



MAINTENANCE INSTRUCTION

M.I. 1300

Service Department
ELECTRO-MOTIVE DIVISION
GENERAL MOTORS CORPORATION
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3CD TYPE AIR COMPRESSORS

The Westinghouse Air Brake Company is constantly improving its product line and researching and developing new products. Changes in design and function of devices and/or equipment may result from this research and development, therefore, the material in this publication is subject to change without notice.

The following description and operation is based on this device and its components being new or this device and its components having been repaired, tested, installed and maintained in accordance with instructions issued by this and any other applicable Westinghouse Air Brake Company publications.

WARNING

At the time any part is replaced in this device, the operation of the complete device must pass a series of tests prescribed in the latest issue of the applicable WABCO Test Specification. At the time this device is applied to the brake equipment arrangement, a stationary vehicle test must be made to insure that this device functions properly in the total brake equipment arrangement. (Consult your local Westinghouse Air Brake Company Representative for identity of the test specifications, with latest revision date, that covers this device.)

IMPORTANT

Only Westinghouse Air Brake Company supplied parts are to be used in the repair of this device in order to obtain satisfactory operation. Commercially available parts are unacceptable.

The equipment and/or devices covered in this publication that were manufactured and/or sold by the Westinghouse Air Brake Company were designed and constructed to perform in the manner stated herein. Proper installation, periodic inspection, testing, and routine specified maintenance of all operating parts in accordance with instructions issued by this and any other applicable Westinghouse Air Brake Company publications must be adhered to. Westinghouse Air Brake Company parts must be used during overhaul or routine maintenance to assure proper operation of equipment and/or devices. No responsibility for the workmanship associated with the maintenance of devices will be accepted if the work is done by a repair center that is not operated by the Westinghouse Air Brake Company.

The following equipment description and the description of equipment operation is based on the equipment and all component devices being new or having been repaired, tested, installed and maintained in accordance with instructions and specifications issued by the Westinghouse Air Brake Company. Instructions contained in this publication are presented as a guide for maintenance and repair shop conditioning following the removal of the specific device from the locomotive.

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1.0 GENERAL

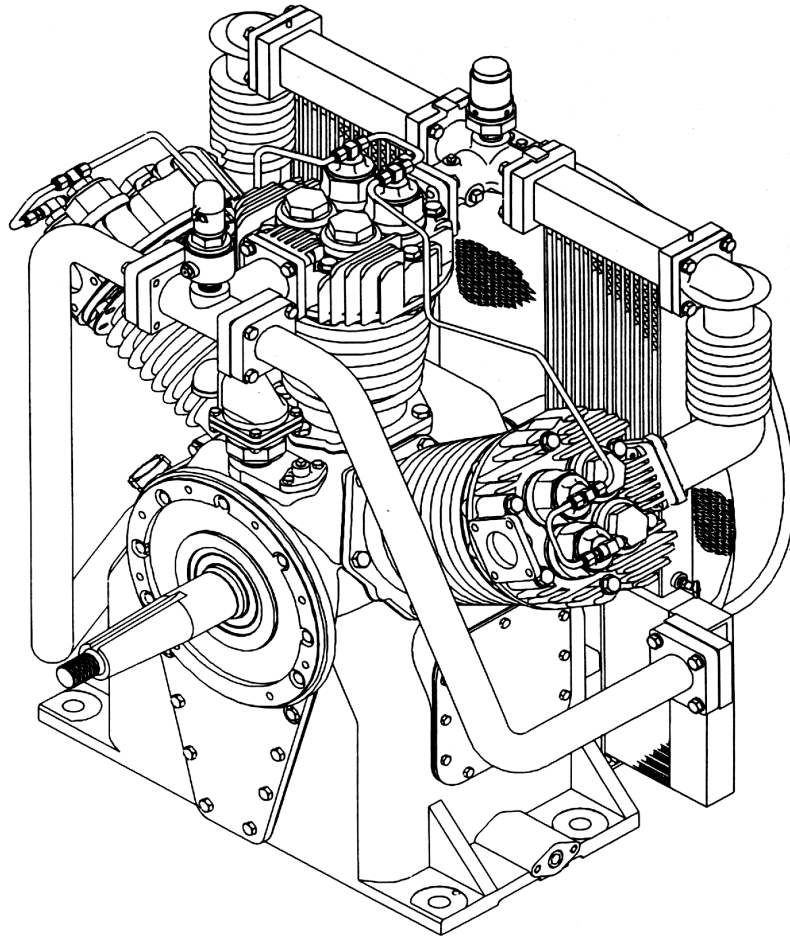


Figure 1 3-CD Type Air Compressor

1.1 GENERAL DESCRIPTION

Reference Figure 1 thru Figure 4. The "3-CD" Type Air Compressor is a two stage, three cylinder "W" configuration, single acting air compressor. It is designed for application to locomotives for the purpose of providing compressed air. The "3-CD" Type Air Compressor may be driven directly off the locomotive's diesel engine through appropriate couplings and drive shaft or driven by an electric motor.

