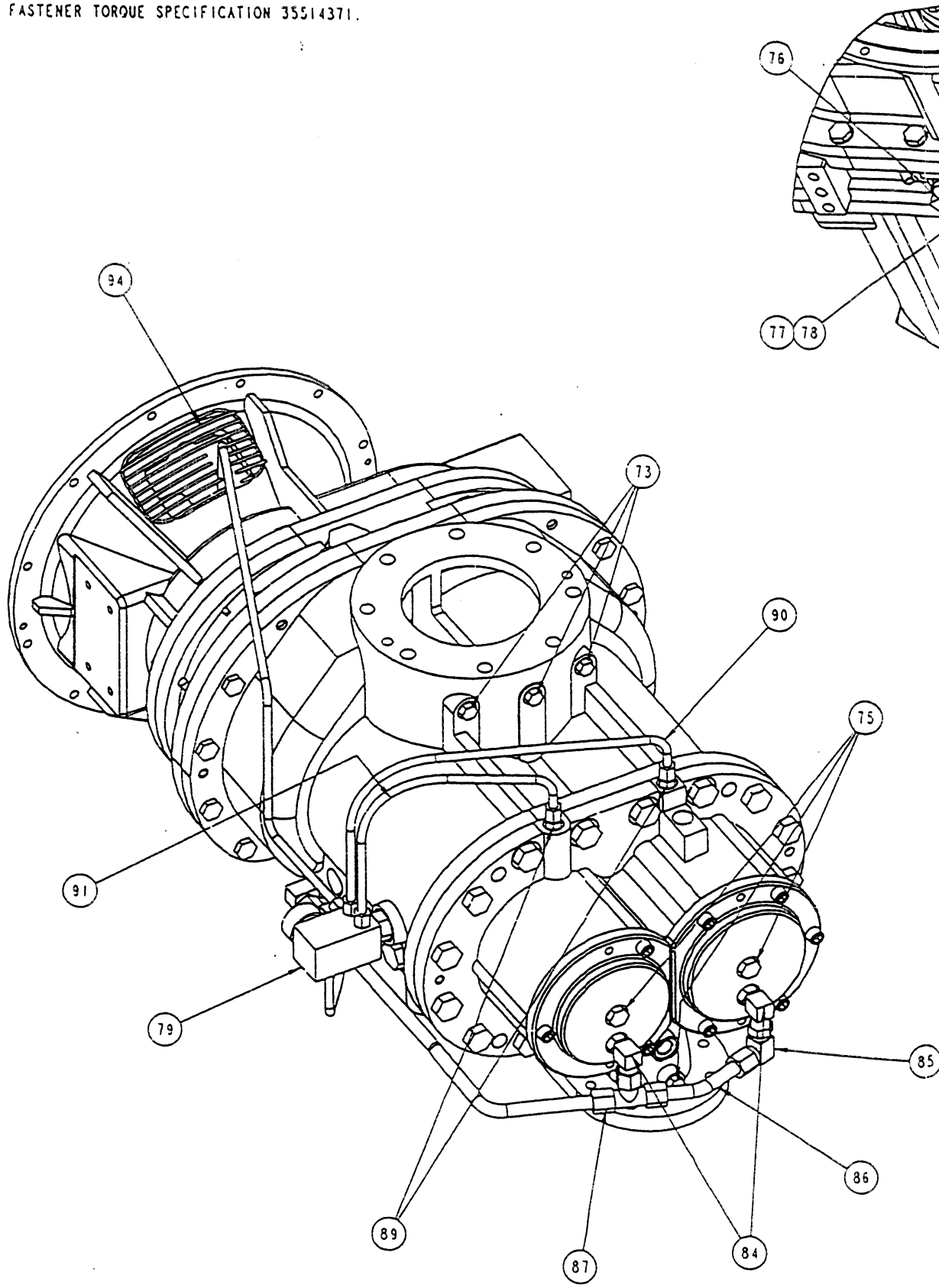
CODE IDENT NO.	PART NO.	REV.
	43201805	

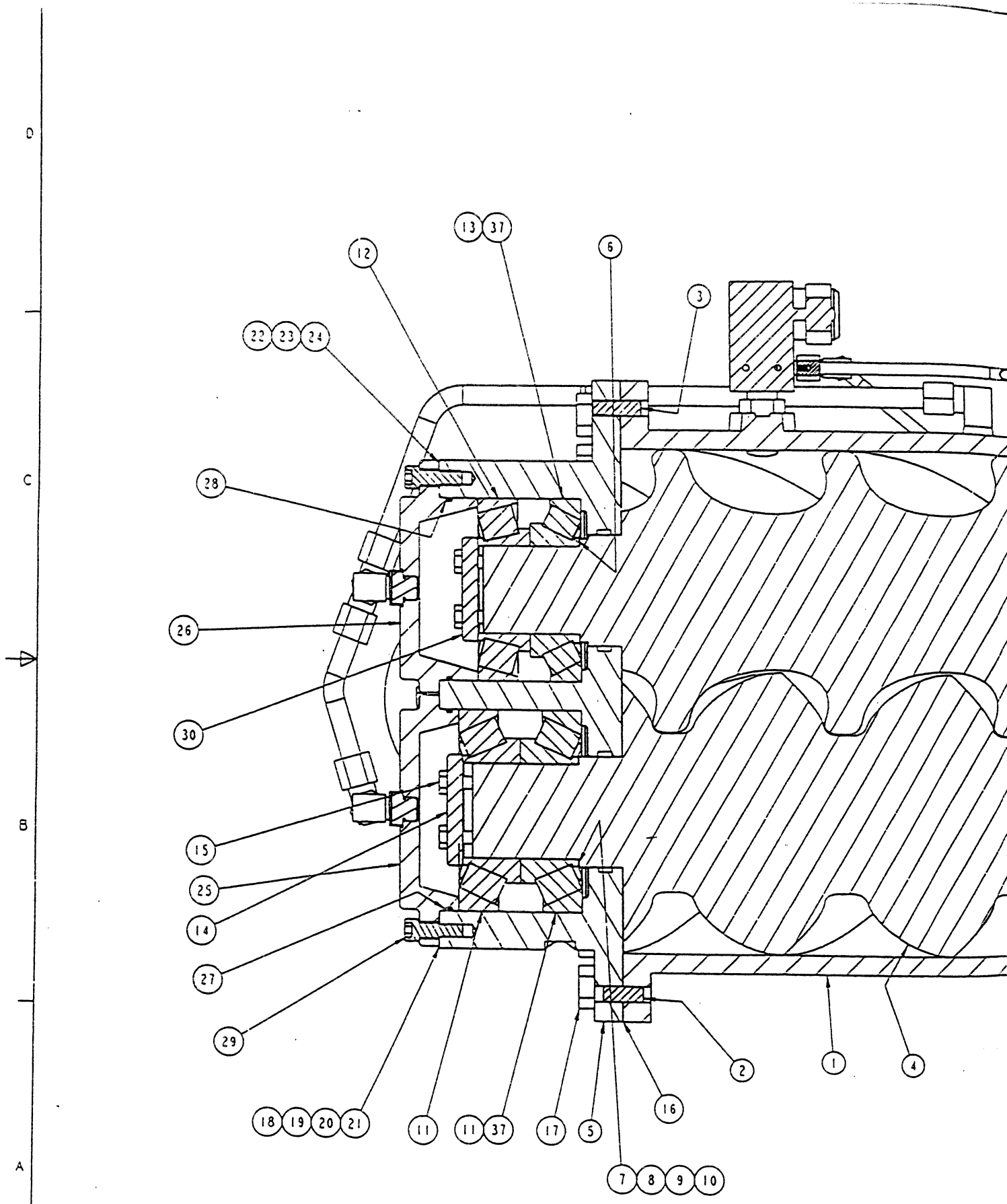
SCALE: NONE UNIT: 950L-N6 SHEET 1 OF 2

(A)	35272558	SCREW (6 REQ'D)
(B)	92341239	SCREW (2 REQ'D)
(C)	36734515	UNLOADER ASSEMBLY
(D)	360032084	AIR END ASSEMBLY
(E)	35501616	GASKET
(F)	35582238	COVER PLATE
(G)	92304435	SCREW (4 REQ'D)
(H)	43200674	FLYWHEEL COUPLING
(J)	43200682	TAPER-LOCK BUSHING
(K)	96715057	SCREW M12-1.75 X 25 MM (8 REQ'D)
(L)	95101598	GASKET

WEIGHT (EST.) ____ LBS. ____ KGS. THIRD ANGLE PROJ.		INGERSOLL-RAND COMPANY AIR COMPRESSOR GROUP PORTABLE COMPRESSOR DIVISION MOCKSVILLE, NC 27028	
DRAWN DKG	DATE 12 AUG 96	TITLE AIR END COMPLETE	
CHECKED			
APPROVED		CODE IDENT NO.	PART NO. 43201805 REV.
REF.		SCALE: NONE	UNIT: 950L-NG SHEET 2 OF 2

NOTES:
1. SEE FASTENER TORQUE SPECIFICATION 35514371.




D
C
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11 37
17
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7 8 9 10
16
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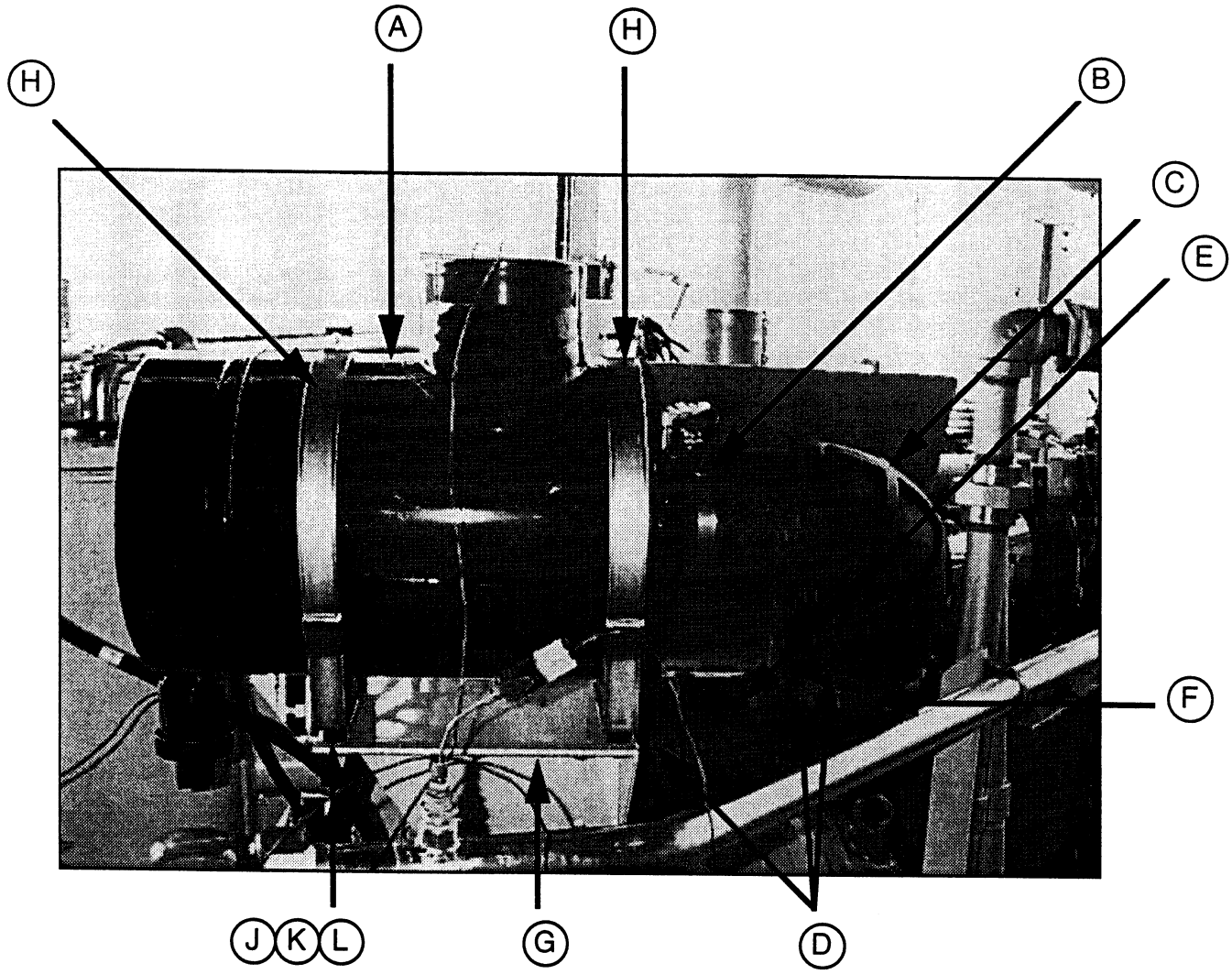
1
4

ITEM	COMPONENT DESCRIPTION	PART NUMBER	QTY	COMMENTS
	COMMENTS	C	-	SEE TORQUE SPECIFICATION DRAWING 35514371
	COMMENTS	C	-	SEE ASSEMBLY DRAWING 39865407
	COMMENTS	C	-	SEE INSTALLATION DRAWING 39866702
1	ROTOR HOUSING L/D 2	39779467	1	
2	DOWEL PIN	95239927	2	MALE SIDE ROTOR HOUSING EACH END
3	LOCATOR PIN	35365261	2	FEMALE SIDE ROTOR HOUSING EACH END
4	ROTOR SET	36005981	1	MALE 36791432; FEMALE 36791440
5	REAR BEARING HOUSING	39853163	1	
6	SHIM SET	35299361	2	M AND F DISCH END CLEARANCE (DEC) TO BE 0.0035 TO 0.0055 IN.
7	SHIM, 0.001 IN.	39457502	4	MALE DISCHARGE
8	SHIM, 0.003 IN.	39457510	2	MALE DISCHARGE
9	SHIM, 0.005 IN.	39457528	1	MALE DISCHARGE
10	SHIM, 0.010 IN.	39457536	2	MALE DISCHARGE
11	BEARING, TAPERED ROLLER	35605203	2	ONE INBOARD, ONE OUTBOARD MALE SIDE
12	BEARING, TAPERED ROLLER	39438221	1	ONE OUTBOARD, FEMALE SIDE
13	BEARING, TAPERED ROLLER	39437686	1	ONE INBOARD, FEMALE SIDE
	COMMENTS	C		APPLY LOCTITE RC 609 TO DISCH BRG BORE FOR INBOARD BRG ONLY
	COMMENTS	C		THIS BORE AREA STARTS 40MM FROM TOP OF BORE AND ENDS AT BOTTOM
	COMMENTS	C		OF BORE. REMOVE EXCESS LOCTITE AFTER INSTALLING CUPS
14	BEARING RETAINER	39457486	1	MALE DISCHARGE BEARING
15	SCREWS, M10 X 30	35293869	6	FOR BEARING CLAMP PLATES, TORQUE TO 52 FT-LBS.
16	GASKET, REAR BRG HSG	35611342	1	BETWEEN REAR BRG HSG AND ROTOR HSG
17	SCREWS, M20 X 45	34M2A8565	16	REAR BRG HSG TO ROTOR HSG
18	SHIM, 0.001 IN.	39457544	3	BETWEEN RBRG HSG AND BRG COV, BRG END PLAY .002-.003 IN.
19	SHIM, 0.003 IN.	39457551	1	BETWEEN RBRG HSG AND BEARING COVER (MALE DISCHARGE)
20	SHIM, 0.005 IN.	39457569	1	BETWEEN RBRG HSG AND BEARING COVER (MALE DISCHARGE)
21	SHIM, 0.010 IN.	39457577	2	BETWEEN RBRG HSG AND BEARING COVER (MALE DISCHARGE)
22	SHIM, 0.001 IN.	39437009	4	BETWEEN RBRG HSG AND BRG COVER (FEMALE DISCHARGE)
23	SHIM, 0.003 IN.	39437017	6	BETWEEN RBRG HSG AND BRG COVER (FEMALE DISCHARGE)
24	SHIM, 0.010 IN.	39437025	4	BETWEEN RBRG HSG AND BRG COVER (FEMALE DISCHARGE)
25	COVER, REAR BEARING	39774583	1	MALE DISCHARGE
26	COVER, REAR BEARING	39774591	1	FEMALE DISCHARGE
27	O-RING	20A11EM258	1	MALE DISCHARGE
28	O-RING	20A11EM254	1	FEMALE DISCHARGE
29	SCREWS, M12 X 35	35273341	8	FIVE FOR MALE CAP, THREE FOR FEMALE CAP
30	BEARING RETAINER	39436977	1	FEMALE DISCHARGE BEARING
31	FRONT BEARING HOUSING	39801857	1	
32	SCREEN	39180526	2	PLACE IN FRONT BRG HSG
33	SCREWS, M6 X 12 ROUND HEAD	39180542	4	TO RETAIN SCREENS
34	GASKET, FRONT BRG HSG	35597723	1	BETWEEN FRONT BRG HSG AND ROTOR HSG
35	SCREWS, M16 X 40	35272541	17	FRONT BRG HSG TO ROTOR HSG
36	BEARING, CYL ROLLER	39481783	1	MALE ROTOR INLET, USE LOCTITE AS REQUIRED
37	LOCTITE	39136304		LOCTITE FOR BRG OUTER RACES ONLY, AS REQUIRED
38				
39				
40				

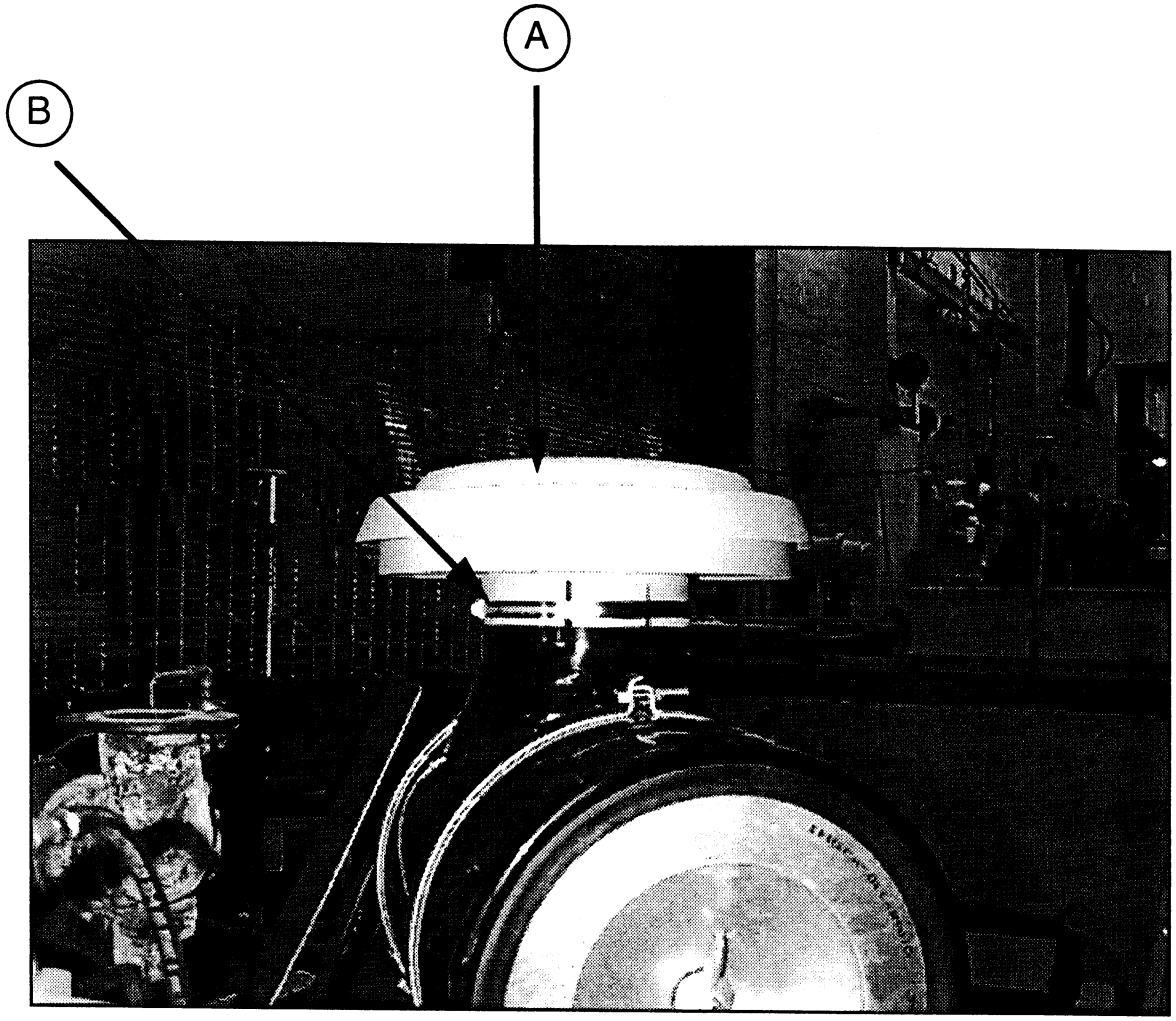
ITEM	COMPONENT DESCRIPTION	PART NUMBER	QTY	COMMENTS
	COMMENTS	C		AIREND PIPING ASSEMBLY
71	PLUG, SAE 1-5/8 IN.	35382100	1	IN TOP OF FRONT BRG HSG
72	PLUG, NPT 1/4 IN.	34A7S3Z1	2	IN TOP OF FRONT BRG HSG
73	PLUG, SAE 9/16 IN.	95938205	4	THREE IN BACK OF INLET, ONE IN RTR HSG FEM SIDE
74	PLUG, SAE 1-1/16 IN.	565A10S6VZ2	1	IN ROTOR HSG FEM SIDE
75	PLUG, SAE 3/4 IN.	95938213	3	TWO IN REAR BRG COVERS, ONE IN DISCH NECK
76	90 DEG ELBOW, SAE, 7/8 IN.	35286442	1	IN BOTTOM OF FRONT BRG HSG
77	REDUCER, SAE -8-6	35296227	1	-8-6 REDUCER ON 90 DEG SAE ELBOW
78	CAPNUT, SAE	35296219	1	USE NUT ON REDUCER TO ELBOW
79	MANIFOLD, OIL INJECTION	36866531	1	IN FEMALE SIDE OF ROTOR HOUSING
80	90 DEG ELBOW, SAE -6	35283068	1	ON MANIFOLD, LOWER NIPPLE TO FRONT BRG HSG
81	TUBE, SAE -6	39578901	1	FROM MANIFOLD SWIVEL ELBOW TO FRONT BRG HSG BOTTOM
82	CONNECTOR, SAE 7/8 IN.	35286954	1	IN ROTOR HSG, FEM SIDE
83	90 DEG ELBOW, SAE -10	35305648	1	ON 7/8 TO -10 SAE CONNECTOR
84	90 DEG ELBOW, SAE 3/4 IN.	35305622	2	IN M AND F REAR BRG COVERS, LOWER SAE PORT
85	90 DEG SWIVEL ELBOW, SAE	35305648	1	ON 90 DEG ELBOW, MALE REAR BRG COVER
86	TUBE, -10 SCAVENGE	36865921	1	BETWEEN 90 DEG SWIVEL AND SAE TEE
87	TEE, SAE	35356450	1	PLACE TEE ON FEM SIDE 90 DEG ELBOW
88	TUBE, REAR BRG SCAVENGE	39578950	1	FROM TEE TO RTR HSG, FEM SIDE, 7/8 IN. SAE PORT
89	CONNECTOR, SAE 9/16 IN.	35283076	2	IN TOP OF REAR BRG HSG, M AND F BRG OIL
90	TUBE, SAE -6	36865889	1	FROM MANIFOLD, FORWARD SAE PORT, TO MALE DISCH BEARI
91	TUBE, SAE -6	36865897	1	FROM MANIFOLD, REAR SAE PORT, TO FEMALE DISCH BEARIN
92	TUBE, SAE -6	36865905	1	FROM MANIFOLD, FORWARD INSIDE SAE PORT, TO SEAL COVE
93	CONNECTOR, SAE 7/16 IN.	36866554	1	IN SHAFT SEAL COVER
94	GUARD, HANDHOLE, W/SLOT	35798361	1	SLOTTED GUARD TO CLEAR SEAL OIL TUBE
95	GUARD, HANDHOLE	36798346	1	IN LOWER FLANGE HANDHOLE
96	LOCTITE	35259282		APPLY TO ALL INTERNAL FASTENERS

COMPRESSOR AIR INTAKE

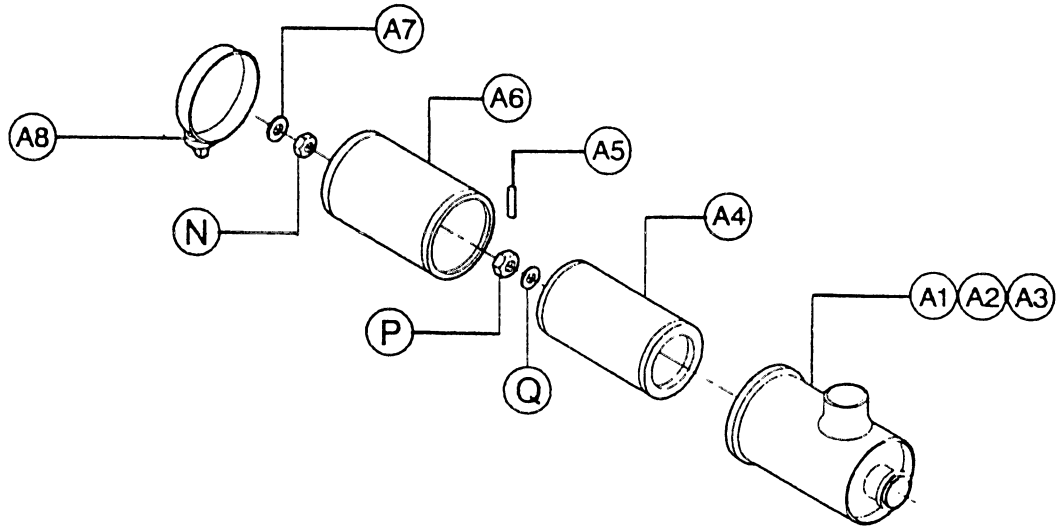


ITEM	PART NUMBER	DESCRIPTION
A	35851310	Air Cleaner Assy.
B	35123496	Clamp
C	35315894	Rubber Elbow
D	35119858	Clamp (3 Req'd)
E	35598838	Rubber Elbow
F	35112648	Tube
G	35850593	Unloader Bracket
H	35863638	Mounting Band (2 Req'd)
J	36849891	Isolator (4 Req'd)
K	35144492	Nut (8 Req'd)
L	95934998	Washer (8 Req'd)

COMPRESSOR AIR INTAKE



ITEM	PART NUMBER	DESCRIPTION
A	35112259	Air Inlet Hood
B	35119858	7" Band Clamp



INGERSOLL-RAND COMPANY
AIR COMPRESSOR GROUP
PORTABLE COMPRESSOR DIVISION
MOCKSVILLE, NC 27028

TITLE: AIR CLEANER

CODE IDENT NO. | PART NO. | REV.

SCALE: | UNIT: | SHEET OF

WEIGHT (EST.) ____ LBS. ____ KGS.

THIRD ANGLE PROJ.

DRAWN | DATE

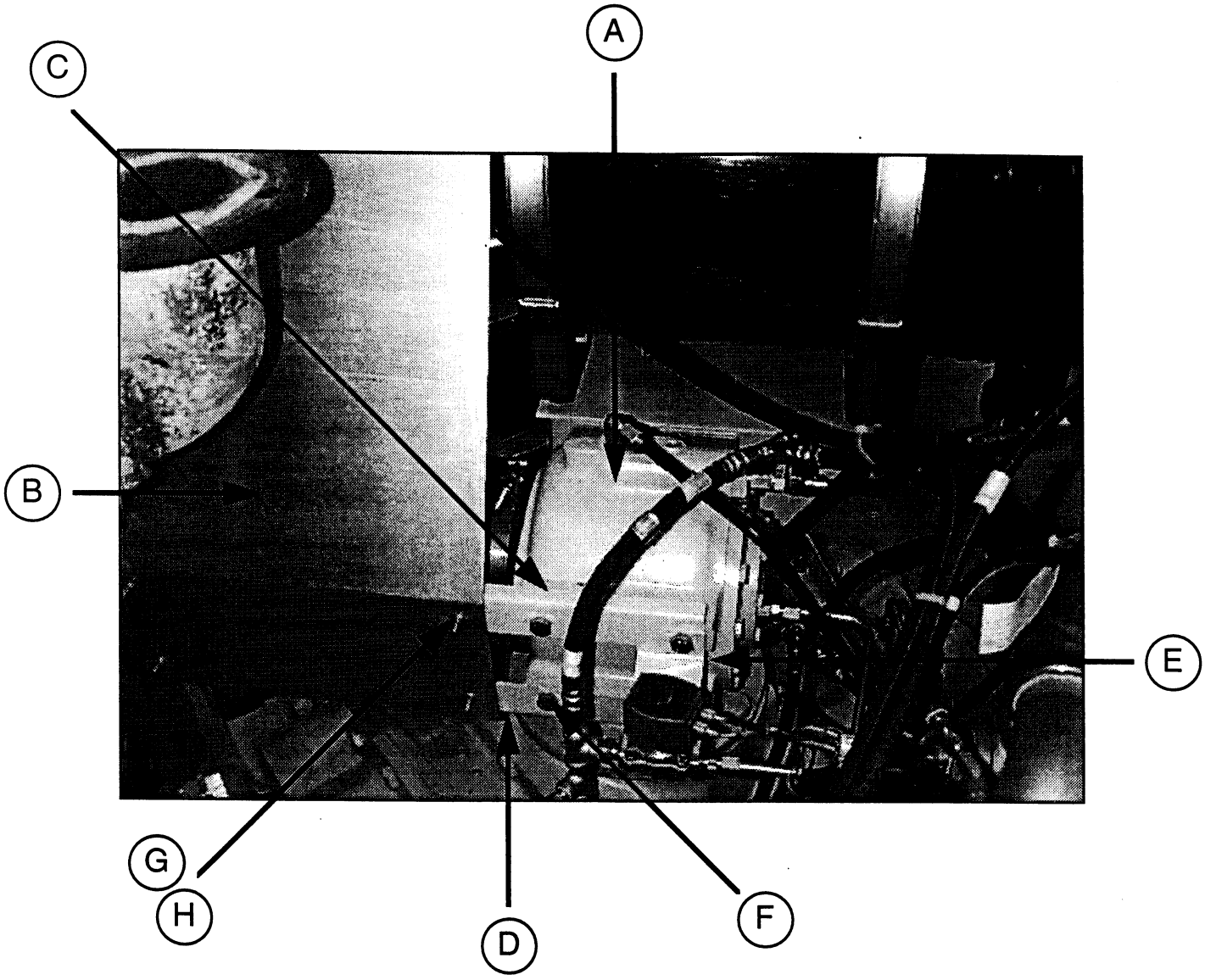
CHECKED

APPROVED

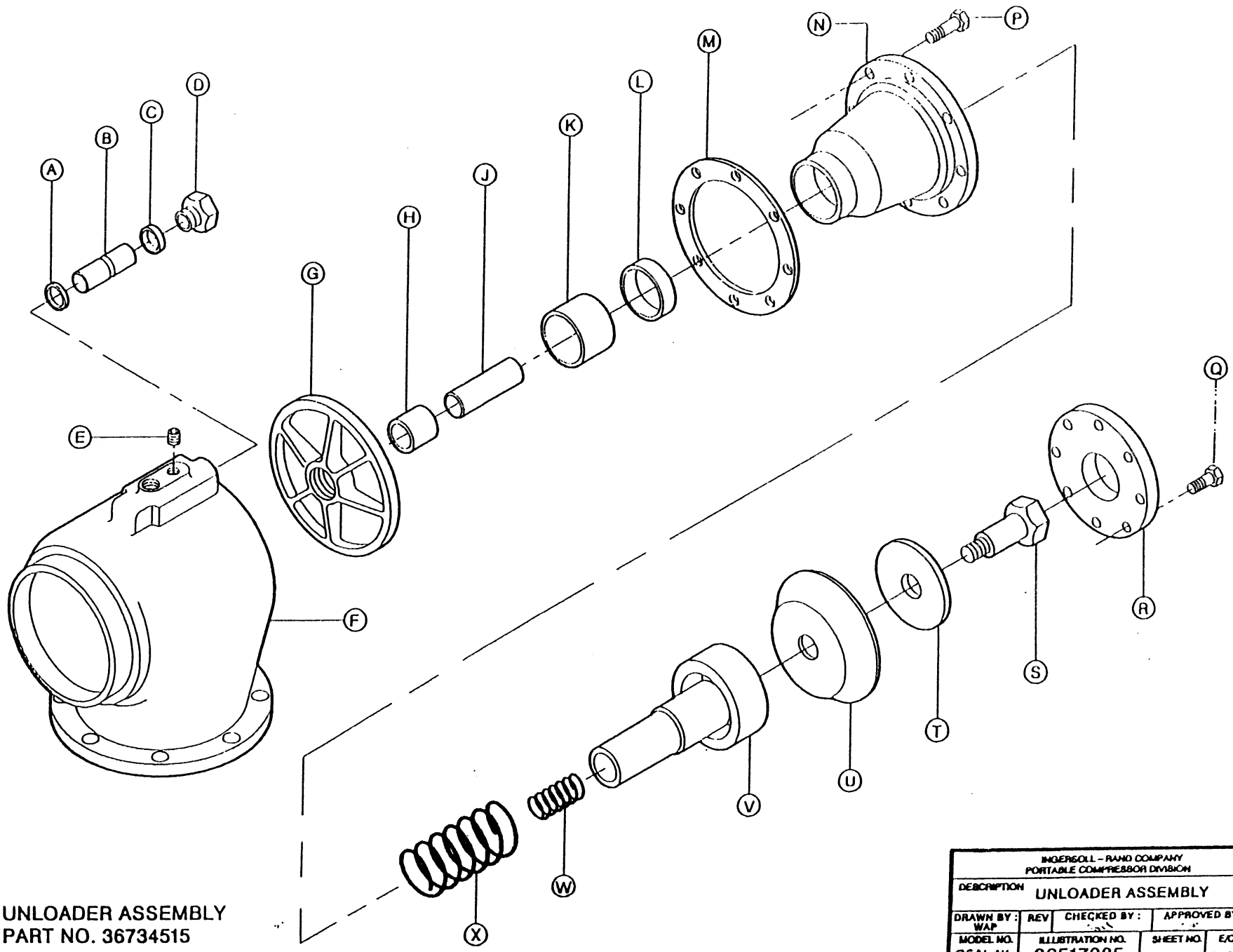
REF.

N	35355403	NUT
P	35355379	NUT
Q	35355361	GASKET
A1	35851310	CLEANER , AIR
A2	35355429	MARKING
A3	35355346	BODY
A4	35355353	ELEMENT , SAFETY
A5	35355387	PIN
A6	35355395	ELEMENT , PRIMARY
A7	35355411	CLIP
A8	35109230	VALVE

UNLOADER



ITEM	PART NUMBER	DESCRIPTION
A	36734515	Unloader Assembly
B	43201706	Heat Shield
C	43201714	Heat Shield Arm Upper
D	43201722	Heat Shield Arm Lower
E	36841658	Solenoid Bracket
F	35295757	Screw M12 - 1.75 x 20 mm (4 req'd)
G	35252451	Screw 1/4 - 20 x 1.00 (4 req'd)
H	35144492	Nut 1/4 - 20 (8 req'd)



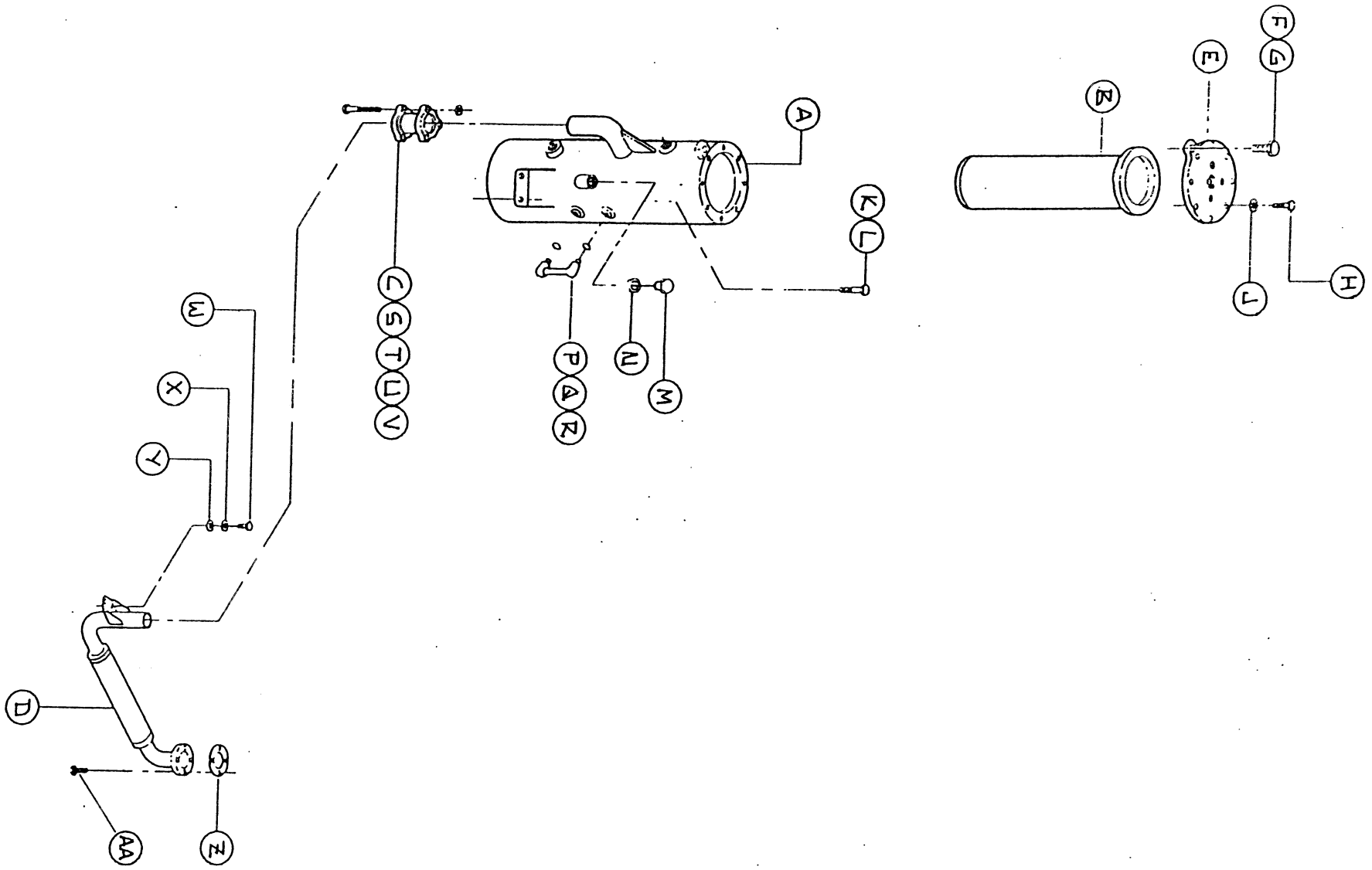
UNLOADER ASSEMBLY
PART NO. 36734515

INGERSOLL-RAND COMPANY PORTABLE COMPRESSOR DIVISION			
DESCRIPTION: UNLOADER ASSEMBLY			
DRAWN BY: WAP	REV	CHECKED BY:	APPROVED BY:
MODEL NO.: 95DL-N6	ILLUSTRATION NO.: 36517985	SHEET NO.: 1 OF 2	E/C: 27539

A	35331586	GROMMET
B	35328210	VALVE
C	35331578	GROMMET
D	35328236	ADAPTER
E	34A7S5	PLUG
F	36734507	BODY
G	35591171	VALVE
H	35328269	BUSHING (2 REQD)
J	35332006	STEM , VALVE
K	35328228	BUSHING
L	35328244	SEAL
M	35328251	GASKET
N	36722460	HOUSING
P	35271188	SCREW (12 REQD)
Q	35273416	SCREW (8 REQD)
R	35591189	COVER , PISTON
S	35A2D217	SCREW
T	35327204	WASHER
U	35592534	DIAPHRAGM
V	35591163	PISTON
W	35332683	SPRING
X	35332691	SPRING

INGERSOLL-RAND COMPANY
PORTABLE COMPRESSOR DIVISION

DESCRIPTION			
UNLOADER ASSEMBLY			
DRAWN BY: WAP	REV: B	CHK.BY / DATE 1-5-93 LE	APPR.BY / DATE 1-5-93 SB
MODEL NO. 150L-A16	ILLUSTRATION NO. 36517985	SHEET NO. 2 OF 2	E/C 27946



WEIGHT (EST.) ____ LBS. ____ KGS.	INGERSOLL-RAND COMPANY
THIRD ANGLE PROJ.	AIR COMPRESSOR GROUP PORTABLE COMPRESSOR DIVISION MOCKSVILLE, NC 27028
DRAWN DKG — DATE 14AUG96	TITLE: SEPARATOR TANK ASSEMBLY
CHECKED	CODE IDENT NO. — PART NO. 43201847 — REV.
APPROVED	SCALE: — UNIT: 950L-N6 — SHEET 1 OF 2
REF.	

(A)	36794915	SEPARATOR TANK
(B)	35856376	ELEMENT
(C)	35214683	DRESSER COUPLING
(D)	35855691	DISCHARGE PIPE
(E)	36850279	COVER
(F)	35602325	SPRING
(G)	95937389	SCREW
(H)	95927273	SCREW
(J)	95081790	WASHER
(K)	36840254	NUT
(L)	36840247	SCREW
(M)	35579630	OIL FILL PLUG
(N)	35279942	O-RING
(P)	35324649	GASKET
(Q)	35323955	SIGHT TUBE FITTING
(R)	92121532	TUBE
(S)	72056856	BODY
(T)	72052269	SEALS
(U)	72056864	FOLLOWER
(V)	72056872	BOLT
(W)	35374842	SCREW
(X)	95064689	WASHER
(Y)	95716890	WASHER
(Z)	95083622	GASKET
(AA)	35379009	SCREW

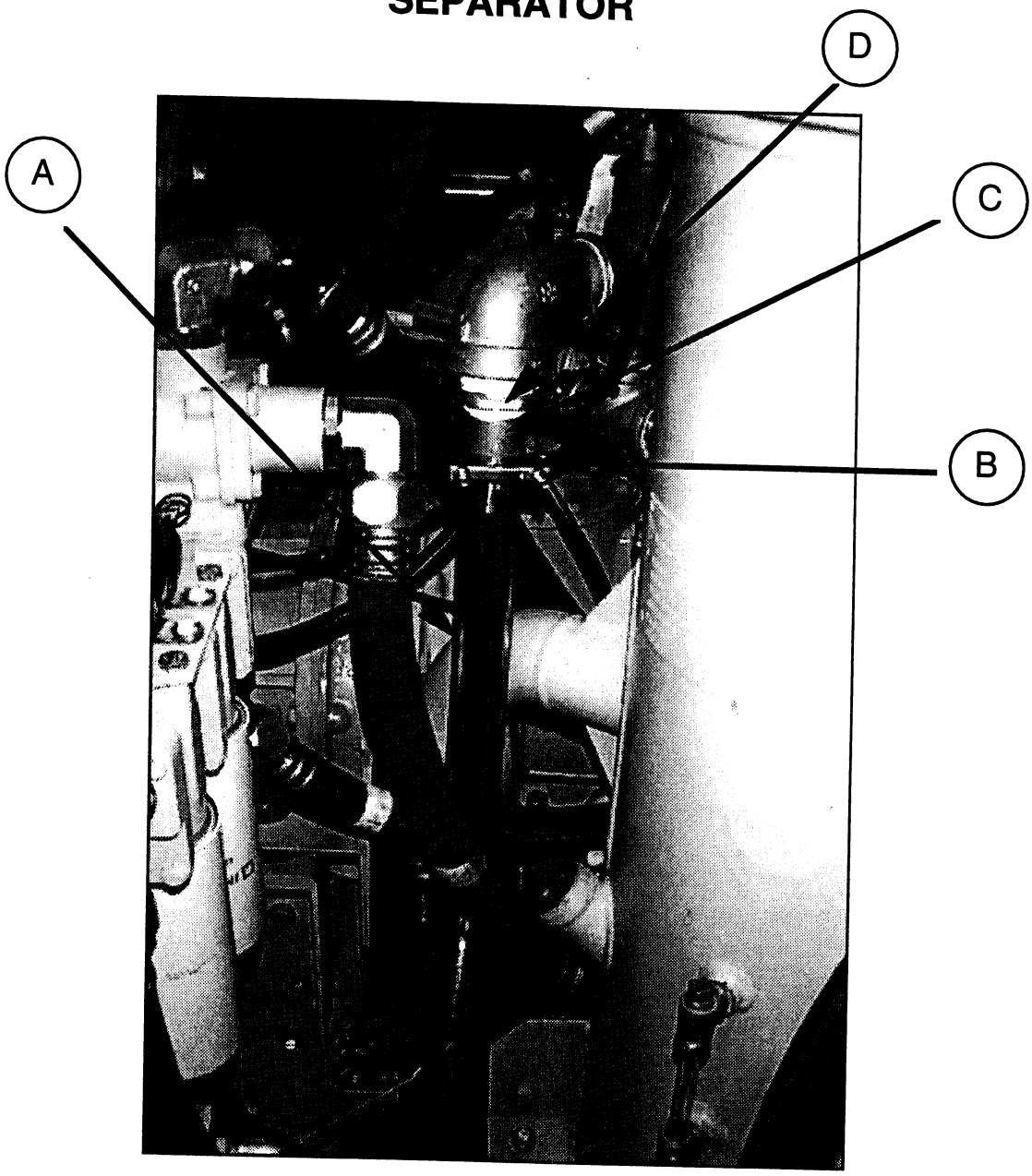
INGERSOLL-RAND COMPANY
AIR COMPRESSOR GROUP
PORTABLE COMPRESSOR DIVISION
MOCKSVILLE, NC 27028

TITLE: SEPARATOR TANK ASSEMBLY

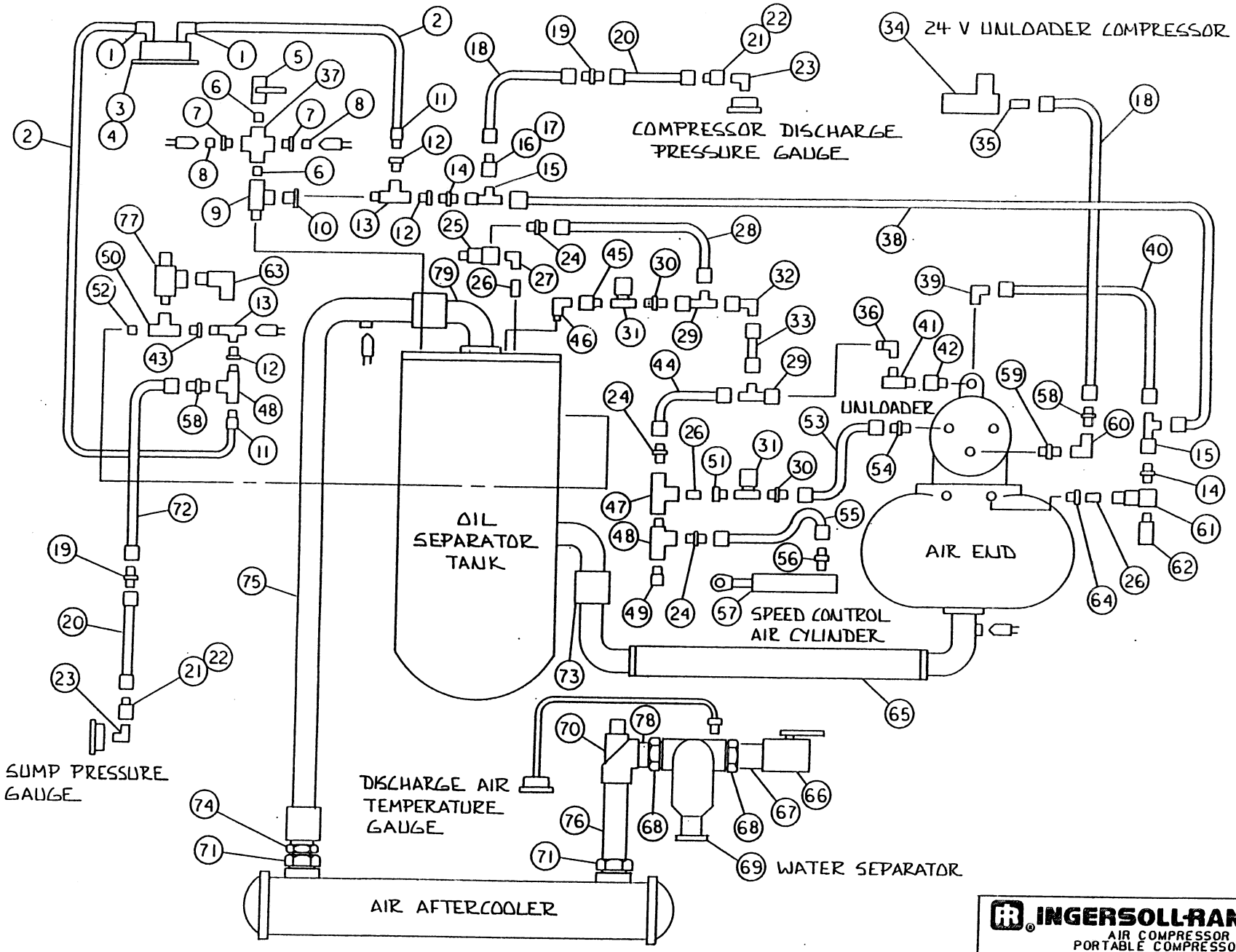
WEIGHT (EST.) ____ LBS. ____ KGS.
THIRD ANGLE PROJ.
DRAWN DKG DATE 14AUG96
CHECKED
APPROVED
MFG.