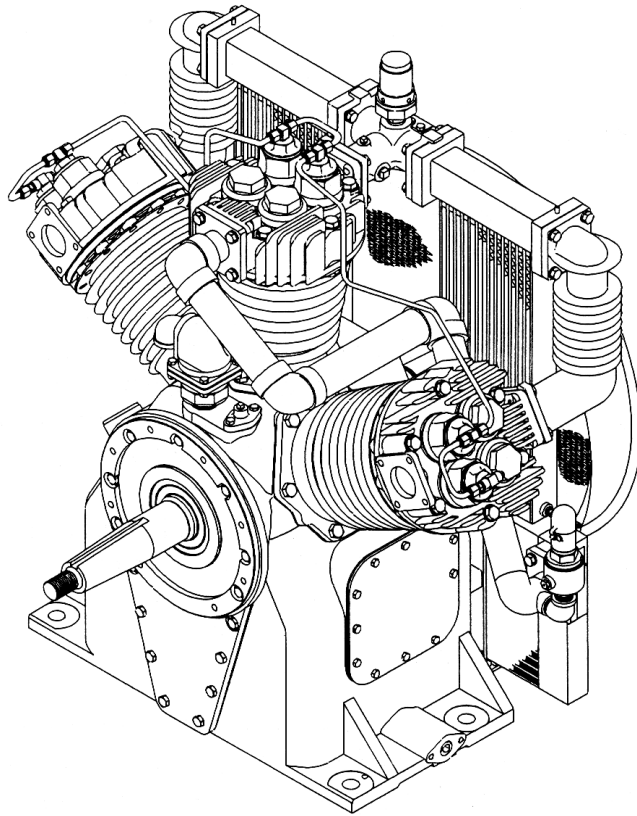


Figure 2 3CDCLA Air Compressor

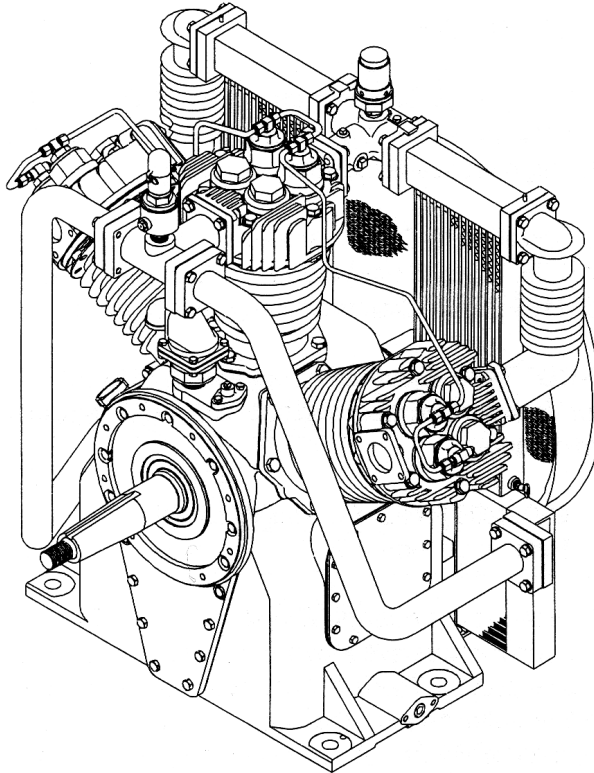


Figure 3 3CDCLA Air Compressor with Bypass

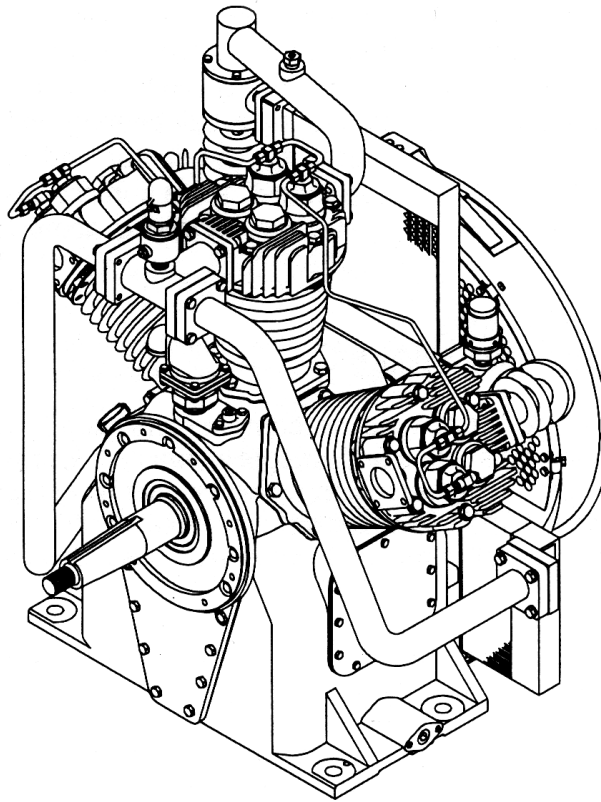


Figure 4 3CDCLAT Air Compressor

Recent compressor designs are driven by a directly coupled electric motor that can be separated from the compressor for replacement or maintenance purposes. The compressor is designed for operation at a maximum discharge pressure of 140 psig (965 kPa). The compressor has a stroke of 4.125" (104.77 mm) or 5.625" (142.87 mm), depending on the type of compressor. See Section 4.0 for designations and the capacities and weights are covered under Section 7.0 - General Specifications. Contact your Westinghouse Air Brake Company Representative or the Westinghouse Air Brake Company Compressor Engineering Department for an additional information.

NOTE

The GENERAL SPECIFICATIONS and POWER REQUIREMENTS for the "3-CD" Type Compressors are covered in Section 7.0 of this manual.

1.2 DESCRIPTION OF COMPONENT PARTS

1.2.1 CYLINDERS

The "3-CD" Type Air Compressor has two 7.75" (196.85 mm) diameter low pressure cylinders and one 5.5" (139.7mm) diameter high pressure cylinder.

1.2.2 CYLINDER HEADS and VALVES

"3-CD" Type Compressors may be equipped with two, three or four valve heads. The latest compressors and exhausters use the four valve heads. The original valves were disc type that operated against helical wound springs. The latest valves are plate type valves, Figure 5, that operate against lentoid springs for longer life.

Unloaders are provided on the inlet valves of compressor cylinder heads to unload the compressor whenever a set main reservoir pressure is reached and not to exceed 140 psig (965 kPa).

NOTE

"Cut-In" pressure should be set at 10 to 15 psig less than the "Cut-Out" pressure. Old standard inlet valves were unloaded by an unloader plunger with pins. Present standard inlet valves contain an integrated unloader that is actuated by the unloader valve via a heavy spring.

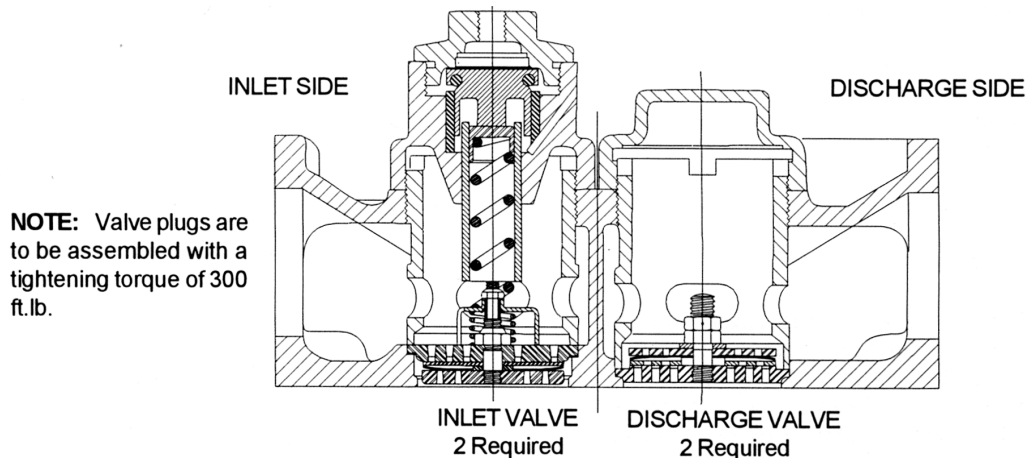


Figure 5 High Pressure Compressor Head

1.2.3 CRANKSHAFT and CONNECTING RODS

Crankshafts and connecting rods were originally made of forged steel. The steel crankshafts can be identified by the word "PARK" forged into the crankshaft.

The present standard crankshafts and connecting rods are made of ductile iron.

The connecting rods are fitted with replaceable bearing inserts and wrist pin bushing.

1.2.4 COMPRESSOR PISTONS

The low pressure trunk type pistons of the compressor portion are elliptical ground aluminum. Each piston has two oil and two compression rings. The high pressure piston is cast iron and also utilizes two oil and two compression rings. The latest design cast iron high pressure piston utilizes teflon layered wrist pin bushings for improved life.

1.2.5 COOLING FAN

Compressor cooling is normally provided by a compressor crankshaft mounted cooling fan that maintains airflow across the compressor portion, intercooler and aftercooler if so equipped.

1.2.6 MAIN BEARING

Two main bearings are utilized in the compressor assembly. The diesel engine driven compressor contains two conrad style ball bearings; whereas the direct electric motor driven compressor uses one conrad style ball bearing and one spherical roller type bearing on the motor end of the compressor. The "main bearings" of the compressor are "splash" lubricated by crankcase oil during compressor operation.

1.2.7 OIL PUMPS

Lubrication for 3CD type air compressors, reference Figure 6, is provided by a fixed displacement reciprocating plunger type oil pump which is driven off an eccentric on the compressor crankshaft. All valves of the oil pump are located in an easy replaceable cartridge.

The cartridge houses an oil pump inlet valve, discharge valve and oil pressure relief valve.

The older "3-CD" Type Air Compressors utilize a uniflow style oil pump plunger assembly that is driven off an eccentric on the compressor crankshaft. The oil pressure relief valve used with the uniflow type oil pump is located in the crankshaft.