CODE IDENT NO. | PART NO. 43201847 | REV.
SCALE: | UNIT: 950L-N6 | SHEET 2 OF 2

SEPARATOR



ITEM	PART NUMBER	DESCRIPTION
A	36764884	Safety Valve Discharge Pipe
B	35192178	Tube Clamp, 2.00"
C	36764389	Nipple, 1 1/2 NPT
D	95937462	Hex Bushing, 2" to 1 1/2 NPT



INGERSOLL-RAND COMPANY
AIR COMPRESSOR GROUP
PORTABLE COMPRESSOR DIVISION
MOCKSVILLE, NC 27028

TITLE: AIR PIPING

CODE IDENT NO.	PART NO.	REV.
	43201730	

SCALE: NONE | UNIT: 950L-NG | SHEET 1 OF 4

1	35370386	Elbow, 1/8 NPT to 3/8 tube
2	35356484	Tube, 3/8 Synflex
3	35825546	Indicator, Separator Element
4	36841922	Bracket, Indicator Mounting
5	35576115	Valve, Ball, 3/8 NPT
6	95647939	Nipple, Close, 3/4 NPT
7	95903589	Hex Bushing, 3/4 to 1/4 NPT
8	95930301	Hex Bushing, 1/4 to 1/8 NPT
9	95647947	Tee, Street, 3/4 NPT
10	95953949	Hex Bushing, 3/4 to 1/2 NPT
11	35369347	Adapter, 1/4 NPT to 3/8 tube
12	95944625	Hex Bushing, 1/2 to 1/4 NPT
13	95944708	Tee, Street, 1/2 NPT
14	35283134	Adapter, 1/4 NPT to -8
15	35287929	Tee, Run, Swivel Nut, -8
16	35299734	Reducer, Female -8 to -4
17	35296219	Nut, Tube, -8
18	35288034	Hose Assy, -4 x 37.00
19	35330257	Conn. -4 to -4
20	35291269	Hose Assy, -4 x 60.00
21	35306091	Reducer, -6 to -4
22	35306109	Nut, Tube, -6
23	35280098	Elbow, 1/4 NPT to Fem -6
24	35284082	Adapter, 1/4 NPT to -6
25	36854495	Pressure Regulator
26	95667341	Nipple, Close, 1/4 NPT
27	95944666	Elbow, Street, 1/4 NPT
28	35282946	Hose Assy, -6 x 9.50
29	35283084	Tee, Run, Swvl Nut, -6
30	35290147	Adapter, 3/8 NPT to -6

INGERSOLL-RAND COMPANY
AIR COMPRESSOR GROUP
PORTABLE COMPRESSOR DIVISION
MOCKSVILLE, NC 27028

TITLE: AIR PIPING

PART NO. 43201730

REV.

SHEET 2 OF 4

CODE IDENT NO.

SCALE:

UNITS

WEIGHT EST.) LBS. ____ KGS.

THIRD ANGLE PROJ.

DRAWN DKG DATE 08 AUG 96

CHECKED

APPROVED

REF.

31	36840841	Solenoid Valve, 3/8 NPT
32	35283068	Elbow, Swvl Nut, -6
33	35283282	Hose Assy, -6 x 18.00
34	36850691	Compressor, 24 VDC
35	95302170	Elbow, 45°, 1/8 NPT to -4
36	35279934	Elbow, 1/4 NPT to -6
37	95947503	Cross, 3/4 NPT
38	35305473	Hose Assy, -8 x 42.00
39	35287937	Elbow, 9/16 -18 to -8
40	35857176	Tube Assy, 1/2
41	36881951	Valve, Flow Control
42	35302314	Adapter, Fem 1/4 NPT to 9/16 -18 O-Ring
43	95940912	Hex Bushing, 1 1/4 to 1/2 NPT
44	35282961	Hose Assy, -6 x 13.00
45	35368927	Adapter, 3/8 NPT to Fem -6
46	95279527	Elbow
47	95298485	Tee, 1/4 NPT
48	95667358	Tee, Street, 1/4 NPT
49	35322346	Orifice Conn, .156
50	95954236	Tee, 1 1/4 NPT
51	95940748	Hex Bushing, 3/8 to 1/4 NPT
52	95112579	Nipple, Short, 1 1/4 NPT x 2.00
53	36867554	Tube Assy
54	36840460	Valve, Relief/Check
55	35284520	Hose Assy, -4 x 88.00
56	95287629	Adapter, 1/8 NPT to -4
57	35594225	Air Cylinder, Speed Control
58	35283472	Adapter, 1/4 NPT to -4
59	36793776	Conn, 1/4 to 1/4 NPT
60	95954095	Elbow, 1/4 NPT

INGERSOLL-RAND COMPANY
AIR COMPRESSOR GROUP
PORTABLE COMPRESSOR DIVISION
MOCKSVILLE, NC 27028

TITLE: AIR PIPING

CODE IDENT NO. | PART NO. 43201730 | REV.

SCALE: | UNIT: | SHEET 3 OF 4

WEIGHT TEST.I ____ LBS. ____ KGS.
THIRD ANGLE PROJ.
DRAWN DKG DATE 08 AUG 91
CHECKED
APPROVED
REF.

61	35322379	Valve, Blowdown
62	36766731	Orifice Muffler
63	95506945	Elbow, Street, 2" NPT
64	35302314	Adapter
65	35855691	Discharge Pipe
	95083622	Gasket
	35379009	Screw
66	35602473	Valve, Ball, 2" NPT
67	95953816	Nipple, 2" NPT x 4.50
68	95953907	Hex Bushing, 2 1/2 to 2" NPT
69	36848968	Water Separator
70	35598770	Valve, Minimum Pressure/Check
71	95951398	Hex Bushing, 3" to 2" NPT
72	35283241	Hose Assy, -4 x 14.00
73	35214683	Dresser Coupling
	72056856	Body
	72052269	Seals
	72056864	Follower
	72056872	Bolt
74	35335124	Adapter, 2" NPT to -32
75	43200047	Tube Assy, -32
76	SEE DETAIL	
77	35318336	Valve, Safety
78	95953808	Nipple, 2" NPT x 3.00
79	43200054	Elbow, Flange to -32
	35292143	Flange Half, SAE 2
	95357976	O-Ring, SAE 2 Flange
	95934659	Screw, 1/2 -13 x 1.25

INGERSOLL-RAND COMPANY
AIR COMPRESSOR GROUP
PORTABLE COMPRESSOR DIVISION
MOCKSVILLE, NC 27028

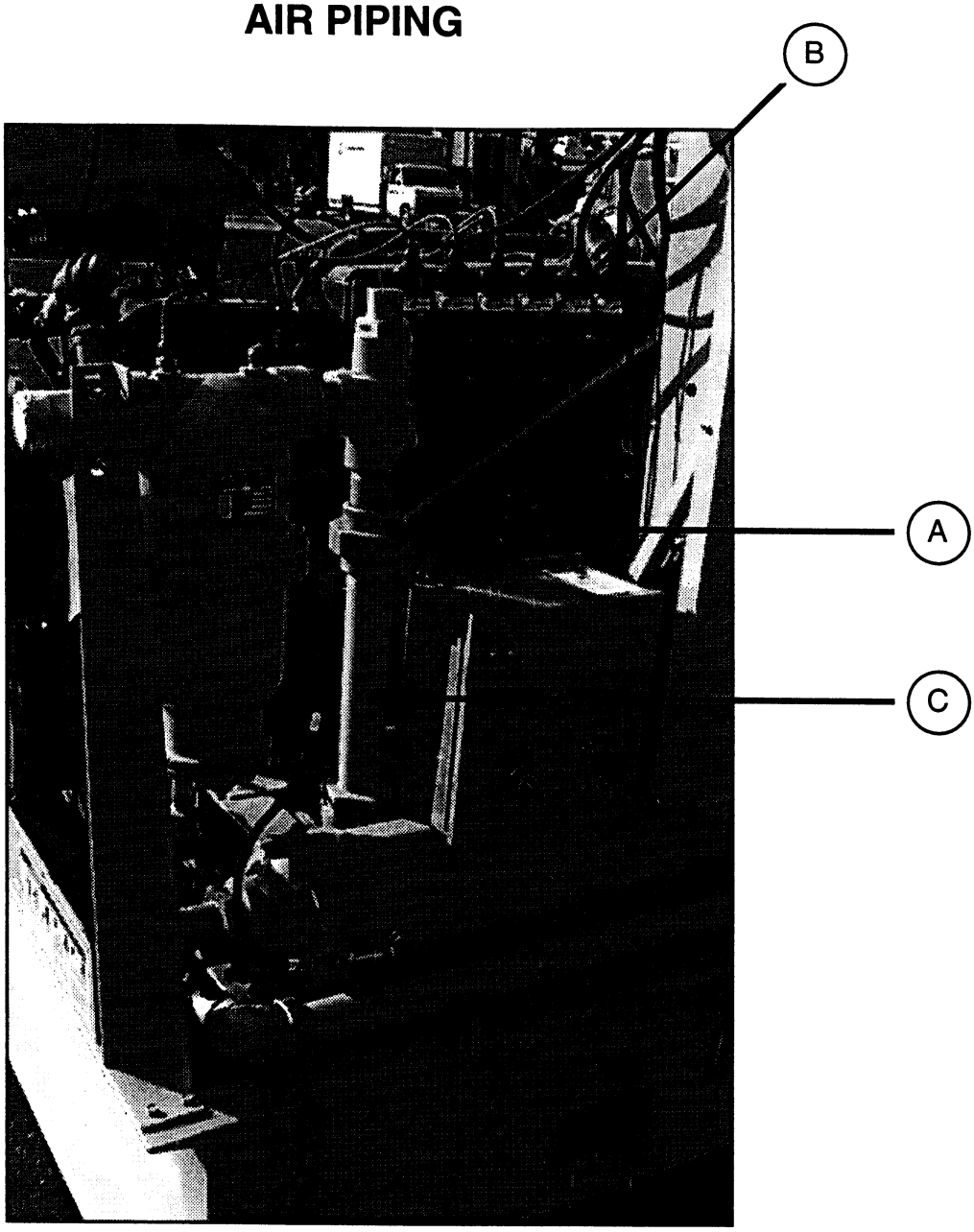
TITLE: AIR PIPING

CODE IDENT NO. | PART NO. 43201730 | REV.

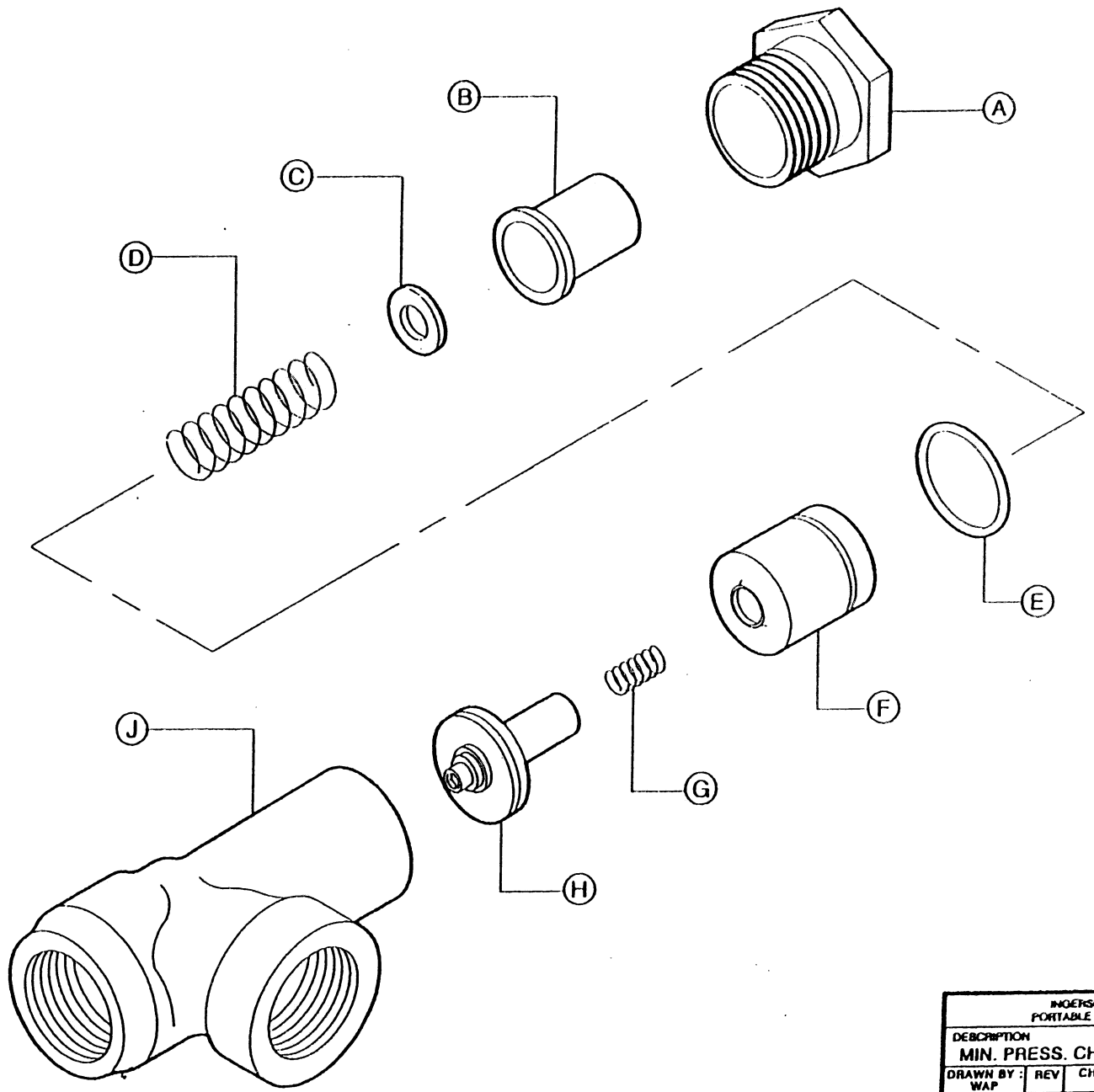
WEIGHT (EST.) ____ LBS. ____ KGS.
THIRD ANGLE PROJ.
DRAWN DKS | DATE 08 AUG 90
CHECKED
APPROVED
REF.
SCALE: | UNITS:

SHEET 4 OF 4

AIR PIPING



ITEM	PART NUMBER	DESCRIPTION
A	95944534	Union, 2" NPT
B	95946174	Nipple, 2" NPT x 4.00
C	43201854	Pipe, 2" NPT x 13.00



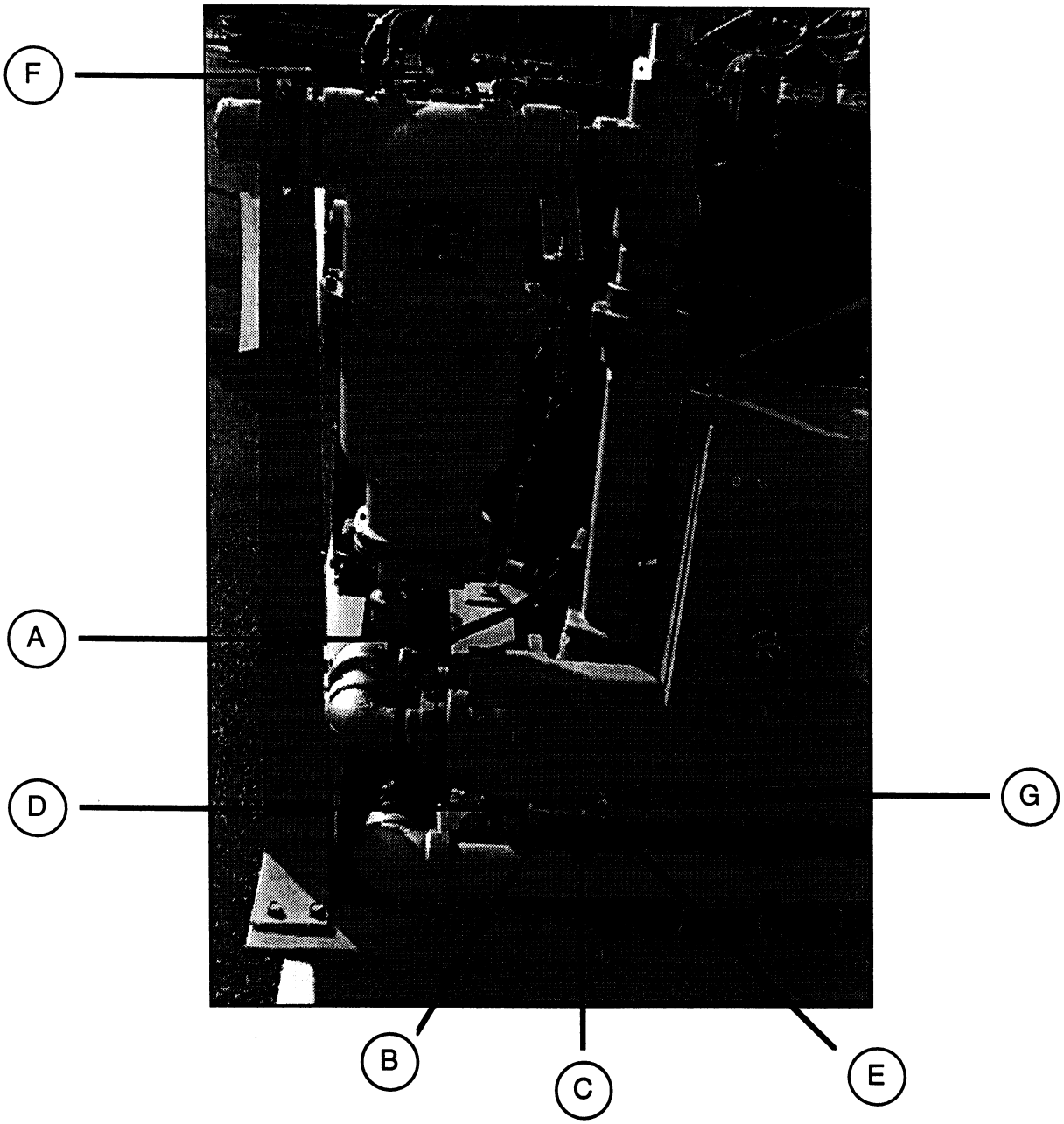
INGERSOLL – RAND COMPANY PORTABLE COMPRESSOR DIVISION				
DESCRIPTION MIN. PRESS. CHECK VALVE ASSEMBLY				
DRAWN BY : WAP	REV	CHECKED BY :	APPROVED BY :	
MODEL NO. 950L-NG	ILLUSTRATION NO. 36518793		SHEET NO. 1 OF 2	E/C 27539

(A)	35367341	CAP
(B)	35367390	INSERT
(C)	11A5C6	WASHER
(D)	35367366	SPRING
(E)	35367374	O – RING
(F)	35367325	PISTON
(G)	35367358	SPRING
(H)	35367317	CHECK VALVE ASSEMBLY
(J)	35367333	BODY

MINIMUM PRESSURE CHECK VALVE ASSEMBLY —— PART NUMBER 35598770

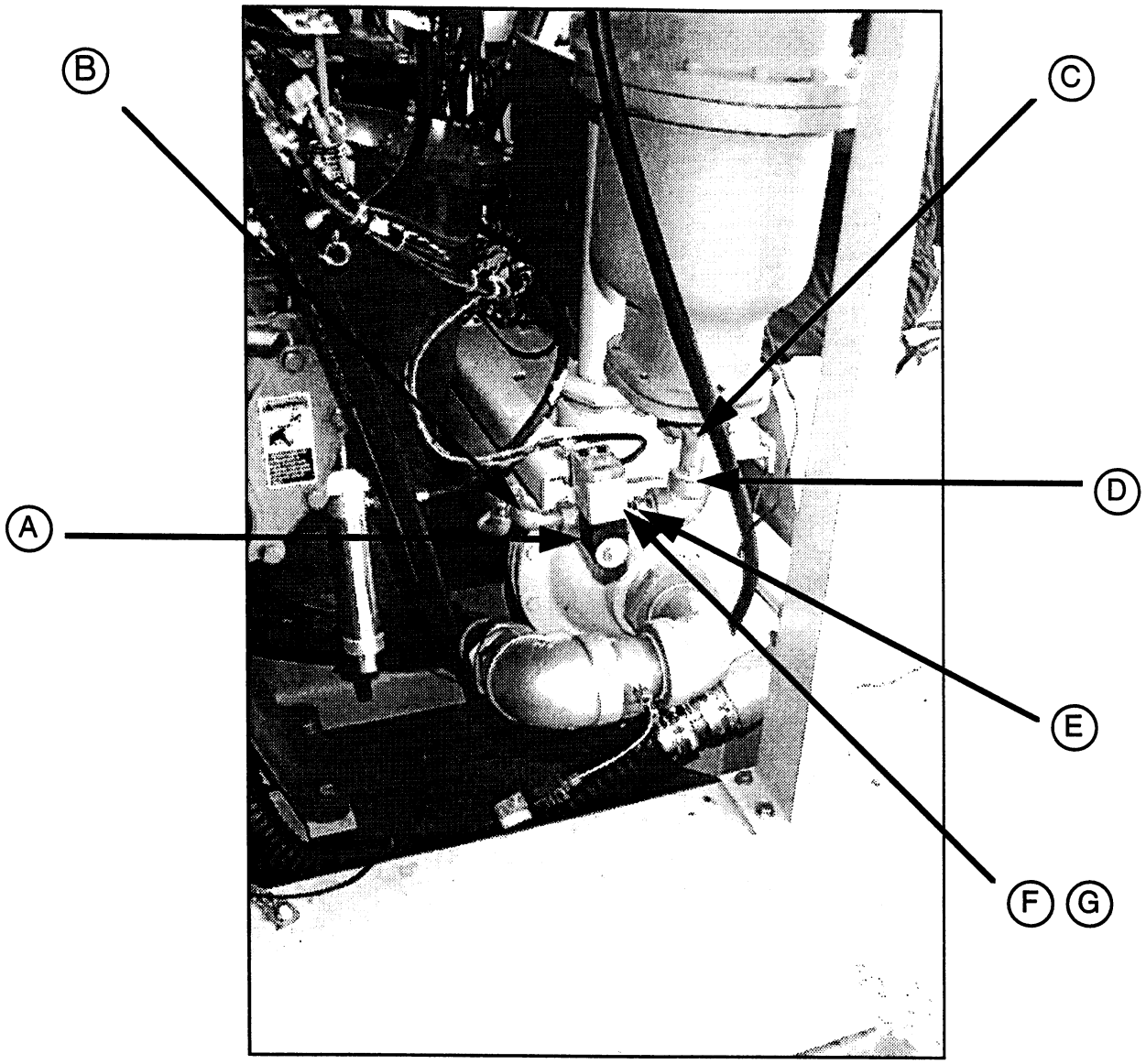
INGERSOLL – RAND COMPANY PORTABLE COMPRESSION DIVISION				
DESCRIPTION MIN. PRESS. CHECK VALVE ASSEMBLY				
DRAWN BY : WAP	REV	CHECKED BY :	APPROVED BY :	
MODEL NO. 950L-NG	ILLUSTRATION NO. 36518793		SHEET NO 2 OF 2	E/C 27539

AIR PIPING



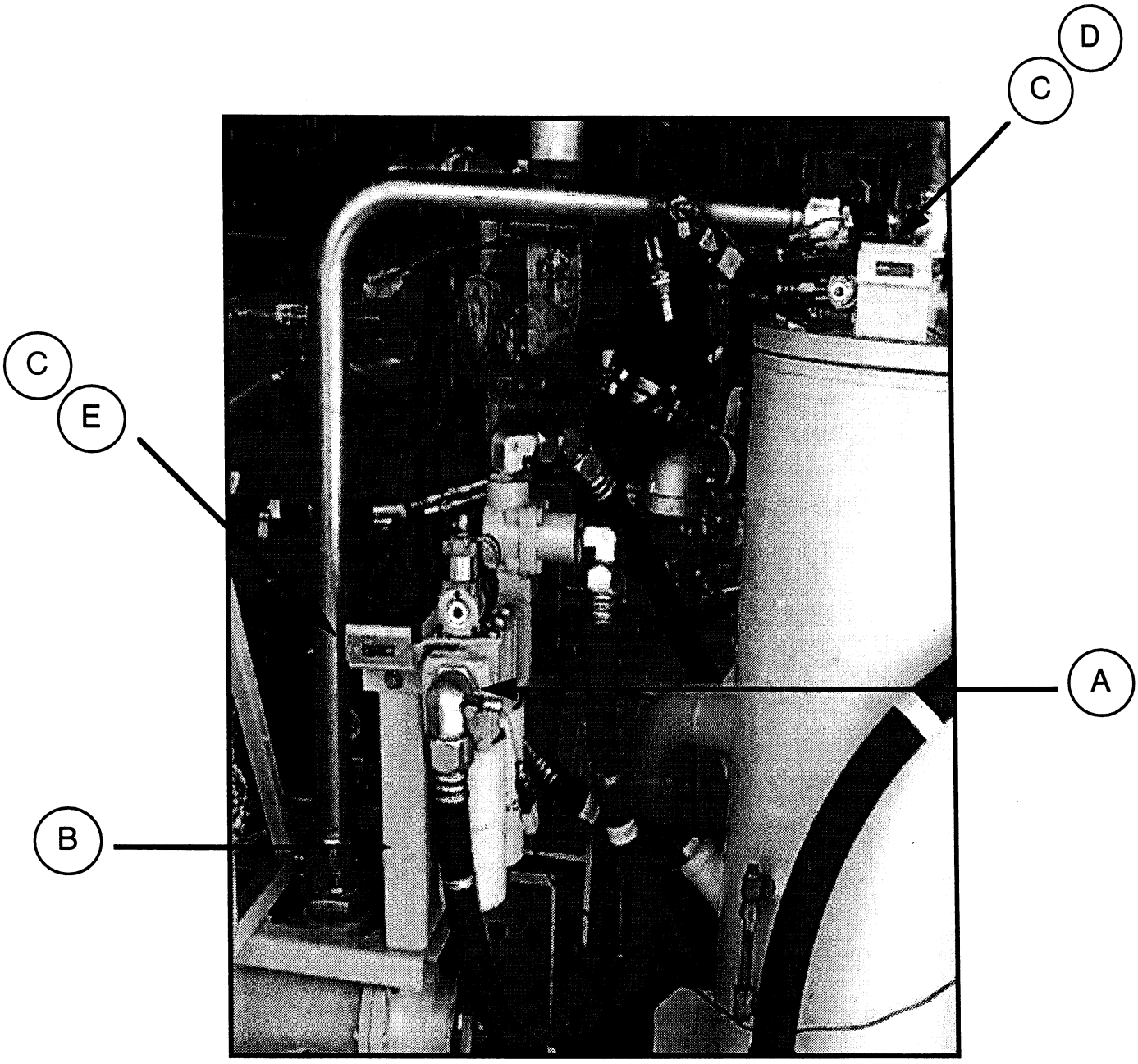
ITEM	PART NUMBER	DESCRIPTION
Ⓐ	35283480	Hose Assy., -4 x 48.00
Ⓑ	35248145	Connector, Ball Check
Ⓒ	36793776	Union, 1/4 NPT
Ⓓ	35283472	Adapter, 1/4 NPT to -4
Ⓔ	95944666	Street Elbow, 1/4 NPT
Ⓕ	35306687	90° Adapter 1/8 NPT to -4
Ⓖ	95940748	Hex Bushing 3/8 to 1/4 NPT

AIR PIPING

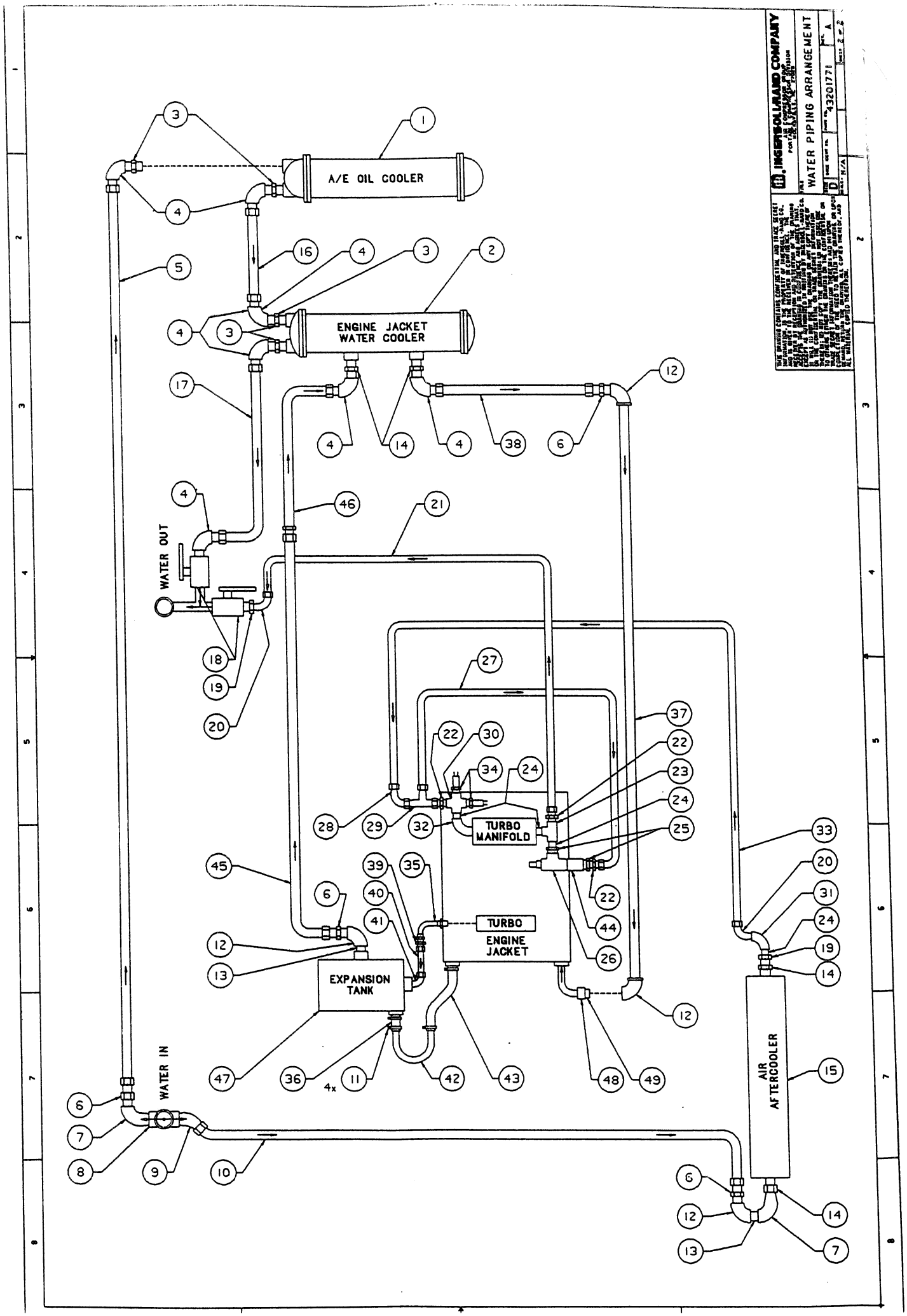


ITEM	PART NUMBER	DESCRIPTION
A	36797967	Auto Drain Valve
B	95954152	Street Elbow, 3/8 NPT
C	95953741	Nipple, 3/4 NPT
D	95954111	Elbow, 3/4 NPT
E	95953949	Hex Bushing, 3/4 to 1/2 NPT
F	95952248	Hex Bushing, 1/2 to 3/8 NPT
G	95953493	Close Nipple, 3/8 NPT

OIL PIPING / AIR PIPING



ITEM	PART NUMBER	DESCRIPTION
A	36739647	Over Temp. By-Pass Valve / Filter Assy.
B	36738672	Oil Filter Mounting Bracket
C	35825546	Restriction Indicator (2 Req'd)
D	36841922	Indicator Bracket
E	35586387	Indicator Bracket


A/E OIL COOLER
ENGINE JACKET WATER COOLER
WATER OUT
WATER IN
TURBO MANIFOLD
TURBO ENGINE JACKET
EXPANSION TANK
AIR AFTERCOOLER
4x
INGERSOLL-RAND COMPANY
WATER PIPING ARRANGEMENT
43201771

NO.	PART NO.	DESCRIPTION
1	43200088	AIR-END OIL COOLER
2	43200088	ENGINE JACKET WATER COOLER
3	95953907	BUSHING, HEX 2 1/2" X 2"
4	95286910	90° ADAPTER, 2" X -32
5	36799732	HOSE ASSEMBLY, -32 X 43.50
6	35335124	ADAPTER, 2" X -32
7	95953394	STREET ELBOW, 2" NPT
8	95944682	TEE, 2" NPT
9	35131192	45° ADAPTER, 2" X -32
10	35141423	HOSE ASSEMBLY, -32 X 64.50
11	35221662	CLAMP, HOSE
12	95948683	ELBOW, 2" NPT
13	95953808	NIPPLE, SHORT 2" NPT
14	95951398	BUSHING, HEX 3" X 2"
15	43200070	AIR AFTERCOOLER
16	43201185	TUBE ASSEMBLY, COOLER LOOP
17	35144419	HOSE ASSEMBLY, -32 X 40.50
18	43201128	VALVE, GATE 2"
19	95939989	BUSHING, HEX 2" X 1"
20	95219853	90° ADAPTER, 1" X -16
21	35142256	HOSE ASSEMBLY, -16 X 112.00
22	95219762	ADAPTER, 1" X -16
23	95414447	TEE, 1" NPT
24	95946117	CLOSE NIPPLE, 1" NPT
25	95937439	BUSHING, HEX 1 1/4" X 1"
26	43201755	VALVE, RELIEF
27	35112135	HOSE ASSEMBLY, -16 X 27.00
28	35292051	90° ELBOW, SWIVEL NUT -16
29	35295641	TEE RUN, SWIVEL -16
30	73A7M6Z1	CROSS, 1" NPT
31	95954129	90° ELBOW, 1" NPT
32	95928180	ELBOW, STREET 1" NPT
33	35114628	HOSE ASSEMBLY, -16 X 91.00
34	95940060	BUSHING, HEX 1" X 1/2"
35	43201870	TUBE ASSEMBLY MOD
36	43201821	HOSE, 1.75 ID RADIATOR
37	43201375	PIPE, 2" NPT X 72.00
38	35256122	HOSE ASSEMBLY, -32 X 35.00
39	35283126	ADAPTER, 3/8" X -8
40	35252782	HOSE ASSEMBLY, -8 X 13.00
41	35309210	90° ADAPTER, 1/2" X -8
42	43200609	TUBE, U-BEND
43	43200625	HOSE, ELBOW 1.75 I.D.
44	95953451	COUPLING, 1 1/4" NPT
45	35114321	HOSE ASSEMBLY, -32 X 29.00
46	36756765	TUBE ASSEMBLY, -32
47	43200658	TANK ASSEMBLY, EXPANSION
48	43201417	HOSE, 2" I.D.
49	36860039	BARBED NIPPLE, 2" NPT X 2" HOSE

REVISIONS

ZONE	REV.	DESCRIPTION	DATE	APVD
-	A	ORIGINAL RELEASE	8-4-06	-

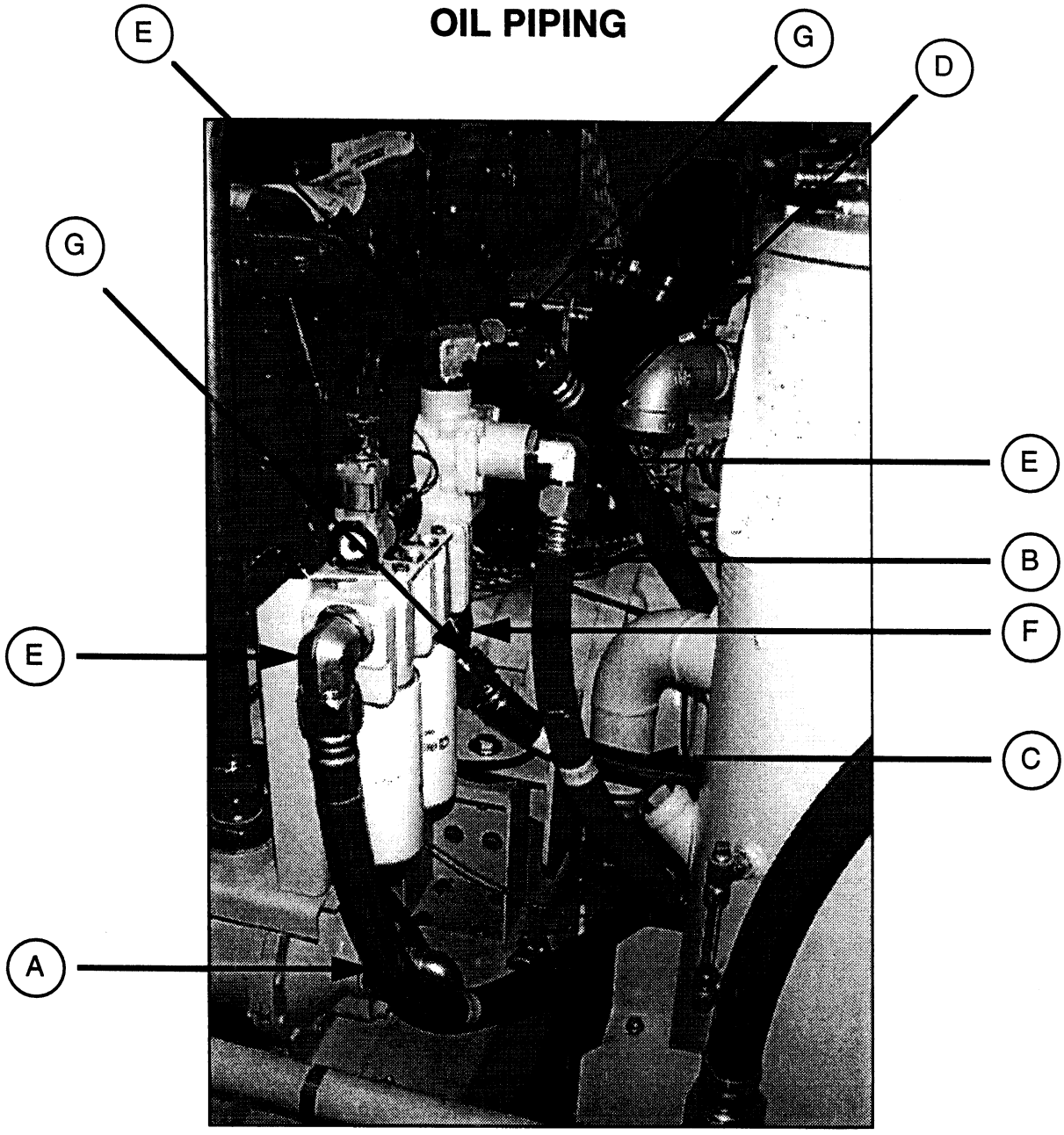
INGERSOLL-RAND COMPANY

WATER PIPING ARRANGEMENT

43201771 A

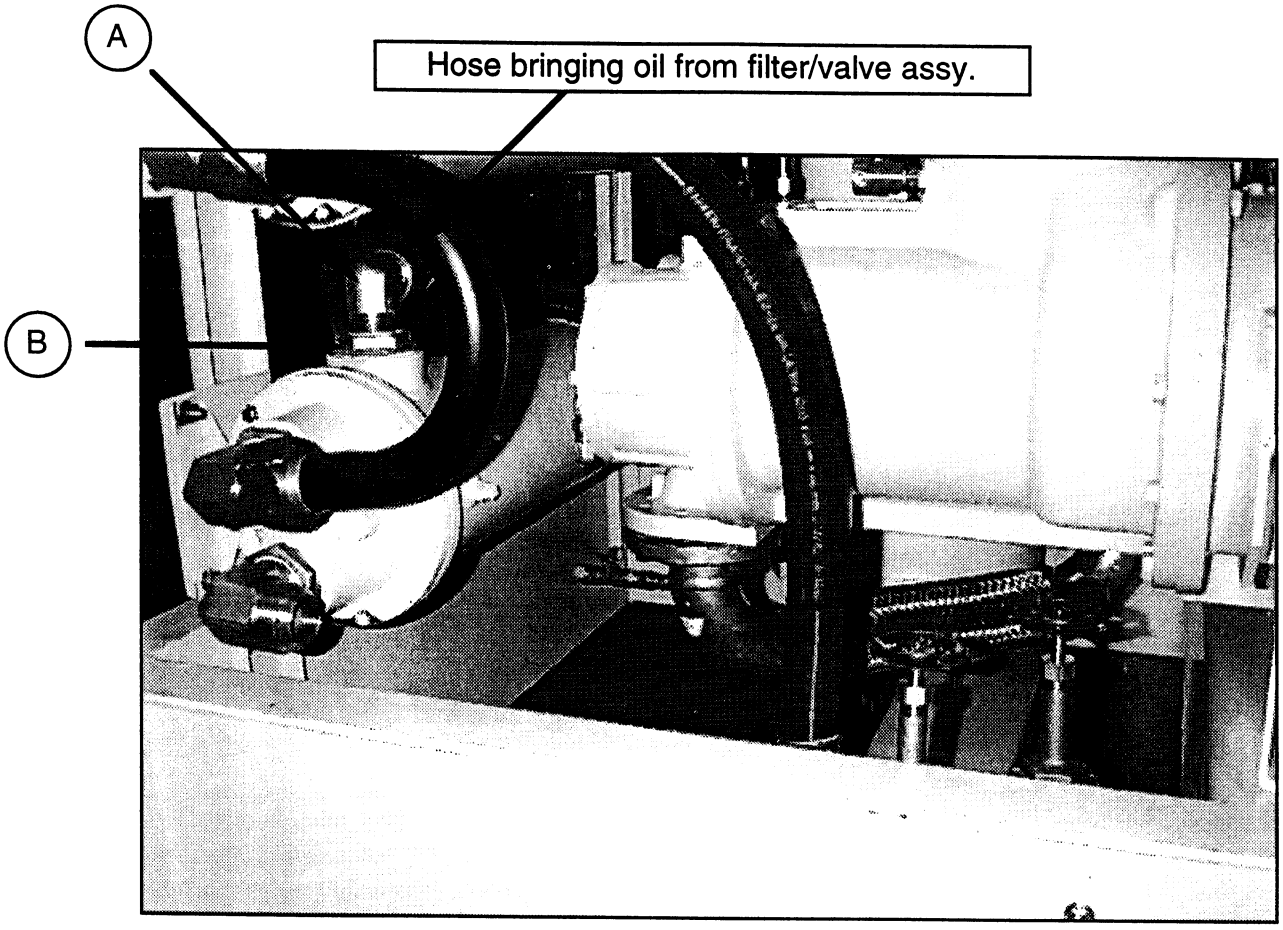
SCALE: N/A SHEET 1 OF 2

OIL PIPING



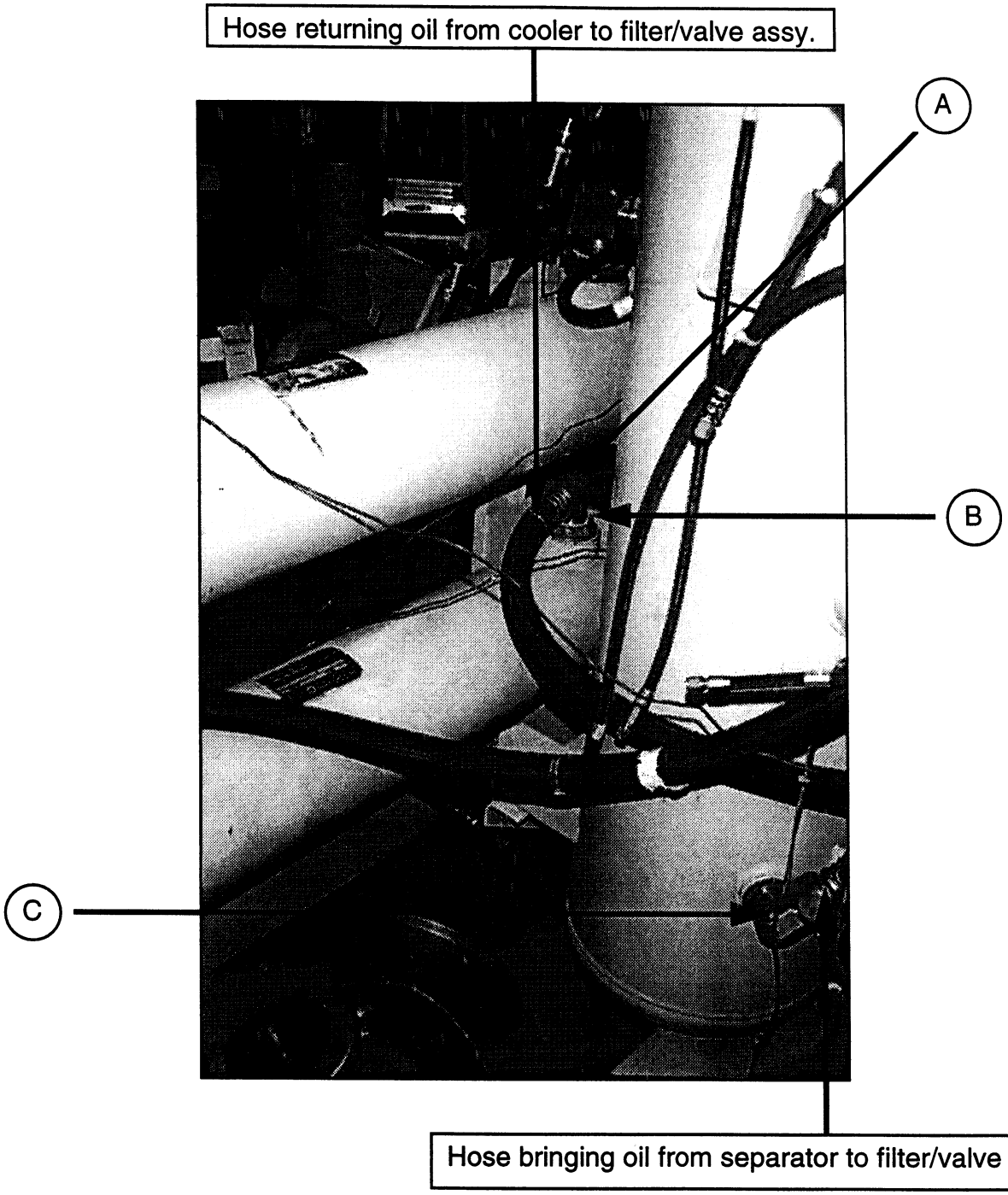
ITEM	PART NUMBER	DESCRIPTION
Ⓐ	35130871	Hose Assy., -24 x 41.75 (From filters to air end oil manifold)
Ⓑ	35309236	Hose Assy., -24 x 27.00 (Oil from separator to filter/valve assy.)
Ⓒ	35142116	Hose Assy., -24 x 47.00 (From compressor oil cooler to filter/valve assy.)
Ⓓ	35117472	Hose Assy., -24 x 62.00 (From filter/valve assy. to compressor oil cooler)
Ⓔ	95431292	90° Adapter, 1 7/8 O-Ring to -24 (3 req'd)
Ⓕ	35296409	Adapter, 1 7/8 O-Ring to -24
Ⓖ	35326172	Elbow, Swivel Nut, -24 (2 req'd)