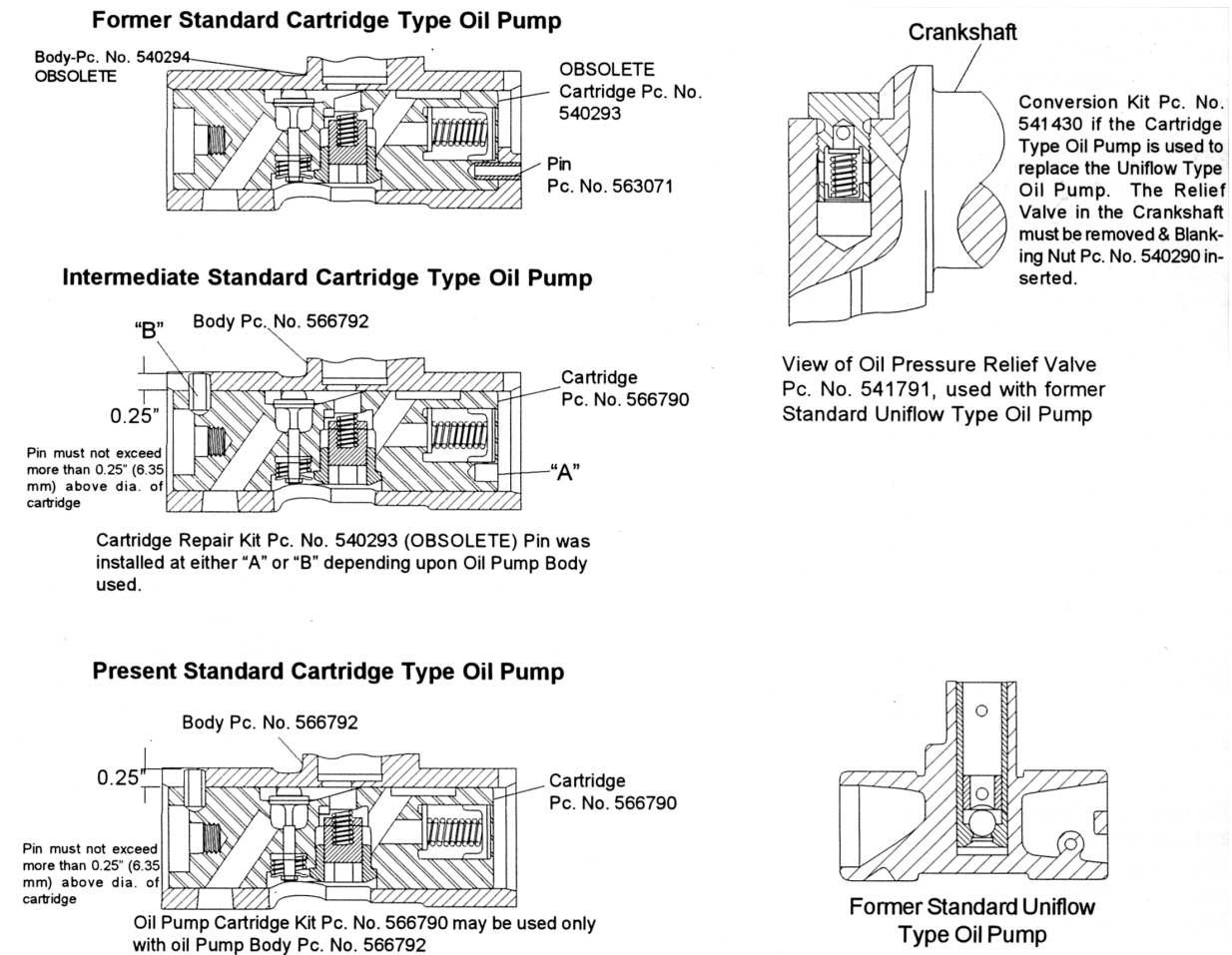


Figure 6 Oil Pumps 3 CD Type Air Compressor

1.2.8 OIL PRESSURE INDICATOR

The Oil Pressure Indicator provides visual evidence when sufficient oil pressure is present for safe operation, the piston stem extends approximately 3/4" (19.05 mm) beyond the cap nut. It features a piston with o-ring design for simplified maintenance and improved reliability and replaces the old standard oil pulsation dampener.

1.2.9 OIL LEVEL GAGE-FLOAT TYPE

The Float Type Oil Gage provides a leak resistant means to measure the approximate oil level in the crankcase. The Float Type Oil Gage consists of a ball or float which rests in the oil supply. The vertical displacement of this float, as determined by the oil level in the crankcase, rotates (through a gear mechanism) a shaft which runs into the gage. A permanent magnet is attached to the gage end of the shaft. This magnet controls the pointer on the visible side of the gage. The magnet arrangement is used to insure that there is no physical opening from the atmosphere to the inside of the crankcase.

1.2.10 OIL LEVEL GAGE -DIPSTICK ASSEMBLY - (NEW STYLE)

The New Style Dipstick Type Oil Level Gage Assembly, when properly installed, is designed to permit oil level in the compressor crankcase to be checked with the compressor running or shut down. No spillage of lubrication oil should occur when an oil level reading is taken.

The dipstick assembly consists of a spring loaded ball check, which is pushed off its seat when the dipstick gage is properly screwed into the dip stick tube to its normal, fully closed, position. This allows the crankcase oil to reach its level within the dip stick tube. When the dip stick gage is removed to take an oil level reading, the ball check seats on the bottom of the tube restricting any oil spilling when the compressor is running.

The dip stick assembly is so designed that no surge of oil should occur within the tube. A positive indication of the oil level is shown on the dipstick gage even when the compressor is operating.

1.2.11 CRANKCASE BREATHER VALVE

The Crankcase Breather Valve, reference Figure 7, operates as a check valve to provide a partial crankcase vacuum during normal operation of the compressor and to discharge air displaced in the crankcase during the compressor process. The breather valve consists of a body, breather valve, and metallic filter material.

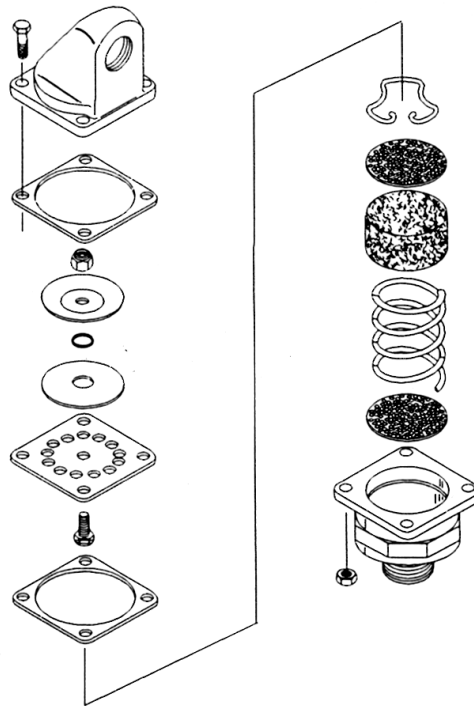


Figure 7 Crankcase Breather Valve

1.2.12 INTERCOOLER & SAFETY VALVES

The intercooler is used to cool the air between the first and second stages of air compression. The intercooler, as included with the "3-CD" Type Compressor, may be made of copper finned tubing or aluminum. The intercooler is designed for easy replacement of the cores. Various intercooler sizes are available depending on the application. A Drain Valve is provided at the bottom of each intercooler core for drainage of condensate.

A Relief Valve set at 60 psig (413.7 kPa) is mounted on the intercooler for the purpose of limiting pressure buildup in the intercooler. The 60 psig pressure setting is used on compressors not equipped with TCIS. On compressors equipped with Thermostatically Controlled Intercooler System (TCIS) the relief valve is set at 75 psig (515 kPa).

WARNING

It is important that the Relief Valve be maintained in good working order and that the pressure setting is such that the Relief Valve will provide pressure relief if and when the intercooler pressure exceeds 60 psig or 75 psig in the case of the TCIS. Failure to comply with this warning may result in serious injury to workmen and/or bystanders.

1.2.13 THERMOSTATICALLY CONTROLLED INTERCOOLER SYSTEM (TCIS)

The TCIS regulates the inter-stage compressed air temperature in order to prevent water condensation in the intercooler. At start-up when the compressor is cold, the L.P. discharge air is routed directly into the H.P. cylinder. In this case, the air is bypassing the intercooler. When the air compressor begins to warm up, the thermostat will begin to open and mix the bypass air with cool air from the intercooler thus regulating the H. P. inlet temperature to approximately 195 °F. The A-1 intercooler relief valve is set at 75 psig nominal for the TCIS equipped compressor.

A rapid unloader valve with heater is applied to the TCIS intercooler system to rapidly exhaust the compressed air in the intercooler. The rapid depressurization of air will ensure that the compressor will start unloaded thus preventing the electric drive motor from attempting to start under load (prevents motor overheating). The heater functions to prevent freezing of the rapid unloader during cold weather operation.

1.2.14 HIGH TEMPERATURE INDICATOR

The high temperature indicator is located on the H.P. inlet manifold on the TCIS equipped air compressors. During normal operation, the indicator stem stays inside the body of the indicator. If the indicator tip experiences a high temperature, the indicator stem will extend out from the indicator body. A high temperature indication is representative of a malfunctioning thermostat. Both the thermostat, its associated o-ring, seal and the high temperature indicator should be replaced.

1.2.15 AFTERCOOLER

WABCO 3CDC Type Air Compressors may be equipped with a patented integral aftercooler that reduces the temperature of the compressed air to near ambient temperatures. Compressors not so equipped can be modified to include the integral aftercoolers. Consult your local WABCO representative for additional information.

Aftercoolers equipped with a bypass pipe provide additional protection in during cold temperature operation. The high pressure discharge header has a built in orifice that interfaces with the aftercooler bypass pipe. In the event of a restriction in the aftercooler caused by frozen condensate, the high pressure discharge air is directed through the orifice to the aftercooler discharge and into the pipe connection to the No.1 main reservoir.