OIL PIPING



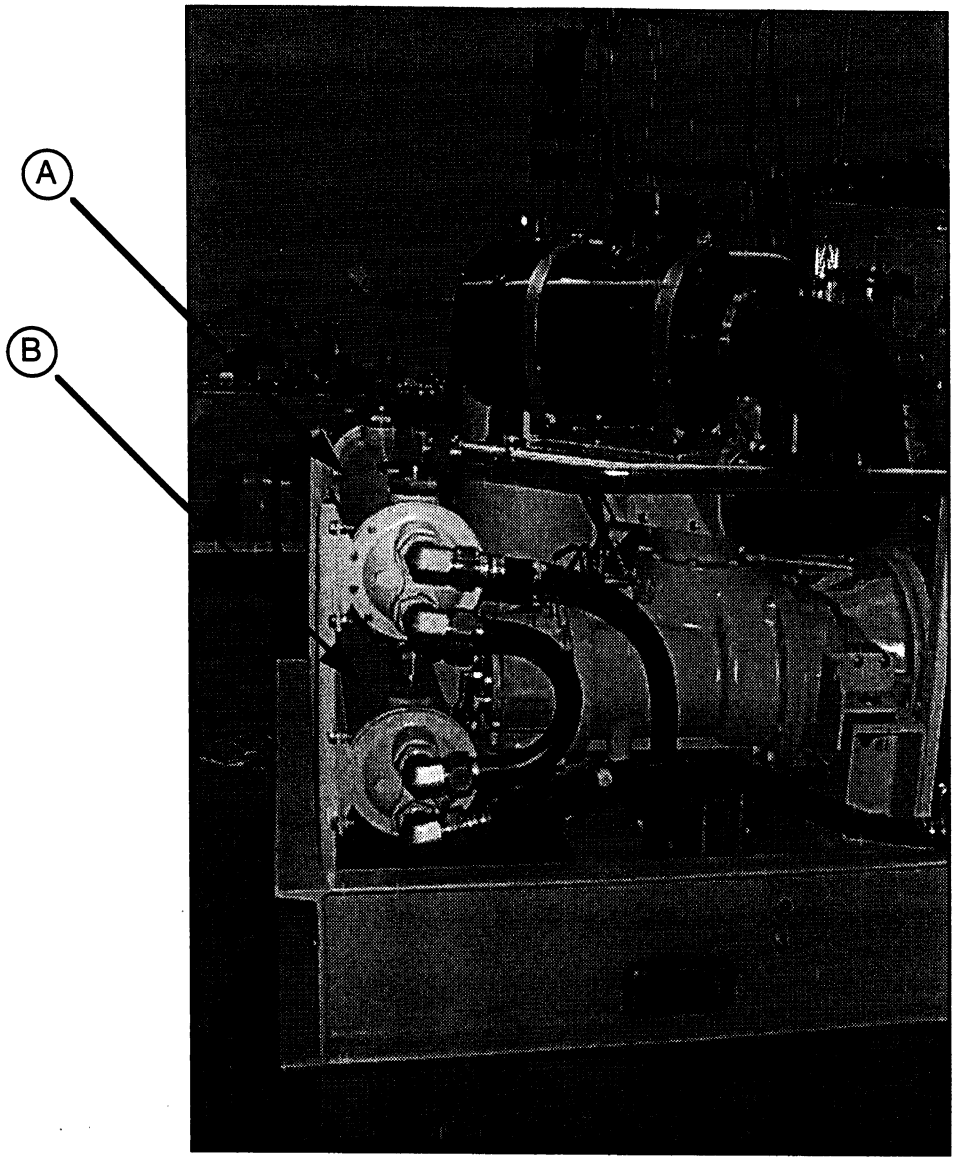
ITEM	PART NUMBER	DESCRIPTION
A	95279477	90o Adapter, 1 1/2 NPT to -24
B	95953840	Hex Bushing, 3" to 1 1/2" NPT

OIL PIPING



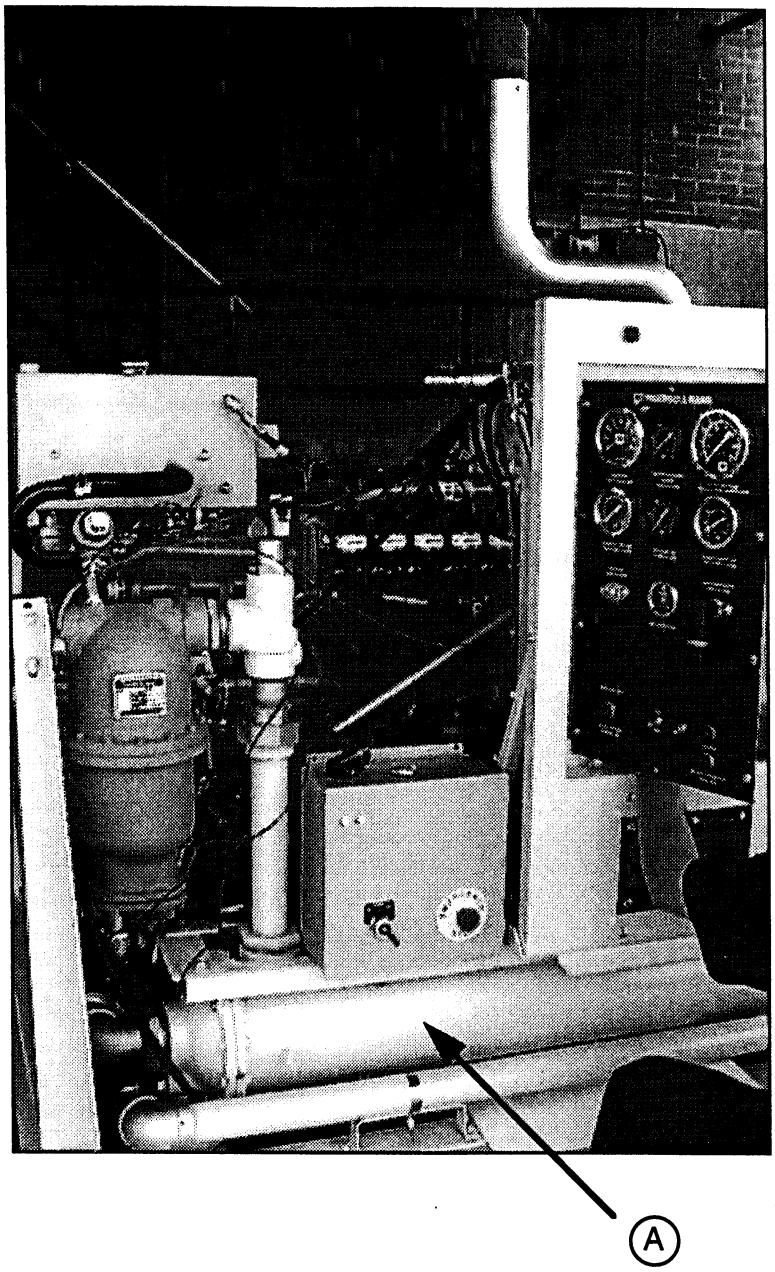
ITEM	PART NUMBER	DESCRIPTION
A	95279477	90° Adapter, 1 1/2 NPT to -24
B	95953840	Hex Bushing, 3" to 1 1/2 NPT
C	95431292	90° Adapter, 1 7/8 O-Ring to -24

HEAT EXCHANGERS



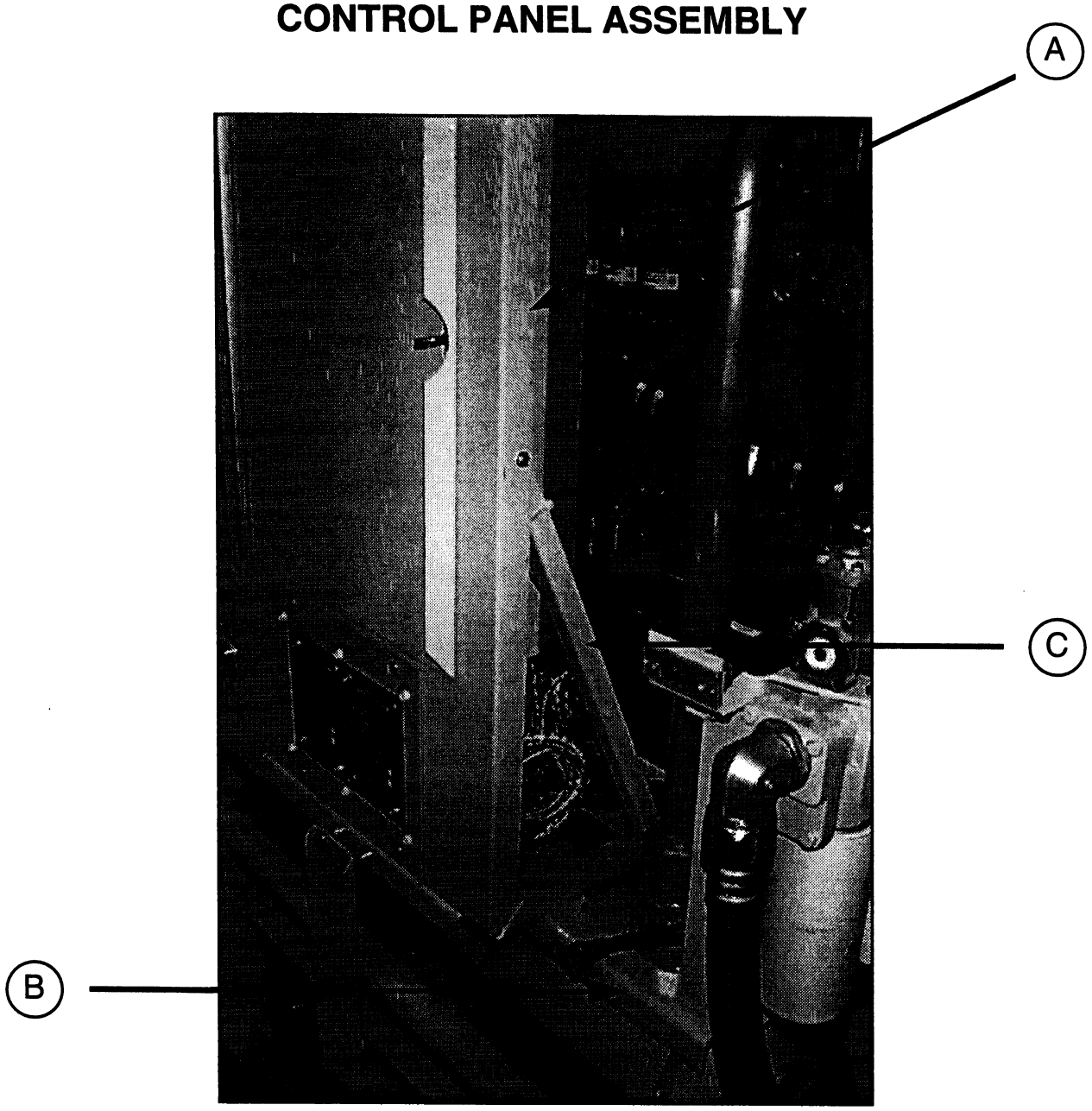
ITEM	PART NUMBER	DESCRIPTION
	43200088	Heat Exchanger, 2 Pass (2 Req'd)
		(A) Engine Jacket Water Cooler
		(B) Compressor Oil Cooler

HEAT EXCHANGERS



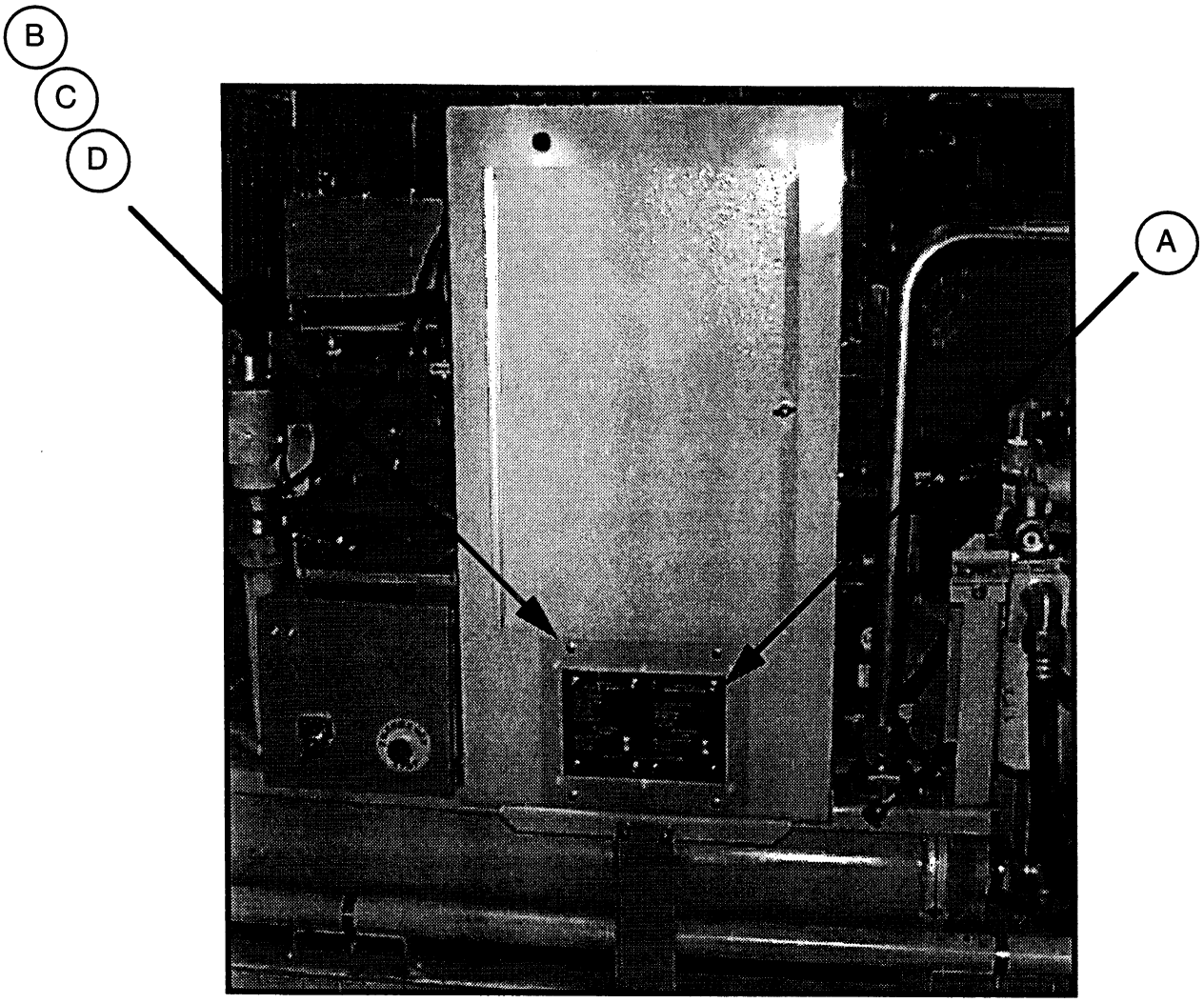
ITEM	PART NUMBER	DESCRIPTION
A	43200070	Heat Exchanger, 1 Pass (Aftercooler)

CONTROL PANEL ASSEMBLY



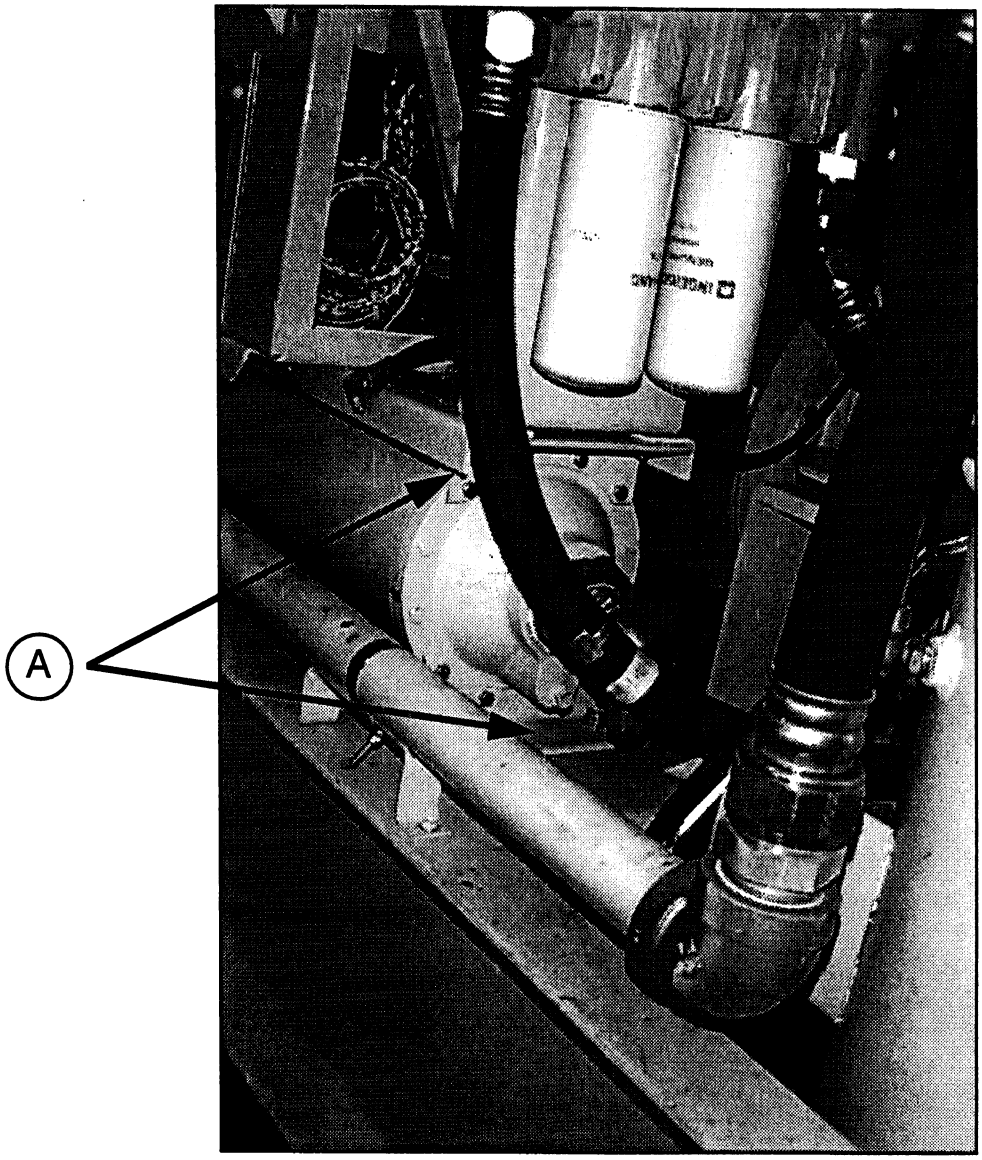
ITEM	PART NUMBER	DESCRIPTION
A	43200401	Control Panel Assembly
B	43200955	Control Panel Base
C	43201490	Control Panel Brace (2 Req'd)

CONTROL PANEL ASSEMBLY

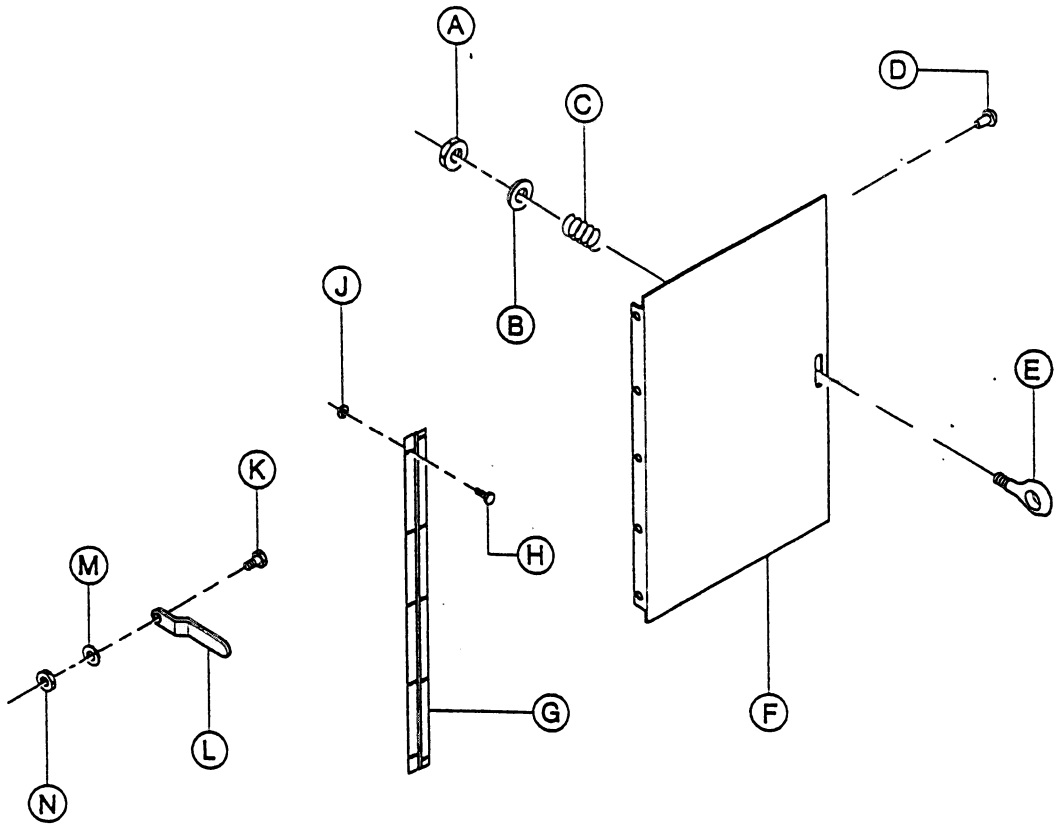


ITEM	PART NUMBER	DESCRIPTION
A	43201110	Diagnostic Panel Mount
B	36761906	Stud, Quarter Turn Fastener (4 req'd)
C	35369180	Retainer, Quarter Turn Fastener (4 req'd)
D	35314582	Latching Element (4 req'd)

CONTROL PANEL ASSEMBLY



ITEM	PART NUMBER	DESCRIPTION
(A)	43200997	Cooler Foot (4 Req'd, 2 each end)



INGERSOLL-RAND COMPANY
AIR COMPRESSOR GROUP
PORTABLE COMPRESSOR DIVISION
MOCKSVILLE, NC 27028

TITLE: CONTROL PANEL ASSY.

CODE IDENT NO. | PART NO. | REV.

SCALE: | UNIT: NAT GAS | SHEET OF

WEIGHT (EST.) ____ LBS. ____ KGS.

THIRD ANGLE PROJ.

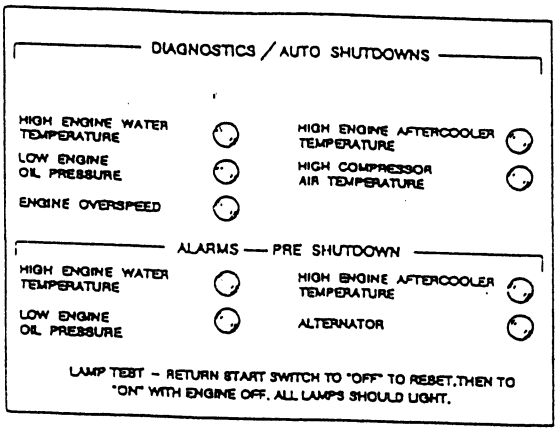
DRAWN | DATE 4/28/96

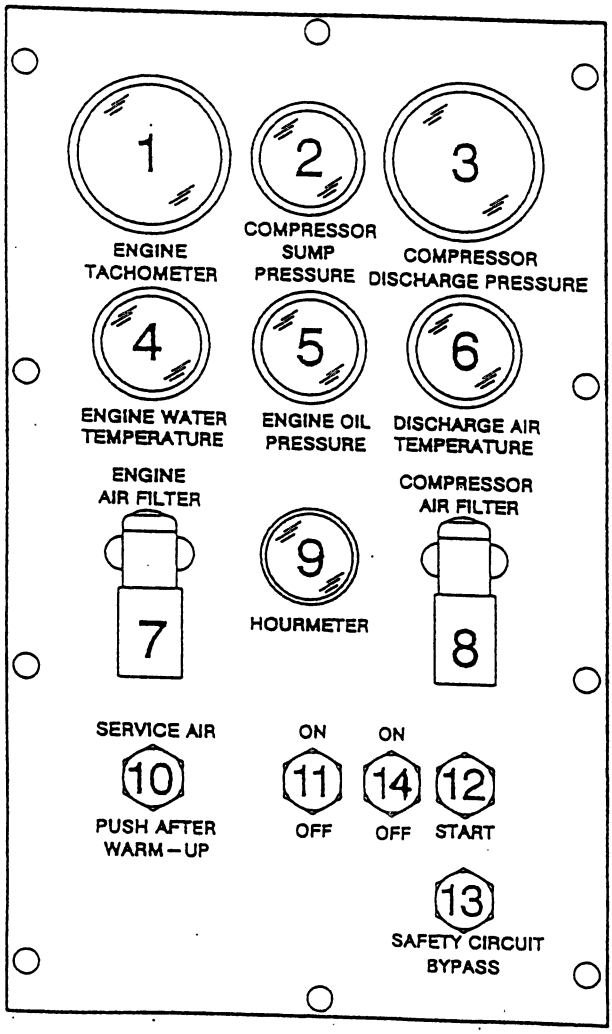
CHECKED | DATE 5/15/96

APPROVED | DATE

REF.

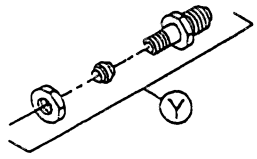
A	67A4C2G	NUT	K	35357995	STUD
B	11A5G3	WASHER	L	35603349	HOLDER , DOOR
C	35327311	SPRING	M	11A5G4	WASHER
D	35356617	RIVET (5 REQD)	N	35273366	NUT
E	35327303	EYEBOLT			
F	36738565	DOOR , CONTROL PANEL			
G	36740405	HINGE , CONTROL DOOR			
H	35144328	SCREW (4 REQD)			
J	35144492	NUT (4 REQD)			

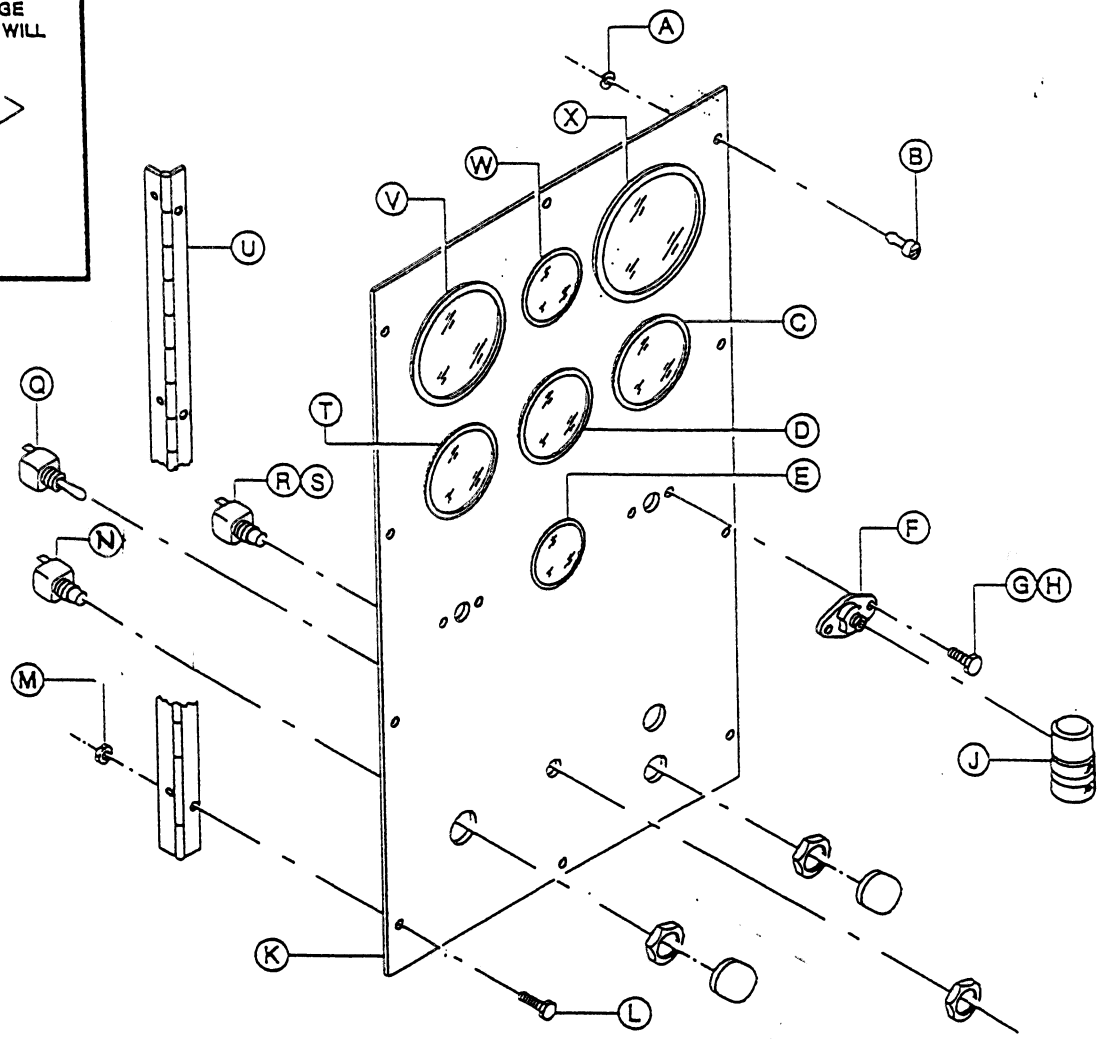




INGERSOLL-RAND COMPANY PORTABLE COMPRESSOR DIVISION				REV.	DESCRIPTION	DATE
DESCRIPTION: INSTR. / CONTROL PANEL				A	ORIGINAL RELEASE PER E/C 25815 WAP	9-10-91
				B		
MODEL NO.	ILLUSTRATION NO.	SHEET NO.	E/C	C		
NAT/GAS	36516862	1 OF 1	25815	D		

WHEN ORDERING TEMP. GAGE 36765808 OR 36765790 YOU WILL ALSO NEED TO ORDER THE FOLLOWING ASSEMBLY :





(A) 35369180	RETAINER (6 REQD)	
(B) 36761906	STUD (6 REQD)	
(C) 36765790	GAGE , AIR TEMPERATURE	
(D) 35863273	GAGE , OIL PRESSURE	
(E) 35602788	HOURMETER	
(F) 35107408	FLANGE , INDICATOR	
(G) 35144328	SCREW (4 REQD)	
(H) 35144492	NUT (4 REQD)	
(J) 35261122	INDICATOR (2 REQD)	
(K) 36797868	PANEL , INSTRUMENT	
(L) 35144328	SCREW (4 REQD)	
(M) 35144492	NUT (4 REQD)	
(N) 35255561	SERVICE AIR BUTTON	
(Q) 35337435	SWITCH , TOGGLE (2 REQD)	
(R) 35255553	SWITCH , START	
(S) 35255561	SWITCH , BY–PASS	
(T) 36765808	GAGE , WATER ,TEMP.	
(U) 36750420	HINGE , INSTRUMENT PANEL	
(V) 36762185	TACHOMETER	
(W) 35863273	GAGE , SUMP PRESSURE	
(X) 36765774	GAGE , DISCHARGE PRESS.	
(Y) 35371681	CONNECTOR , THERM.	

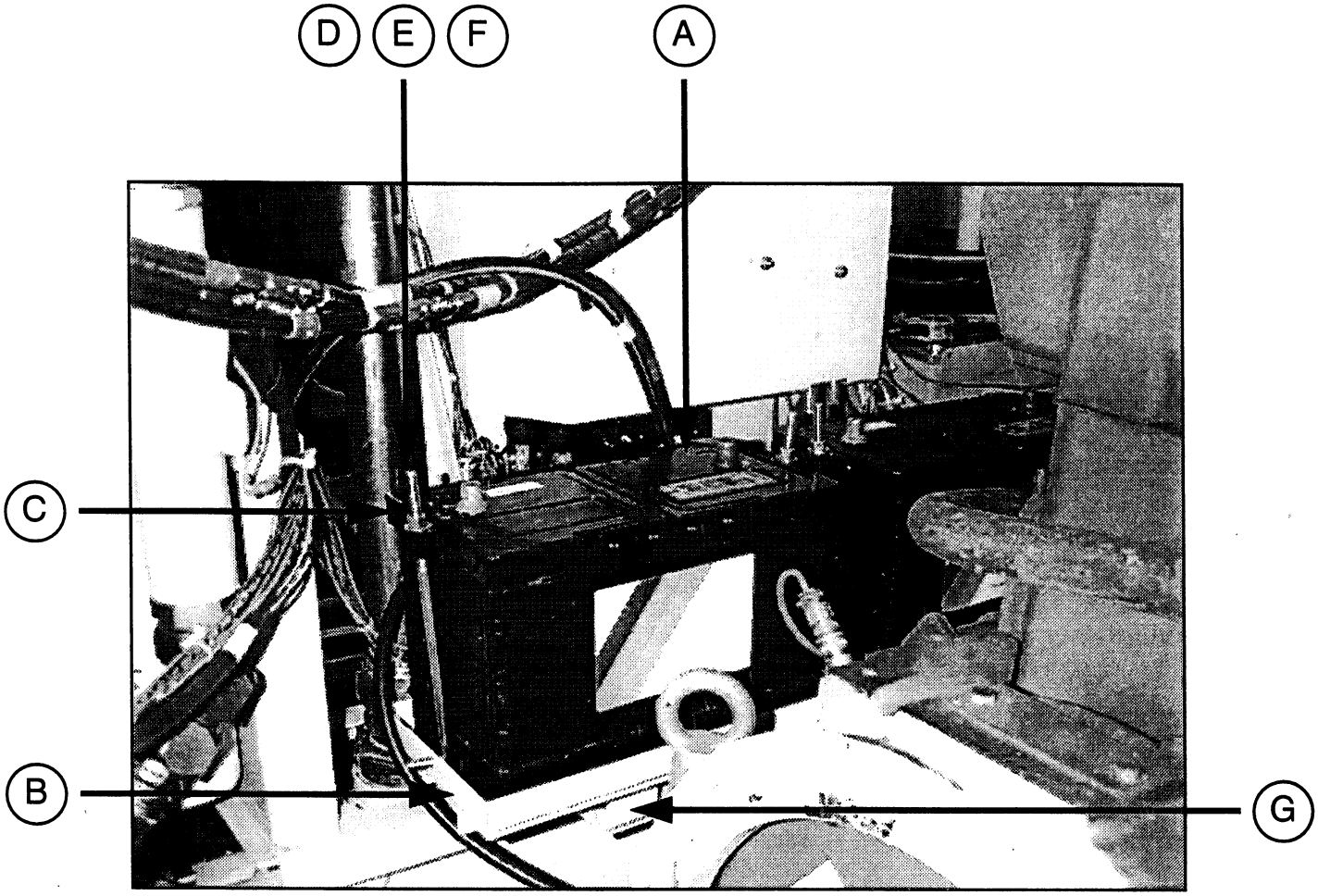
INGERSOLL-RAND COMPANY
PORTABLE COMPRESSOR DIVISION

DESCRIPTION: INSTRUMENT & CONTROL PANEL

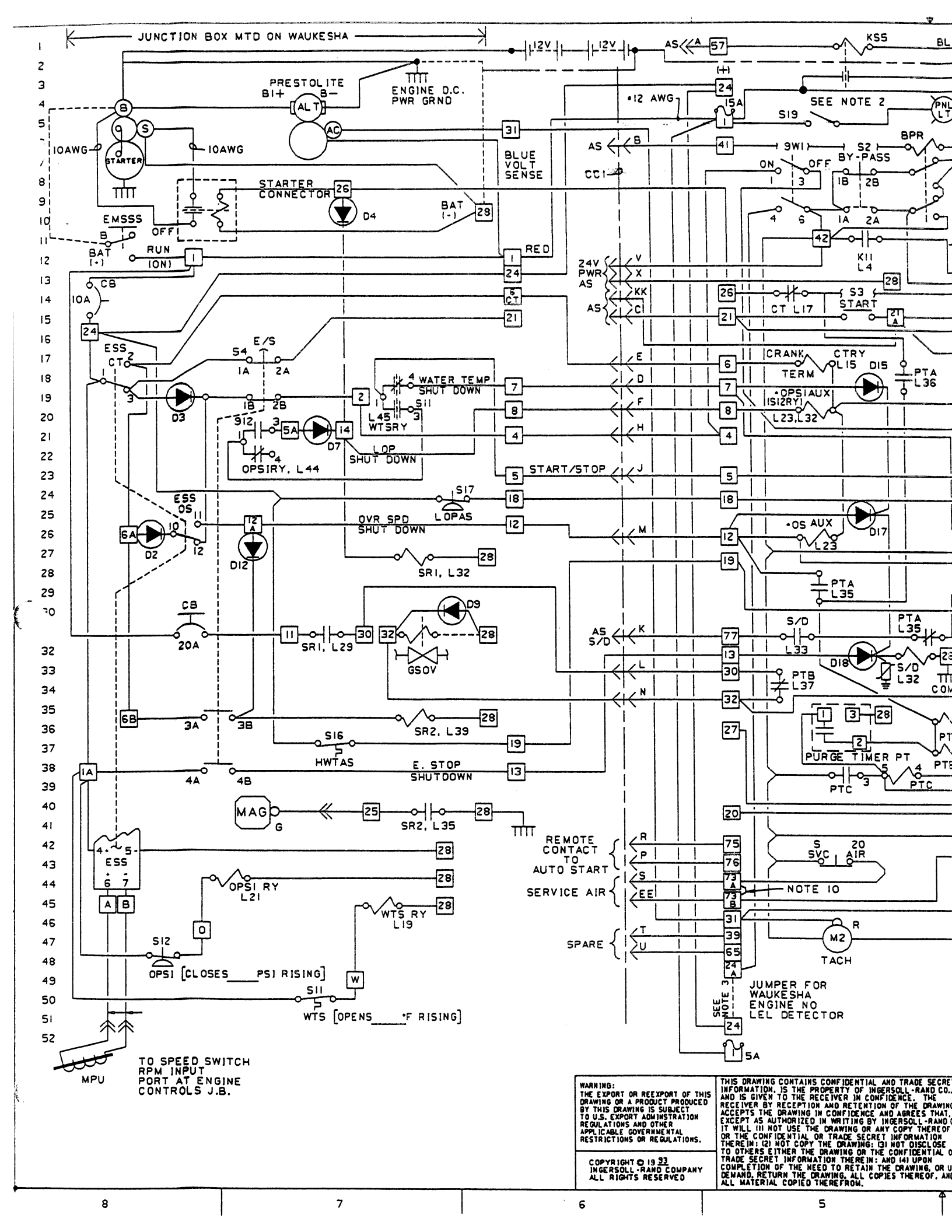
MODEL NO.	ILLUSTRATION NO.	SHEET NO.	E/C
NAT/GAS	36516615	1 OF 1	25815

REV.	DESCRIPTION	DATE
A	ORIGINAL RELEASE PER E/C 25815 WAP	7-24-91
B		
C		
D		

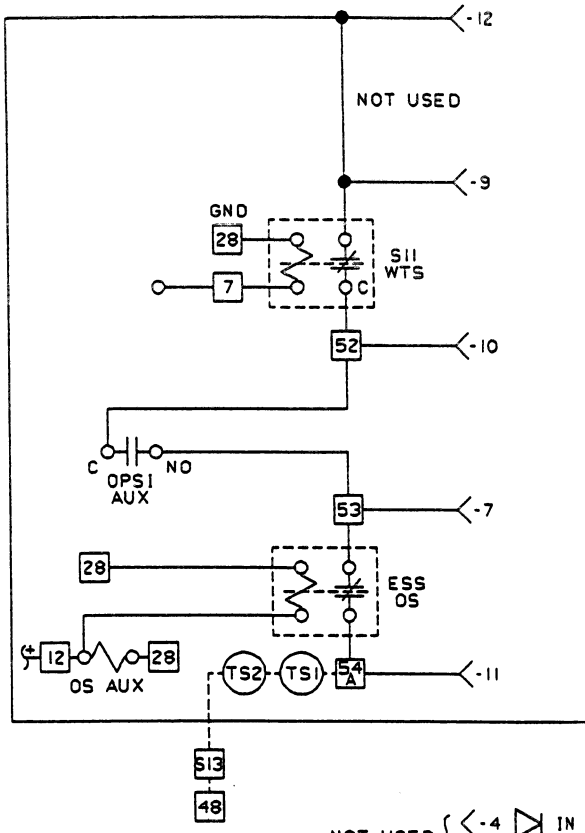
BATTERIES & MOUNTING

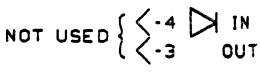


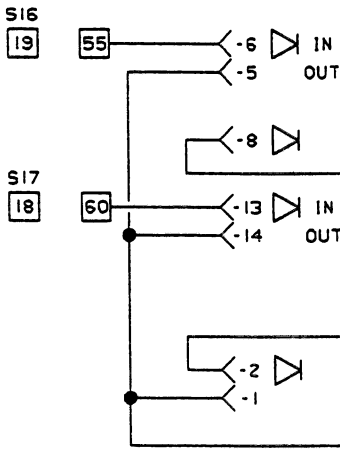
ITEM	PART NUMBER	DESCRIPTION
A	36844975	Battery (2 Req'd)
B	36853232	Battery Tray (2 Req'd)
C	35582394	Battery Hold Down Frame (2 Req'd)
D	35129097	Rod (4 Req'd)
E	95922894	Nut (4 Req'd)
F	95934899	Washer (4 Req'd)
G	43201433	Battery Tray Riser
	35582410	Cable, Positive #0 x 20.0 (Not Shown)
	35587088	Cable, Negative #0 x 17.0 (Not Shown)
	35258789	Cable, Jumper #000 x 12.0 (Not Shown)



U2 ENGINE
FRONT OF DECAL







ALT	See Eng. Parts List	Alternator
BPR	35577873	By-Pass Relay
CB	36845980	Circuit Breaker
COPS (S13)	36757581	Comp Oil Press Sw N.O. Close on Rising Press @ 12 PSI
CT (K7)	Part of 36846012	Crank Terminate on ESS
CTRY	Part of 36846012	Relay Activated by CT at ESS
D15-22	## 1N4007	Diode
D23	## 1N5408	Diode
EACTA (S15)	See Table	Hi Engine Aftercooler Temp. Alarm N.O. Close on Rising Temp
EMSSS	35255553	Engine Master Start-Stop Switch
ESPB	36846020	Emergency Stop Push Button
ESS	36846012	Electronic Speed Switch Module
EWTS (S11)	35327980	Engine Water Temperature Switch NC Open on Rising Temp @ 215°F
FAN AIR FLO	# Model 1910-1	Fan Box Air Flow SW
GSOV	36846004	Gas Shut-Off Valve
K10	35586130	Alarm Sense Relay
K2	35586130	Shutdown Relay
K3	35583442	Alternator Charge Relay (12 VDC)
K5	* KUP14D15	Lock-In Relay in Fan Box
K5AUX	* KUP11D55	Auxiliary Relay Contacts
K6	** ERD1	Unloader Time Delay Relay
KS5	35586130	Auto Start Activator for Unloader Compressor
KSA	35586130	Latching Relay for SAV Solenoid
LEL	36841054	Lower Explosive Limit Gas Detector
M1	35602788	Hour Meter
MPU	See Eng. Parts List	Magnetic Pickup For ESS
OPS1	36757581	Oil Pressure Shutdown Switch N.O. closes on Rising Press @ 12 psi
OPS1 AUX	* KUP11D55	Auxiliary Relay Contacts
OPS2	36789469	Unloader Solenoid Valve Control Switch N. O. Close on Rising Press @ 2.5psi
OS (K8)	Part of 36846012	Over Speed Switch on ESS
OS AUX	35586130	Auxiliary Relay Contacts
OSRY	35586130	Over Speed Relay
PNL LT	36841252	Front Panel Light
	35290089	Bulb, Light
PS	See Eng. Parts List	Starter Pinion Solenoid
PS AUX (K1)	35577973	Auxiliary Support Relay
PT	** HRDM22A1	Purge Timer
PTA	* KUP14D55	Slave Relays

DESCRIPTION		
ELECTRICAL SCHEMATIC		
MODEL NO.	ILLUSTRATION NO.	SHEET NO.
NAT/GAS	43201763	3 of 4

Vendor: Dwyer Instruments

* Vendor: Potter & Brumfield

** Vendor: Solid State Advanced Controls (SSAC) Corp.

Vendor: Various Suppliers

PTB	35586130	Slave Relays
PTC	35586130	Slave Relays
RTC	Part of 36797967	Repeat Cycle Timer at Condensate Valve
S/D	35586130	Auto Start Shutdown Relay
S10	36798841	Low Engine Aftercooler Flow S/D Sw
S16	43201557	Hot Water Temp Alarm SW N.O. Close on Rising Temp @ 205°F
S17	36757573	Low Engine Oil Press Alarm NC Opens on Rising Press @ 20 PSI
S2	35255561	By-Pass Switch
S2O	35255561	Service Air Push Button N.C.
S5	35366988	Push Button for Unloader Compressor
S7	(See Table)	High Engine Aftercooler S/D SW NC Opens on Rising Temp
S8	35577592	High Comp Air Temp S/D SW NC Opens on Rising Temp @ 248°F
SAV	36840841	Service Air Valve NC -- Energize to Open
SM	See Eng. Parts List	Starter Motor
SPAP (S14)	36757573	Start Air Protection NC Opens on Rising Press @ 20 PSI
SR1	See Eng. Parts List	Slave Relay to GSOV
SR2	See Eng. Parts List	Slave Relay to Mag Gnd
SW1	35337435	Main 24VDC Panel Power SW
TACH	36762185	Tachometer in Instrument Panel
TS1	36764777 36021632 *	Air Service Temperature S/D SW
TS2	36764769 36021632 *	Separator Tank Temperature S/D SW
U1	36771434	Diagnostic Module, Compressor
U2	36771434	Diagnostic Module, Engine
WTS RY	35586130	Relay Activated By EWTS
	36840841	Unloader Solenoid Valve NC -- Energize to Open
	* Diactor 95-100 volt	Surge Arrestor - TECCOR "DIACTOR" 95-100 Volt

TABLE -- TEMPERATURE SWITCHES

		Caterpillar	Waukesha
Unit with Catalytic Converter			
S-15 EACTA	Turbocharger A/C Alarm 90° NO - Close on rise	43201078	N/A
S-7 Aftercooler	Turbocharger A/C Shut Down 100° NC - Open on rise	43201060	N/A
Units without Catalytic Converter			
S-15 EACTA	Turbocharger A/C Alarm 120° NO - Close on rise	36845782	36845782
S-7 Aftercooler	Turbocharger A/C Shut Down 130° NC - Open on rise	36845774	36845774

DESCRIPTION
ELECTRICAL SCHEMATIC

MODEL NO.	ILLUSTRATION NO.	SHEET NO.
NAT/GAS	43201763	4 of 4

* Vendor: Teccor

* use SW7 36857SC
+ 3/4 x 1/2 Bushing

2

M

ALARM AND SHUTDOWN
SETPOINTS

The following is a list of 'alarm' and 'shutdown' setpoints by engine series for various engine operating parameters. These values can be used as a guide when designing protection or monitoring systems.

The 'alarm' values shown are suggested values; they can be changed to suit a specific application or measurement device.

By utilizing controls which simultaneously shut off the fuel supply and ignition system upon reaching a 'shutdown' value, the potential for engine damage is reduced.

Alarm and shutdown values are based on dry natural gas (900 BTU/cu.ft. SLHV). Refer to Gaseous Fuel Specification sheet S7884C and Lube Oil Recommendations sheet S1015Y or latest revisions for typical changes in operation temperatures for jacket water and lube oil when running on landfill or digester gas fuels.

Refer to the most recent version of the Gas Engine Price Book to determine which shutdown devices are included as standard equipment with any specific engine model.

E.N. 116741
E.N. 114034, Supp. #1
E.N. 114034

AT25GL/AT27GL

JACKET WATER OUTLET TEMPERATURE:

Standard Cooling System:

Normal: 180°F (82°C) for continuous rating
200°F (93°C) for intermittent rating
Alarm: 10°F (5.5°C) above normal/design temperature
Shutdown: 20°F (11°C) above normal/design temperature

Elevated Temperature Solid Water Cooling System:

Normal: 210°F - 250°F (99 - 121°C) solid water
Alarm: 5°F (3°C) above normal/design operating temp.[1]
Shutdown: 10°F (5.5°C) above normal/design operating temp.[1]

LUBE OIL HEADER TEMPERATURE:

Normal: 180°F (82°C)
Alarm: 195°F (91°C)
Shutdown: 205°F (96°C)

LUBE OIL HEADER PRESSURE:

Normal: 45 - 50 psi (310 - 345 kPa)
Alarm: 40 psi (276 kPa)
Shutdown: 35 psi (241 kPa)

INTAKE MANIFOLD TEMPERATURE:

Normal: Up to 10°F (5.5°C) above design intercooler water inlet temp.
Alarm: 20°F (11°C) above design intercooler water inlet temp.
Shutdown: 30°F (17°C) above design intercooler water inlet temp.

INTAKE MANIFOLD PRESSURE:
Contact Application Engineering.

MAIN BEARING TEMPERATURE:
Shutdown: 250°F (121°C)

OVERSPEED:
Shutdown: not to exceed 10% over governed speed.

[1] Waukesha Power Systems code 1105, 1105A, or equivalent pressure/temperature shutdown system is recommended when jacket water temperature exceeds 210°F (99°C).

Waukesha DRESSER

TITLE — ALARM AND SHUTDOWN SETPOINTS

DR JWJ
CH RWS
APP AMD

S
8382

VHP

JACKET WATER OUTLET TEMPERATURE:

Standard Cooling System:

Normal: 180°F (82°C) for continuous rating
200°F (93°C) for intermittent rating
Alarm: 10°F (5.5°C) above normal/design temperature
Shutdown: 20°F (11°C) above normal/design temperature

Elevated Temperature Solid Water Cooling System:

Normal: 210°F - 235°F (99°C - 113°C) solid water
Alarm: 5°F (3°C) above normal/design operating temp.[1]
Shutdown: 10°F (5.5°C) above normal/design operating temp.[1]

Ebullient Cooling System:

Normal: 212°F - 250°F (100°C - 121°C)
Alarm: See Note 2 below
Shutdown: See Note 2 below

LUBE OIL HEADER TEMPERATURE:

Normal: 180°F (82°C)
Alarm: 195°F (91°C)
Shutdown: 205°F (96°C)

LUBE OIL HEADER PRESSURE:

Six and Twelve Cylinder Models:

Normal: 40 - 55 psi (275 - 380 kPa)
Alarm: 30 psi (207 kPa)
Shutdown: 20 psi (138 kPa)

Sixteen Cylinder Models:

Normal: 35 - 50 psi (240 - 345 kPa)
Alarm: 25 psi (172 kPa)
Shutdown: 15 psi (103 kPa)

[1] Waukesha Power Systems code 1105, 1105A, or equivalent shutdown system is recommended when jacket water temperature exceeds 210°F (99°C).

[2] Waukesha Power Systems code 1106, 1106A, or equivalent shutdown system is recommended for ebulliently cooled engines.

(cont. next page)

Waukesha DRESSER

TITLE— ALARM AND SHUTDOWN SETPOINTS

DR. JWJ
CH. RWS
APP. HMD

S
8382

VHP (Cont.)

INTAKE MANIFOLD TEMPERATURE (GSI & GL ENGINES):

Normal: Up to 10°F (5.5°C) above design intercooler water inlet temp.
Alarm: 15°F (8°C) above design intercooler water inlet temp.
Shutdown: 20°F (11°C) above design intercooler water inlet temp.

INTAKE MANIFOLD PRESSURE:
Contact Application Engineering.

MAIN BEARING TEMPERATURE:
Shutdown: 250°F (121°C)

OVERSPEED:
Shutdown: 10% over governed speed.

Waukesha DRESSER

TITLE— ALARM AND SHUTDOWN SETPOINTS

DR JWJ
CH RWS
APP

S
8382

VGF

JACKET WATER OUTLET TEMPERATURE:

Standard Cooling System:

Normal: 180° F (82° C) for continuous rating
200° F (93° C) for intermittent rating
Alarm: 10° F (5.5° C) above normal/design temperature
Shutdown: 20° F (11° C) above normal/design temperature

Elevated Temperature Solid Water Cooling System:

Normal: 210° - 265° F (99° -130° C) solid water
Alarm: 10° F (5.5° C) above normal/design temperature[1]
Shutdown: 15° F (8.5° C) above normal/design temperature[1]

LUBE OIL HEADER TEMPERATURE (with a jacket water outlet temp. of 180° F (82° C) and intercooler temperatures of 85° F - 130° F (29° C - 54° C) only):

Normal: F18/H24 170° F - 190° F (76.5° C - 88° C) L36/P48 185° F (85° C)
Alarm: 205° F (96° C)
Shutdown: 210° F (99° C)

LUBE OIL HEADER PRESSURE:

Normal: 45 - 55 psi (310 - 379 kPa) (Vee engines only)
Normal: 60 - 75 psi (414 - 517 kPa) (in-line engines only)
Alarm: 35 psi (241 kPa)
Shutdown: 25 psi (173 kPa)

INTAKE MANIFOLD TEMPERATURE (GL engines):

Standard Intercooler Water Temperatures (85° - 130° F/29° - 54° C)

Normal: Up to 10° F (5.5° C) above design intercooler water temp.
Alarm: 20° F (11° C) above design intercooler water temp.
Shutdown: 30° F (17° C) above design intercooler water temp.

Elevated Intercooler Water Temperatures (131° - 175° F/55° - 79.5° C)

Normal: Up to 10° F (5.5° C) above design intercooler water temp.
Alarm: 15° F (8.5° C) above design intercooler water temp.
Shutdown: 20° F (11° C) above design intercooler water temp.

INTAKE MANIFOLD PRESSURE:
Contact Application Engineering.

[1] Waukesha Power Systems code 1105, 1105A, or equivalent pressure/temperature shutdown system is recommended when jacket watertemperatures exceeds 210° F (99° C).

(cont. next page)

Waukesha DRESSER	TITLE - ALARM AND SHUTDOWN SETPOINTS	DR. JWJ CH. RWS APP. JMD	S 8382

VGF (cont.)

MAIN BEARING TEMPERATURE:
Contact Application Engineering.

OVERSPEED:
Shutdown: Not to exceed 15% over governed speed.

E.N. 114034

Waukesha DRESSER

TITLE— ALARM AND SHUTDOWN SETPOINTS

DR. JWJ
CH. RWS
APP. AMD

S
8382

VSG

JACKET WATER OUTLET TEMPERATURE:

Normal: 180 (82°C)
Alarm: 200°F (93°C)
Shutdown: 210°F (99°C)

LUBE OIL HEADER TEMPERATURE (With a Jacket Water Temp of 180°F/82°C):

F11G Model

Normal: 205°F (96°C)
Alarm: 215°F (102°C)
Shutdown: 225°F (107°C)

F11GSI Model

Normal: 190°F (89°C)
Alarm: 200°F (93°C)
Shutdown: 210°F (99°C)

LUBE OIL HEADER PRESSURE:

Normal: 65 - 87 psi (448 - 600 kPa)
Alarm: 40 psi (276 kPa)
Shutdown: 30 psi (207 kPa)

INTAKE MANIFOLD TEMPERATURE (GSI ENGINES):

Normal: Up to 15°F (8°C) above design intercooler water inlet temp.
Alarm: 20°F (11°C) above design intercooler water inlet temp.
Shutdown: 25°F (14°C) above design intercooler water inlet temp.

INTAKE MANIFOLD PRESSURE (GSI Engines):
Contact Application Engineering.

MAIN BEARING TEMPERATURE:
Contact Application Engineering.

OVERSPEED:
Shutdown: Not to exceed 15% over governed speed.

Waukesha DRESSER

TITLE— ALARM AND SHUTDOWN SETPOINTS

DR. JWJ
CH RWS
APP. [illegible]

S
8382

F1197

JACKET WATER OUTLET TEMPERATURE:

Normal: 180°F (82°C)
Alarm: 200°F (93°C)
Shutdown: 210°F (99°C)

LUBE OIL HEADER TEMPERATURE:

Normal: 160°F - 210°F (71°C - 99°C)
Alarm: 225°F (107°C)
Shutdown: 235°F (113°C)

LUBE OIL HEADER PRESSURE:

Normal: 40 - 50 psi (276 - 345 kPa)
Alarm: 15 psi (103 kPa)
Shutdown: 10 psi (69 kPa)

INTAKE MANIFOLD TEMPERATURE:

Not Applicable.

INTAKE MANIFOLD PRESSURE:

Contact Application Engineering.

MAIN BEARING TEMPERATURE:

Contact Application Engineering.

OVERSPEED:
Shutdown: Not to exceed 15% over governed speed.

F817

JACKET WATER OUTLET TEMPERATURE:

Normal: 180°F (82°C)
Alarm: 195°F (91°C)
Shutdown: 205°F (96°C)

LUBE OIL HEADER TEMPERATURE:

Normal: 160°F - 230°F (71°C - 110°C)
Alarm: 240°F (116°C)
Shutdown: 250°F (121°C)

LUBE OIL HEADER PRESSURE:

Normal: 35 - 45 psi (241 - 310 kPa)
Alarm: 15 psi (103 kPa)
Shutdown: 10 psi (69 kPa)

INTAKE MANIFOLD TEMPERATURE:

Not Applicable.

INTAKE MANIFOLD PRESSURE:

Contact Application Engineering.

OVERSPEED:
Shutdown: Not to exceed 15% over governed speed.

Waukesha DRESSER

TITLE— ALARM AND SHUTDOWN SETPOINTS

DR JWJ
CH RWS
APP MD

S
8382

VR

JACKET WATER OUTLET TEMPERATURE:

Normal: 180°F (82°C)
Alarm: 205°F (96°C)
Shutdown: 210°F (99°C)

LUBE OIL HEADER TEMPERATURE:

Normal: 210°F (99°C)
Alarm: 225°F (107°C)
Shutdown: 230°F (110°C)

LUBE OIL HEADER PRESSURE:

VR 155
Normal: 25 - 35 psi (172 - 241 kPa)
Alarm: 15 psi (103 kPa)
Shutdown: 10 psi (69 kPa)

VR220 and VR330
Normal: 25 - 50 psi (172 - 345 kPa)
Alarm: 15 psi (103 kPa)
Shutdown: 10 psi (69 kPa)

INTAKE MANIFOLD TEMPERATURE:

Not Applicable.

INTAKE MANIFOLD PRESSURE:

Contact Application Engineering.

OVERSPEED:
Shutdown: Not to exceed 15% over governed speed.

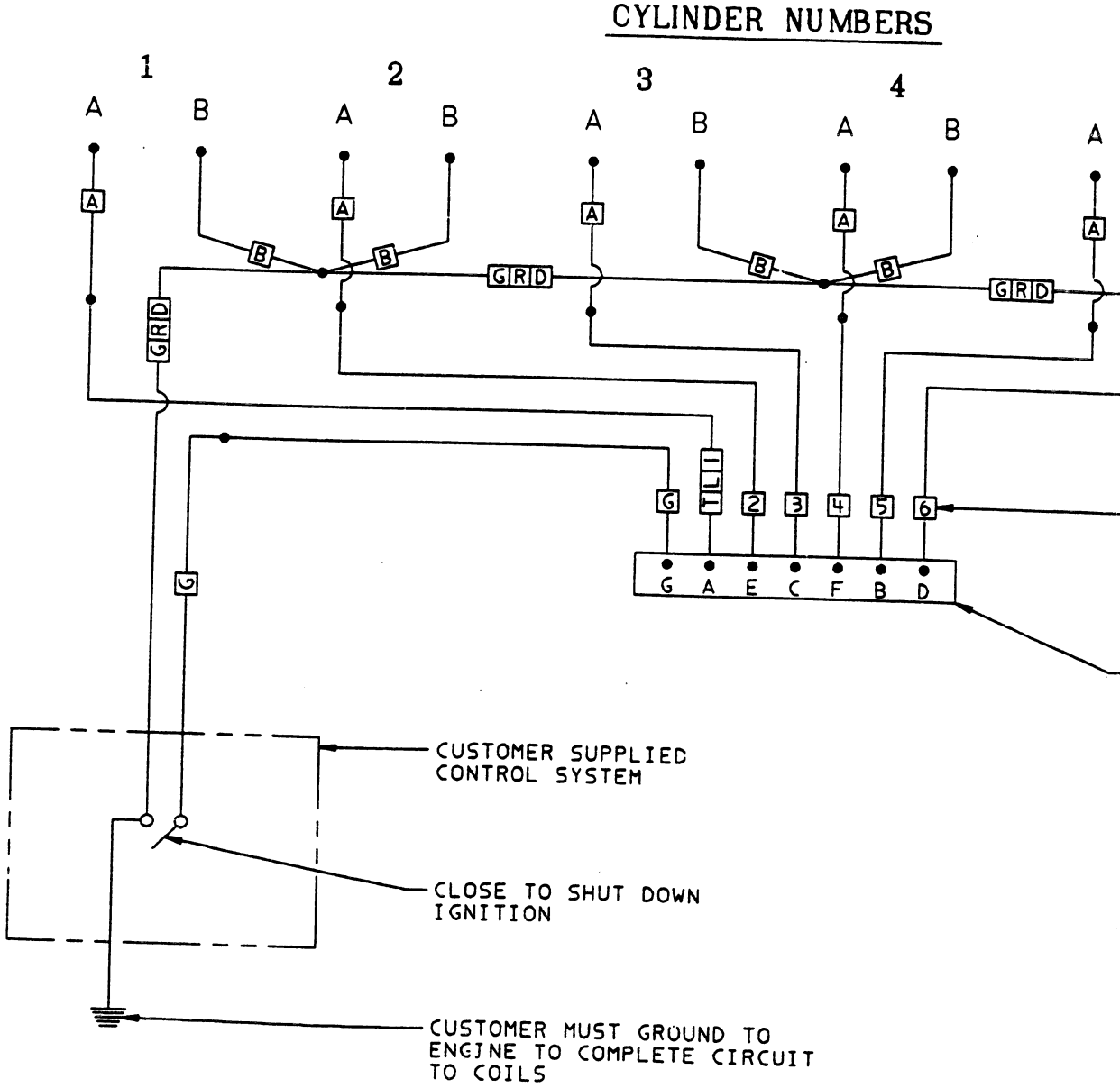
Waukesha DRESSER

TITLE— ALARM AND SHUTDOWN SETPOINTS

DR JWJ
CH RWS
APP'D

S
8382

SC6901-39



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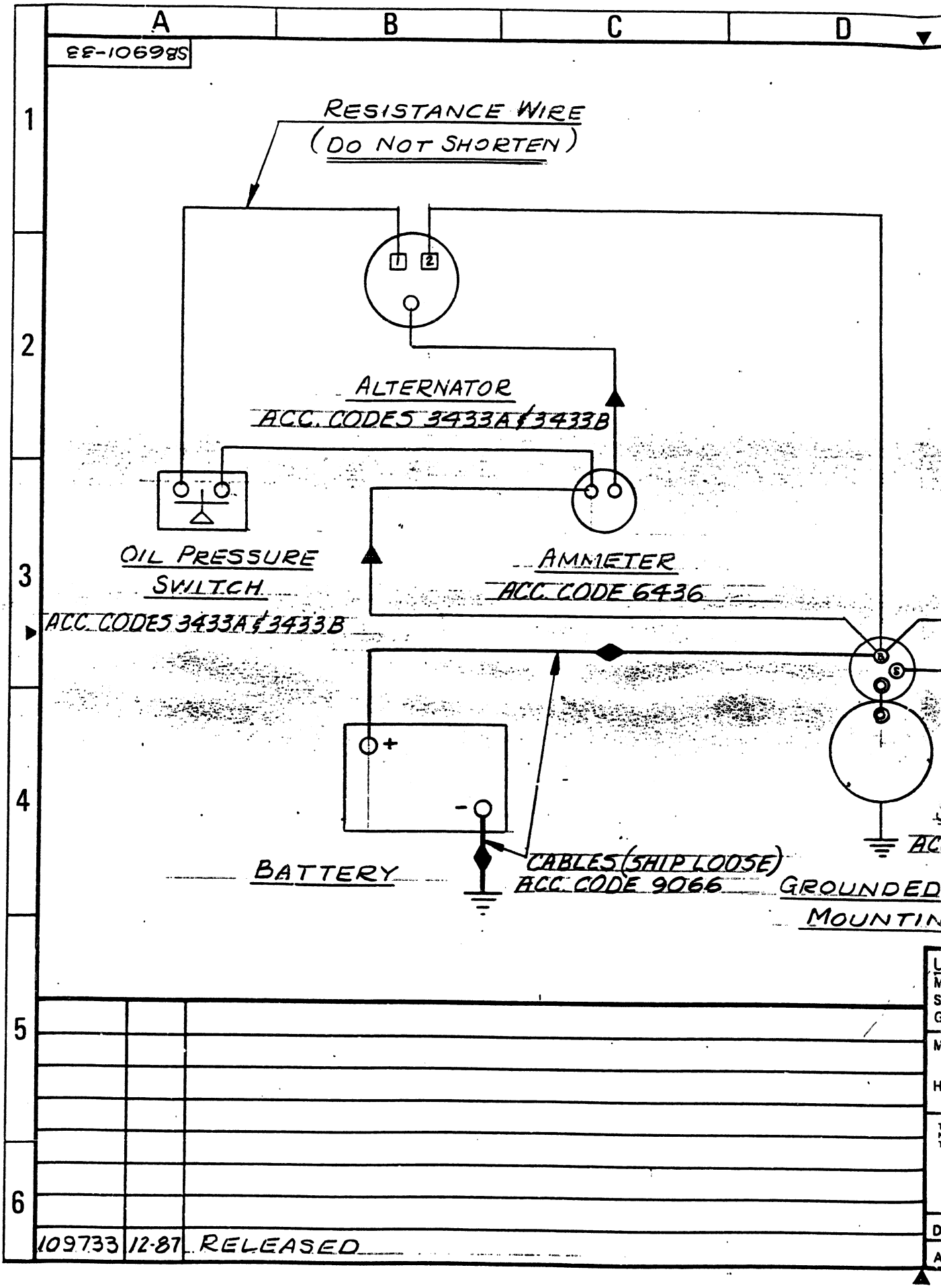
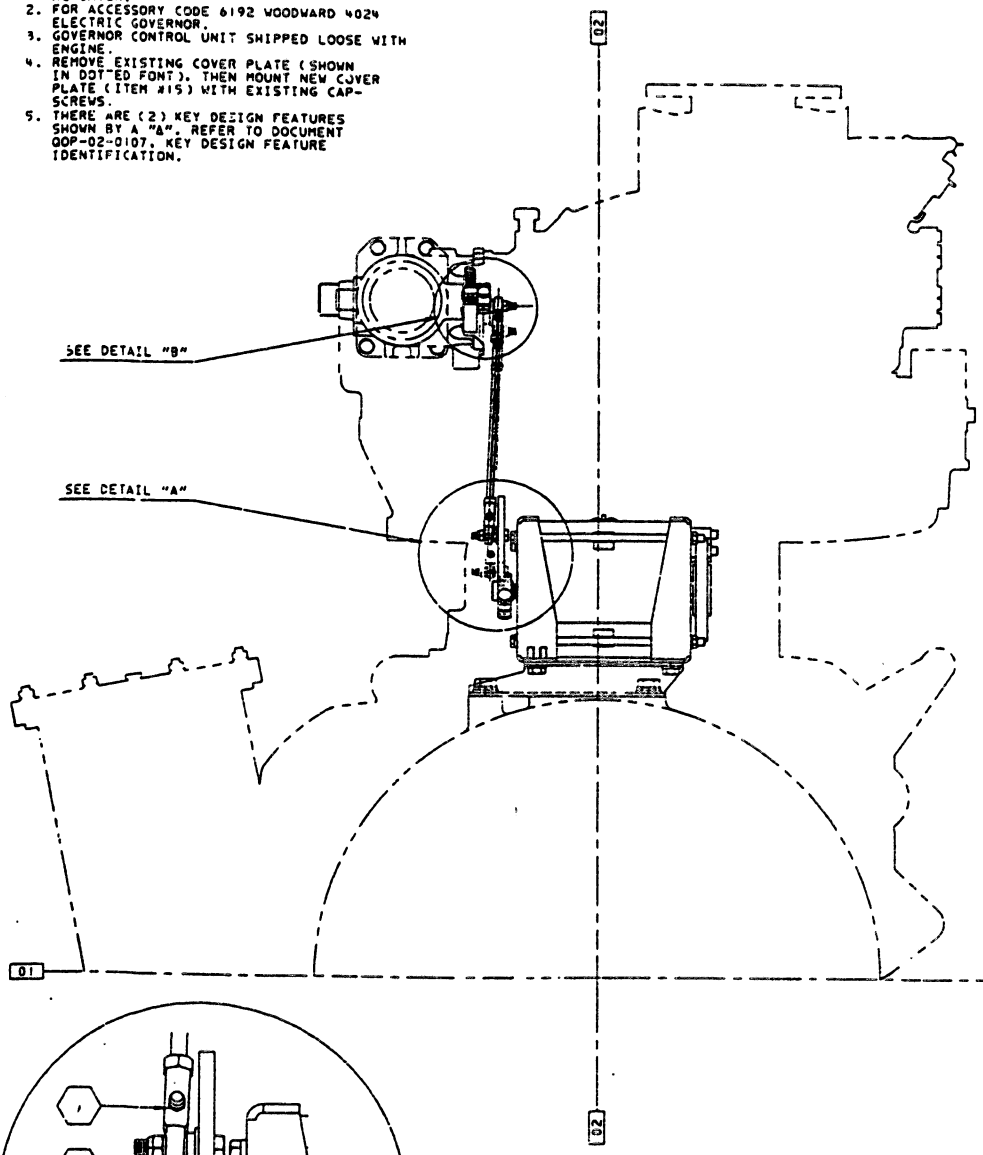

A
B
C
D
1
2
3
4
5
6
88-10698-33
RESISTANCE WIRE
(DO NOT SHORTEN)
1
2
ALTERNATOR
ACC. CODES 3433A & 3433B
OIL PRESSURE
SWITCH
ACC. CODES 3433A & 3433B
AMMETER
ACC. CODE 6436
+
-
BATTERY
CABLES (SHIP LOOSE)
ACC. CODE 9066
GROUNDED
MOUNTIN
109733
12-87
RELEASED
TELEDYNE POST
N39227

LINKAGE ADJUSTMENT INSTRUCTIONS

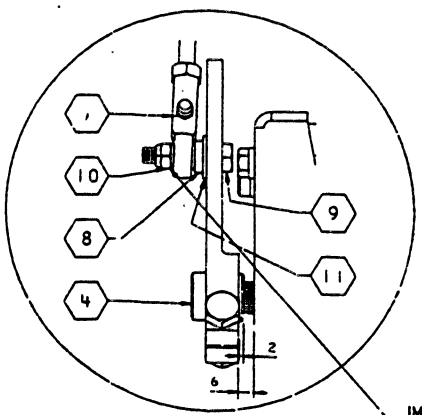
1. BACK OUT LOW IDLE STOP SCREW (SEE DETAIL "B"), UNTIL IT DOESN'T CONTACT STOP PIN WHEN BUTTERFLY PLATE IS CLOSED (REFERENCE THAT APPROXIMATE BUTTERFLY PLATE POSITION IS INDICATED BY A LINE ON EITHER END OF BUTTERFLY SHAFT). ROTATE HAND CONTROL LEVER (SEE DETAIL "C"), CLOCKWISE UNTIL BUTTERFLY PLATE IS HELD CLOSED. ADJUST BUTTERFLY SHAFT LEVER "D" TO ANGLE=20° AS SHOWN IN DETAIL "C" (PIN LEVER TO SHAFT AFTER ENGINE TEST). AFTER ADJUSTING LEVER "D", MOVE HAND CONTROL LEVER BACK TO THE HORIZONTAL POSITION.
2. ATTACH GOVERNOR ROD ASSEMBLY TO GOVERNOR LEVER "E" AND THEN INSTALL LEVER WITH SPLINED BUSHING, ONTO GOVERNOR. ADJUST GOVERNOR LEVER "E" TO ANGLE F=59° AS SHOWN IN DETAIL "C" (NOTE TO MAINTAIN DIMENSIONS 6 AND 2 AS SHOWN IN DETAIL "A". ALSO NOTE POSITION OF LOCKNUT).
3. CHECK THAT GOVERNOR ROD ENGAGEMENT, INTO THE ROD ENDS, IS ABOUT THE SAME ON BOTH ENDS. HOLD THE FREE ROD END AND SHORTEN THE GOVERNOR ROD ASSEMBLY BY TURNING THE GOVERNOR ROD LIKE A TURNBUCKLE (MAKE GOVERNOR ROD ASSEMBLY SHORT ENOUGH TO ATTACH TO LEVER "D". EXACT LENGTH NOT IMPORTANT AT THIS TIME). ATTACH GOVERNOR ROD ASSEMBLY TO BUTTERFLY SHAFT LEVER "D" (SEE DETAIL "B". NOTE POSITION OF LOCK NUT). TURN GOVERNOR ROD, LIKE A TURNBUCKLE, UNTIL BUTTERFLY PLATE JUST CLOSES. TIGHTEN ROD END JAM NUTS.
4. MOVE GOVERNOR LEVER "E" THROUGH RANGE OF MOTION TO CHECK THAT LINKAGE OPERATES SMOOTHLY. THERE SHOULD BE NO TOGGLING OVER CENTER AT GOVERNOR LEVER.
5. ADJUST BUTTERFLY VALVE LOW IDLE STOP SCREW (SEE DETAIL "B"). SO THAT BUTTERFLY PLATE IS JUST CRACKED OPEN.

NOTES:

1. CUSTOMER TO FURNISH WIRE BETWEEN MAGNETIC PICK-UP AND CONTROL BOX AND BETWEEN CONTROL BOX AND GOVERNOR ACTUATOR.
2. FOR ACCESSORY CODE 6192 WOODWARD 4024 ELECTRIC GOVERNOR.
3. GOVERNOR CONTROL UNIT SHIPPED LOOSE WITH ENGINE.
4. REMOVE EXISTING COVER PLATE (SHOWN IN DOTTED FONT), THEN MOUNT NEW COVER PLATE (ITEM #15) WITH EXISTING CAP-SCREWS.
5. THERE ARE (2) KEY DESIGN FEATURES SHOWN BY A "A". REFER TO DOCUMENT QOP-02-0107, KEY DESIGN FEATURE IDENTIFICATION.

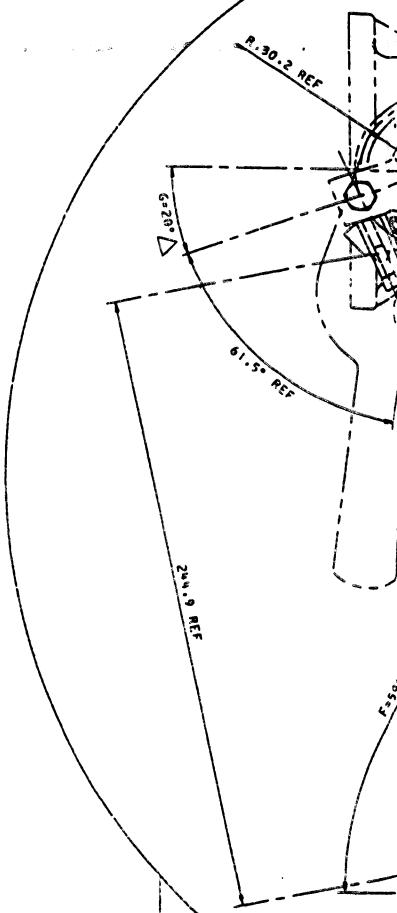


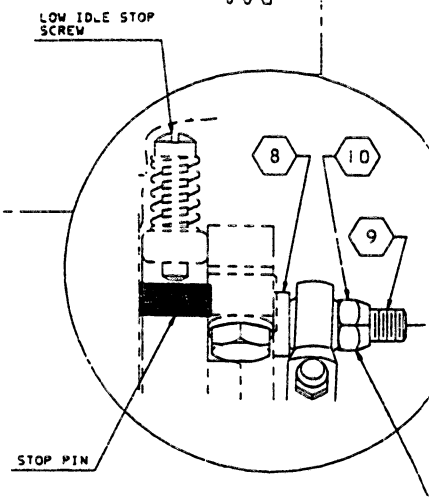
REAR VIEW



IMPORTANT: ASSEMBLE LOCKNUT AGAINST ROD END

DETAIL "A"
(SCALE 1:1)





DETAIL "B"
(SCALE 2:1)

Installation & Maintenance Instructions

GENERAL PURPOSE OR

RAINTIGHT/EXPLOSIONPROOF SOLENOIDS

SERIES

8010

Form No.V6927

NOTICE: See separate valve installation and maintenance instructions for information on: Operation, Positioning, Mounting, Piping, Strainer or Filter Requirement, Flow Controls, Cleaning, Preventive Maintenance, Causes of Improper Operation, Disassembly and Reassembly of Basic Valve.

DESCRIPTION

Series 8010 solenoids when supplied on an ASCO solenoid valve may be provided with a Type 1, General Purpose Solenoid Enclosure or with a Raintight/Explosionproof Solenoid Enclosure depending upon requirements. The Raintight/Explosionproof Solenoid Enclosure meets Type 3–Raintight, Type 7 (C&D) Explosionproof Class I, Division 1, Groups C&D and Type 9 (E, F & G) – Dust Ignitionproof Class II, Division 1, Groups E, F & G Hazardous Locations.

OPERATION

See basic valve installation and maintenance instructions.

INSTALLATION

Check nameplate for correct catalog number, voltage, frequency, wattage and service.

Temperature Limitations

Maximum ambient temperature 77°F.

Enclosure Types 3, 7 and 9

⚠ CAUTION: To prevent fire or explosion, do not install solenoid enclosure where ignition temperature of hazardous atmosphere is less than 160° C. See nameplate for service. Open circuit before disassembling. Reassemble before operating.

⚠ CAUTION: To protect the solenoid valve, install a strainer or filter, suitable for the service involved in the inlet side as close to the valve as possible. Clean periodically depending on service conditions. See ASCO Series 8600, 8601 and 8602 for strainers.

Positioning

See basic valve installation and maintenance instructions.

Wiring

Wiring must comply with local codes and the National Electrical Code. On some solenoids, a grounding wire which is green or green with yellow stripes is provided. Use rigid metallic conduit to ground all enclosures not provided with a green grounding wire. For the raintight/explosionproof solenoid enclosure, electrical fittings must be approved for use in hazardous locations. The solenoid enclosure has a 1/2" conduit connection and may be rotated clockwise 360° to facilitate wiring.

⚠ WARNING: To prevent the possibility of personal injury or property damage, from accidental disengagement of solenoid from valve body, hold housing securely by wrenching flats while removing or replacing housing cover.

To rotate enclosure, loosen housing cover using a 1" socket wrench. Two wrenching flats are provided on the housing to hold it securely in place while the cover is being loosened or tightened. Rotate housing to desired position and replace housing cover before operating. Torque housing cover to 135 ± 15 in–lbs [15,3 ± 1,7 Nm].

Note: All Series 8010 solenoids are direct current (DC) construction.

Solenoid Temperature

Standard solenoids are supplied with coils designed for continuous duty service. When the solenoid is energized for a long period, the solenoid enclosure becomes hot and can be touched by hand only for an instant. This is a safe operating temperature. Any excessive heating will be indicated by the smoke and odor of burning coil insulation

MAINTENANCE

⚠ WARNING: To prevent the possibility of personal injury or property damage, turn off electrical power, depressurize solenoid valve and vent fluid to a safe area before servicing.

Cleaning

All solenoid valves should be cleaned periodically. The time between cleanings will vary depending on the medium and service conditions. In general, if the voltage to the coil is correct, sluggish valve operation, excessive noise or leakage will indicate that cleaning is required. In the extreme case, faulty valve operation will occur and the valve may fail to shift. Clean strainer or filter when cleaning the valve.

Preventive Maintenance

- Keep medium flowing through the valve as free from dirt and foreign material as possible.
- While in service, the valve should be operated at least once a month to ensure proper shifting.
- Depending on the medium and service conditions, periodic inspection of internal valve parts for damage or excessive wear is recommended. Thoroughly clean all parts. If parts are worn or damaged, install a complete ASCO Rebuild Kit.

Causes of Improper Operation

- **Faulty Control Circuit:** Check the electrical system by energizing the solenoid. A metallic *click* signifies that the solenoid is operating. Absence of the *click* indicates loss of power supply. Check for loose or blown fuses, open–circuited or grounded coil, broken lead wires or splice connections.
- **Burned–Out Coil:** Check for open–circuited coil. Replace if necessary. Check supply voltage; it must be the same as specified on nameplate and as marked on the coil.
- **Low Voltage:** Check voltage across the coil leads. Voltage must be at least 85% of nameplate rating.

Coil Replacement/Solenoid Disassembly

1. Disconnect coil lead wires and grounding wire if present. If required, disconnect rigid conduit from housing for complete disassembly of solenoid.

⚠ WARNING: To prevent the possibility of personal injury or property damage from accidental disengagement of solenoid from valve body, hold housing securely by wrenching flats while removing or replacing housing cover.

2. Unscrew housing cover using 1" socket wrench. Two wrenching flats are provided to hold the housing securely in place while the cover is being removed or replaced.
3. Remove take–up spring, flux washer, grounding wire (if present) insulating washer, coil and insulating washer.

Note: Insulating washers (2) are omitted when a molded coil is used.

4. For complete disassembly of solenoid, unscrew solenoid base sub–assembly using special wrench adapter supplied in ASCO Rebuild Kit. For wrench adapter only, order Kit No. K218949.
5. Remove solenoid base sub–assembly and housing.
6. Refer to basic valve installation and maintenance instructions for additional disassembly.

Coil Replacement/Solenoid Reassembly

1. Reassemble solenoid in an orderly fashion using exploded view for identification and placement of parts.
2. Before reassembly, read special instructions below for raintight/explosionproof solenoid enclosure.

Special Instructions For Raintight/Explosionproof Solenoid Enclosure

- **Installation and maintenance of raintight/explosionproof equipment requires more than ordinary care to ensure safe performance. All finished surfaces of the solenoid are constructed to provide flame–proof seal. Be sure that the surfaces are wiped clean before reassembling. Grease the raintight/explosionproof solenoid enclosure with DOW CORNING® 111 Compound lubricant or an equivalent high–grade silicone grease. Grease all joints thoroughly including the underside of the solenoid base sub–assembly flange and external threads of the housing cover.**

3. Install solenoid base sub–assembly and torque to 175 ± 25 in–lbs [19,8 ± 2,8 Nm].
4. Rotate housing to desired position.
5. Install coil on solenoid base sub–assembly simultaneously thread coil lead wires through 1/2" NPT conduit hub. For non–molded coils be sure to install an insulating washer at each end of coil.

Note: If a grounding wire is present, it must be installed simultaneously with the coil and insulating washers (2).

6. Install flux washer, take–up spring and housing cover. Thread housing cover by hand as far as possible.
7. Hold housing securely in place by wrenching flats and torque housing cover to 135 ± 15 in–lbs [15,3 ± 1,7 Nm].
8. Make electrical connections to solenoid, see *Wiring* section.

⚠ CAUTION: Solenoid must be fully reassembled because the housing and internal parts complete the magnetic circuit. Be sure to replace insulating washer at each end of non–molded coil.

ORDERING INFORMATION

FOR COILS

When Ordering Coils, specify Catalog Number, Serial Number, Voltage and Frequency. Specify number stamped on coil (if visible).

Torque Chart

Part Name	Torque Value Inch–Pounds	Torque Value Newton–Meters
Solenoid base sub–assembly	175 ± 25	19,8 ± 2,8
Housing cover	135 ± 15	15,3 ± 1,7

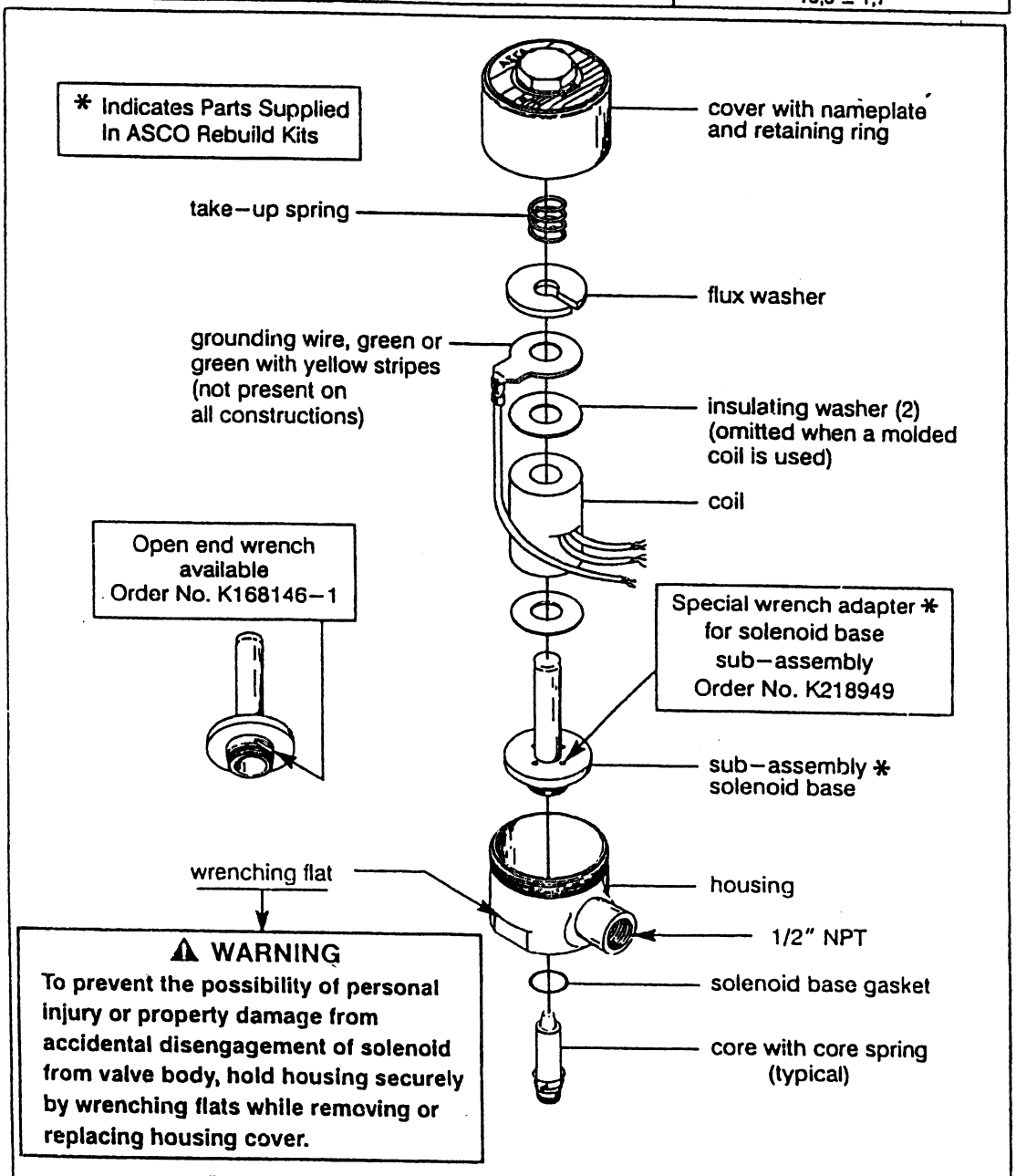


Figure 1. Series 8010, raintight/explosionproof solenoid enclosure shown.

WARNING: DEVIATION FROM THESE INSTALLATION INSTRUCTIONS MAY LEAD TO IMPROPER OPERATION OF THE ENGINE WHICH COULD CAUSE PERSONAL INJURY TO OPERATORS OR OTHER NEARBY PERSONNEL.

1.0 SYSTEM DESCRIPTION:

1.1 The Altronic EPC-100 is an air/fuel ratio controller for use on carbureted gas engines. The controller utilizes microprocessor technology, allowing a high level of sophistication in control strategy, ease of programming and diagnostic capability. The EPC-100 is designed for use on engines operating at or near a stoichiometric air/fuel ratio (lambda .95 - 1.05) and is ideally suited for application with 3-way catalytic converters.

NOTE: When used in conjunction with a catalyst, a separate means of catalyst over-temperature detection and protection should be installed. An Altronic DPYH temperature gauge with alarm/shutdown switch can provide this function. Refer to Altronic Form DPYH13.

1.2 One model is universal and can be applied to in-line or V-type, naturally-aspirated or turbocharged engines.

1.3 The EPC-100 provides dual channel operation for application with one or two carburetors. All inputs and outputs are used in duplicate for a V-engine with two carburetors. An oxygen sensor is used in the exhaust stream to sense O_2 content; a thermocouple input signals when proper temperatures have been reached to allow for accurate sensor operation. A fuel/control valve installed in the fuel line to the carburetor is precisely adjusted by a stepper-motor under microprocessor control to maintain the correct 0_2 content in the exhaust. The desired air/fuel ratio can be easily adjusted by changing the control target voltages through the sealed membrane keypad or through the use of a PC.

1.4 The EPC-100 has an alphanumeric LCD display showing the target voltage, estimated operating lambda, sensor voltage and operating temperature, stepper motor position and diagnostic information.

1.5 Power requirement is 24VDC, 1 amp. In remote areas, power can be provided by the Altronic 24VDC Alternator Power Package. Refer to Altronic Form ALT.

2.0 SYSTEM COMPONENTS:

2.1 Contents of Installation Kit:

DESCRIPTION	PART NO.	QUANTITY EPC-101	QUANTITY EPC-102
Air/Fuel Controller	EPC-100	1	1
Control Valve Assy.			
Standard Model	693 154-1	1	2
Low Horse Power Model	693 154-2		
Cable Assy.-Control Valve	690 154	1	2
Oxygen Sensor	610 621	1	2
Cable Assy. - Sensor	693 006	1	2
Also required: (not supplied in Kits)			
"K" Thermocouple Probe (ungrounded w/thermowell)	——	1	2
"K" Thermocouple Ext. Wire	——	50 ft.	100 ft.
12-16 AWG Hook-up Wire	——	150 ft.	150 ft.

2.2 See Fig. 1 for illustration of kit components.

2.3 Refer to Fig. 2 for the general layout of components used in the EPC-100 control system.

3.0 MOUNTING THE EPC-100:

3.1 The EPC-100 is preferably panel-mounted off the engine in such a manner as to minimize exposure to vibration. Refer to Fig. 3 for physical mounting details.