1.2.16 AFTERCOOLER SAFETY VALVE

This safety valve is located on the aftercooler or high pressure discharge manifold on the aftercooler equipped with aftercooler bypass pipe feature. A safety valve set at 180 psig (1241 kPa) is intended to protect the aftercooler from excessive pressure buildup.

WARNING

It is important that the safety valve be maintained in good working order and that the pressure setting is such that the safety valve will provide pressure relief if and when the aftercooler pressure exceeds 180 psig (1241 kPa). Failure to comply with this warning may result in serious injury to workmen and/or bystanders.

1.2.17 OIL LEVEL SWITCH

A Oil Level Switch has been used on small crankcase compressors where oil capacity is 13 quarts. The Oil Level Switch is used to detect a low oil level condition and signal an alarm condition.

1.3 OPERATION

IMPORTANT

The two low pressure cylinder heads when bolted to the larger of the three cylinders are to be fitted with WABCO approved air intake filters mounted in the recommended position on the intake flanges.

Each low pressure cylinder discharges into the intercooler system which discharges into a manifold to supply air to the high pressure cylinder for the second stage of compression.

On the downstroke of the low pressure piston, air passes through the air intake filter from atmosphere into the chamber above the two inlet valves in the cylinder head. Partial vacuum created in the cylinder underneath the valve plates, by the downward stroke of the piston, permits atmospheric pressure above the inlet valves to overcome the resistance of a valve spring under the valve plates and forces the valve plate from its seat. Air then flows into the cylinder until the pressure above and below the valve plates are about equal, then the inlet valve is closed by its spring.

On the upward stroke of the low pressure piston, the air is compressed sufficiently to lift the discharge valves against the resistance of both the springs and intercooler pressure. The compressed air then passes through the discharge valve into the intercooler where it is cooled before it flows into the inlet side of the high pressure cylinder head.

The discharge valves are closed by their respective springs when the pressure above the valve becomes equal to pressure underneath.

The cycle of operation described for each low pressure cylinder is repeated in the high pressure cylinder. In this way, the intermediate intercooler pressure is raised to the second stage level which is slightly greater than main reservoir pressure. This main reservoir pressure IS NOT TO EXCEED 140 psig (965 kPa).

The compressor operates "loaded" until the buildup of main reservoir pressure increases to the cutout pressure setting of the compressor control switch or governor which may or may not be supplied by WABCO. This setting should normally be 140 psig (965 kPa). At this point the compressor control switch or governor should function to direct air to the unloader line and unloaders.

Air requirements then reduce the main reservoir pressure to the cut-in pressure setting of the compressor control switch or governor and the cycle is again repeated. The cut-in pressure setting should be normally 130 psig (897 kPa) .

NOTE

"Cut-In" pressure should be at least 10 to 15 psig (68.96- 103 kPa) less than the "Cut-Out" pressure.

Air displaced in the crankcase during compression processes is discharged by way of the crankcase breather which provides a partial crankcase vacuum during normal operation.

1.4 DESIGNATIONS –"3-CD" TYPE COMPRESSORS

1.4.1 FIRST SYMBOL

A number indicating the number of cylinders.

1.4.2 SECOND SYMBOL

The letter "C" indicates a compound compressor.

1.4.3 THIRD SYMBOL

"D" = Direct Drive

"B" = Belt Drive

"W" = Water Cooled

"M" = Motor Driven with WABCO Installed Drive Motor

1.4.4 FOURTH SYMBOL

If a letter "C" is used here, it will indicate a compressor with the shortened stroke, 41/8" (104.775 mm) versus 55/8" (142.875 mm).

If one of the letters under the third symbol is used here, it will retain the same meaning (except the "3-CD8" where "8" = cooling fan).

1.4.5 FIFTH SYMBOL

If a letter "L" is used here, it will indicate a compressor with a large oil capacity crankcase (65 quarts -61.5 liters).

If one of the letters listed under the third symbol is used here (except the "3-CDC8" where "8" cooling fan) it will retain the same meaning.

If the letter "C" is used here, it will indicate a compressor with short stroke 4 1/8" (104.775 mm).

1.4.6 SIXTH SYMBOL

If a letter "L" is used here, it will indicate a compressor with a large oil capacity crankcase (65 quarts -61.5 liters).

If a letter "8" is used here, it will indicate a compressor with a cooling fan as in "3CMDC8L".

If a letter "A" is used here, it will indicate a compressor with an integral aftercooler as in "3CDCLA".

1.4.7 SEVENTH SYMBOL

If a letter "L" is used here, it will indicate a compressor with a large oil capacity crankcase (65 quarts -61.5 liters). If a letter "T" is used here, it will indicate a Thermostatically Controlled Intercooler System, as in the "3CDCLA T".

1.4.8 SERIALIZATION

Older "CD" Type Compressors were first serialized by consecutive numbers.

"CD" Type Compressors were later serialized as to the quarter of year, the year and number (sequence) of compressor built.

Example: D-76-44; indicates that this compressor was built in the fourth quarter of 1976 and was the forty-fourth compressor built in that week.