3.2 The EPC-100 controller should be mounted within 50 ft. of the exhaust stack of the engine which will be controlled.

3.3 Operating temperature range is -40° to 158° F. / -40° to 70° C. Humidity specification is 0 - 95%, non-condensing. Housed in a Nema 4 enclosure, the EPC-100 is splash resistant; however the mounting site should provide as much protection from inclement weather as is practical. Avoid mounting the LCD display and keypad in direct sunlight.

4.0 MOUNTING THE OXYGEN SENSORS:

4.1 The sensor should be installed in the exhaust system between the engine and the catalytic converter and/or muffler. The mounting location should be as close to the exhaust manifold of the engine as possible. The tip of the sensor should be exposed to the unobstructed flow of the exhaust gases from all cylinders to be controlled by that sensor. On a Vee engine using two control banks, each sensor should be mounted such that it is exposed only to exhaust from the appropriate bank of the engine. This requires that the sensors be positioned at a point before the two banks join together. On engines using only one control bank, exhaust flow from all cylinders must be sensed. This means that the sensor should be mounted near, but still before the exhaust stack. Do not locate the sensor in a coupling or in a location where the exhaust gas flow is uneven due to obstructions or sharp bends. The sensor location chosen should allow easy access since sensor replacement may be required as often as every 2000 hours in some applications. The location chosen should not subject the exterior shell of the sensor to an ambient air temperature greater than 350°F.

4.2 Drill, tap and spot face a hole in the exhaust pipe at the selected location. A flat smooth sealing surface is required to assure accurate readings since air or exhaust leaks will impact sensor operation. See Fig. 4 for details. Note: A weldment boss may be required for sensor installation in soft or thin wall exhaust systems.

4.3 New sensors are packaged with an anti-seize compound already applied to the threads. There is no need to apply additional anti-seize unless reinstalling a used sensor. If required, use high temperature anti-seize very sparingly and apply only to the sensor threads. Sensors should be torqued to 28-34 Lb. Ft.

5.0 MOUNTING THE K-TYPE THERMOCOUPLES:

5.1 Thermocouples are used to monitor the temperature of exhaust gases near the exhaust oxygen sensor and should be mounted as close as possible to the appropriate O_2Sensor. As with the O_2Sensor, the location should be easily accessible, and the tip of the probe, which should be enclosed by a thermowell, should be surrounded by unobstructed exhaust flow.

5.2 ONLY UNGROUNDED thermocouple probes can be used with the EPC-100. Grounded type thermocouples will not function correctly. Resistance from either lead of the thermocouple to the probe shell should be 2 megohms or greater.

6.0 MOUNTING THE FUEL CONTROL VALVES:

6.1 In order to control the air/fuel ratio, an electronically controlled valve is connected in series between each regulator and carburetor. These valves should be installed as close to the fuel inlet of the carburetors as possible. The distance from the valve to the carburetor inlet should not exceed 12 pipe diameters in length. The valves should be installed with the control cable connector facing upward to avoid the collection of condensation in the stepper motor. Pre-drilled mounting holes are provided for user supplied brackets. See Fig. 5 .

6.2 If possible connection piping should be of the same diameter as currently in use. The threaded connection to the valve body may require the use of thread adapters. If adapters are used, proper plumbing procedures must be followed. See Fig. 5 .

6.3 The control valves are connected to the EPC-100 using the 693 005 cables. If it is desired to enclose the cables in conduit this can be accomplished by cutting the 693 005 cable in half. The cables are color coded and must be reconnected with each wire color matching. These cables must not be run in the same conduit as the ignition primary or other wires. A distance of 4 to 6 inches should be maintained between EPC-100 wiring and other engine wiring. Note that the upper connector on the EPC-100 controls the left bank stepper valve.

7.0 ELECTRICAL HOOK-UP

7.1 The power connections to the EPC-100 must be in accordance with the National Electrical Code. The EPC-100 is suitable for installation in Class I, Division 2 Group D locations.

7.2 Although the input power has internal protective fuses (3-amp), an external fuse near the power source is recommended.

7.3 The EPC-100 can be powered in one of the following ways:

A. 24 volt battery with trickle charger (1 amp min. output).

B. DC power supply capable of furnishing 18-30 VDC, 2 amps.

C. Altronic 24 VDC Alternator Power Package - see form ALT.

NOTE: Voltage and current supplied must be sufficient to operate all transducers used in the installation. If a heated Oxygen Sensor is required the heater current must be added to the requirements above.

7.4 Power wiring and signal (transducers) wiring must be in separate conduits and conduit entries into the EPC-100 to avoid undesired electrical interaction. Separate as follows (see Fig. 6):

Left Conduit Entry	Power Wiring & Earth Grounding
Center Conduit Entry	Signal Wiring: Oxygen Sensor wiring & Thermocouple inputs.
Right Conduit Entry	Alarm Output.

7.5 Input power supply wires (16 AWG minimum) should enter the left most conduit entry and connect to the 24 volt supply terminals of terminal block TS2A. An earth ground wire (12 AWG minimum) should enter this same location and connect to the Earth Ground terminal. This connection is in addition to the power negative which may also be grounded.

NOTE: Engines using positive ground DC accessories or starter motors will require a separate dedicated ungrounded power supply for the EPC-100.

7.6 Oxygen Sensors are connected via shielded cable P/N 693 006. These should be run in conduit with and only with the EPC-100 thermocouple connections. These cables should enter the EPC-100 enclosure through the center conduit opening and connect to terminal block TS2B. The red wire should be connected to the O_2Sensor (red) terminal, and the black wire to the O_2Sensor (black) terminal. The shield wire should be cut short and not connected. Care should be taken to identify the left from right bank sensor wires. The cables provided are terminated with weather tight connectors which mate to the O_2Sensors provided by Altronic. The shield wire (green wire at connector end) must be connected to the exhaust piping near to the sensor. This shield will assist in rejecting noise from other wiring which could affect the O_2Sensor signal.

7.7 The thermocouple (24 AWG Min. Type K Extension) wires should be run in a conduit with and only with the EPC-100 O_2Sensor wires. These thermocouple wires should enter the enclosure through the center conduit opening and connect to terminal block TS2C. The yellow wire should be connected to the T/C (yellow) terminal and the red wire to the T/C (red) terminal. Again, care should be taken to identify the left from right bank thermocouple wires.

7.8 The "Dual Bank" or "Single Bank" mode of the EPC-100 is programmed via a jumper wire connection on terminal block TS1. The "Dual Bank" mode is the default mode which results from NO jumper connection between terminals "V_{SS}" and "V_{EE}". For single carburetor applications a jumper wire must be added between terminals "V_{SS}" and "V_{EE}" to configure the EPC-100 in the "Single Bank" mode.

NOTE: See fig. 7 for Wire Terminal Lay-Out.

7.9 Although the EPC-100 does not require a computer to be operated or installed, a serial port, located on the control board assembly, has been included which can be used to communicate with a personal computer. See Fig. 9 . An optional software package which will permit communication with the EPC-100 will be available in the near future. This program will provide operational monitoring and the capability to adjust default parameters and set-points. A separate user guide will be supplied with the software.

WARNING: Connection to the communications port without the proper communications software (provided by Altronic) may cause erratic operation or result in the loss of the EPC-100 core control program.

8.0 THEORY OF OPERATION:

8.1 The primary task of the EPC-100 is to accurately control the exhaust air fuel ratio (AFR) of an engine. Control should be maintained through reasonable load and fuel BTU variations.

8.2 Three-Way Catalysts are used to oxidize CO and HC and to reduce NOx. These processes require high temperature and correct AFR control. Catalysts perform best for all emissions when operated near the stoichiometric AFR.

8.3 The Stoichiometric AFR is the AFR at which exactly the required amount of air (O_2) is present to completely burn all of the fuel. Because no engine can perform perfect combustion, typical emission byproducts include O_2, HC, NO and CO even though the engine is running at stoichiometry. The Stoichiometric AFR is determined by the chemical composition of the fuel, thus they are different for each fuel, or BTU rating.

(eg. Methane => 16.09 : 1 & Gasoline => 14.70 : 1)

8.4 Because the fuel type is not always known, it is often easier to specify the AFR target in terms of Lambda. Lambda is an indicator of AFR normalized to the appropriate Stoichiometric AFR.

(Lambda = Actual AFR/Stoichiometric AFR)

Thus Lambda for stoichiometric combustion would be 1.0, no matter what the fuel. Lambda > 1 = Lean, Lambda < 1 = Rich.

8.5 An O_2Sensor (lambda sensor) is used to provide exhaust AFR feedback to the EPC-100. This type of sensor uses a Zirconia element which, when combined with a catalyzing outer surface, creates an output voltage used to indicate lambda. Characteristics of the sensor include: an output range of about .1 to .9 volts when above 650° F, a very high output impedance when cool, a very high sensitivity at stoichiometry and a very low sensitivity away from stoichiometry. The output signal provides a very suitable means of controlling just rich of Lambda 1.0 which is the AFR range required to obtain best catalyst efficiencies for methane-based fuels. Fig. 8 describes a typical sensor output voltage curve versus lambda.

8.6 Type K thermocouples are used to assure that exhaust temperatures are high enough for correct operation of the sensor before closed loop control is enabled.

e. Control valve operation should be verified during a start position command. This can easily be done if the valves are not yet fully installed in the fuel line. Press "ALARM ACK." if the alarm LED is on. Then press "F1" followed by "START POS". During the start position activity, the left valve plunger should be fully retracted then positioned near the middle of its travel, followed by the right valve. No movement, erratic movement, or movement in the wrong direction will result from incorrect wiring of the stepper cables.

f. The set-up values should be returned to the factory default values. This can be done by slowly pressing the following keys in order "F1,F3,F2,F4". Then once the screen indicates that you are in the set-up mode, press "F2" followed by "F2" again to restore default setup values. Then press "F4" to exit the setup mode. The default values are set as follows:

Gain Value	= 0.40
Left O_2Target	= 0.80 volts
Left Default Position	= 1000 steps
Right O_2Target	= 0.80 volts
Right Default Position	= 1000 steps

9.3 When all of these checks have been made successfully, move on to the Start-Up Procedure.

10.0 START-UP PROCEDURE:

10.1 Before starting engine:

a. Check for fuel leaks where the fuel line was modified.

b. Verify that a catalyst over-temp protection device is in place and functional.

c. Be sure that the power screw adjustments on carburetors are full open or full rich. If these adjustments are not fully open, then the control range of the stepper control valve will be limited.

d. If the alarm output of the EPC-100 is being used, temporarily disconnect or override this signal so that an alarm indication will not shut down the engine during setup.

e. Press "F1", then press "START POS" on the EPC-100 Keypad to reset stepper position and enable the warm-up delay.

f. Place EPC-100 controller in manual mode by pressing "LEFT MANUAL", then "RIGHT MANUAL" keys.

g. Start and warm-up engine.

10.2 With the engine running:

a. Load engine to desired operating point.

b. Verify that the exhaust temperature data screen is displaying reasonable values, and that the temperatures exceed 650°F. Refer to section 14.0 for an explanation of the display key operation.

c. Enable automatic control by pressing the "AUTO OPER" key. The unit should begin adjusting the stepper valves trying to control the engines air/fuel ratio. Use any diagnostic warnings which may occur to trouble-shoot the system. Rich or lean limit errors are a good indication that the pressure regulators need some adjustment.

d. Once the unit has gained control of the engine (O_2 sensor voltage very near the target voltage), adjust the fuel pressure regulators until the EPC-100 is controlling with the stepper valve positions near 1000 steps. This is approximately the middle of the valve's control range.

10.3 Fine Tune The Control Setpoints:

a. Using an exhaust analyzer, determine the set-point voltage which results in the best emission performance. This can be done by incrementally adjusting the O_2Target voltage in the Set-Up Mode. Reference section 12.0 for an explanation of the setup mode. Alternatively, manual mode can be used to adjust the control valves to the positions which give the best emissions performance. Reference section 15.0 for an explanation of manual mode operation. Then the O_2Target voltages should be adjusted to match the actual sensor voltages using the Set-Up Mode.

b. The control gain rate and default stepper positions can also be adjusted now; however, the default values represent the best typical values for these parameters.

10.4 Once the system is controlling at the best emissions point, the alarm output can be re-enabled.

10.5 At this point, the EPC-100 set-up is complete, and the unit should be controlling the engine.

11.0 GENERAL - KEYPAD AND DISPLAY OPERATION:

11.1 The EPC-100 includes a front mounted keypad and an LCD display which permits the monitoring and adjustment of various parameters and actions. Two LED indicators are also included. The power LED (green) is illuminated any time there is power to the unit. The alarm LED (yellow) will come on momentarily on power up then go out as soon as the unit is running. The alarm LED is used to indicate when a diagnostic test is violated. Reference section 16.0 for more detail regarding diagnostics and the alarm indicator.

11.2 The keypad and display function together as the user interface. Only one key on the pad should be pressed at one time. Some commands require a key sequence (a series of key presses, one followed by the next). Whenever possible, special messages indicate what is happening or why a command is not accepted.

11.3 With the engine not running (cool exhaust), when power is first applied to the EPC-100, the display will show an Altronic product description message.

Altronic Inc.
StoicA/F Control

11.4 After a few seconds the display will indicate that the controller is in warm-up mode. This display indicates that the thermocouples are still reading temperatures too cool for the O_2Sensors to function correctly. The number at the end of the message indicates the current stepper valve position in steps. If the engine is not started this condition will persist for 10 minutes.

L Warm-Up 1000
R Warm-Up 1000

11.5 After 10 minutes with a cool exhaust, the display will now begin rotating the diagnostic messages for low exhaust temperature. All diagnostic messages include the "!" character for recognition. Diagnostics exist for several functions and are explained in detail in section 15. When any diagnostic condition is present, the warning message will appear, then all of the appropriate descriptions will follow in rotation. The number in the warning message represents the present stepper valve position.

L !WARNING! 1000 and **L EXH TEMP LO !**
R !WARNING! 1000 and **R EXH TEMP LO !**

11.6 Press "ALARM ACK." and the alarm LED which was turned on by the above warning will begin to flash. The low temperature alarm has now been acknowledged and the EPC-100 will accept other keypad commands. Any time the alarm LED is on steady, no keypad commands will be accepted until the "ALARM ACK." key is pressed. The display will indicate that the unit is responding to this command with message "**WORKING**".

12.0 SETUP MODE - KEYPAD AND DISPLAY OPERATION:

12.1 Once the alarm LED is no longer on steadily, press "F1" followed by "F3" followed by "F2" followed by "F4". This is the setup mode entry key sequence. The display will indicate that the setup mode is now active. Note that all screens in setup mode include the "**$**" character.

$$$ SETUP $$$
F1=Next F4=EXIT

12.2 Press "F2" then press "F2" again to restore factory default parameters. This special command can be used only from this screen when the user wants to restore factory default values. A message will indicate that the default values have been restored, then will return to the main setup message. Note default values which are listed in section 9.2(f).

RESTORING DEFAULT SETUP then **$$$ SETUP $$$**
F1=Next F4=EXIT

12.3 Press "F1" to increment to the control gain setup screen. The factory default value for this parameter is 0.5 as shown on the display. This parameter determines the stepper valve adjustment rate when in automatic mode. The higher the value the faster the controller will move the stepper in response to the O_2Sensor.

$ F2=Up F3=Dn $
GAIN VALUE=0.50

12.4 Press "F2" to increase the value for the gain parameter. The display will indicate that the value is being changed, then return to the gain value screen with the updated value. At this point the value is updated and will be used until the value is changed again. Note: Multiple presses of the key are required to continue incrementing the value. If the key is pressed too fast, some of the presses will be ignored.

MODIFYING C/L GAIN VALUE then **$ F2=Up F3=Dn $**
GAIN VALUE=0.60

12.5 Press "F3" to decrease the value. Now the value is decreased to the default value again. Note that the range for the gain value is limited to (0.1 to 2.0). The value cannot be moved beyond its limits.

MODIFYING C/L GAIN VALUE then **$ F2=Up F3=Dn $**
GAIN VALUE=0.50

12.6 Press "F1" to increment to the left O_2Target setup screen. The factory default value for this parameter is 0.80 volts as shown on the display. Like the gain value, the target can be increased and decreased with the "F2" and "F3" keys. The typical range is near 0.8 volts. The allowable range is 0.01 to 1.05; however most sensor's output range is limited to 0.1 to 0.9 volts.

$ F2=Up F3=Dn $
LO2Target=0.800v

12.7 Press "F1" to rotate to the left default stepper position screen. The default position is used when any of the O_2Sensor or thermocouple diagnostics are active. The number on the right is the current default position. Because the temperature diagnostic is still active, the actual stepper position on the left is also 1000.

$F2=chng L.dflt$
1000 ---> 1000

12.8 Press "F2" to update the default position (on right) with the value of the current position (on left). Since both values are the same no change was actually made in this example. By using the manual mode which is described in section 15.0, the actual position can be adjusted to the desired position before entering the setup mode.

UPDATING LEFT DEFAULT POSITION then **$F2=chng L.dflt$ 1000 —> 1000**

12.9 Press "F1" to move to the right O_2Target setup screen. This screen functions just like the one described in section 12.6 for the left bank. Note that if this was a single bank application (see section 7.8), this command would have returned to the main setup screen described in section 12.1 .

$ F2=Up F3=Dn $
RO2Target=0.800v

12.10 Press "F1" to move to the right default stepper position screen. This screen functions just like the one described in section 12.7 for the left bank.

$F2=chng L.dflt$
1000 —> 1000

12.11 Press "F1" to rotate back to the main screen.

$$$ SETUP $$$
F1=Next F4=EXIT

12.12 Press "F4" to exit the setup mode. "F4" can be used from any setup screen. Remember all setup screens have the "$" character on them somewhere. This returns the display to the warning message which was caused by low exhaust temperatures.

L !WARNING! 1000
R !WARNING! 1000 and **L EXH TEMP LO !**
R EXH TEMP LO !

13.0 ENGINE STARTUP - KEYPAD AND DISPLAY OPERATION:

13.1 Press "ALARM ACK." to acknowledge alarms if alarm LED is ON.

13.2 Press "F1" then press "START POS" to send the steppers to start position (stepper default position) and disable the alarm warnings for 10 minutes. The controller will return each stepper to its start position and then display the warmup screen. This procedure should ALWAYS be used when starting the engine.

Moving L Stepper to Start Pos.	**Moving R Stepper to Start Pos.**	**L Warm-Up 1000** **R Warm-Up 1000**

13.3 Now the engine should be started, warmed up and loaded. Temperature requirements would be met before the 10 minute delay expires and the controller would go into automatic control. Both the current left O_2Sensor voltage, and the current left stepper valve position are provided on the automatic display screen.

L Auto 0.81v1010
R Auto 0.79v 982

Fig. 2

GENERAL INSTALLATION LAYOUT

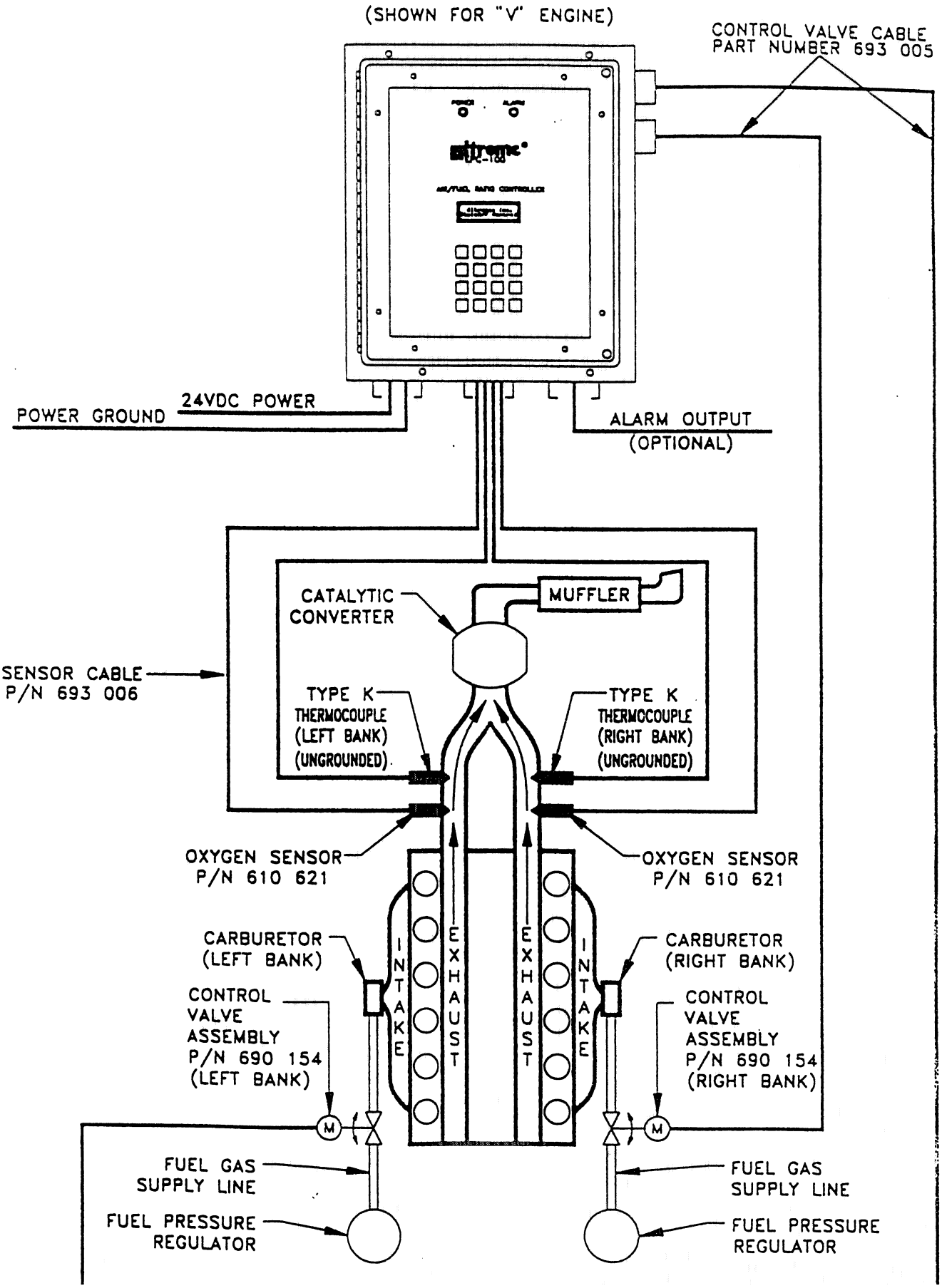
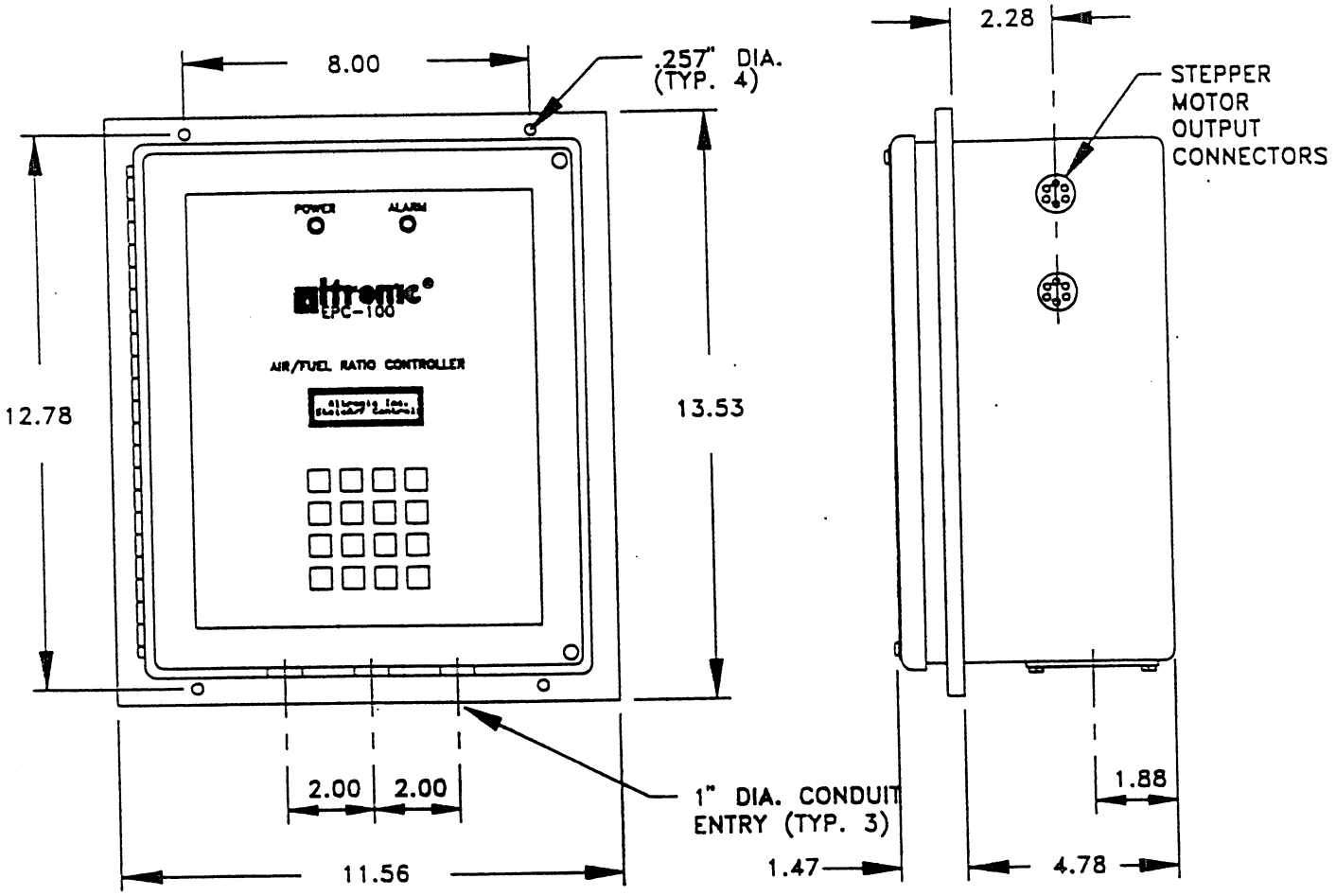


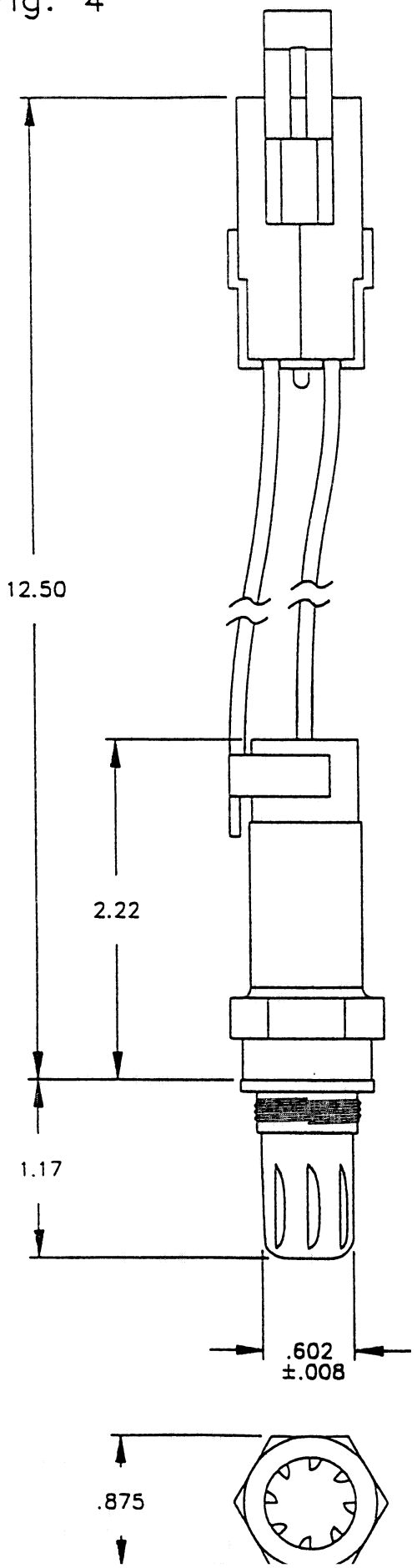
Fig. 3

MOUNTING DETAIL



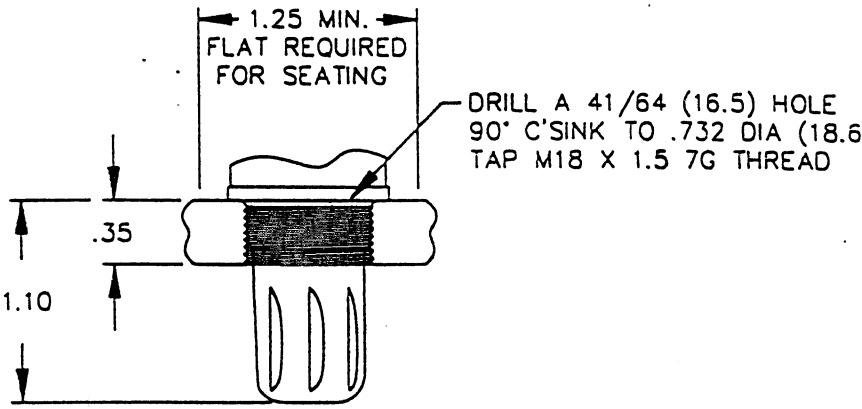
NOTE: PANEL CUT-OUT IS 10.12" X 12.12"
ALL DIMENSIONS ARE IN INCHES.

Fig. 4



CONNECTOR PIN	WIRE COLOR	PIN AND WIRE CONNECTION
A	TAN	SENSOR (GROUND)
B	BLACK	SENSOR (OUTPUT)

MATING CONNECTOR:
PACKARD ELECTRIC DIV. PART NO. 12010501



RECOMMENDED INSTALLATION DIMENSIONS

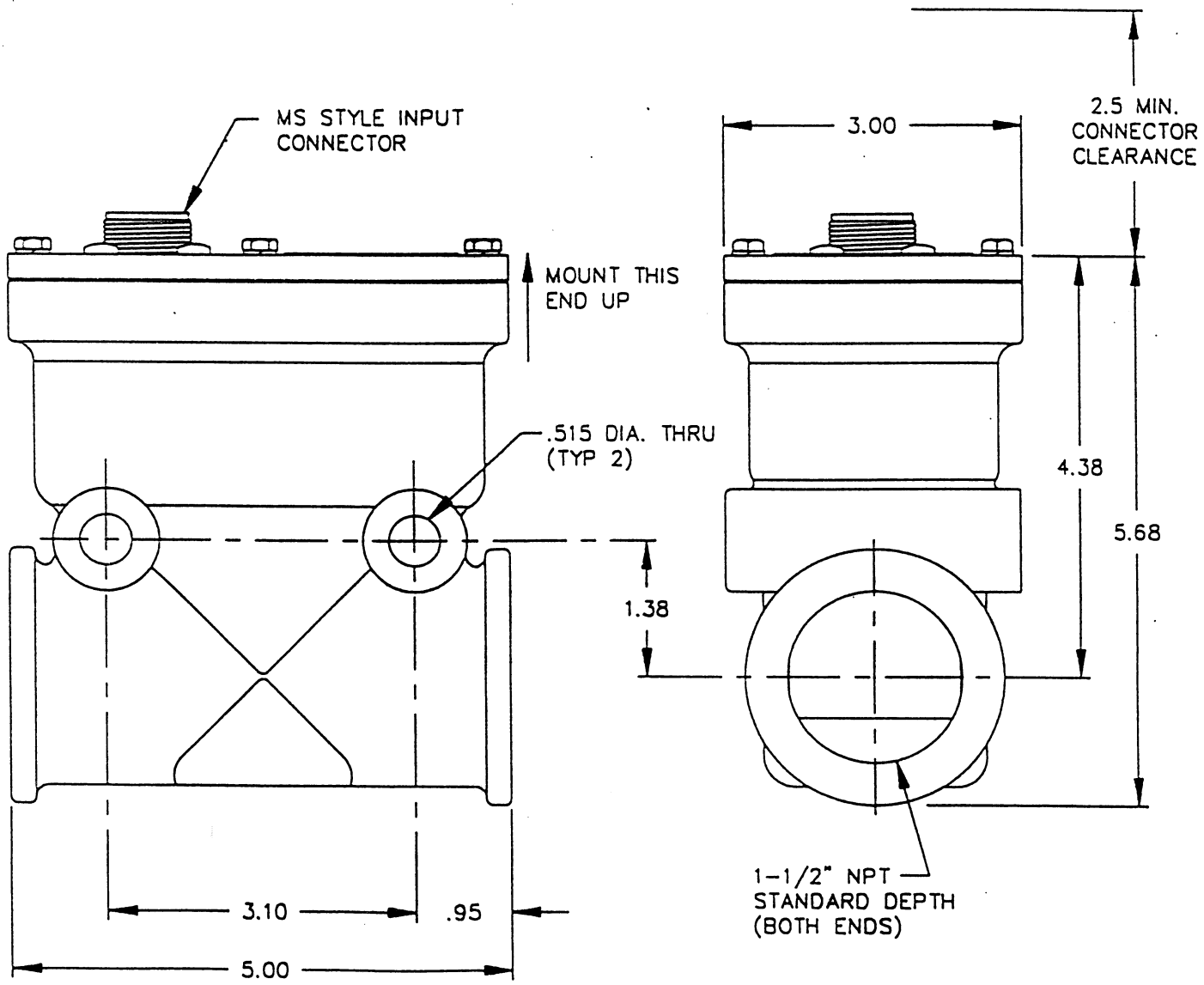
INSTALLATION INSTRUCTIONS:

1. INSTALL IN THE APPROPRIATE MOUNTING HOLE TO A TORQUE OF 28–34 Lb. Ft.
2. USE A 7/8" WRENCH SIZE.
3. SENSORS ARE TO BE SUPPLIED WITH THREADS COATED WITH MS–0572 ANTISEIZE COMPOUND.
   CAUTION: DO NOT APPLY ANTISEIZE COMPOUND TO AREAS OTHER THAN THE MOUNTING THREADS.
4. FOR OPTIMUM RESISTANCE TO WATER INTRUSION. AC RECOMMENDS MOUNTING SENSORS SUCH THAT THE EXPOSED END (WIRE END) OF THE SENSOR IS ORIENTED AT OR ABOVE HORIZONTAL.
5. THIS SENSOR IS DESIGNED FOR WATER SPLASH RESISTANCE.

Fig. 5

SPECIFICATIONS

MEDIA COMPATIBILITY	–	304 STAINLESS STEEL BODY AND COVER, NYLON PISTON, CORROSION RESISTANT STEPPER MOTOR
ELECTRICAL SPECIFICATION	–	12 VOLTS @ 5 WATTS MAX.
MAX. WORKING PRESSURE	–	40 PSIG
MAX. OPERATING TEMPERATURE	–	−40 TO 175°F



14.0 DATA VIEWING - KEYPAD AND DISPLAY OPERATION:

14.1 Press "DISP SEL" to display the first data view screen. The first data screen displays the current O_2Sensor Voltages.

L O2Sensor= 0.81v
R O2Sensor= 0.79v

14.2 Press "DISP SEL" again to display current O_2Target voltages.

L O2Target= 0.80v
R O2Target= 0.80v

14.3 Press "DISP SEL" again to display current estimation of lambda which is based on the actual O_2Sensor voltage.

L LAMBDA = 0.98
R LAMBDA = 0.98

14.4 Press "DISP SEL" again to display the current stepper valve positions.

L STEPPER = 1010
R STEPPER = 982

14.5 Press "DISP SEL" again to display the default stepper position values.

L Default P=1000
R Default P=1000

14.6 Press "DISP SEL" again to display the min and max possible stepper positions.

L min 0 max1700
R min 0 max1700

14.7 Press "DISP SEL" again to display the exhaust temperature readings from the thermocouples near the O_2Sensors.

L EXH TMP=1100°F
R EXH TMP=1105°F

14.8 Press "DISP SEL" again to display the closed loop control gain value.

- - - - - - - - - - - - -
GAIN VALUE=0.50

14.9 Press "DISP SEL" again to loop back to the automatic screen.

L Auto 0.81v1010
R Auto 0.79v 982

15.0 MANUAL MODE - KEYPAD AND DISPLAY OPERATION:

15.1 Press "LEFT MANUAL" to enter the manual mode for the left bank. The display will indicate "**WORKING**" and then return with the left bank in manual mode. This mode can be used to help setup the controller, and to diagnose problems. Because no diagnostic alarms are present, it was not necessary to acknowledge alarms. Also, once in manual mode, diagnostic alarms for that bank are disabled. The alarm LED will flash while in manual mode to serve as a reminder that the EPC-100 is not in automatic control.

L MAN! 0.81v1010
R Auto 0.79v 982

15.2 Press "RIGHT MANUAL" to enter the right bank manual mode.

L MAN! 0.81v1010
R MAN! 0.79v 982

15.3 Press "LEFT LEAN" to increase the stepper position by 25 steps. A descriptive message will be displayed and then the modified position will be returned. Increasing the position causes the valve to close and the mixture to change in the lean direction.

MOVING		**L MAN! 0.81v1035**
STEPPER	**then**	**R MAN! 0.79v 982**

15.4 Press "LEFT FAST", then press "LEFT LEAN" to increase the stepper position by 100 steps.

MOVING		**L MAN! 0.81v1135**
STEPPER	**then**	**R MAN! 0.79v 982**

15.5 Press "LEFT RICH" to decrease the stepper position by 25 steps. Decreasing the position causes the valve to open and the mixture to change in the rich direction. These same commands are used to operate the right bank using the "RIGHT LEAN", "RIGHT RICH" and "RIGHT FAST" keys.

MOVING		**L MAN! 0.81v1110**
STEPPER	**then**	**R MAN! 0.79v 982**

15.6 Press "AUTO OPER" to return to automatic mode. Any time this key is pressed, automatic mode will be enabled for both banks.

L Auto 0.81v1110
R Auto 0.79v 982

16.0 DIAGNOSTIC DISPLAYS & OPERATION:

16.1 The Alarm LED and Alarm Output operate in conjunction with the diagnostic features of the EPC-100. The three operation modes of these alarm features are described below.

a. Alarm LED OFF - Indicates that the unit is operating correctly in automatic mode, or in warm-up mode waiting for the exhaust temperatures to increase.

b. Alarm LED ON Steady - Indicates that the unit is attempting automatic control; however one of the diagnostic criteria has not been satisfied. The alarm indicator will stay on solid until the alarm acknowledge key is pressed at which time the LED will flash. A solid on yellow LED also indicates that the alarm output terminal is in its alarm state.

c. Alarm LED Flashing - Indicates one of two things; either an acknowledged alarm condition still exists, or the unit is in manual operation mode. The flashing LED should simply signify to the operator that the unit is not in normal automatic control. The alarm output terminal is in its normal state if the LED is flashing.

Note: Both the alarm LED and the alarm output return to the normal condition when the system fault is corrected.

16.2 The ALARM OUTPUT is configured as a NORMALLY CLOSED output signal. Any system fault will open the alarm circuit including loss of power, diagnostic warnings, etc. As described above, the alarm output would be in its fault condition (open) any time that the alarm indicator on the front panel is On solid.

16.3 The system diagnostics included in the EPC-100 are designed to identify conditions which are not considered normal operation. These diagnostic tests are performed continuously while the controller is in automatic mode. Each of the diagnostics will display a descriptive message, turn on the Alarm LED (yellow) and place the alarm output in the fault condition (open).

16.4 Active diagnostic warning messages are displayed in rotation, each message being displayed for about 1 second. A generic warning message is also displayed and includes the current stepper position.

L !WARNING! 1000
R Auto 0.80v 982

16.5 The Exhaust Temperature diagnostic - monitors the exhaust temperatures near the O_2Sensors as measured with the thermocouples. If the temperature is below 650°F or above 1400°F, then the EPC-100 displays the appropriate low or high message and activates the Alarm LED and Alarm Output. Automatic control is also disabled and the stepper valves are positioned at the default stepper position. Note that thermocouple probe or thermocouple connection failures will also activate this diagnostic.

L EXH TEMP LO !
R Auto 0.80v 982

or

L EXH TEMP HI !
R Auto 0.80v 982

NOTE: When "F1" then "START" are pressed before starting the engine, the exhaust temperature diagnostic will be delayed 10 minutes displaying the warm-up screen.

16.6 The Sensor Ready Diagnostic - Is designed to identify problems with the O_2Sensor. The controller has a very high impedance pull up resistor to 0.5 volts in parallel with each exhaust sensor input. When the sensor is too cool or disconnected this will force the input to read 0.5 volts. If the controller sees that the sensor output is 0.5 volts for 10 or more seconds the EPC-100 will display the sensor not ready message and activate the Alarm LED and Alarm Output. Automatic control is also disabled and the stepper valves are moved to the default stepper position. The sensor ready test is only performed if the exhaust temperature requirements of 16.5 are satisfied. Failure of this test indicates a cold, disconnected or failed sensor.

L O2 NOT READY!
R Auto 0.80v 982

16.7 The Sensor Input Voltage Diagnostic - Is also designed to identify problems with the O_2Sensor. Normal input voltages should be between 0.1 and 0.9 volts. If the sensor input voltage is less than 0.1 volts or more than 1.1 volts, the EPC-100 will display the appropriate low or high message and activate the Alarm LED and Alarm Output. Automatic control is also disabled, and the stepper valves are moved to the default stepper position.. Failure of this diagnostic test indicates shorted wiring or a failed sensor.

L O2 SIGNAL LO!
R Auto 0.80v 982

or

L O2 SIGNAL HI!
R Auto 0.80v 982

16.8 The Lean & Rich Limit Diagnostic - monitors the stepper positions. If the position of a stepper valve is at the minimum (0) or maximum (1700) travel limit, the EPC-100 displays the appropriate message and activates the Alarm LED and Alarm Output. The rich limit warning indicates that the engine is too lean and the controller cannot open the valve any further to richen the mixture. The lean limit warning indicates that the engine is too rich and the controller cannot close the valve any further.

L RICH LIMIT !
R Auto 0.80v 982

or

L LEAN LIMIT !
R Auto 0.80v 982

17.0 TROUBLE SHOOTING THE EPC-100 SYSTEM:

17.1 Green LED and LCD display are blank; power is interrupted.
- a. Check power supply voltage at EPC terminal block TS2A (18-30 volts), while still connected.
- b. Power down unit, then remove and check resistance of on-board fuse (F1) (< 2 ohms). See Fig. 7.1 for fuse location.
- c. Verify tight cable connections between control and display boards.

17.2 Display reads (Execution Suspended); control board is not running.
- a. Power-down unit for 1 minute. Then re-power and check display.
- b. Power-down unit, remove and separate control board pair. Examine both blue socketed IC's for tight engagement. Reassemble & re-power.
- c. Replace control board assembly. See Fig. 10.

17.3 Display reads (Execution Suspended by User); stopped through serial port.
- a. Power-down unit for 1 minute. Then re-power and check display.
- b. Replace control board assembly. See Fig. 10.

17.4 Display top row is dark, bottom row is light; display board is not running.
- a. Power-down unit for 1 minute. Then re-power and check display.
- b. On back of display board, examine both blue socketed IC's for tight engagement.
- c. Check cable connection between control and display boards.
- d. Replace display board assembly. See Fig. 10.

17.5 Display is blank, but green LED is on. Contrast adjustment required.
- a. On back of display board adjust contrast potentiometer. Clockwise = Lighter & Counterclockwise = Darker. See Fig. 9 for location.
- b. Replace display board assembly. See Fig. 10.

17.6 Key pad entries cause no display response.
- a. At bottom of display board, verify connection of keypad ribbon connector.
- b. Replace enclosure and keypad assembly. See Fig. 10.

17.7 Alarm LED is on Solid.
- a. Read the warning message on the display, and reference the diagnostic section for an explanation of the warning.
- b. Press "Alarm Ack" to permit normal keypad operation and to disable the alarm output terminal.

17.8 EPC-100 will not move stepper valves during "F1" then "Start Pos." command.

a. Check stepper cable connections at EPC-100 and at stepper valve.
b. Inside EPC-100 verify that red LED on stepper driver board is ON. If LED is off, check the 2-wire power connection cable between the control board and the stepper driver board. Check the fuse on the stepper driver board.
c. Check the ribbon cable connection between stepper drive board and control input board.
d. Test EPC-100 with a spare stepper valve assembly.
e. Test EPC-100 and stepper valve assembly, with a spare stepper cable.
f. Replace stepper drive board assembly. See Fig. 10.

17.9 High or low exhaust temp warnings persist.

a. If engine is not running, start and warm up engine.
b. Test the disconnected thermocouple reading at EPC-100 with an alternate thermocouple reading device.
c. Replace thermocouple or correct wiring if temperatures are incorrect. The life of thermocouple probes is highly dependent on the use of a thermowell and on corrosives in exhaust.
d. If low temperature is a problem during first installation, an alternate sensor and probe location may be required. Please contact the factory before pursuing any other action to raise sensor temps.
e. Replace control board assembly. See Fig. 10.

17.10 Rich or lean limit warnings persist.

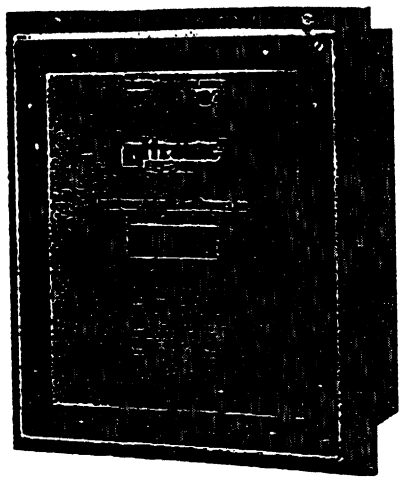
a. A misfiring engine can cause the system to shift in the rich direction. Check the engine for misfiring cylinders using a timing light or exhaust pyrometer.
b. Use an exhaust analyzer and the EPC-100 manual mode to adjust the $\%O_2$ before the converter to around 1.0%. If the $\%O_2$ cannot be manipulated in the manual mode, then test to make sure the stepper valve is functioning as was done during installation.
c. If manual mode moves the $\%O_2$ but cannot attain 1.0%, then the fuel system may need to be readjusted. First verify that the load screw adjustments on the carburetors are full rich or full open. If they are not full open, the control range of the stepper valves will be limited. Second, adjust the fuel pressure regulators so that when in automatic mode, the stepper valves are controlling near 1000 steps.
d. If the fuel system appears to be adjusting correctly, use an exhaust analyzer and the EPC-100 manual mode to sweep the $\%O_2$ from around 3% down to 0.2% while watching the O_2Sensor voltage on the display. The voltage should move from around 0.2 volts toward 0.8 volts as the $\%O_2$ is changed. If this is not the case, a new sensor should be tested.
e. If EPC-100 O_2Sensor voltage display does not match actual sensor voltage, test for ground loop problems. As described in section 9.2(d).
f. Replace control board assembly. See Fig. 10.

17.11 EPC-100 setup values are lost at power-down; battery for BBRAM is failed.

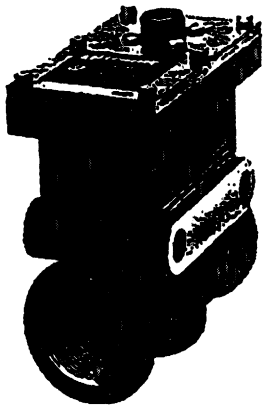
a. Replace control board assembly. See Fig. 10.