"CD" Type Compressors built after January 1, 1977 are serialized according to the week, year and number of compressors built in that week.

Example: 05 77 18; This compressor was built in the fifth week of 1977 and was the eighteenth compressor assembled during the fifth week.

2.0 SAFETY PROCEDURES AND WARNINGS

Regular operating property and/or shop safety procedures must be followed when performing any work on a "3-CD" Type Compressor. The work area should be clean.

WARNING

Extreme care must be taken when handling this device and its components and while performing the many tasks associated with its repair. It is of utmost importance that the workman read, understand and comply with the appropriate warnings listed below during maintenance procedure.

The use of an air jet, which must be less than 30 psig, to blow parts clean or to blow them dry after being cleaned with a solvent will cause particles of dirt and/or droplets of the cleaning solvent to be airborne. These conditions may cause skin and/or eye irritation.

When using an air jet do not direct it toward another person. Improper use of air jet could result in bodily injury.

Personal eye protection must be worn when performing any work on this device or its component parts to avoid any possible injury to the eyes.

The use of solvents as cleaning agents and the use of lubricants can involve health and/or safety hazards. The manufacturers of the solvents and lubricants should be contacted for safety data (such as OSHA Form OSHA-20 or its equivalent). The recommended precautions and procedures of the manufacturers should be followed.

When performing any test or work on devices or equipment while they are on the vehicle, special precautions must be taken to insure that vehicle movement will not occur which could result in injury to personnel and/or damage to equipment.

WARNING (continued)

Assembly may be under a spring load. Exercise caution during disassembly so that no parts "Fly Out" and cause bodily injury.

All air supply and/or electric current to this device and/ or to any components part must be cut-off before this device and/or any component part is removed from the equipment arrangement.

"Bottled" up air under pressure (even though air supply is cut-off) may cause gaskets and/or particles of dirt to become airborne and an increase in sound level when this device and/or any component part is removed from the equipment arrangement.

Personal eye and ear protection must be worn and care taken to avoid possible injury when performing any work on this device and/or component part.

When performing work where high temperature is involved, use insulated gloves.

To prevent receiving electrical shock when performing electrical test, hands must be clear of electrical components, contacts and housing and required "in-lab" grounding procedures must be strictly adhered to. A wooden work bench should be used. Failure to heed this **WARNING** could result in severe injury or death.

An adequate support or lifting device must be available to support the complete unit or its major components during removal, installation and maintenance procedures. Observe weight information stated throughout this repair procedure.

3.0 CLEANING SOLVENTS AND LUBRICANTS

3.1 CLEANING SOLVENTS

The solvent used to clean specified reusable metal parts **MUST BE** an aliphatic organic solution, such as mineral spirits that will dissolve oil or grease, and that will permit the parts to be cleaned without abrasion.

Alkaline cleaners may be used to clean aluminum type intercoolers, aftercoolers, and low pressure aluminum pistons.

IMPORTANT

No caustic cleaners are to be used on aluminum intercooler and aftercooler cores and aluminum pistons.

3.2 LUBRICANTS

NOTE

The following lubricants are required when working on the "3-CD" Type Compressors. Number 2 Silicon Grease, Westinghouse Air Brake Company Specification M- 7680-2.

Compressor Oil for Heavy Duty Compressors, for operations at ambient temperatures below +10° F (-12° C) ATSM Viscosity Grade Number SUS @ +10° F = 215 (ISO V.G. 46). Westinghouse Air Brake Company Specification M-7615-20. This oil shall be a high quality , solvent refined, paraffin base or suitable blend. Additives to inhibit foaming, rust, oxidation, and wear are required. DETERGENTS ARE NOT PERMISSIBLE. Anti-wear additives are recommended.

Compressor Oil for Heavy Duty Compressors, for operation at or above ambient temperature above +10° F (-12° C) ATSM Viscosity Grade Number SUS @ +10° F = 315 (ISO V.G. 68). Westinghouse Air Brake Company Specification M-7616-20. This oil shall be a high quality, solvent refined, paraffin base or suitable blend. Additives to inhibit foaming, rust, oxidation, and wear are required. DETERGENTS ARE NOT PERMISSIBLE. Anti-wear additives are recommended.

Compressor Oil for Heavy Duty Compressors, for high ambient temperatures operations at or above +125° F (52° C) A TSM Viscosity Grade Number SUS @ 100° F = 465 (ISO V.G. 100). Westinghouse Air Brake Company Specification M- 7617. This oil shall be a high quality, solvent refined, paraffin base or suitable blend. Additives to inhibit foaming, rust, oxidation, and wear are required. DETERGENTS ARE NOT PERMISSIBLE. Anti-wear additives are recommended.

Mixing of compressor oil grades or manufacture are to be avoided.

4.0 MAINTENANCE SCHEDULE

WARNING

It is recommended that the procedures listed in this maintenance schedule be performed at least once during the specified time period, or more frequently if service conditions so indicate. Failure to perform the procedures at the specified time period may result in damage to equipment which could possibly cause a malfunction that may result in property damage and/or bodily injury. Shorter maintenance intervals may be found necessary, depending on the severity of the service to which the compressor is subjected. **IT IS THE USER'S** responsibility to determine if more frequent schedules for maintenance are required.