FIGURES SECTION: (1 - 12)

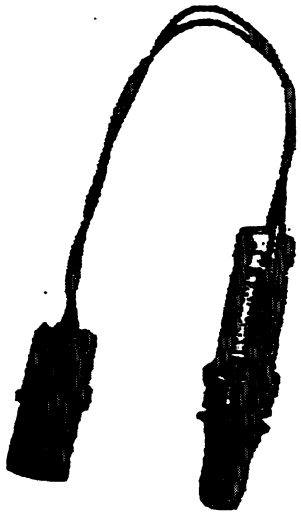
Fig. 1 EPC-100 Components



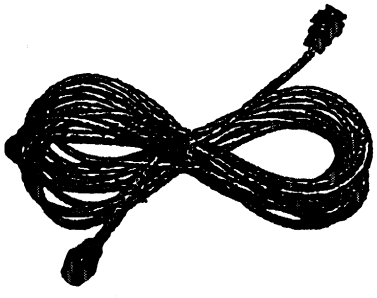
Air/Fuel Controller
EPC-100



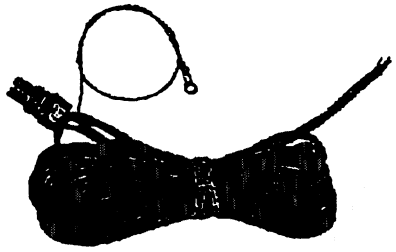
Control Valve
690 154-1



Oxygen Sensor
610 621



Control Valve Cable
693-005



Sensor Cable
693-006

Fig 12.0 CONTROL VALVE PARTS IDENTIFICATION:

The following replacement parts are available from authorized Altronic distributors.

REF.NO.	QTY.	PART NO.	DESCRIPTION
1	1	610 651	Valve Body, Machined
2	1	680 003-1	Motor/Connector/Piston Assy. (690 154-1)
		680 003-2	Motor/Connector/Piston Assy. (690 154-2)
3	8	901 004	Lockwasher, #10
4	2	902 628	Screw, 8-24 x 1/2" Socket Hd.
5	1	501 335	Gasket, Connector
6	1	610 609	Cover Plate
7	4	902 632	Screw, 8-24 x 3/8", Seal, Pan Hd.
8	1	610 610	Gasket,Cover Plate
9	6	902 472	Screw, 10-24 x 5/8", Hex Hd.

NOTE: Reference numbers can be used to identify parts on Fig. 11.

EPC-100

AIR/FUEL RATIO CONTROLLER

TROUBLE SHOOTING

&

SUGGESTIONS GUIDE

CONTENTS

1. REVIEW THE ALTRONIC MANUAL

a. Check the power supply - 24 VDC, 1 amp

b. Check that all components are properly grounded to the engine skid, which in turn is grounded to earth ground.

2. MANUAL MODE - Verification of EPC-100 System

a. With the engine running and loaded, place the controller in manual mode.

NOTE: **If the display is locked up, disconnect the power to the unit for 1 (one) minute and then repower the unit.**

b. Verify the operation of the thermocouple and oxygen sensor either by reading the EPC readout or measuring the voltage ouput of the sensors with a multimeter.

c. Perform an F-1 Start Command. Default position should be 1000 steps, at least for this verification procedure.

NOTE: **The carburetor load screw should be backed out about 5-1/2 turns.**

d. Adjust fuel pressure regulators to obtain near 0.78 volts on both O_2 sensors.

i. If O_2 voltage is always high:
- decrease and verify fuel pressure at final regulator.
-verify O_2 sensor with a second instrument.

ii. If O_2 voltage is always low:
-increase and verify fuel pressure at final regulator.
-check for engine or ignition misfire.
-verify O_2 sensor with a second instrument.
-check stepper motor valve and drive circuit.

e. Manually adjust the left bank stepper in the lean direction until the O_2 sensor reads less than 0.3 volts. The right bank voltage should not change.

f. Manually adjust the right bank stepper in the lean direction until the O_2 sensor reads less than 0.3 volts. The left bank voltage should not change.

g. Manually adjust the left bank stepper in the rich direction until the O_2 sensor reads greater than 0.8 volts. The right bank voltage should not change. Repeat on right bank.

h. Manually adjust the left bank stepper in the lean direction until the O_2 sensor reads near 0.8 volts. Repeat on right bank.
Stepper positions should be near original default position (± 150 steps) again. If position is far from the original default position, then check the stepper motor valve and drive circuit.

i. If steps (a-e) have been completed without any problem proceed to verify automatic operation.

3. AUTOMATIC MODE - Verification of the EPC-100 System

a. Adjust the O_2 Target Voltage to 0.77 volts. This is a voltage that will satisfy most catalysts and is well within the control capability of the sensor.

b. Enable Automatic Mode.

Observe operation of the valves in response to the O_2 voltages. The stepper position number should decrease if the sensor voltage is below 0.77 volts, and should increase if above 0.77 volts.

c. If rich or lean limit positions are reached, then slowly adjust the appropriate pressure regulator so the unit can control.

NOTE: **A "Rich Limit" warning on the EPC-100 simply indicates that the EPC has attempted to richen the air fuel mixture to reach the O_2 target voltage, was unable to reach the O_2 target voltage, and cannot richen the mixture further (i.e. control valve is fully open). Similarly, a "Lean Limit" warning indicates that the EPC was unable to lean the air fuel mixture further in attempting to reach the O_2 target voltage.**

d. After the EPC-100 is in control, then fine tune the pressure regulators so that 0.77 volts is maintained with the steppers near 1000-1200 steps.
(see pressure regulator adjustment notes)

e. At this point you are ready to start emissions analysis and fine tuning.

4. TUNING FOR EMISSIONS

a. In order to achieve best conversion efficiency from the catalyst, an emissions analyzer is required to locate the optimized exhaust oxygen content so that the AFRC may be tuned with the corresponding O_2 sensor target voltage.

b. High NOx can be reduced by running the engine slightly richer.
(increase the target voltage)

High CO or HC can be reduced by running the engine slightly leaner.
(decrease the target voltage)

c. Keeping both O_2 targets the same, determine the target for best emissions by adjusting the targets in unison and observing the emission results.

d. Often times, variation in the engine itself and in each sensor may exist. To further optimize emissions performance adjust the setpoints independently while keeping the average of the both setpoints constant. By doing this you may be able to reduce control differences between the banks and further improve emissions performance.

e. Remember that catalysts and sensors do age, and periodic recalibration of the setpoints is required to maintain good emissions performance.

5. CHECKING STEPPER MOTOR VALVES AND DRIVERS

a. Stop the engine, AND turn off fuel supply to the regulator.

NOTE: **When shutting down engines with catalytic converters, fuel should be cut off first, and then ignition. Doing so assures that unburned fuel is not inadvertently exhausted to the catalyst.**

b. Carefully remove stepper motor valve from the engine.

CAUTION: Do not attempt to turn the white piston, or to manually extend or retract the stepper motor. This action will damage the motor.

c. Connect the Stepper Motor to the control cable and to the EPC-100.

d. Execute the F1-Start command and visually verify the motion of the piston in the valve.

- The piston should retract all the way to the full-open position. This leaves just less than 0.75" of the white piston exposed in the bore.

- Then the piston will extend to the default position.

This leaves about 1.125" of the white piston exposed in the bore.

NOTE: **When fully extended, a 0.25" gap remains at the bottom of the piston.**

e. Perform several fast rich then several fast lean commands while feeling the piston move with your finger. The movement should be smooth in both directions.

f. If movement of the motor is smooth and seems to follow the manual commands accurately, then the valve and the driver are working properly.

- If motor movement is not smooth, check all wiring connections to see that they are secure; if motor movement is still not smooth, consider replacement of the valve.

- If the motor does not move at all, test the controller with another motor.

- If the controller will not drive a good motor, test the wiring and connections; or, consider replacing the stepper drive board or the control board assembly inside the EPC.

6. VERIFYING O_2 SENSOR WITH ANALYZER

a. Because an O_2 sensor's usable range is so narrow around stoichiometry, and because the sensor must be very hot (>650° F) to operate, it is very difficult to test the sensor other than on an engine.

b. With an emissions analyzer however, it is possible to verify the performance of the sensor through comparison.

c. When an O_2 sensor outputs a low voltage (<0.15 volts) it is indicating that the engine is running lean of stoichiometry. With an analyzer, you can determine that the engine is lean by the following:

-Low CO but High NOx emissions (post-catalyst)
-percent O_2 above 0.7% (pre-catalyst)

These indicators confirm that the engine is operating lean and the sensor is functioning correctly. This lean condition could be caused by the following:

-Too little fuel pressure (regulator or restriction)
-Cylinder misfire

-Exhaust leak (loose sensor, hole in expansion joints, loose turbocharger collar, etc.)

d. When the O_2 sensor outputs a high voltage ($\geq$ 0.95 volts) it is indicating that the engine is running rich. With an analyzer you can determine that the engine is rich by observing the following:

-Low NOx and High CO emissions (post-catalyst)
-Percent O_2 less than 0.15% (pre-catalyst)

These indicators confirm that the engine is operating rich and the sensor is functioning correctly. This rich condition could be caused by the following:

-Too much fuel pressure (regulator)

e. Sensors are slightly more expensive than a few spark plugs. Spare sensors represent very little cost burden.

PLEASE REMEMBER that the O_2 sensor is designed for catalyst control using a set point of 0.78 volts. Control targets above 0.85 volts and below 0.2 volts are considered extreme for this sensor. Control setpoints outside this range have been used successfully but should be approached cautiously.

7. PRESSURE REGULATOR ADJUSTMENT NOTES

a. With the engine at full load, the stepper valves should control at near 900 to 1200 steps. This leaves adequate authority in both directions to compensate for fuel or load changes.

b. Make sure that the bias spring in the regulator is not at the minimum or maximum adjustment limit. An adjustment screw that is near the very top and just touching the spring will not perform correctly. Also, a spring that is fully compressed will not control correctly. Be sure to verify that neither of these conditions exist. A heavier spring or larger orifice may be required to increase the fuel pressure to the control valve.

c. Measure the pressure difference between the fuel pressure regulator and air intake to the carburetor on each bank. This will help to detect any problems like carburetor imbalance.

On an engine, the fuel to air pressure can be measured with a mechanical gauge or a water manometer. Typical fuel pressures at the regulator outputs are 6-12 inches of water column, or as high as 1.5 times the manufacturers recommended value.

d. The regulator should maintain the same "fuel over air" pressure for the entire load range, full load to idle. Verify this by taking readings at various load points from idle to full load. If the "fuel over air" does not stay nearly constant, action should be taken to ensure that the same "fuel over air" pressure is maintained over the load range. Verify that the inlet pressure to the regulator is at least 5 psi greater than the maximum boost pressure. Also verify that the regulator orifice is correctly sized for this application.

8. RICH AND LEAN LIMIT PROBLEM

There are three potential situations which might exist.

a. EPC-100 has limited control capability due to regulator adjustment.

Symptoms:
i. O_2 sensor voltage does not match target.
ii. Performing F1-Start does not correct the problem.
iii. Adjustment of the regulator brings the O_2 voltage back to the target.

Corrective action: Adjust pressure regulator.
If small adjustments of the regulator result in both rich and lean limits, then a more restrictive control valve may be required.
(Application would normally be a small engine)

2. O_2 sensor problem.

Symptoms:
i. O_2 voltage is near the target but fluctuates quickly about the target.
ii. Target voltage is above 0.8 volts or below .2 volts.
iii. Performing F1-Start does not correct the problem.
iiii. Even coarse adjustment with the fuel regulator cannot bring the sensor voltage to the target.

Corrective Action: Try adjusting setpoint between 0.8 and 0.2 volts.
Verify sensor is tight and sealed.
Replace sensor.

3. EPC-100 Valve Wiring Anomoly.

Symptoms:

i. Control valve motor appears to be operating (i.e., control valve body vibrates with motor pulses) but plunger does not move.
ii. Rich and Lean manual commands have no inputs in changing the O_2 sensor voltage.

Corrective Action: Adjust gain to 2.0 (eliminates half steps)
Consult factory

9. EPC-100 REMINDERS

-Regulator problems are most common.

-Grounded thermocouples and grounded oxygen sensors do not work.

-Solar/Battery Power Sources should provide 1 amp constant duty.

-Reverse power polarity WILL damage the EPC-100 controller. An in-line power fuse is required in the ground line connected to the EPC.

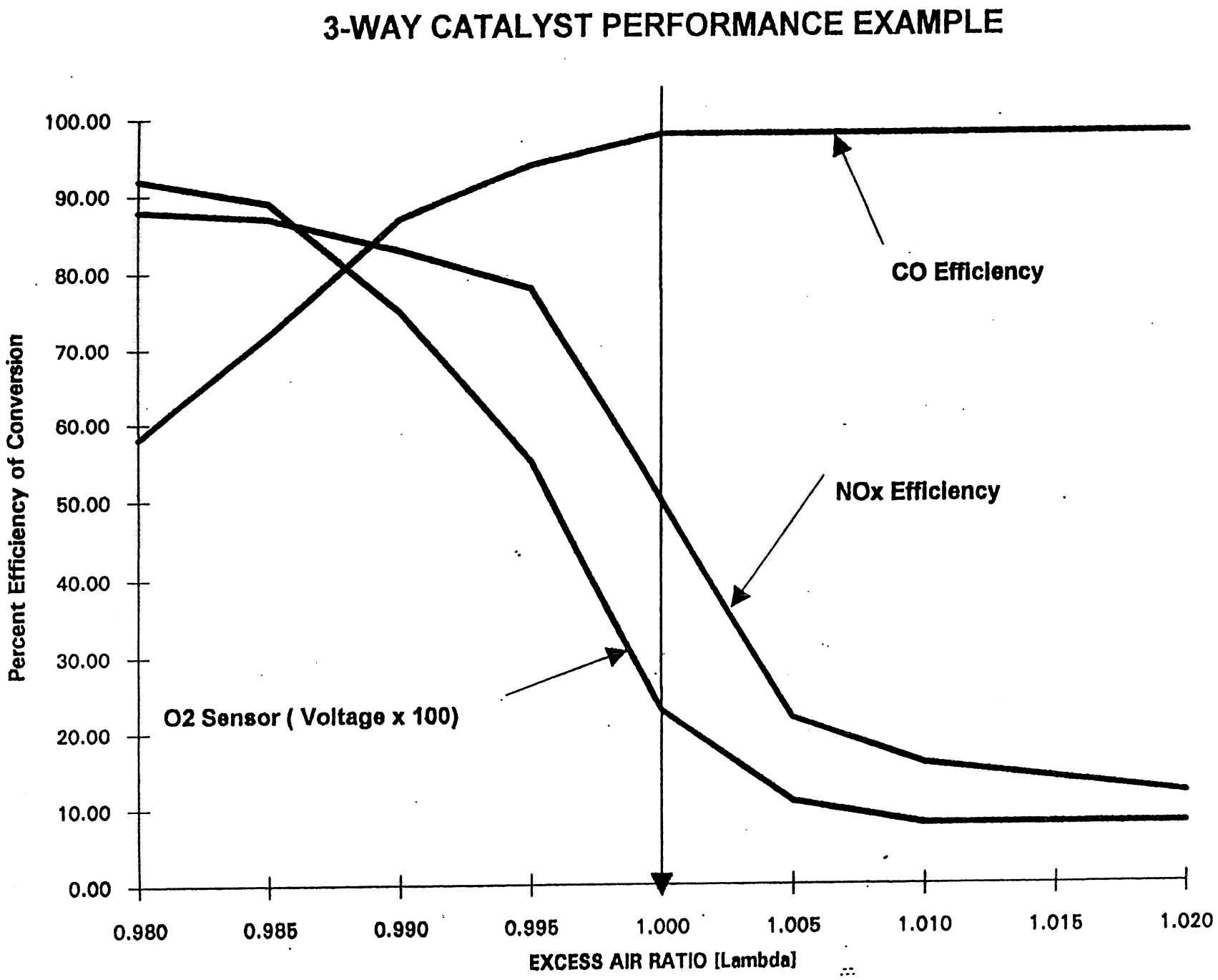
-The Alarm output is normally closed.

-Rich and Lean Limits do not move the control valves to the default stepper position..

-The O_2 sensor has limitations; they are designed for catalyst control. The usable range is 0.2 volts to 0.85 volts. Expected life is 2000 hours or three months. O_2 sensors should be changed when the spark plugs are changed.

-Dual carburetor single exhaust manifold engines present a problem to everyone.

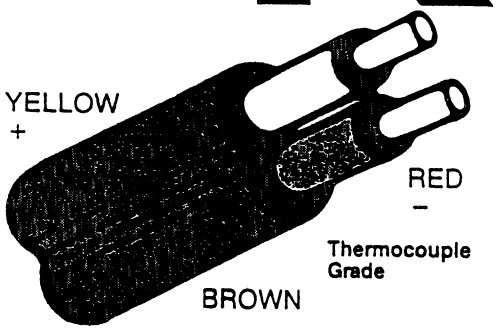
-An "Execution Suspended" error message indicates that the EPC has lost power temporarily (or possibly experienced a gradual power drop). Consequently, the EPC will have lost its programmed default settings and when power is restored, the display may be locked up. To solve this problem, disconnect the power from the unit for one minute and then repower the unit.


3-WAY CATALYST PERFORMANCE EXAMPLE
Percent Efficiency of Conversion
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.980
0.985
0.990
0.995
1.000
1.005
1.010
1.015
1.020
EXCESS AIR RATIO [Lambda]
CO Efficiency
NOx Efficiency
O2 Sensor (Voltage x 100)

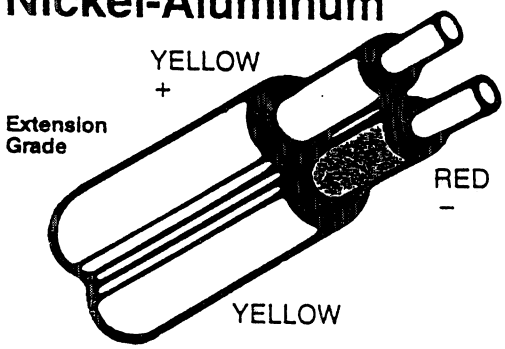
Thermocouple Reference Tables

TYPE K

Reference Tables
N.I.S.T. Monograph 125



Nickel-Chromium vs. Nickel-Aluminum



MAXIMUM TEMPERATURE RANGE
Thermocouple Grade
– 328 to 2282°F
– 200 to 1250°C
Extension Grade
32 to 392°F
0 to 200°C

LIMITS OF ERROR
(whichever is Greater)
Standard: 2.2°C or 0.75% Above 0°C
2.2°C or 2.0% Below 0°C
Special: 1.1°C or 0.4%

COMMENTS, BARE WIRE ENVIRONMENT:
Clean Oxidizing and Inert; Limited Use in Vacuum or Reducing; Wide Temperature Range; Most Popular Calibration

TEMPERATURE IN DEGREES F
REFERENCE JUNCTION AT 32°F

THERMOELECTRIC VOLTAGE IN ABSOLUTE MILLIVOLTS

DEG F	0	1	2	3	4	5	6	7	8	9	10	DEG F
550	11.702	11.725	11.748	11.770	11.793	11.816	11.839	11.862	11.885	11.908	11.931	550
560	11.931	11.954	11.977	12.000	12.023	12.046	12.069	12.092	12.115	12.138	12.161	560
570	12.161	12.184	12.207	12.230	12.254	12.277	12.300	12.323	12.346	12.369	12.392	570
580	12.392	12.415	12.438	12.461	12.484	12.507	12.530	12.553	12.576	12.599	12.623	580
590	12.623	12.646	12.669	12.692	12.715	12.738	12.761	12.784	12.807	12.831	12.854	590
600	12.854	12.877	12.900	12.923	12.946	12.969	12.992	13.016	13.039	13.062	13.085	600
610	13.085	13.108	13.131	13.154	13.178	13.201	13.224	13.247	13.270	13.293	13.317	610
620	13.317	13.340	13.363	13.386	13.409	13.433	13.456	13.479	13.502	13.525	13.549	620
630	13.549	13.572	13.595	13.618	13.641	13.665	13.688	13.711	13.734	13.757	13.781	630
640	13.781	13.804	13.827	13.850	13.874	13.897	13.920	13.943	13.967	13.990	14.013	640
650	14.013	14.036	14.060	14.083	14.106	14.129	14.153	14.176	14.199	14.222	14.246	650
660	14.246	14.269	14.292	14.316	14.339	14.362	14.385	14.409	14.432	14.455	14.479	660
670	14.479	14.502	14.525	14.548	14.572	14.595	14.618	14.642	14.665	14.688	14.712	670
680	14.712	14.735	14.758	14.782	14.805	14.828	14.852	14.875	14.898	14.922	14.945	680
690	14.945	14.968	14.992	15.015	15.038	15.062	15.085	15.108	15.132	15.155	15.178	690
700	15.178	15.202	15.225	15.248	15.272	15.295	15.318	15.342	15.365	15.389	15.412	700
710	15.412	15.435	15.459	15.482	15.505	15.529	15.552	15.576	15.599	15.622	15.646	710
720	15.646	15.669	15.693	15.716	15.739	15.763	15.786	15.810	15.833	15.856	15.880	720
730	15.880	15.903	15.927	15.950	15.974	15.997	16.020	16.044	16.067	16.091	16.114	730
740	16.114	16.138	16.161	16.184	16.208	16.231	16.255	16.278	16.302	16.325	16.349	740
750	16.349	16.372	16.395	16.419	16.442	16.466	16.489	16.513	16.536	16.560	16.583	750
760	16.583	16.607	16.630	16.654	16.677	16.700	16.724	16.747	16.771	16.794	16.818	760
770	16.818	16.841	16.865	16.888	16.912	16.935	16.959	16.982	17.006	17.029	17.053	770
780	17.053	17.076	17.100	17.123	17.147	17.170	17.194	17.217	17.241	17.264	17.288	780
790	17.288	17.311	17.335	17.358	17.382	17.406	17.429	17.453	17.476	17.500	17.523	790
800	17.523	17.547	17.570	17.594	17.617	17.641	17.664	17.688	17.711	17.735	17.759	800
810	17.759	17.782	17.806	17.829	17.853	17.876	17.900	17.923	17.947	17.971	17.994	810
820	17.994	18.018	18.041	18.065	18.088	18.112	18.136	18.159	18.183	18.206	18.230	820
830	18.230	18.253	18.277	18.301	18.324	18.348	18.371	18.395	18.418	18.442	18.466	830
840	18.466	18.489	18.513	18.536	18.560	18.584	18.607	18.631	18.654	18.678	18.702	840
850	18.702	18.725	18.749	18.772	18.796	18.820	18.843	18.867	18.890	18.914	18.938	850
860	18.938	18.961	18.985	19.008	19.032	19.056	19.079	19.103	19.127	19.150	19.174	860
870	19.174	19.197	19.221	19.245	19.268	19.292	19.316	19.339	19.363	19.386	19.410	870
880	19.410	19.434	19.457	19.481	19.505	19.528	19.552	19.576	19.599	19.623	19.646	880
890	19.646	19.670	19.694	19.717	19.741	19.765	19.788	19.812	19.836	19.859	19.883	890
900	19.883	19.907	19.930	19.954	19.978	20.001	20.025	20.049	20.072	20.096	20.120	900
910	20.120	20.143	20.167	20.190	20.214	20.238	20.261	20.285	20.309	20.332	20.356	910
920	20.356	20.380	20.403	20.427	20.451	20.474	20.498	20.522	20.545	20.569	20.593	920
930	20.593	20.616	20.640	20.664	20.688	20.711	20.735	20.759	20.782	20.806	20.830	930
940	20.830	20.853	20.877	20.901	20.924	20.948	20.972	20.995	21.019	21.043	21.066	940
950	21.066	21.090	21.114	21.137	21.161	21.185	21.208	21.232	21.256	21.280	21.303	950
960	21.303	21.327	21.351	21.374	21.398	21.422	21.445	21.469	21.493	21.516	21.540	960
970	21.540	21.564	21.587	21.611	21.635	21.659	21.682	21.706	21.730	21.753	21.777	970
980	21.777	21.801	21.824	21.848	21.872	21.895	21.919	21.943	21.966	21.990	22.014	980
990	22.014	22.038	22.061	22.085	22.109	22.132	22.156	22.180	22.203	22.227	22.251	990
1,000	22.251	22.274	22.298	22.322	22.346	22.369	22.393	22.417	22.440	22.464	22.488	1,000
1,010	22.488	22.511	22.535	22.559	22.582	22.606	22.630	22.654	22.677	22.701	22.725	1,010
1,020	22.725	22.748	22.772	22.796	22.819	22.843	22.867	22.890	22.914	22.938	22.961	1,020
1,030	22.961	22.985	23.009	23.032	23.056	23.080	23.104	23.127	23.151	23.175	23.198	1,030
1,040	23.198	23.222	23.246	23.269	23.293	23.317	23.340	23.364	23.388	23.411	23.435	1,040
1,050	23.435	23.459	23.482	23.506	23.530	23.553	23.577	23.601	23.624	23.648	23.672	1,050
1,060	23.672	23.695	23.719	23.743	23.766	23.790	23.814	23.837	23.861	23.885	23.908	1,060
1,070	23.908	23.932	23.956	23.979	24.003	24.027	24.050	24.074	24.098	24.121	24.145	1,070
1,080	24.145	24.169	24.192	24.216	24.240	24.263	24.287	24.311	24.334	24.358	24.382	1,080
1,090	24.382	24.405	24.429	24.453	24.476	24.500	24.523	24.547	24.571	24.594	24.618	1,090
1,100	24.618	24.642	24.665	24.689	24.713	24.736	24.760	24.783	24.807	24.831	24.854	1,100
1,110	24.854	24.878	24.902	24.925	24.949	24.972	24.996	25.020	25.043	25.067	25.091	1,110
1,120	25.091	25.114	25.138	25.161	25.185	25.209	25.232	25.256	25.279	25.303	25.327	1,120
1,130	25.327	25.350	25.374	25.397	25.421	25.445	25.468	25.492	25.515	25.539	25.563	1,130
1,140	25.563	25.586	25.610	25.633	25.657	25.681	25.704	25.728	25.751	25.775	25.799	1,140
1,150	25.799	25.822	25.846	25.869	25.893	25.916	25.940	25.964	25.987	26.011	26.034	1,150
1,160	26.034	26.058	26.081	26.105	26.128	26.152	26.176	26.199	26.223	26.246	26.270	1,160
1,170	26.270	26.293	26.317	26.340	26.364	26.387	26.411	26.435	26.458	26.482	26.505	1,170
1,180	26.505	26.529	26.552	26.576	26.599	26.623	26.646	26.670	26.693	26.717	26.740	1,180
1,190	26.740	26.764	26.787	26.811	26.834	26.858	26.881	26.905	26.928	26.952	26.975	1,190
1,200	26.975	26.999	27.022	27.046	27.069	27.093	27.116	27.140	27.163	27.187	27.210	1,200
1,210	27.210	27.234	27.257	27.281	27.304	27.328	27.351	27.375	27.398	27.422	27.445	1,210
1,220	27.445	27.468	27.492	27.515	27.539	27.562	27.586	27.609	27.633	27.656	27.679	1,220
1,230	27.679	27.703	27.726	27.750	27.773	27.797	27.820	27.843	27.867	27.890	27.914	1,230
1,240	27.914	27.937	27.961	27.984	28.007	28.031	28.054	28.078	28.101	28.124	28.148	1,240
1,250	28.148	28.171	28.195	28.218	28.241	28.265	28.288	28.311	28.335	28.358	28.382	1,250
1,260	28.382	28.405	28.428	28.452	28.475	28.498	28.522	28.545	28.569	28.592	28.615	1,260
1,270	28.615	28.639	28.662	28.685	28.709	28.732	28.755	28.779	28.802	28.825	28.849	1,270
1,280	28.849	28.872	28.895	28.919	28.942	28.965	28.988	29.012	29.035	29.058	29.082	1,280
1,290	29.082	29.105	29.128	29.152	29.175	29.198	29.221	29.245	29.268	29.291	29.315	1,290
1,300	29.315	29.338	29.361	29.384	29.408	29.431	29.454	29.477	29.501	29.524	29.547	1,300
1,310	29.547	29.570	29.594	29.617	29.640	29.663	29.687	29.710	29.733	29.756	29.780	1,310
1,320	29.780	29.803	29.826	29.849	29.872	29.896	29.919	29.942	29.965	29.989	30.012	1,320
1,330	30.012	30.035	30.058	30.081	30.104	30.128	30.151	30.174	30.197	30.220	30.244	1,330
1,340	30.244	30.267	30.290	30.313	30.336	30.359	30.383	30.406	30.429	30.452	30.475	1,340
1,350	30.475	30.498	30.521	30.545	30.568	30.591	30.614	30.637	30.660	30.683	30.706	1,350
1,360	30.706	30.730	30.753	30.776	30.799	30.822	30.845	30.868	30.891	30.914	30.937	1,360
1,370	30.937	30.961	30.984	31.007	31.030	31.053	31.076	31.099	31.122	31.145	31.168	1,370
1,380	31.168	31.191	31.214	31.237	31.260	31.283	31.306	31.329	31.353	31.376	31.399	1,380
1,390	31.399	31.422	31.445	31.468	31.491	31.514	31.537	31.560	31.583	31.606	31.629	1,390
1,400	31.629	31.652	31.675	31.698	31.721	31.744	31.767	31.790	31.813	31.836	31.859	1,400
1,410	31.859	31.882	31.905	31.927	31.950	31.973	31.996	32.019	32.042	32.065	32.088	1,410
1,420	32.088	32.111	32.134	32.157	32.180	32.203	32.226	32.249	32.272	32.294	32.317	1,420
1,430	32.317	32.340	32.363	32.386	32.409	32.432	32.455	32.478	32.501	32.523	32.546	1,430
1,440	32.546	32.569	32.592	32.615	32.638	32.661	32.683	32.706	32.729	32.752	32.775	1,440
1,450	32.775	32.798	32.821	32.843	32.866	32.889	32.912	32.935	32.958	32.980	33.003	1,450
1,460	33.003	33.026	33.049	33.072	33.094	33.117	33.140	33.163	33.186	33.208	33.231	1,460
1,470	33.231	33.254	33.277	33.300	33.322	33.345	33.368	33.391	33.413	33.436	33.459	1,470
1,480	33.459	33.482	33.504	33.527	33.550	33.573	33.595	33.618	33.641	33.664	33.686	1,480
1,490	33.686	33.709	33.732	33.754	33.777	33.800	33.823	33.845	33.868	33.891	33.913	1,490
1,500	33.913	33.936	33.959	33.981	34.004	34.027	34.049	34.072	34.095	34.117	34.140	1,500
1,510	34.140	34.163	34.185	34.208	34.231	34.253	34.276	34.299	34.321	34.344	34.366	1,510
1,520	34.366	34.389	34.412	34.434	34.457	34.480	34.502	34.525	34.547	34.570	34.593	1,520
1,530	34.593	34.615	34.638	34.660	34.683	34.705	34.728	34.751	34.773	34.796	34.818	1,530
1,540	34.818	34.841	34.863	34.886	34.909	34.931	34.954	34.976	34.999	35.021	35.044	1,540
DEG F	0	1	2	3	4	5	6	7	8	9	10	DEG F

* CONVERTED FROM DEGREES CIIPTS 1968).

Note: NIST (formerly NBS) is planning on revising the Thermocouple Reference Tables, and OMEGA will publish these new tables as soon as they are released.

SPECIFICATIONS

INPUTS:
- (2) Oxygen Sensors (1/carburetor)
- (2) Type K Ungrounded Thermocouples (1/carburetor)

OUTPUTS:
- (2) Stepper-Motor Controls (1/carburetor)
- (1) Alarm

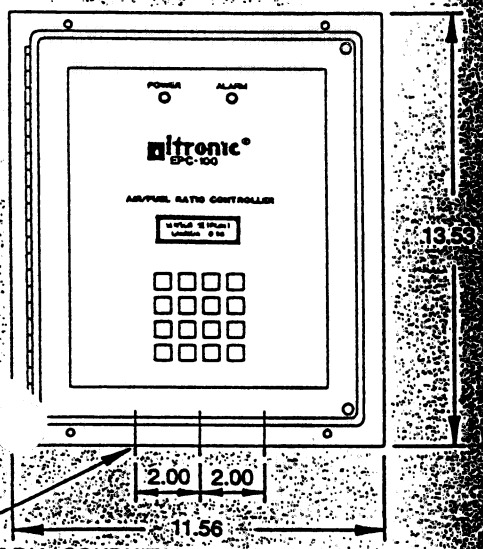
DISPLAY:
Alpha-numeric 2x16 character

POWER REQUIREMENT:
18-30 VDC, 1 AMP

TEMPERATURE:
-40°F. to +158°F. / -40°C. to +70°C.

DIMENSIONS:

Panel cutout: 10.12"W x 12.12"H



1" DIA. CONDUIT ENTRY (TYP. 3)

ORDERING INFORMATION

SYSTEM COMPONENT PARTS:

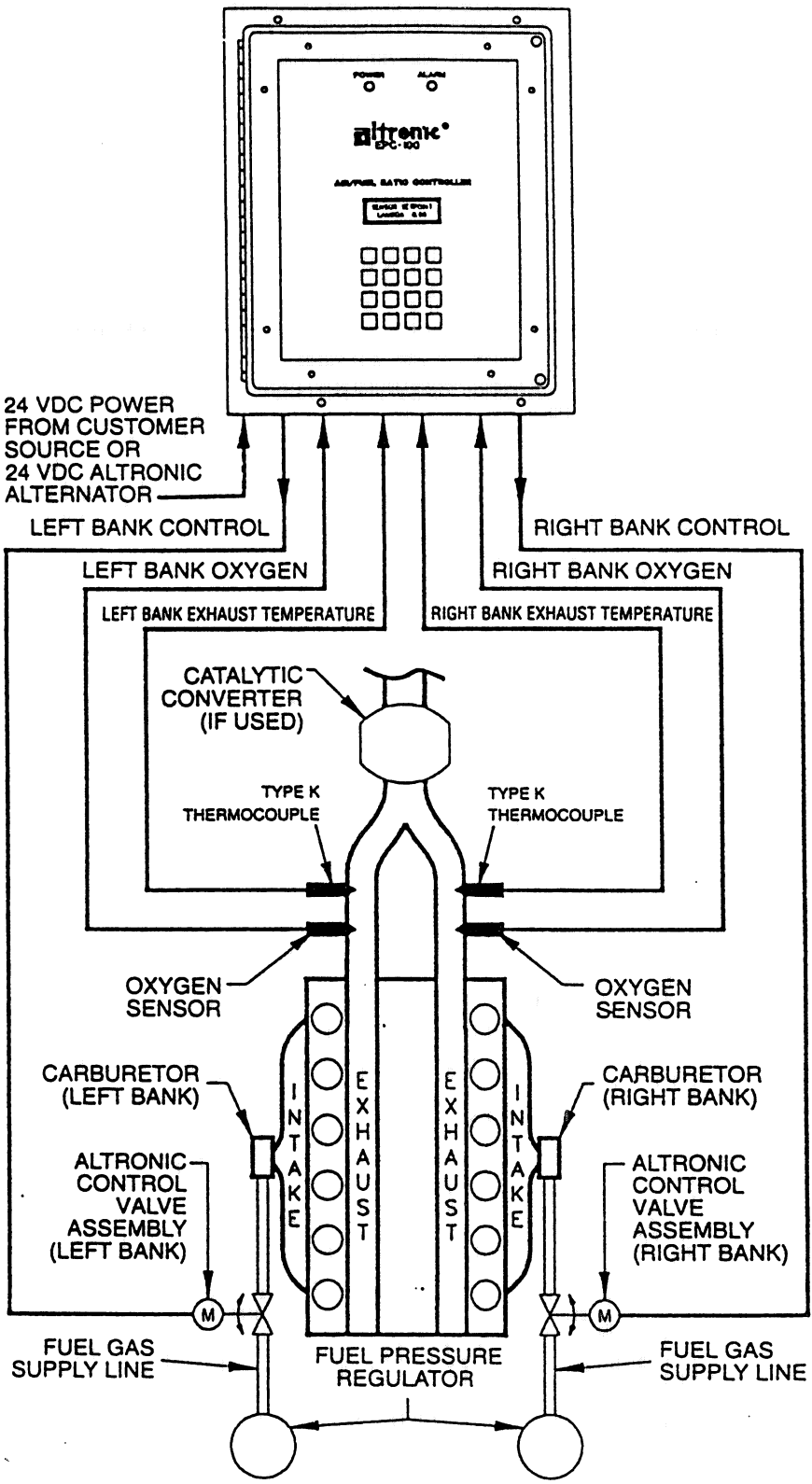
Air/fuel Ratio Controller	EPC-100
Oxygen Sensor	610 621
Control Valve Assembly:	
1.5" line, 250-1,000 hp/valve	690 154-1
1.5" line, below 250 hp/valve	690 154-2
Cable Assembly - Control Valve:	
25 ft. length	693 005-1
50 ft. length	693 005-2
Cable Assembly - 02 sensor:	
25 ft. length	693 006-1
50 ft. length	693 006-2

AIR/FUEL RATIO CONTROL SYSTEM KIT:

		SINGLE CARBURETOR EPC-101	DUAL CARBURETOR EPC-102
EPC-100	AFR Controller	1	1
610 621	Oxygen Sensor	1	2
690 154-1	Control Valve	1	2
693 005-1	Cable Assembly	1	2
693 006-1	Cable Assembly	1	2

NOTE: Type K ungrounded thermocouple required (one per carburetor) is not furnished in kit.

EPC-100 SYSTEM DIAGRAM (V-engine)



altronic® inc.
712 TRUMBULL AVENUE/GIRARD, OHIO 44420
(216) 545-9768/FAX: (216) 545-9005

Form EPC100 2-94

EquiNOx Catalyst Manual

MIRATECH Corporation
Tulsa, Oklahoma

TABLE OF CONTENTS

Your **MIRATECH EquiNOx Catalytic Converter** is designed for maximum reduction of Oxides of Nitrogen (NOx), Carbon Monoxide (CO), and Hydrocarbons (HC). With proper engine control and maintenance practices, the catalyst will provide years of trouble free emissions abatement. This manual will provide information to maintain the performance and life span of your EquiNOx Catalytic Converter.

Typical applications for EquiNOx Catalytic Converters and Catalytic Systems are:

- Gas Compression
- Pumping Stations
- Power Generation
- Irrigation
- Co-generation

I. CATALYST DESCRIPTION

The EquiNOx Catalyst is composed of a proprietary metal foil coated with a high surface area material and a combination of catalytically active Platinum Group Metals (PGM). This combination of materials provides high specific catalyst activity, low pressure drop, and resistance to vibration and shock. As a result, operators are rewarded with low-cost operation, long life, and minimal impact on engine operation.

The catalyst is assembled in a modular monolith design to provide easy maintenance, inspection, and cleaning of the catalyst. Each module is banded in stainless steel with lifting ears to assist operators in removing the element from the housing.

II. HOUSING DESCRIPTION

The EquiNOx catalyst housing is designed and constructed to operate in hostile environments. The housings are flanged at both ends with 1/2" thick carbon steel flat-faced flanges with the bolt hole pattern straddling the centerline. The remainder of the housing is constructed of type 304 stainless steel with flow diffusers, catalyst access cover plate, lifting lugs, and (2) - 1/2" NPT couplings in both the inlet and outlet sections. These design features provide:

1. Easy installation of the catalyst housing into existing or new exhaust piping
2. 1/2" NPT couplings for instrumentation fittings to monitor catalyst ΔP and ΔT, or emissions
3. Easy access to install or service the one (1) or two (2) catalyst elements in the housing
4. Durable construction that can be insulated to protect operators and enhance cold weather conversion efficiency

Catalyst access through the housing is provided through a simple cover plate design, thus eliminating the need to unflange the housing from the exhaust piping to service the catalyst. The benefits to operators are simple and quick installation, maintenance, and performance monitoring, all of which save time and money. An outline drawing and exploded view assembly drawing are provided at the back of the manual.

III. INSTALLATION

A. Catalyst

Handling the EquiNOx Catalytic Converter does not pose any health or safety hazard. However, operators should comply with OSHA regulations and sound safety practices when installing or servicing the unit. The EquiNOx Catalytic Converter is installed in the same manner as an engine muffler with flanged connections. The catalytic converter can be mounted vertically or horizontally. Location of the catalyst should insure that the catalyst will operate in a temperature window between 700°F to 1250°F. The converter should be supported within the limits of good and acceptable piping practice.

> NOTE: **Due to the high exhaust temperature of naturally aspirated Superior engines, it is recommended to mount the catalyst downstream of the muffler.**

When handling the catalyst element, protective gloves should be worn to prevent contact with hot elements or abrasive surfaces. The element should be handled by the protective stainless steel octagon band surrounding the element. When the catalyst is installed, inspected, or replaced, the procedure in Appendix E should be followed.

With the growing enforcement of exhaust emissions regulations, several measures may be taken during the installation of the catalyst housing that will facilitate future upkeep of the catalyst system. MIRATECH makes the following recommendations which will provide greater safety and reduced downtime during emissions testing, catalyst changeout for washing, and other catalyst upkeep necessary to remain in compliance:

- The housing should be located such that the following operations may be performed with the least engine downtime: catalyst removal for visual inspection; cleaning. Non-slip walking grids and/or safety railings should be provided in the area surrounding the catalyst housing and in the area surrounding the exhaust outlet.
- A 3/8" inlet port with set screw may be placed in the exhaust piping downstream of the catalyst. This port allows an exhaust gas analyzer probe to be inserted to sample the exhaust stream; the set screw assures that the probe will be held securely in place during the monitoring. With exhaust gas monitoring becoming more common, this small modification will greatly reduce the time required to monitor the exhaust emissions.

B. Engine

Engines are not expected to be in "like new" condition. However, an emission system's performance can be compromised by engines in which excessive wear exists. Make sure the compression ratio, oil consumption, ignition timing, fuel pressure, and other indicators are within normal limits. Catalyst element(s) can be permanently damaged when exposed to continuous misfires and when engine set-up procedures have been ignored.

Start-up Sequence:	Air - Ignition - Fuel
Shut-Down Sequence:	Fuel - Ignition - Air

C. Ignition System

Check spark gap, wiring harness and secondary leads as well as coils and magneto. Timing must be set at manufacturer's recommended DBTDC for the given site fuel and engine conditions.

D. Carburetor(s) and Fuel Systems

The fuel supply and carburetor system may also impact the general performance and load carrying capacity of the engine. Balanced regulators and carburetors are a must. All internals should be examined for debris, contamination, and spring and diaphragm condition. Problem areas include both excessive and insufficient fuel pressure bias across the regulator and air leakage though worn carburetor throttle seals and regulator seals. Check engine manufacturer's set-up procedure for required fuel pressure ("H_20) to the carburetor.

E. Catalyst Over-Temperature

Verify that an <u>OPERATIONAL</u> Catalyst Over-Temp Protection Device is in place and functional.

F. Manual Setup

Using the engine manufacturer's suggested procedure, balance the engine on manifold vacuum or manifold pressure. *On V-engines, both banks must be balanced.* Set air/fuel ratio by adjusting carburetor power screw(s) and/or butterfly valve at correct fuel supply. Fine tune with a digital multimeter-meter and zirconia oxygen sensor, if installed, or if an 18mm opening is available (See table in Section G for typical sensor voltage signals).

G. Automatic Air Fuel Ratio Setup

After you have manually set up the engine, follow closely the air/fuel ratio controller manufacturer's installation and start-up procedures.

H. Setting Up Engine With Exhaust Gas Analyzer

Analyze sample exhaust gases for NOx, CO, and O_2, both before and after the catalytic converter. This will establish a setup condition for optimizing converter performance and determine/define the operating window or setup condition for your engine. The following table shows general relationships, pre and post converter.

DATA	PRE-CONVERTER	POST-CONVERTER
SENSOR VOLTAGE	700-800 mV	N/A
$\%0_2$ - EXHAUST	0.25 - 0.50%	0.2 OR LESS
CO	3800 - 5500 ppm	500 PPM OR LESS
NOx	2300 - 3000 ppm	200 PPM OR LESS
FUEL AIR PRESSURE	6-12" H_20	N/A

IV. OPERATION

The EquiNOx Catalytic Converter is designed to simultaneously reduce NOx, CO and HC levels from stoichiometric natural gas engines with an exhaust oxygen content of less than 0.5%. This type of catalyst is called a 3-way or NSCR (Non-Selective Catalytic Reduction) catalyst. The 3-way catalyst requires inlet temperatures of 700°F to 1250°F to chemically react the NOx, CO and HC. The chemical reactions that occur simultaneously across the catalyst include:

$$CO + 1/2\ O_2 = CO_2$$
$$H_2 + 1/2\ O_2 = H_2O$$
$$HC + O_2 = CO_2 + H_2O$$
$$NO_x + CO = CO_2 + N_2$$
$$NO_x + H_2 = H_2O + N_2$$
$$NO_x + HC = N_2 + H_2O + CO_2$$

In plain language, the NO_x, CO and HC are converted into environmentally safe nitrogen, carbon dioxide and water vapor.

V. DEACTIVATION

By definition a catalyst is a substance that promotes a chemical reaction, but is itself unchanged by the process. However, operating conditions exist that will eventually deactivate or destroy the catalyst. These can result from poisoning, inhibition, fouling, masking, and thermal deactivation of the catalyst.

A. Poisoning

Poisons are materials that chemically combine with the catalyst and reduce catalyst activity. This process cannot typically be reversed and the catalyst must be replaced. For example, Lead and Phosphorous are know catalyst poisons. In addition, the following elements known to poison catalysts must be avoided:

Iron, Zinc, Calcium, Nickel, Lead, Arsenic, Chromium, Bismuth, Antimony, Copper, Mercury and Phosphorous.

The EquiNOx Catalyst is designed to resist poisoning. There are, however, several sources for poisons in normal engine operation. These sources include the engine fuel, lube oil, and coolants. Airborne contaminants may also be ingested by the engine and deposited on the catalyst. Poison concentrations in excess of 0.25 PPM in the fuel are not recommended. Lube oil sulfated ash is also a common source of catalyst poisons. It is therefore important to minimize the lube oil consumption rate and sulfated ash content. Digester and landfill gas contain known catalyst poisons and require extensive pre-treatment when catalysts are used.

MIRATECH Corporation will assist in the determination and identity of catalyst poisons should there be suspicion of catalyst poisoning.

B. Inhibition - Fouling - Masking

1. **Catalyst inhibition** is a reversible process where certain elements and compounds can be absorbed on the active catalyst surface area rendering it inactive until it is removed by certain treatments depending on the level of inhibition. SO_2 and C are common examples of catalyst inhibitors. The presence of SO_2 will inhibit the ability of the catalyst to reduce hydrocarbons.

2. **Fouling** is a condition where solids plug the cells of the catalyst, blocking exhaust flow and lowering catalyst conversion rates. This can be caused by byproducts of combustion or particulate material in the exhaust stream. A regular check of pressure drop (ΔP) will alarm this condition as will visual inspection of the catalyst. If possible, the source of the fouling agent should be identified and corrected.

High engine back pressures resulting from a fouled catalyst may result in engine stalls and increased fuel consumption. MIRATECH offers catalyst washing to remove any fouling agents and restore catalyst activity. The MIRATECH "Loaner Program" supplies you with "Loaner" elements that may be used while your element is being washed.

3. **Masking** occurs when a film of solid material is deposited over the surface of the catalyst. Catalytic activity is lost as a result. The film of material prevents the exhaust gas from coming in contact with the active catalyst. A number of materials can cause masking. Zinc Phosphate from the burning of ZDP oil additives can mask or foul the catalyst.

C. Thermal Deactivation

Precious metals are applied on the catalyst as highly dispersed species which are bonded to an Alumna based washcoat. When the catalyst operates in elevated temperature conditions (> 1500°F), sintering occurs. This process causes precious metals to agglomerate, thus reducing the active catalyst sites; also, the alumina based washcoat transforms to a lower surface area crystalline structure. The resulting lower conversion rates cannot be reversed. The most common cause of thermal deactivation is engine misfires. Misfire conditions send unburned air and fuel down the exhaust stream which ignite across the catalyst producing these high temperature conditions, typically 50-250° F above normal.

NOTICE

The EquiNOx Catalytic Converter should be equipped with a high temperature alarm or shutdown set at no more than 1350°F. This will help protect the catalyst from thermal deactivation. MIRATECH recommends adjusting the shutdown setpoint to between 100°F and 150° F above the normal operating exhaust temperature, but no greater than 1350° F.

VI. MAINTENANCE

The EquiNOx Catalytic Converter is designed for years of trouble free operation. A comprehensive maintenance and inspection program for both the catalyst and engine is of utmost importance.

There are several ways to insure your EquiNOx Catalyst is performing smoothly. Depending on operating conditions and fuel gas composition, maintenance programs should include all of the following.

Recording Data

When the catalyst is first installed, it is important to gather data for future reference. This data should include performance data at rated conditions (i.e. at set speed, load, ignition timing, and AFR setpoint) such as:

1. Temperature Rise
2. Pressure Drop
3. Emission Reductions of NO_x and CO

Emission reductions are expressed as conversion efficiencies. Simply put, conversion efficiency relates the amount of NO_x, CO or HC reduced relative to inlet levels. This is determined with exhaust gas analyzers measuring pollutants before and after the catalyst. Other recorded data should include monitoring pressure drop (ΔP) across the catalyst.

exhaust flow rate, and the temperature before and after the catalyst. Monitoring the temperature rise (ΔT) across the catalyst is a very useful indicator of catalyst activity. A temperature rise (exotherm) across the catalyst of typically 50°F to 100°F can be expected. Any other information, such as lube oil consumption rate, fuel gas composition, and ambient conditions, is helpful.

Physical Inspection

The catalyst should be inspected periodically for physical damage and fouling. If conversion efficiency or ΔT decreases, or ΔP increases, physical inspection should be performed. After removing the catalyst tray, inspect for cell blockage or other obstruction. Excessive cell blockage must be cleaned before catalyst is re-installed.

Catalyst Samples

To determine why the catalyst lost activity, samples can be taken from the EquiNOx Catalyst for purposes of laboratory testing. A core drilling kit can be provided to obtain a catalyst sample. Laboratory analysis consists of testing catalyst activity. Further testing via X-ray diffraction and microscopy can be performed. Please contact MIRATECH Corporation or your local distributor should this service be required.

Catalyst Cleaning

Fouling and masking agents can often be removed by cleaning the catalyst. Monitoring conversion efficiencies and pressure drop across the catalyst will determine when a catalyst is in need of cleaning. There are several safe methods for catalyst cleaning. Two methods are vacuuming and/or washing the catalyst.

Vacuuming Clear

Fouling and ash buildup can sometimes be cleared by vacuuming the catalyst face. This is a simple and direct procedure to restore catalyst activity.

Washing

This procedure can restore catalyst activity by reducing poisons, masking, fouling or inhibiting agents on the catalyst. If the catalyst does not respond to other treatments, washing the catalyst may be an effective method. A rinse in de-ionized water may be sufficient to remove some agents. A high pH wash is extremely effective in removing most organic resins, residues and many deposits resulting from lube oil contamination. For inorganics, a low pH wash will be effective. A copy of this procedure can be obtained by contacting MIRATECH Corporation or your local distributor. If you chose to wash your

own catalysts, please contact your local authorities as there are some local and state regulations governing the disposal of the spent solutions.

MIRATECH provides this washing service for all makes of catalytic elements -- both ceramic and metal monoliths. MIRATECH also offers a "Loaner Program" which offers you the option of using MIRATECH "Loaner" elements while your elements are being washed.

VII. TROUBLE SHOOTING - PROBLEMS WITH THE CATALYST

A. Normal Condition

Catalyst Appearance/Performance:
Note the black, brown to grayish color and the minimal amount of carbon or ash. This appearance clearly indicates the catalyst is operating within the correct heat range and has been operating at near correct air/fuel ratio. The temperature rise across the catalyst is in the 25° to 100°F range, which is an indicator that the reaction conversion performance is greater than or equal to 90% of N0x.

Cause: "Healthy " engine environment.

Action Required: NONE.

B. CARBON FOULED/MASKED

Catalyst Appearance/Performance:
Soft, black sooty deposits are easily detected and characteristic of carbon fouling. Symptoms of carbon fouling are high back pressure, low temperature rise, and reduced conversion performance. A high back pressure can cause damage to the catalyst, reduce engine load carrying capacity and increase fuel consumption . Misfiring-firing of the engine could also cause burning of surface deposits.

Cause: Possible causes of carbon fouling are clogging of air cleaner, carburetor problem, or a too-rich air/fuel ratio mixture. A weak ignition voltage or extreme low cylinder compression can also contribute to carbon fouling.

Action Required: Correct air/fuel ratio - engine
Chemical wash of the Catalyst
Check air filter, carburetor, and ignition system

C. ASH-FOULED/MASKED

Catalyst Appearance/Performance:
A gray/white powdery covering of the surface of the catalyst and filling the catalyst cells is ash fouling. High back pressure, high temperatures rises, and lower than normal conversions are indicative of ash fouling.

Cause: Ash fouling originates from the sulfated ash content in the engine oil.

Action Required: Chemical Wash of the Catalyst
Check lube oil sulfated ash content and consumption rate

D. OIL-FOULED/MASKED

Catalyst Appearance/Performance:
The catalyst will appear to be dark bronze to black in color. Symptoms of oil fouling are high back pressure, reduced conversion, plugging of the catalyst, and high temperature shutdowns/alarms.

Cause: Oil fouling is caused by too much oil entering the combustion chamber or a damaged turbocharger. This is often caused by rings or cylinder walls that are badly worn. Oil may also be pulled into the chamber because of excessive clearance in the valve stem guides. A build-up of crankcase pressure can force vapors past the rings and valve guides into the combustion chamber.

Action Required: Correct Engine
Chemical Wash of the Catalyst

E. MASKING

Catalyst Appearance/Performance:
Catalyst masking is the build-up of combustion deposits or ZDPs from lube oil accumulating over an extended period of time resulting in plugging of the catalyst. High back pressure, high temperature rises, and reduced conversion are indicative of masking. Misfiring-firing may result in burning of deposits and catalyst surface.

Cause: Deposits stem primarily from burning of oil additives during engine operation.

Action Required: Lower engine lube oil consumption rate; lower ZDPs
Chemical Wash of the Catalyst

F. OVERHEATING

Catalyst Appearance/Performance:

The catalyst has a clean, white powdery appearance. Pinholes can be observed in the substrate by holding the substrate up to the light. Symptoms of overheating are high temperature shutdowns, reduced conversions, and physical changes to the integrity of the catalyst element.

Cause: This condition is caused by over advance ignition timing, poor engine cooling or efficiency, lean air/fuel ratio mixture, leaking intake manifold, low fuel pressure, or improper crankcase ventilation.

Action Required: Correct Engine Malfunctions
Replace Catalyst

VIII. TROUBLE-SHOOTING PROBLEMS CAUSED BY THE ENGINE

A. Mechanical Damage

Symptoms: Low Back Pressure and low catalyst conversions.

Cause: Mechanical damage may be caused or accelerated by excess vibration or engine backfires which have accidentally occurred,

Actions Required: It is recommended that a complete recalibration of all engine parameters be completed to ensure correct engine operation. Inspect and possibly replace catalyst element.

B. Detonation

Symptoms: High temperature tripping and low conversions.

Cause: Detonation applies extreme pressure on internal engine components. Major reasons for detonation include ignition timing advanced too far, lean air/fuel ratio mixture, and insufficient fuel heating values. The aforementioned can lead to higher than normal temperatures, which, if not corrected, can cause permanent catalyst damage.

Actions Required Correct Engine Malfunctions
Replace Catalyst Element
Calibrate/Inspect High Temperature Shut Down Switches

CATALYST DESIGN SPECIFICATIONS

INDUSTRIAL 3-WAY* NSCR ** CATALYST SYSTEM

A. Overview

1. These specifications cover the catalyst definition-element and housing; catalyst element features; catalyst housing features; operating conditions; and recommended maintenance.
2. 3-way NSCR catalyst are designed to reduce nitrogen oxides (NOx), carbon monoxide (CO) and hydrocarbon (HC) emissions from the engine based on specified operating and input condition.
3. The 3-way NSCR catalyst system is designed for continuous industrial engine duty.

B. Catalyst System Definition

1. A catalyst system is composed of two major components- the catalyst element(s), and the catalyst housing.
2. The purpose of the 3-way NSCR catalyst system is: to reduce NOx, CO and HC to required operating permit levels; to be simply installed in the exhaust pipe with flanged end connections; and to provide easy access to the catalyst element for inspection and maintenance.
3. Two (2) 1/2" NPT couplings are provided in the intake and two (2) 1/2" NPT in the exhaust pipe of he housing to provide ports to monitor the catalyst temperature rise (ΔT) and pressure drop (ΔP).

C. Catalyst Element Features

1. The NSCR catalyst elements are composed of three components; substrate, washcoat, and catalytically active materials.
2. The catalyst substrate material is a proprietary aluminized stainless steel foil. The substrate is formed by alternate layers of corrugated and flat strips of the foil. The net effect is the formation of a honeycomb-like structure.
3. The substrate design eliminates nesting by providing a positive separation between corrugated layers.
4. The substrate design provides minimum flow restriction to the exhaust per unit of face area and fixed cell density.
5. The substrate design provides maximum protection from engine induced vibration and shock due to reinforcement bars within the element.
6. The catalyst washcoat is deposited on the substrate and is composed primarily of high surface area alumina.
7. The surface substrate alumina and washcoat alumina bond physically and chemically to resist damage from thermal or mechanical shock.
8. The catalytically active materials are deposited by chemisorption and are composed of proprietary combinations and concentrations of Platinum Group Metals (PGM). These metals include, but are not limited to Platinum, Palladium and Rhodium.
9. PGM catalyst provide low catalyst inlet temperature requirements, thermal durability, and some poison resistance.
10. Minimum catalyst inlet operating temperature is 750° F, the maximum inlet temperature is 1250°F. maximum catalyst outlet operating temperature is 1350°F.
11. The catalyst element is banded with 304 SS to protect operators from abrasions, from the steel foil.
12. Welded, lifting handles are placed on two faces of the element to aid element extraction.
13. A reinforcement bar is driven through the element to stiffen the element and eliminate additional support requirement during inspection, maintenance and washing. (US patent 4,741,082 and 5,055,275).

*3-Way = Simultaneous reduction of three exhaust pollutants: NOx, CO, and HC.
**NSCR = Non-Selective Catalytic Reduction

D. Catalyst Housing Features

1. Flat faced carbon steel flanges with bolt holes that straddle the housing centerline.
2. 304 stainless steel metal construction throughout. Fabrication steel is 12 gauge or thicker to provide structural support and rigidity.
3. Four (4) 1/2" NPT coupling in the housing 2 in the inlet, and 2 in the outlet pipe.
4. Two exhaust flow diffuser plates based on a proprietary perforated plate design. One plate is located before, the other after, the catalyst elements.
5. Catalyst element tray design provides integral lifting handles on the catalyst element or panel. The catalyst tray slides between welded steel bars in the housing that guide and seal the tray, and provide structural support for the housing.
6. Space is provided for at least two (2) catalyst element trays.
7. The catalyst element is sealed into the housing with Durablanket insulation and an element cover.
8. Catalyst access cover is flat and rectangular with a lifting handle and positive seal bolt pattern on its perimeter.
9. Non-asbestos Fiberfrax gasket seal between the access panel and the catalyst housing.
10. Welded internal axial supports for the catalyst trays provide support during rapid transients.
11. Four (4) catalyst housing lifting lugs, two (2) at each end, opposed by 180° to provide installation lifting sites.
12. Mounting support channel bars to provide a mounting access point and structural housing support.
13. MIRATECH identification plate providing serial number and manufacturer reference material.

E. Operating Conditions

NOTE: BEFORE THE CATALYST ELEMENTS OR PANELS ARE INSTALLED IN HOUSING RUN THE ENGINE AT LEAST 50 HOURS.

1. The catalyst is designed to meet the emission requirements based on the application data specified in tables A & B of the proposal.
2. The minimum catalyst inlet operating temperature is 750°F. The maximum catalyst outlet temperature is 1350°F. The performance guarantee is set for the operating conditions and temperature specified in the proposal.
3. In general, the catalyst efficiency will increase as the inlet temperature increases.
4. Catalyst efficiency is defined for NOx, CO and NMHC as:

$$\frac{[\text{NOx inlet}] - [\text{NOx outlet}]}{[\text{NOx inlet}]} \times 100 = \text{NOx Reduction \%}$$

5. Catalyst efficiency can decrease based on high temperature conditions (above 1350°F) from ignition misfiring, or from poisoning or fouling due to lube oil, coolant, fuel soot or ash.

F. Recommended Maintenance

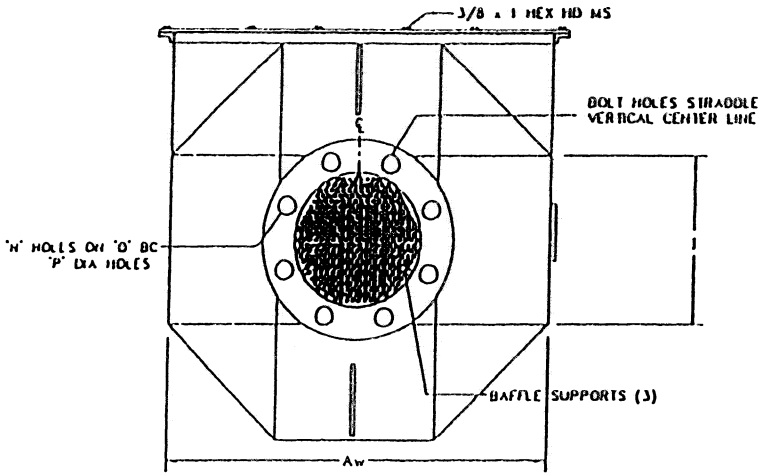
1. At a fixed load, speed, ignition timing, and exhaust oxygen sensor mV reading, monitor and record the catalyst ΔT and ΔP at installation and monthly thereafter.
2. If the ΔT changes from fresh conditions by more than + 25°F, check the engine for misfiring conditions, and/or inspect the catalyst for damage or fouling.
3. If the ΔP changes from fresh conditions by more than 2" W.C., inspect the catalyst for damage or fouling.
4. Inspect the catalyst annually and check the emissions performance at rated conditions.
5. If the catalyst if fouled, catalyst washing by MIRATECH or a qualified facility can, in many cases, restore catalyst activity. Do not use soaps, or detergents to wash catalysts since they may contain phosphates which will poison the catalyst.
6. Surface ash can be removed by gently vacuuming the catalyst face, in some cases.
7. Analytical and support service are available through MIRATECH or your local MIRATECH Representative or Distributor.

MIRATECH Corporation

PO Box 470424
Tulsa, OK 74147-0424
Telephone: (918) 622-7077

4224 S. 76th E. Ave.
Tulsa, OK 74145
Fax: (918) 663-5737

APPENDIX B



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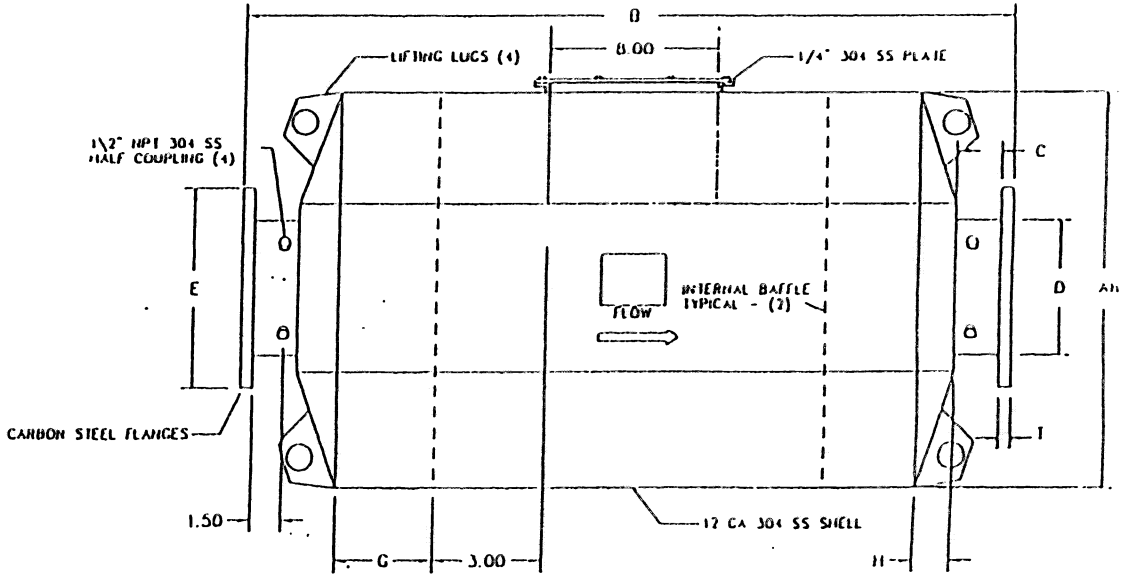


ELEVATION

TABLE A

EQ Model#	Aw	Ah	B	C
300	12.50	12.50	31.00	3.00
400	15.50	15.50	32.00	3.00
600	18.50	18.50	34.00	3.00
700	18.50	21.50	37.00	3.00
800	21.50	21.50	37.00	3.00
950	21.50	24.50	39.00	3.00
1100	24.50	24.50	40.00	3.00
1400	27.50	27.50	43.00	3.00
1700	30.50	30.50	46.00	3.00

EQ- _____ - _____ - _____

SIZE from TABLE A

FLANGE SIZE from TABLE B

TYPE (D or O) and QTY (1 or 2)

MODEL NUMBER CODING

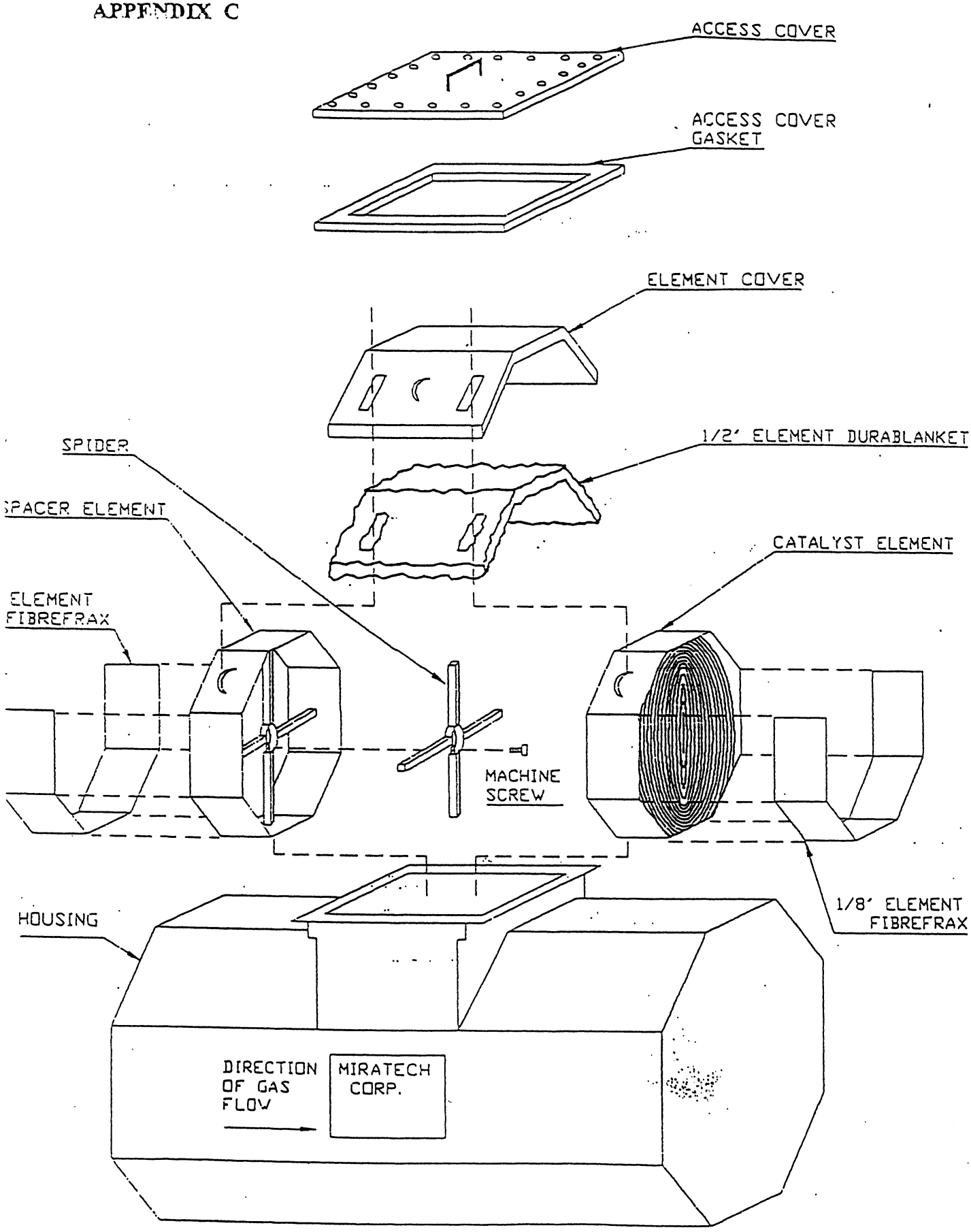
EXAMPLE: EQ-600-10-D1

TABLE B

FLANGE	D	E	N	O	P	T
4	4.563	9.00	8	7.50	0.750	.375
5	5.625	10.00	8	8.50	0.750	.375
6	6.187	11.00	8	9.50	0.875	.375
8	8.750	13.50	8	11.75	0.875	.500
10	10.875	16.00	12	14.25	1.000	.500
12	12.875	19.00	12	17.00	1.000	.500
14	14.000	21.00	12	18.75	1.125	.500
16	16.000	23.50	16	21.25	1.125	.500
18	18.000	25.00	16	22.75	1.125	.500

EquiNOx HOUSINGS

APPENDIX C


ACCESS COVER
ACCESS COVER GASKET
ELEMENT COVER
1/2' ELEMENT DURABLANKET
SPIDER
SPACER ELEMENT
CATALYST ELEMENT
ELEMENT FIBREFRAX
MACHINE SCREW
1/8' ELEMENT FIBREFRAX
HOUSING
DIRECTION OF GAS FLOW
MIRATECH CORP.

APPENDIX D

EquiNOx Catalyst Parts List

PART NAME:

Housing
1/8" Element Fiberfrax gasket
Spacer Element
Spider
Catalyst Element
1/2" Element Durablanket
Element Cover
Access Cover Gasket
Access Cover

TO ORDER PARTS:

1) Specify the model number and serial number of the unit
2) Specify the part name to be ordered
3) Send inquiries to:

MIRATECH Parts and Service
P.O. Box 470424
Tulsa, Oklahoma 74147-0424

4224 South 76 East Avenue
Tulsa, Oklahoma 74145

Telephone: (918) 622-7077

Fax: (918) 663-5737

APPENDIX E

CATALYST INSTALLATION AND MAINTENANCE PROCEDURE
STANDARD EQUINOx CATALYST
(Refer to Drawing of EQ Models)

CAUTION:

Handling the MIRATECH Metal Monolith catalyst does not pose any particular health or safety hazard related to cataly composition or formulation. When following this procedure, ensure that all work is performed in a safe manner in accordance with all OSHA or other applicable safety regulations currently in effect at your plant facility. This extends, is not limited to, the use of ladders, small tools and mobile/lifting equipment. This procedure does not include detailed safety practices relative to the operations described.

Consult your company Safety Officer for details on Safe working practices. Areas of concern include but are not limite to:

1. Safe installation of engine and exhaust system sensors and controls.
2. Safe removal of catalyst tray. (NOTE: Due to the size and weight of a catalyst tray, protective gloves must be worn at all times - catalyst is fabricated from metal foil and can cause severe cuts).
3. Safe lifting and installation of catalyst housing.
4. Deposited residues on the catalyst.
5. Hot metal parts.
6. Climbing large structures.

INTRODUCTION

The installation of the EquiNOx Catalyst and Housing is accomplished in a manner similar to that of a flanged silencer an engine exhaust pipe. The engine should be operated within the guidelines established by the engine manufacturer wi regards to rated speed, load, fuel composition, lube oil, and coolant system requirements. It is important to note that n or newly overhauled engines should run for a period of not less than 50 hours, before the catalyst is installed. This wil allow the rings to seal, valves to seat properly, and most major problems associated with engine start-up to be resolved, thus protecting your investment in the EquiNOx catalyst.

INSTALLATION PROCEDURE:

1. Thoroughly read this manual, review the installation schematic and parts list, and review all necessary safety equipment and procedures.
2. Make sure the catalyst element has been removed from the housing by unbolting the access cover from the housing.
3. Lift the catalyst from the housing with a gloved hand by the handles or with a lifting hook and straps through the handles. Care should be taken to avoid excessive lifting force. Store the catalyst element a safe, clean, and dry space.
4. Reassemble the catalyst housing and access cover plate without the catalyst or gasket materials.
5. Attach mating flanges to the housing and lift the unit either with the lifting lugs on the housing or wid lifting straps.
6. Position the catalyst housing in the exhaust piping to allow safe access to the catalyst element.
7. Insert the unit into the exhaust system and weld the mating flanges to the exhaust pipe once the

NOTE: a) Add catalyst and pipe supports within the limits of good and acceptable piping
b) Prior to operation gasket material should be inserted between the mating flan
c) The catalyst is not designed as a structural member. Avoid excessive torsion, compressive, and tension stress to the unit.

8. Run the engine for at least 50 hours to allow the engine rings to set. Set and calibrate the ignition timing and air to fuel ratio control (AFRC) equipment.

9. Following a sufficient engine break in period, install the catalyst element in the housing:
   a. Allow the housing to cool after the engine is shut off.
   b. Remove the catalyst access cover plate. Wipe or vacuum out any accumulated dust or dirt in the housing.
   c. Apply the 1/8" Fiberfrax gasket to the catalyst element with silicone seal. Install the catalyst and spacer element into the housing either with a gloved hand or lifting straps through the handles
   d. Install the 1/2" element Durablanket. The gasket material is a non-asbestos material.
   e. Replace the element cover and access cover. Use new zinc plated carbon steel bolts, nuts, and lock washers.
   f. Start up the engine and check for leaks around exhaust pipe flanges and the catalyst access cover plate.
   g. At standard engine operating conditions, monitor and log catalyst reduction performance for NOx and combustibles, ΔT, and ΔP. This should be done on a monthly basis.

NOTE: Standard engine operations condition are a fixed set of: speed, load, ignition, timing, and oxygen concentration (%) or O_2 sensor mV setting.

MAINTENANCE PROCEDURE

NOTE: When it has been determined from engine operation or emission measurements that the catalyst requires inspection, cleaning or replacement, the procedure below shall be followed for the efficient removal of the catalyst.

CATALYST REMOVAL

The MIRATECH EquiNOx catalyst unit was designed to allow removal of the catalyst tray without having to remove the catalytic converter housing from the exhaust pipe.

1. Make sure engine and auxiliary equipment are safely locked out and cannot be engaged.
2. Prior to removing the catalyst access cover plate (see Appendix C), it is essential to ensure there are no compressive forces on the converter housing.
3. Remove bolts retaining the access cover; gently remove cover and place in a safe area.
4. Remove the catalyst access plate gasket, element cover, and 1/2" element Durablanket.
5. Remove the catalyst by the lifting handle(s).
6. After the catalyst tray has been removed, lay it flat on a wire mesh or other type of support for inspection/cleaning.

TO REASSEMBLE CONVERTER -Follow the Installation Procedures from step 9-c.

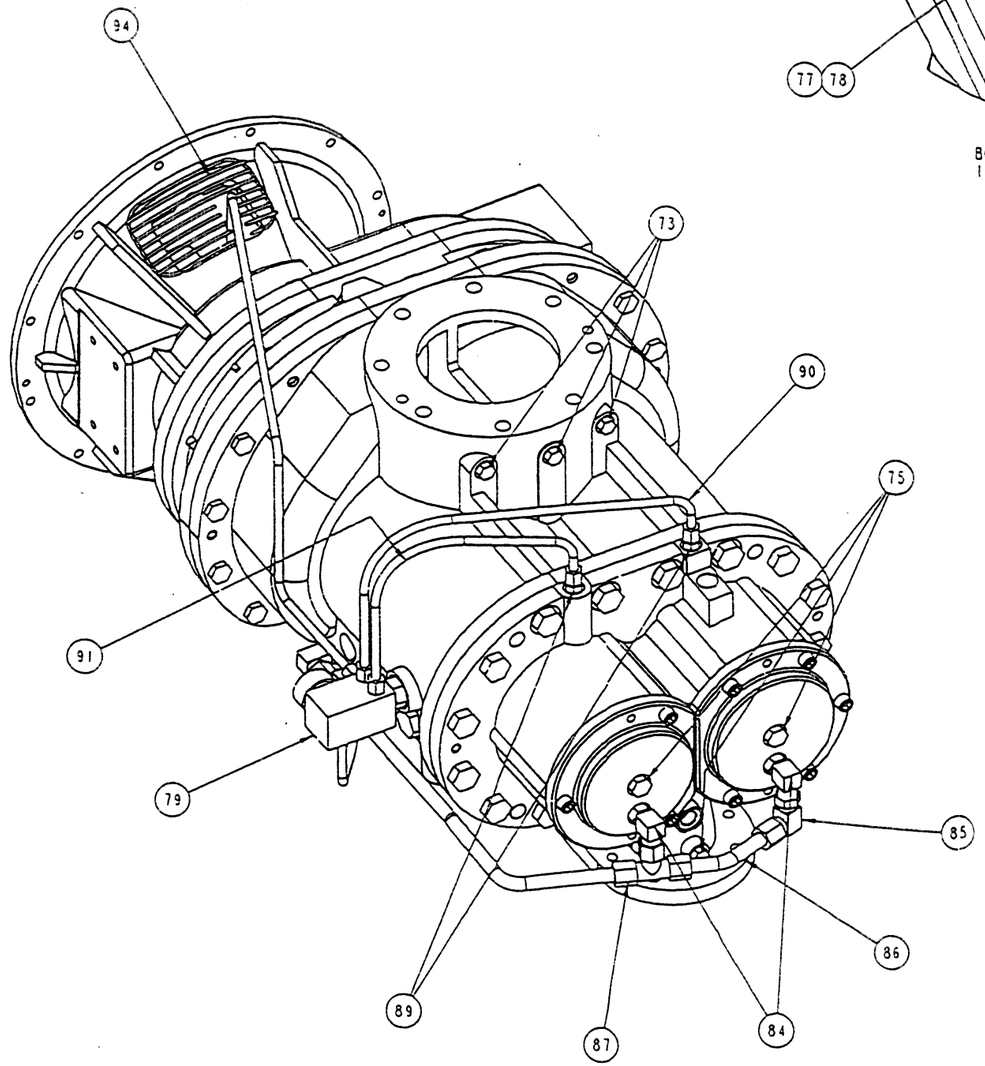
SERVICE AND ASSISTANCE

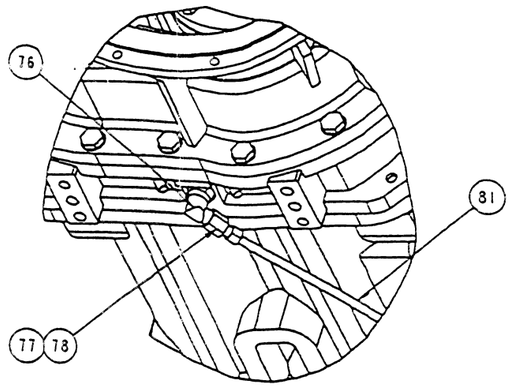
For further service and assistance regarding the operation of your EquiNOx Catalytic Converter, please contact your local distributor at:

or **MIRATECH Corporation** at
P.O. Box 470424
Tulsa, OK 74147
Phone: 918/622-7077
FAX: 918/663-5737

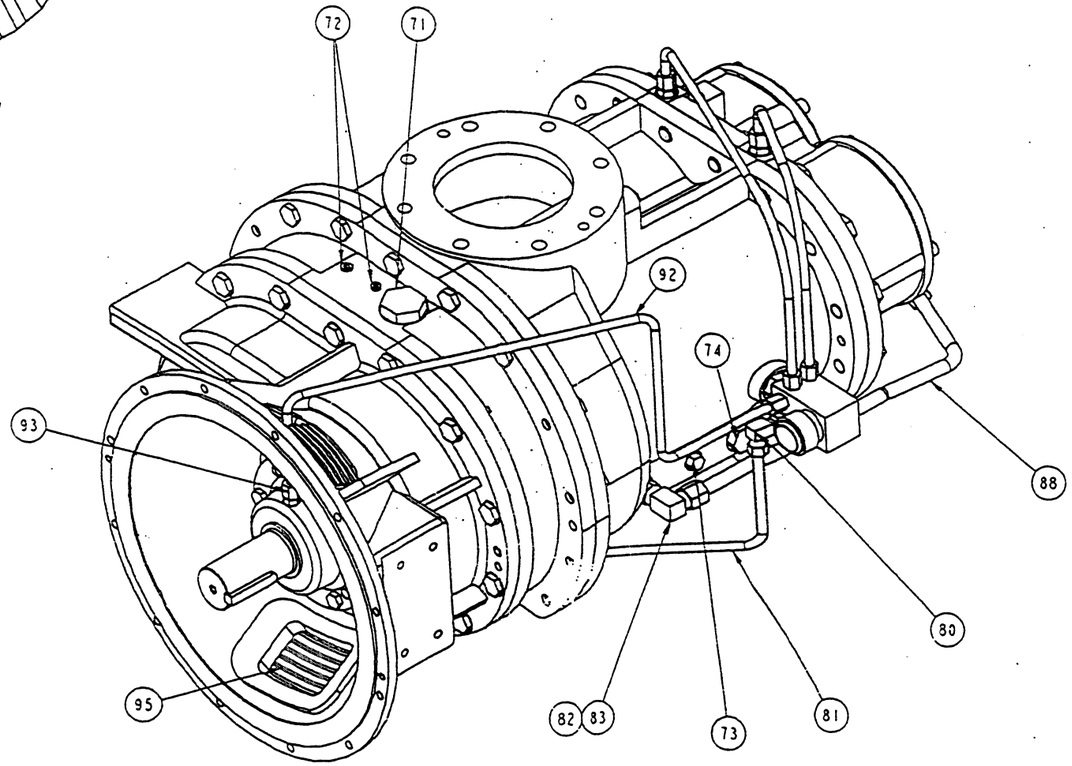
REVISION						
ZONE	REV	ECN	DESCRIPTION	DATE	DRN	APV
	02	62014	ORIGINAL DWG RELEASE, ASSY BOM RELEASED ON E/C 61642	6/28/95	MPW	

NOTES:
1. SEE FASTENER TORQUE SPECIFICATION 35514371.





BOTTON
ISOMETRIC VIEW



DRAWING CONFORMS TO ANSI Y14.5M-1982

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS ~~AND TOLERANCES ON DIMENSIONS ARE DECIMALS.~~

~~ONE PLACE (.X) ± 1.7~~
~~TWO PLACE (.XX) ± 0.25~~

MICROFILM BLOWBACK SCALE
0 10mm

PROPRIETARY NOTICE

CADD GENERATED DRAWING - NO MANUAL REVISIONS
CADD NAME: ~~/acad~~/prodeng/226-ER2.PCD PCD-226MM-ASSY-39865407

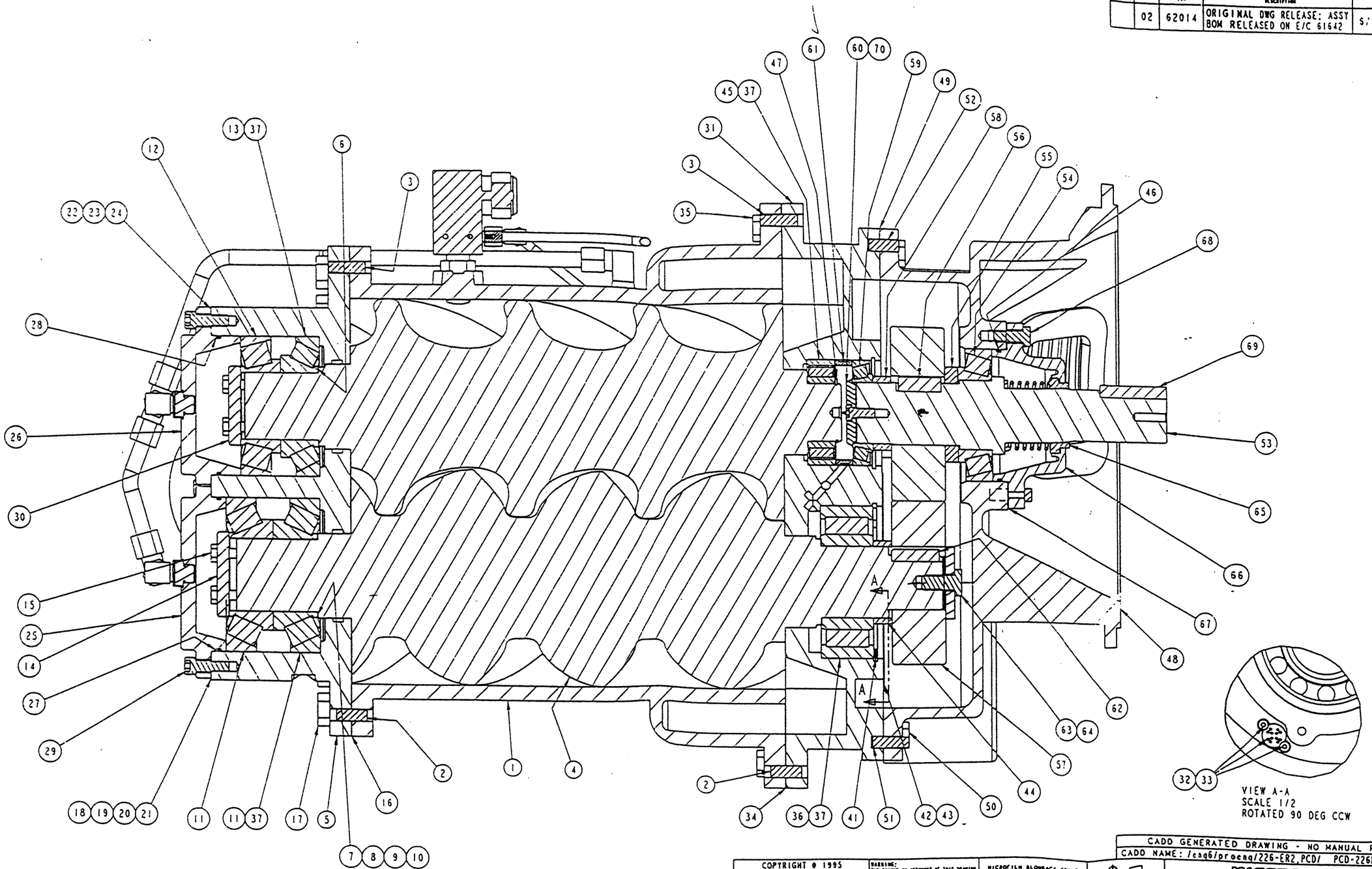
INGERSOLL-RAND
ROTARY-RECIP COMPRESSOR DIVISION
P.O. BOX 1600, 800-A BEATY ST., DAVIDSON, N.C. 28036

MCDONALD	6/28/95	
TAB	6/28/95	
	6/28/95	
14.42		
FSCN 6R484		

ASSY, 226MM ER2
750-900 CFM PCD APPLICATION

SIZE	DWG. NO.	REV
D	62014	
WT.	565 KG.	36032084 02
SCALE	0.3	SHEET 1 OF 4
	226MM / ER2	

REVISION						
ZONE	REV	ECN	DESCRIPTION	DATE	DWN	APP
	02	62014	ORIGINAL DWG RELEASE: ASSY BOM RELEASED ON E/C 61642	5/28/95	MPM	JAB



VIEW A-A
SCALE 1/2
ROTATED 90 DEG CCW

DRAWING CONFORMS TO ANSI Y14.5M-1982

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS ~~AND TOLERANCES OR DIMENSIONS ARE DECIMAL:~~

~~WHOLE: (1) : ±1.1~~
~~ONE PLACE: (.1) : ±.25~~
~~ANGLES: ± 1°~~

MICROFILM BLOWBACK SCALE
0 1 2 3 4 5 6 INCHES

CADD GENERATED DRAWING - NO MANUAL REVISIONS
CADD NAME: /eng6/proeng/226-ER2,PCD/ PCD-226MM-ASSY-39865407

INGERSOLL-RAND
ROTART-RECIP COMPRESSOR DIVISION
P.O. BOX 1600, 800-A BEATY ST., DAVIDSON, N.C. 28036

DRAWN	MCDONALD	5/28/95
DESIGNED	JAB	
APPROVED		
MFG APPL.	14, 42	
FSCM 6R484		

ASSY, 226MM ER2
750-900CFM PCD APPLICATION

SIZE	DWG. NO.	REV
D	36032084	02
WEIGHT	565 KG.	
SCALE	.5	SHEET 2 OF 4
	226MM ER2	

ITEM	COMPONENT DESCRIPTION	PART NUMBER	QTY	COMMENTS
	COMMENTS	C	-	SEE TORQUE SPECIFICATION DRAWING 35514371
	COMMENTS	C	-	SEE ASSEMBLY DRAWING 39865407
	COMMENTS	C	-	SEE INSTALLATION DRAWING 39866702
1	ROTOR HOUSING L/D 2	39779467	1	
2	DOWEL PIN	95239927	2	MALE SIDE ROTOR HOUSING EACH END
3	LOCATOR PIN	35365261	2	FEMALE SIDE ROTOR HOUSING EACH END
4	ROTOR SET	36005981	1	MALE 36791432: FEMALE 36791440
5	REAR BEARING HOUSING	39853163	1	
6	SHIM SET	35299361	2	M AND F DISCH END CLEARANCE (DEC) TO BE 0.0035 TO 0.0055 IN.
7	SHIM, 0.001 IN.	39457502	4	MALE DISCHARGE
8	SHIM, 0.003 IN.	39457510	2	MALE DISCHARGE
9	SHIM, 0.005 IN.	39457528	1	MALE DISCHARGE
10	SHIM, 0.010 IN.	39457536	2	MALE DISCHARGE
11	BEARING, TAPERED ROLLER	35605203	2	ONE INBOARD, ONE OUTBOARD MALE SIDE
12	BEARING, TAPERED ROLLER	39438221	1	ONE OUTBOARD, FEMALE SIDE
13	BEARING, TAPERED ROLLER	39437686	1	ONE INBOARD, FEMALE SIDE
	COMMENTS	C		APPLY LOCTITE RC 609 TO DISCH BRG BORE FOR INBOARD BRG ONLY
	COMMENTS	C		THIS BORE AREA STARTS 40MM FROM TOP OF BORE AND ENDS AT BOTTOM
	COMMENTS	C		OF BORE. REMOVE EXCESS LOCTITE AFTER INSTALLING CUPS
14	BEARING RETAINER	39457486	1	MALE DISCHARGE BEARING
15	SCREWS, M10 X 30	35293869	6	FOR BEARING CLAMP PLATES, TORQUE TO 52 FT-LBS.
16	GASKET, REAR BRG HSG	35611342	1	BETWEEN REAR BRG HSG AND ROTOR HSG
17	SCREWS, M20 X 45	34M2AB565	16	REAR BRG HSG TO ROTOR HSG
18	SHIM, 0.001 IN.	39457544	3	BETWEEN RBRG HSG AND BRG COV. BRG END PLAY .002-.003 IN.
19	SHIM, 0.003 IN.	39457551	1	BETWEEN RBRG HSG AND BEARING COVER (MALE DISCHARGE)
20	SHIM, 0.005 IN.	39457569	1	BETWEEN RBRG HSG AND BEARING COVER (MALE DISCHARGE)
21	SHIM, 0.010 IN.	39457577	2	BETWEEN RBRG HSG AND BEARING COVER (MALE DISCHARGE)
22	SHIM, 0.001 IN.	39437009	4	BETWEEN RBRG HSG AND BRG COVER (FEMALE DISCHARGE)
23	SHIM, 0.003 IN.	39437017	6	BETWEEN RBRG HSG AND BRG COVER (FEMALE DISCHARGE)
24	SHIM, 0.010 IN.	39437025	4	BETWEEN RBRG HSG AND BRG COVER (FEMALE DISCHARGE)
25	COVER, REAR BEARING	39774583	1	MALE DISCHARGE
26	COVER, REAR BEARING	39774591	1	FEMALE DISCHARGE
27	O-RING	20A11EM258	1	MALE DISCHARGE
28	O-RING	20A11EM254	1	FEMALE DISCHARGE
29	SCREWS, M12 X 35	35273341	8	FIVE FOR MALE CAP, THREE FOR FEMALE CAP
30	BEARING RETAINER	39436977	1	FEMALE DISCHARGE BEARING
31	FRONT BEARING HOUSING	39801857	1	
32	SCREEN	39180526	2	PLACE IN FRONT BRG HSG
33	SCREWS, M6 X 12 ROUND HEAD	39180542	4	TO RETAIN SCREENS
34	GASKET, FRONT BRG HSG	35597723	1	BETWEEN FRONT BRG HSG AND ROTOR HSG
35	SCREWS, M16 X 40	35272541	17	FRONT BRG HSG TO ROTOR HSG
36	BEARING, CYL ROLLER	39481783	1	MALE ROTOR INLET, USE LOCTITE AS REQUIRED
37	LOCTITE	39136304		LOCTITE FOR BRG OUTER RACES ONLY, AS REQUIRED
38				
39				
40				

ITEM	COMPONENT DESCRIPTION	PART NUMBER	QTY	COMMENTS
41	SNAP RING	161A13S625	1	MALE INLET BRG (FBH)
42	BEARING RETAINER (OIL DAM)	39481734	1	OVER MALE INLET BEARING
43	SCREWS, M10 X 20	39141825	3	FOR BRG RETAINER TO FBH
44	BRG SPACER	39485982	1	ON MALE ROTOR SHAFT, BETWEEN CYL BRG AND DRIVEN GEAR
45	BEARING, CYL ROLLER	39481791	1	FEMALE ROTOR INLET
46	O-RING	20A11C2M252	1	ON SEAL COVER
47	SNAP RING	95096806	1	FEMALE ROTOR SHAFT BRG, INNER RACE
48	GEAR CASE, SAE NO. 2	39861851	1	
49	GASKET, GEAR CASE	39482138	1	BETWEEN GEAR CASE AND FRONT BEARING HSG
50	SCREWS, M16 X 40	35272541	14	GEAR CASE TO FRONT BRG HSG
51	LOCATING PIN	35365261	1	IN FRONT BRG HSG, MALE SIDE
52	DOWEL PIN	17A13A289	1	IN FRONT BRG HSG, FEMALE SIDE
53	DRIVE SHAFT	36846400	1	
54	BEARING, TAPERED ROLLER	36846426	1	ON DRIVE SHAFT
55	BRG SPACER	39314679	1	BETWEEN TRB AND DRIVE GEAR
56	DRIVE KEY	35361328	1	ON DRIVE SHAFT, UNDER GEAR
57	GEAR SET	35296011	1	GEAR RATIO 1.49 TO 1
58	BRG SPACER	39314687	1	BETWEEN GEAR AND BRG 36854925
59	BEARING, TAPPERED ROLLER	36854925	1	ON END OF DRIVE SHAFT
60	BEARING RETAINING CAP	36764785	1	TO RETAIN BEARING ON END OF SHAFT
61	BRG SPACER	35262963	1	FEMALE ROTOR SHAFT, BETWEEN BRG AND GEAR
62	DRIVE KEY	35361310	1	ON MALE ROTOR, UNDER GEAR
63	CLAMP, GEAR	35255819	1	ON MALE ROTOR GEAR
64	SCREW, M16 X 35	34M2AB513	1	TO RETAIN CLAMP 3525581
65	SEAL, DRIVE SHAFT, MECHANICAL	35593508	1	OVER DRIVE SHAFT
66	COVER, SEAL	36507515	1	
67	SHIM SET	36846442	1	DRIVE SHAFT BRG END PLAY 0.002 TO 0.004 IN.
68	SCREWS, M12 X 30	34M2AB462	6	SEAL COVER TO GEAR CASE
69	DRIVE KEY	35364975	1	IN DRIVE SHAFT (COUPLING END)
70	SCREW, M10 X 25 LOW HD SOC	35336304	1	TO RETAIN BRG CLAMP 36764785

MK	REV	ECN	DESCRIPTION	DATE	BY	APP
	02	62014	ORIGINAL DWG RELEASE; ASSY BOM RELEASED ON E/C 61642	6/28/95	MP	

DRAWING CONFORMS TO ANSI Y14.5M-1982

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS AND TOLERANCES ON DIMENSIONS ARE DECIMALS.

WHOLE ±1
ONE PLACE ±.1
TWO PLACE ±.01
ANGLES ±1°

MICROFILM BLOWBACK SCALE
0 1in

CADD GENERATED DRAWING - NO MANUAL REVISIONS
CADD NAME: /cad6/procaq/226-ER2.PCD PCD-226MM-ASST-39865407

INGERSOLL-RAND
ROTARY-RECIP COMPRESSOR DIVISION
P.O. BOX 1600, 800-A BEATY ST., DAVIDSON, N.C. 28036

MCDONALD 6/28/95
TAB 7/7/95
14, 42
FSCM 6R484

ASSY, 226MM ER2
750-900 CFM PCD APPLICATION

SIZE D | DWG. NO. 62014 | REV 02
WT. 565 KG
SCALE N/A
36032084
226MM / ER2 | SHEET 3 OF 4

ITEM	COMPONENT DESCRIPTION	PART NUMBER	QTY	COMMENTS
	COMMENTS	C		AIREND PIPING ASSEMBLY
71	PLUG, SAE 1-5/8 IN.	35382100	1	IN TOP OF FRONT BRG HSG
72	PLUG, NPT 1/4 IN.	34A7S3Z1	2	IN TOP OF FRONT BRG HSG
73	PLUG, SAE 9/16 IN.	95938205	4	THREE IN BACK OF INLET, ONE IN RTR HSG FEM SIDE
74	PLUG, SAE 1-1/16 IN.	565A10S6VZ2	1	IN ROTOR HSG FEM SIDE
75	PLUG, SAE 3/4 IN.	95938213	3	TWO IN REAR BRG COVERS, ONE IN DISCH NECK
76	90 DEG ELBOW, SAE, 7/8 IN.	35286442	1	IN BOTTOM OF FRONT BRG HSG
77	REDUCER, SAE -8-6	35296227	1	-8-6 REDUCER ON 90 DEG SAE ELBOW
78	CAPNUT, SAE	35296219	1	USE NUT ON REDUCER TO ELBOW
79	MANIFOLD, OIL INJECTION	36866531	1	IN FEMALE SIDE OF ROTOR HOUSING
80	90 DEG ELBOW, SAE -6	35283068	1	ON MANIFOLD, LOWER NIPPLE TO FRONT BRG HSG
81	TUBE, SAE -6	39578901	1	FROM MANIFOLD SWIVEL ELBOW TO FRONT BRG HSG BOTTOM
82	CONNECTOR, SAE 7/8 IN.	35286954	1	IN ROTOR HSG, FEM SIDE
83	90 DEG ELBOW, SAE -10	35305648	1	ON 7/8 TO -10 SAE CONNECTOR
84	90 DEG ELBOW, SAE 3/4 IN.	35305622	2	IN M AND F REAR BRG COVERS, LOWER SAE PORT
85	90 DEG SWIVEL ELBOW, SAE	35305648	1	ON 90 DEG ELBOW, MALE REAR BRG COVER
86	TUBE, -10 SCAVENGE	36865921	1	BETWEEN 90 DEG SWIVEL AND SAE TEE
87	TEE, SAE	35356450	1	PLACE TEE ON FEM SIDE 90 DEG ELBOW
88	TUBE, REAR BRG SCAVENGE	39578950	1	FROM TEE TO RTR HSG, FEM SIDE, 7/8 IN. SAE PORT
89	CONNECTOR, SAE 9/16 IN.	35283076	2	IN TOP OF REAR BRG HSG, M AND F BRG OIL
90	TUBE, SAE -6	36865889	1	FROM MANIFOLD, FORWARD SAE PORT, TO MALE DISCH BEARING
91	TUBE, SAE -6	36865897	1	FROM MANIFOLD, REAR SAE PORT, TO FEMALE DISCH BEARING
92	TUBE, SAE -6	36865905	1	FROM MANIFOLD, FORWARD INSIDE SAE PORT, TO SEAL COVER
93	CONNECTOR, SAE 7/16 IN.	36866554	1	IN SHAFT SEAL COVER
94	GUARD, HANDHOLE, W/SLOT	36798361	1	SLOTTED GUARD TO CLEAR SEAL OIL TUBE
95	GUARD, HANDHOLE	36798346	1	IN LOWER FLANGE HANDHOLE
96	LOCTITE	35259282		APPLY TO ALL INTERNAL FASTENERS

UC	62014	BOM RELEASED ON E/C 81042

DRAWING CONFORMS TO ANSI Y14.5M-1982

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS ~~AND TOLERANCES OR DIMENSIONS ARE DECIMALS:~~
~~WHOLE: (1) ± 0.1~~
~~ONE PLACE: (.1) ± 0.15~~
~~ANGLES: ± 1°~~

MICROFILM BLOWBACK SCALE

CADD GENERATED DRAWING - NO MANUAL REVISIONS
CADD NAME: /cnq6/proecnq/226mm-ER2.PCD PCD-226MM-ASST-39865407

INGERSOLL-RAND.
ROTARY-RECIP COMPRESSOR DIVISION
P.O. BOX 1600, 800-A BEATY ST., DAVIDSON, N.C. 28036

DRAWN	MCDONALD	6/28/95	
CHECKED	TAB		
APPROVED			
MATL. WGT.	14.42		
FSCM 6R484			

TITLE: ASSY, 226MM ER2
750-900 CFM PCD APPLICATION

SIZE	DWG. NO.	REV.
D	36032084	02
SCALE: N/A	SHEET: 226MM / ER2	SHEET 4 OF 4

REVISIONS					
ZONE	REV.	DESCRIPTION	DATE	APVD	E/C

JUNCTION BOX MTD ON WAUKESHA

12V 12V

AS A 57 KS5 BLK 28

S5 AT RCVR TANK (+) (-) B2

UNLOADER COMPRS'R MTR

64A 64

24 (+)

PRESTOLITE B1+ B- ALT AC

ENGINE D.C. PWR GRND

*12 AWG 15A

SEE NOTE 2

S19 PNL LT

10AWG STARTER S B 10AWG

31 BLUE VOLT SENSE

AS B 41 9WI S2 BY-PASS BPR

CC1 ON OFF 3 1B 2B

STARTER CONNECTOR 26 D4 BAT (-) 28

79 NTE5809 D23 K-2 L23 K-10 L9

4 5 1A 2A 42 K11 L4

L10 K11 HOUR MTR M1 28

K10 L11 46B D19 46A 47 28

K6 8 TDOE L25 NOTE 10

S6 1 2 EOPS 2 2.5PSI D14

UNLOADER SOL VALVE (IN C)

EMSSS B OFF BAT (-) RUN (ON) 1 RED

24V PWR AS V X KK C

A2 GENERIC ALARM SIGNAL (LOSS OF K2 SEAL)

MM LL + AUTO START N.C. TERMS

PRESTART AUTO START OUTPUT ALARM 28 H PRESTART ALARM

CB 10A 24 5 CT 21

26 CT L17 S3 START 21A 28

D21 71 72 S14 20PSI SPAP (AIR)

ESS CT 2 3 S4 E/S 1A 2A D3

CRANK TERM CTRY L15 D15 PTA L36 D20

4 WATER TEMP SHUT DOWN S11 3 L45 WTSRY 2

*OPSI AUX (SI2RY) L23, L32

JUMPER-OUT

S7 AFTER COOLER 130° S8 COMPR AIR TEMP S9 PACKAGE TEMP S10 AFTER FS CLR FLOW TS1 AIR SVCE TS2 SEP. TNK

E D F H 6 7 8 4

312 3 5A 14 D7 LOP SHUT DOWN

4 OPSIRY, L44

START/STOP J 5

K2 C L9 3 K9A OS-AUX 28 S12A OPSI-AUX C NO

S13 48 COPS K-6 L12 49 54A

2 1K 1W C WTSRY

ESS OS 11 6A 10 12 D2 12A D12

S17 LOPAS

OVR SPD SHUT DOWN M 12

*OS AUX L23 D17

SR1, L32 28

PTA L35

19 51A

K3 L45 50 51

CB 20A 11 SR1, L29 30 32 D9 GSOV 28

S/D L33 PTA L35 D18 S/D L32 23 COMM B

C NO OPSI AUX L20 52 53 54 SPARE

AS S/D K 77

L 13 30 PTB L37

N 32 27

S15 1° 120° F EACTA 55 28

56 58 59 60 81 62

PURGE TIMER PT 1 3 28 2 5 4 PTA PTB PTC 3 PTC

28 OSRY C 2

6B 3A 3B SR2, L39 28

S16 HWTAS 19

E. STOP SHUTDOWN 1A 4A 4B 13

MAG G 25 SR2, L35 28

78 78 D22 28 70 28 73

RCT COND DRAIN VALVE

SAV (N.C.)

20

REMOTE CONTACT TO AUTO START R P 75 76

SERVICE AIR S EE 73A 73B NOTE 10

S 20 SVC AIR

C KSA K3 12VDC 28

SPARE T U 31 39 65

M2 R TACH

24A SEE NOTE 3 JUMPER FOR WAUKESHA ENGINE NO LEL DETECTOR

1 5A

4- 5- ESS 6 7 28

A B OPSI RY L21 28 WTS RY L19 28

S12 O OPSI [CLOSES ___ PSI RISING]

S11 W WTS [OPENS ___ °F RISING]

MPU TO SPEED SWITCH RPM INPUT PORT AT ENGINE CONTROLS J.B.

9- -11 -9 11- 7- 10- -12 12- 14- -2 13- 2- -10 -7 -6 -1 -3 NOT USED 1- 5- 4- NOT USED 3- NOT USED -5 -13 -4 NOT USED -14 6- 8- -8

SEE SHT 2 FOR NOTES

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
MICRO FILM BLOWBACK SCALE 3 INCHES

UNLESS OTHERWISE SPECIFIED TOLERANCES ON DIMENSIONS ARE

DECIMALS:
ONE PLACE (.X) : ±.1
TWO PLACE (.XX) : ±.03
THREE PLACE (.XXX) : ±.010
ANGLES ± 0°-30'

CADD LAYOUT NAME PCD.43201763.PRO-A

GEOMETRIC SYMBOLS

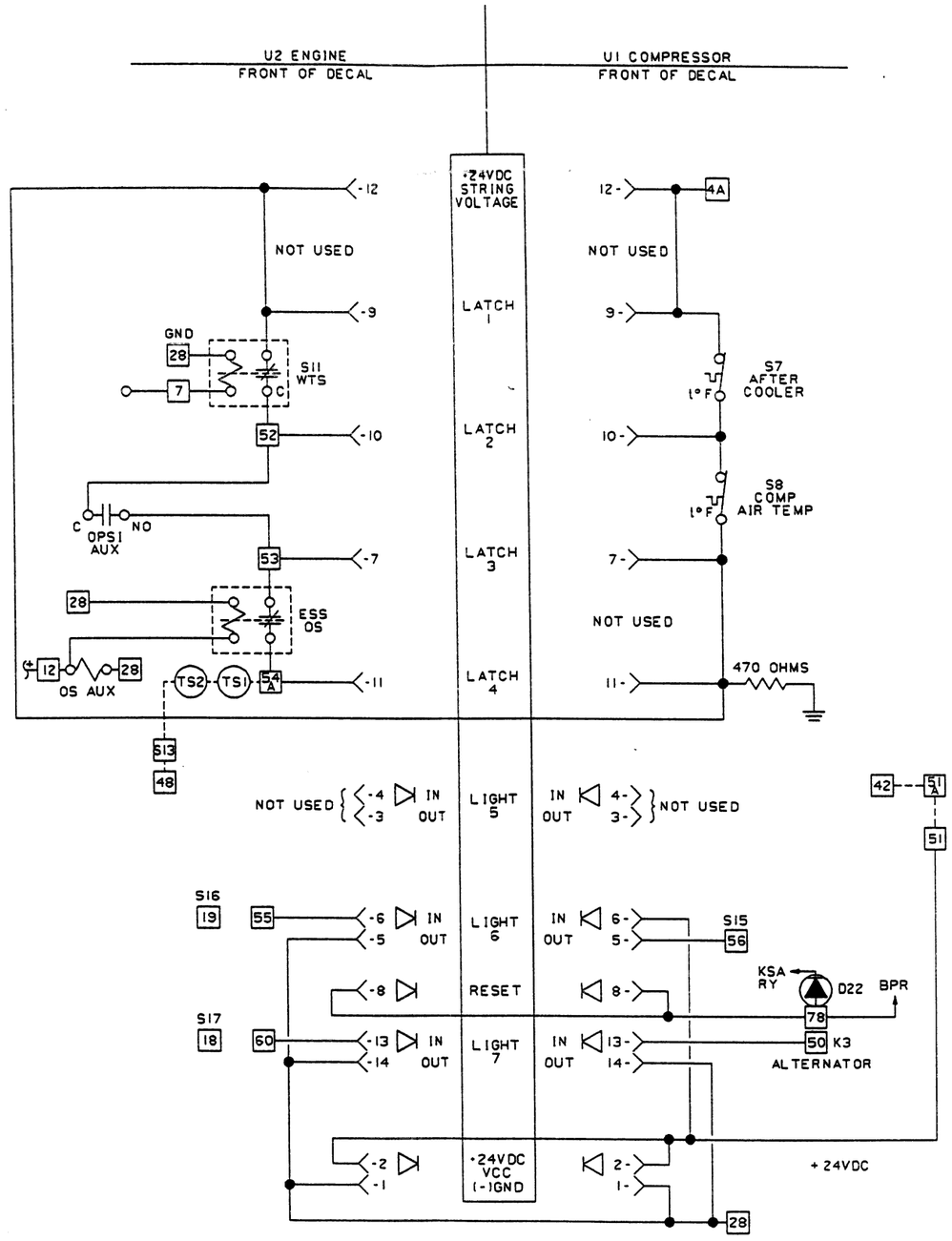
— STRAIGHTNESS	// PARALLELISM	WEIGHT (EST.) ___ LBS.	UNIT: 950L-NG
○ CIRCULARITY	∠ ANGULARITY		THIRD ANGLE PROJ.
⌭ CYLINDRICITY	⌖ TRUE POSITION	WEIGHT ACTUAL ___ LBS.	DRAWN M.ECKELSON 9/5/96
▱ FLATNESS	◎ CONCENTRICITY		CHECKED [illegible] 9/5/95
⌓ PROFILE OF SURFACE	↗ CIRCULAR RUN OUT	NEXT HIGHER ASSY	APPROVED
⌒ PROFILE LINE	⌰ TOTAL RUNOUT		SIMILAR TO:
⊥ PERPENDICULARITY			

INGERSOLL-RAND COMPANY
CONSTRUCTION & MINING
PORTABLE COMPRESSOR DIVISION
MOCKSVILLE, NC 27028

TITLE: NG ENGINE CONTROL SYSTEM FOR WAUKESHA MODELS

SIZE D | CODE IDENT NO. | PART NO. 43201763 | REV PRO-B

SCALE: | SHEET 1 OF 2



NOTE:

1. IR CONTROL BOX TERMINAL BOARD MARKED 7,12,13, CONTROL THE DIODES SHOWN FEEDING THE RELAY TERMINAL LABELED S/D FOR SHUT-DOWN F/B TO MURPHY PANEL. BLOCKING DIODES ARE INL 4007.
2. FUSES AS NOTED ARE CONTAINED IN ITS TERMINAL BLOCK IR CB BOX MARKED 1 & 1A CONTAIN FUSES OF 15A & 5A RESPECTIVELY. = BUSS #B24202 FUSE BLOCK.
3. IF LEL DETECTOR IS NOT REQUIRED PLACE JUMPER BETWEEN TERMINALS 24-24A.
4. PROVIDE TRANSIENT PROTECT DEVICE ACROSS EACH SOLENOID COIL.
5. TERMINAL 28 AS USED, GROUND CLAMPS TO DIN RAIL PROVIDING (-) CONNECTION TO CIRCUITS.
6. M ⟵ SYMBOL INDICATES A FEED CONNECTION TO BOX. AUTO START.
7. S18 = LEL RESET PB AND LEL ALARM PL ARE MOUNTED ABOVE I-R CONTROL PANEL AND BELOW U, U2 DIAGNOSTIC PANELS.
8. OBSERVE CONNECTION AT NC PTB CONTACTS LINE 37. TERM'S 30-32 LOOP THROUGH FOR CATERPILLAR ENGINE WHERE TERM 30 PICKS UP 24VDC AND OUTPUTS THROUGH TERM 32 TO THE WAUKESHA ENGINE.
9. ENGINE SHUT DOWN SIGNALS OCCUPY IST FOUR POSITIONS OF (NO-) POSITIONS ON LEFT. COMPRESSOR S/D SIGNALS ARE IN IST FOUR (-NO) POSITIONS ON RIGHT SIDE DISPLAY.
10. IF REMOTE START NOT USED THEN JUMPER TERMS 73A TO 73B. AND 46A-47.

INGERSOLL-RAND COMPANY
CONSTRUCTION & MINING
PORTABLE COMPRESSOR DIVISION
MOCKSVILLE, NC 27028

TITLE: NG ENGINE CONTROL SYSTEM FOR WAUKESHA MODELS

SIZE	CODE IDENT NO.	PART NO.	E/C
D		43201763	PRO-B

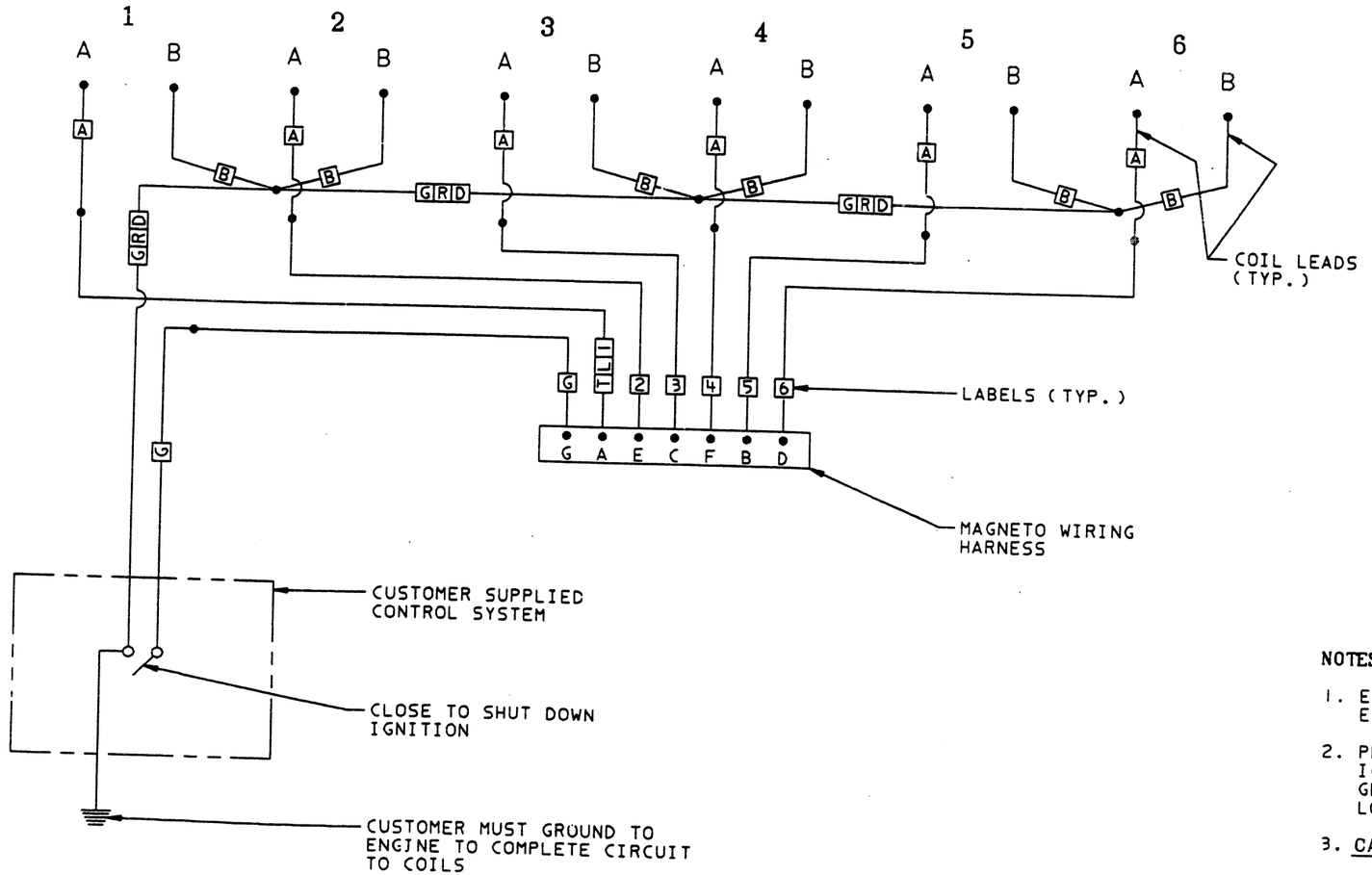
SCALE: 1 SHEET 2 OF 2

8 7 6 5 4 3 2 1

SC6901-39

ITEM	PART NO.	REQD.	NAME

CYLINDER NUMBERS



ENGINE FIRING ORDER:
1-5-3-6-2-4

NOTES:

1. ENGINE TO BE GROUNDED PER LOCAL ELECTRICAL CODES.
2. PRIMARY WIRING OF ALTRONIC V IGNITION FOR CSA CLASS I, GROUP D, DIVISION 2, HAZARDOUS LOCATION.
3. CAUTION: IT IS CUSTOMERS RESPONSIBILITY TO PROVIDE HIGH WATER TEMPERATURE AND LOW LUBE OIL PRESSURE SAFETY SHUTDOWN EQUIPMENT.

FOR ALTRONIC V MAGNETO
(CCW ROTATION)

116642	8-93	RELEASED

CAD MADE NO REVISIONS ON THIS REPRODUCIBLE

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS.
MACHINED DIMENSION TOLERANCE STANDARD-
SURFACE FINISH STANDARD-
GEOMETRIC CHARACTERISTICS SYMBOL STANDARD-

CAUTION: THIS DRAWING IS IN FIRST ANGLE PROJECTION

MATERIAL:

HEAT TREATMENT:

THIS PRINT IS PROPRIETARY TO A DISTRIBUTED RANGE, NOT TO BE USED IN ANY WAY DETRIMENTAL TO THE INTEREST OF WAUKESHA ENGINE DIVISION.

Waukesha

MODELS: VSG F11

C.C.

FILE

DR. JJI DATE: 8-10-93 APP. WHH DATE 8-24-93

CHK: CH DATE: 8-24-93 APP. DATE

C

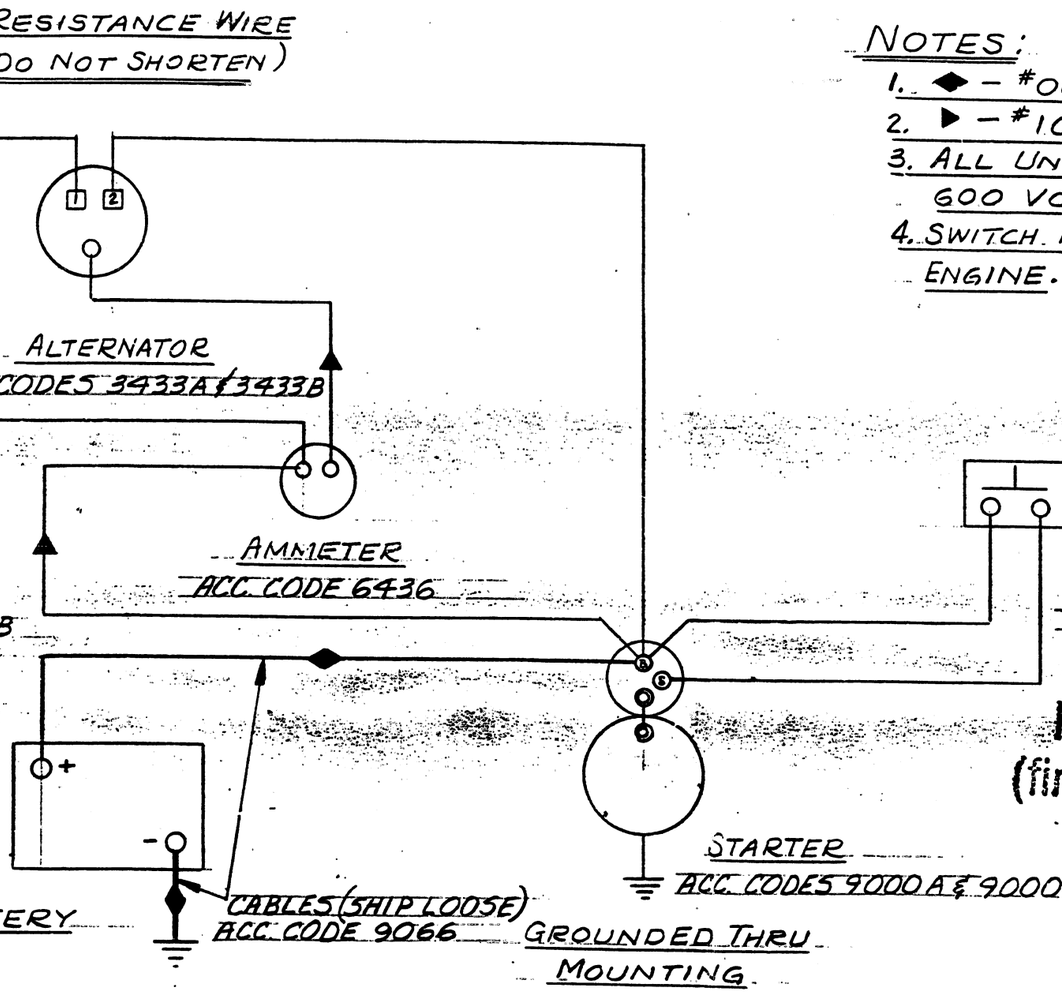
REF. LR7928-175
LR7928-177

NAME: DIAGRAM, WIRING CSA SPECIAL

PART NO. SC6901-39

SHT. 1 OF 1 SCALE: NONE

A	B	C	D	E	F	G	H
88-109788				ITEM / PART NO.	REQD.	NAME	



NOTES:

1. ◆ – #00 BATTERY CABLE
2. ▶ – #10 WIRE, RATED 600 VOLTS
3. ALL UNMARKED WIRING #14 WIRE RATED 600 VOLTS.
4. SWITCH POSITIONS ARE SHOWN FOR NON-OPERATING ENGINE.

CAUTION
METRIC DRAWING
(first angle projection)

UNLESS OTHERWISE SPECIFIED
TOLERANCES

DIMENSION	MACHINED	NON-MACHINED
0 – 500		
501 – 1000		
1001 – 2000		
OVER 2000		

5		
6	109733	12-87 RELEASED

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS.
MACHINED DIMENSION TOLERANCE STANDARD –
SURFACE FINISH STANDARD –
GEOMETRIC CHARACTERISTIC SYMBOL STANDARD –

CAUTION: THIS DRAWING IS IN FIRST ANGLE PROJECTION

MATERIAL:

HEAT TREATMENT:

REF. LR 7928-82
69753A, 69753B

NAME: WIRING DIAGRAM ELECTRICAL SYSTEM

Waukesha DRESSER
WAUKESHA, WI.

MODELS: F11G, G51

C.C. ____ FILE B

PART NO. SB6901-33

DR: DES DATE: 12-14-87 CHK: Jaf DATE: 12/18/87

APP: Jaf DATE: 12/18/87 APP: DATE:

SHT. ____ OF ____ SCALE: ____

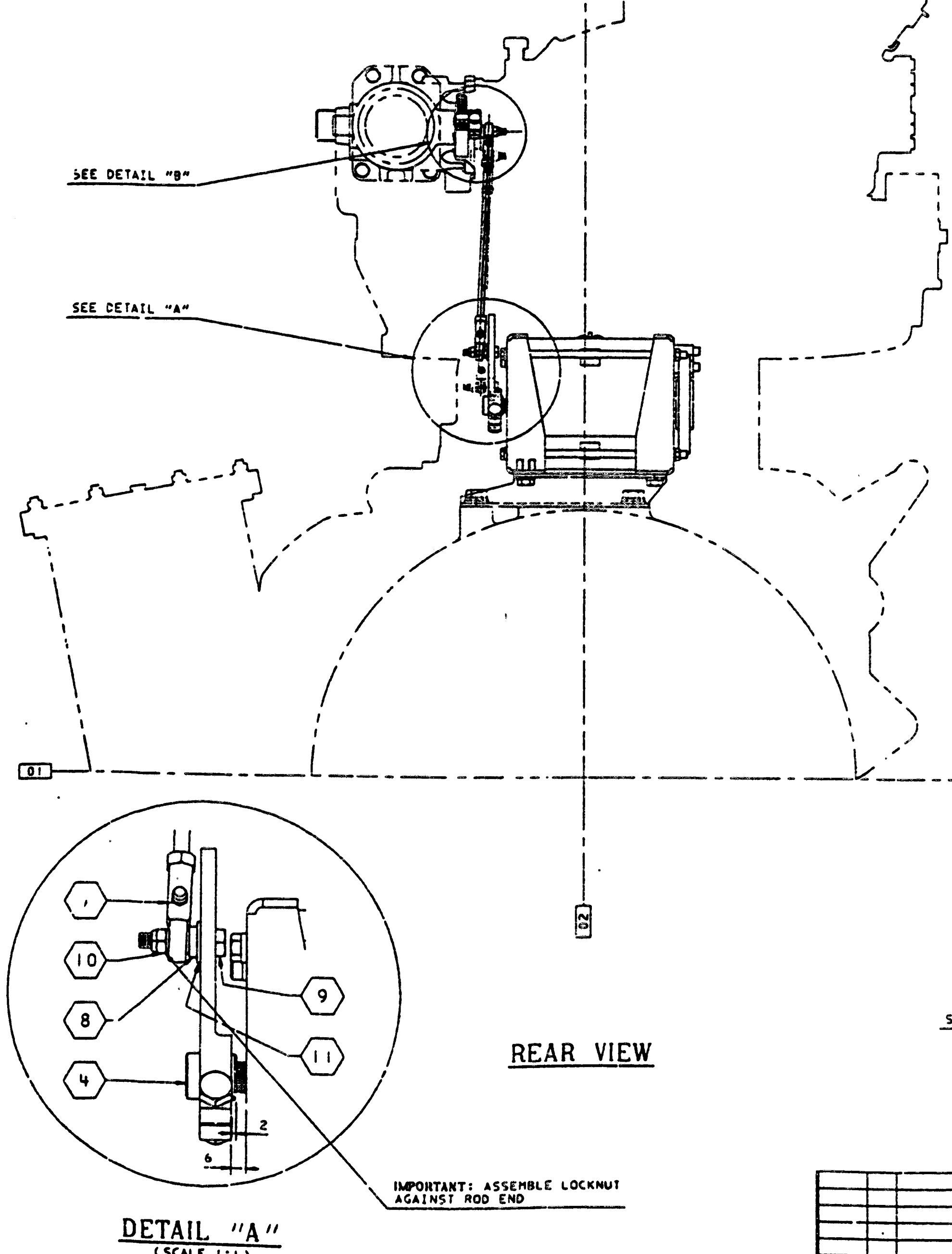
TELEDYNE POST N59227

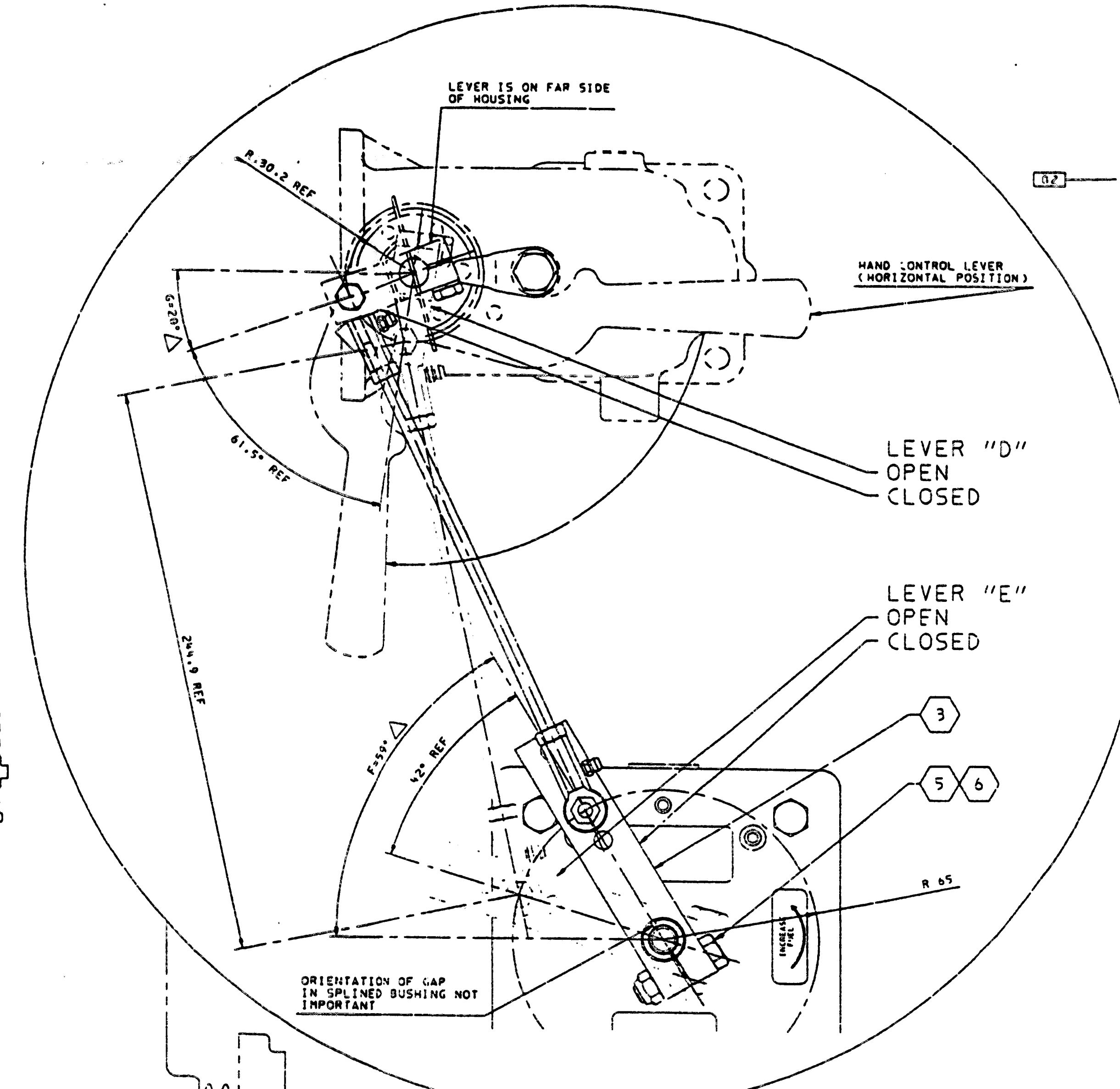
LINKAGE ADJUSTMENT INSTRUCTIONS

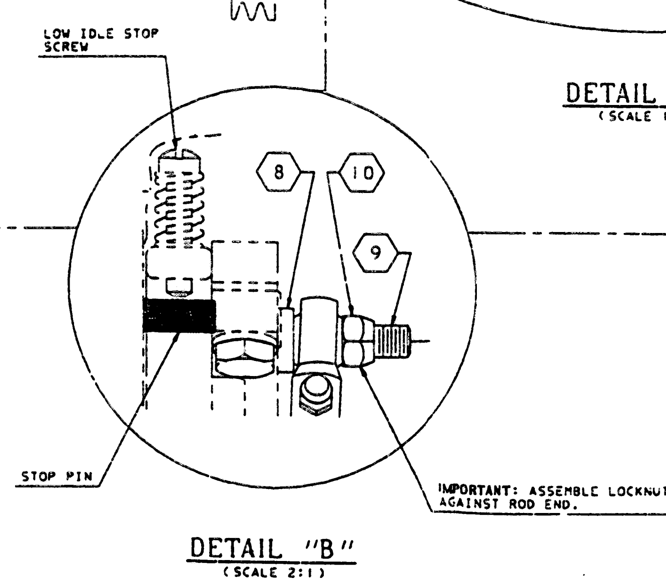
1. BACK OUT LOW IDLE STOP SCREW (SEE DETAIL "B"). UNTIL IT DOESN'T CONTACT STOP PIN WHEN BUTTERFLY PLATE IS CLOSED (REFERENCE THAT APPROXIMATE BUTTERFLY PLATE POSITION IS INDICATED BY A LINE ON EITHER END OF BUTTERFLY SHAFT). ROTATE HAND CONTROL LEVER (SEE DETAIL "C"). CLOCKWISE UNTIL BUTTERFLY PLATE IS HELD CLOSED. ADJUST BUTTERFLY SHAFT LEVER "D" TO ANGLE=20° AS SHOWN IN DETAIL "C" (PIN LEVER TO SHAFT AFTER ENGINE TEST). AFTER ADJUSTING LEVER "D". MOVE HAND CONTROL LEVER BACK TO THE HORIZONTAL POSITION.
2. ATTACH GOVERNOR ROD ASSEMBLY TO GOVERNOR LEVER "E" AND THEN INSTALL LEVER WITH SPLINED BUSHING. ONTO GOVERNOR. ADJUST GOVERNOR LEVER "E" TO ANGLE F=59° AS SHOWN IN DETAIL "C" (NOTE TO MAINTAIN DIMENSIONS 6 AND 2 AS SHOWN IN DETAIL "A". ALSO NOTE POSITION OF LOCKNUT).
3. CHECK THAT GOVERNOR ROD ENGAGEMENT. INTO THE ROD ENDS. IS ABOUT THE SAME ON BOTH ENDS. HOLD THE FREE ROD END AND SHORTEN THE GOVERNOR ROD ASSEMBLY BY TURNING THE GOVERNOR ROD LIKE A TURNBUCKLE (MAKE GOVERNOR ROD ASSEMBLY SHORT ENOUGH TO ATTACH TO LEVER "D". EXACT LENGTH NOT IMPORTANT AT THIS TIME). ATTACH GOVERNOR ROD ASSEMBLY TO BUTTERFLY SHAFT LEVER "D" (SEE DETAIL "B". NOTE POSITION OF LOCK NUT). TURN GOVERNOR ROD. LIKE A TURNBUCKLE. UNTIL BUTTERFLY PLATE JUST CLOSES. TIGHTEN ROD END JAM NUTS.
4. MOVE GOVERNOR LEVER "E" THROUGH RANGE OF MOTION TO CHECK THAT LINKAGE OPERATES SMOOTHLY. THERE SHOULD BE NO TOGGLING OVER CENTER AT GOVERNOR LEVER.
5. ADJUST BUTTERFLY VALVE LOW IDLE STOP SCREW (SEE DETAIL "B"). SO THAT BUTTERFLY PLATE IS JUST CRACKED OPEN.

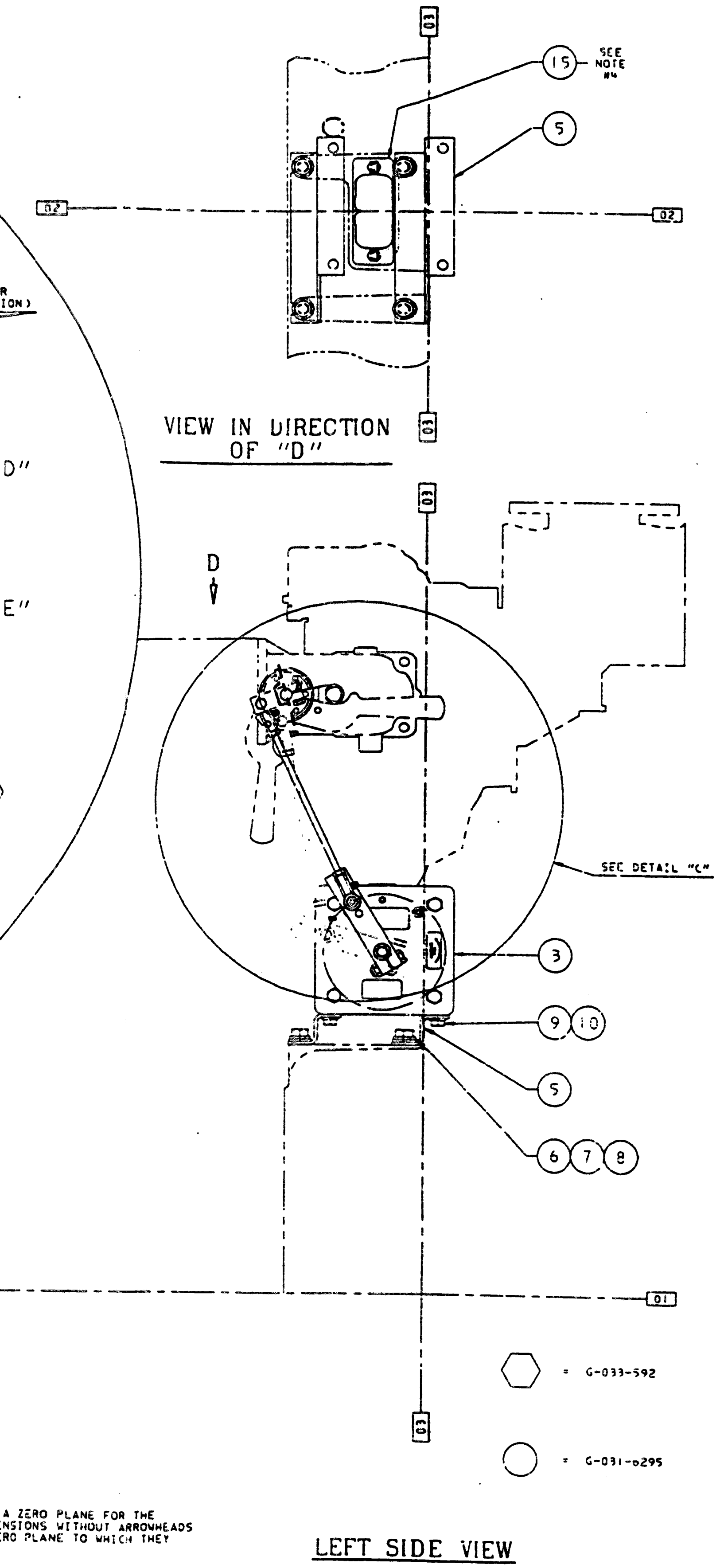
NOTES:

1. CUSTOMER TO FURNISH WIRE BETWEEN MAGNETIC PICK-UP AND CONTROL BOX AND BETWEEN CONTROL BOX AND GOVERNOR ACTUATOR.
2. FOR ACCESSORY CODE 6192 WOODWARD 4024 ELECTRIC GOVERNOR.
3. GOVERNOR CONTROL UNIT SHIPPED LOOSE WITH ENGINE.
4. REMOVE EXISTING COVER PLATE (SHOWN IN DOTTED FONT). THEN MOUNT NEW COVER PLATE (ITEM #15) WITH EXISTING CAP-SCREWS.
5. THERE ARE (2) KEY DESIGN FEATURES SHOWN BY A "Δ". REFER TO DOCUMENT QOP-02-0107. KEY DESIGN FEATURE IDENTIFICATION.









= G-033-592

= G-031-0295

THE ▭—▭ LINE IS USED AS A ZERO PLANE FOR THE VIEW IN WHICH IT APPEARS. DIMENSIONS WITHOUT ARROWHEADS ARE PRINTED PARALLEL TO THE ZERO PLANE TO WHICH THEY PERTAIN.

01 CENTERLINE OF CRANKSHAFT

02 CENTERLINE OF ENGINE

03 REAR FACE OF FLYWHEEL HOUSING

117867	9-96	ADDED THE FOLLOWING ITEM ... VIEW IN DIRECTION OF "D". (2) KEY DESIGN FEATURES ... AND NOTES ...
117115	1-96	MISCELLANEOUS REVISIONS FOR CLARITY
116246	5-93	RELEASED

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS.

CAUTION

MATERIAL:

HEAT TREATMENT:

MODELS: 4SG F11, 4SI, 4SID

REF.

NAME: ELECTRIC GOVERNOR. WOODWARD 4024

DR. JJI DATE 5-5-93

PART NO. SP7541-43

SHT. 1 OF 1 SCALE: 1:2.5