EVERY 30 DAYS (Small crankcase equipped compressors)

- Check small crankcase oil and if necessary, add oil.

EVERY 3 MONTHS (Large crankcase equipped compressors)

- Check large crankcase oil and if necessary, add oil.

EVERY 6 MONTHS

- Check operation of Unloaders and Rapid Unloader (Purge Valve) if so equipped.
- Check exterior of Intercooler Assembly. Clean.
- Check exterior of Aftercooler Assembly if so equipped. Clean.
- Inspect, remove and blow clean and, if necessary, replace the Compressor Intake Filters.

EVERY 12 MONTHS

- Change crankcase oil (Refer to Section 9.2). Clean interior of crankcase using a natural sponge and mineral spirits. After cleaning, dry the crankcase completely.
- Clean Oil Pump Strainer, Replace if necessary (Pc. No.517747).
- Replace Compressor Intake Filters.
- Check the operation of the Purge Valve Heater on TCIS equipped compressors. The heater has a built in thermostat to activate the heater. Subject the heater to a temperature of less than 45° F to turn the heater "ON". At a location on the purge valve close to the heater -feel the purge valve for warmth. Replace heater if necessary.

EVERY 24 MONTHS (Non- TCIS equipped compressors)

Replace or overhaul all Discharge Valves (Pc. No.578773). Replace or overhaul all Inlet Valves (Pc. No.680001 or 680002). (The life of Inlet and Discharge Valves depends on the severity of service, available cooling air, oil passing rate of compressor, efficiency of inlet air filtration, etc. A two year valve change period is recommended by the Westinghouse Air Brake Company. Individual operating conditions will have a strong influence on the valves life).

- Clean and inspect unloader mechanism.
- Replace Crankcase Breather Valve (Pc. No.575308) in all Non- TCIS & TCIS equipped compressors.

EVERY 36 MONTHS (TCIS equipped compressors ONLY)

- Clean and inspect unloader mechanism.
- Renew valves.

AT LEAST ONCE EVERY 4 YEARS (48 MONTHS)

The four year overhaul period is recommended for 3-CD Type Compressors.

AT LEAST ONCE EVERY 6 YEARS (72 MONTHS)

The six year overhaul period is only recommended for Motor Driven Compressors equipped with the Thermostatically Controlled Intercooler System (TCIS).

IMPORTANT

The four and six year overhaul period represents the TIME PERIOD between overhauls that is recommended by Westinghouse Air Brake Company. The actual time of compressor operation or service before an overhaul is performed is heavily influenced by the type of service in which the compressor is used, the mileage of the locomotive between overhauls, the ambient temperature in which the compressor operates, the running speed of the compressor, oil change periods, the environmental conditions, and inlet air filtration.

The actual time periods between overhauls MUST BE established by the USER and should be based on USER conditions and experience.

The compressor is to be removed from the locomotive for regular overhaul utilizing genuine WABCO replacement parts.

5.0 REMOVING THE COMPRESSOR FROM THE LOCOMOTIVE

WARNING

A lifting and support mechanism capable of safely handling 3000 pounds (1360.8 kilograms) is to be used during compressor removal.

Apply locomotive handbrake and/or parking brake. All power to the Compressor is to be cut-off. Wheel chocks are to be applied to the wheels to prevent vehicle movement. WARNING placards are to be placed on and about the vehicle indicating that work is to be performed.

1. Drain the oil from the compressor crankcase.
2. Remove the compressor from the locomotive following EMD Service instructions. It is advisable to leave the mounting base shims in their respective positions, preferably by wiring them in place if the same compressor is to be reinstalled in the same locomotive from which it was removed. This will aid considerably in properly aligning the machine as well as saving considerable time and effort.
3. Transport the removed compressor to the shop area for maintenance. The transporting mechanism must be able to support 3000 pounds (1360.8 kilograms).
4. Installation of an overhauled or replacement compressor should be done in reverse order of removal following locomotive builder-owner/operator instructions.
5. Remove all WARNING placards and wheel chocks before attempting to move the locomotive.

6.0 REPAIR PROCEDURES - DISASSEMBLY

6.1 PREPARATION

The external surfaces of the unit **MUST BE** thoroughly cleaned before disassembly. Use a low pressure jet of clean, dry air to blow the surface clean.

DO NOT USE CAUSTIC cleaners on the aluminum type intercooler cores, aftercooler cores and aluminum pistons.

6.2 REMOVAL OF DRIVE MOTOR

Remove the compressor drive motor according to the locomotive builder's specifications. Consult the locomotive builder's representative for further assistance.

6.3 COMPRESSOR CRANKSHAFT COUPLING HALF

To avoid damaging crankshaft bearings, exercise care when removing or installing the crankshaft coupling half. If the couplings have a shrink fit on the shaft, quick heating of the coupling hub, while using a gear puller, will aid in their removal. When hydraulic removal feature is incorporated into the shaft or coupling, it should be used. Remove the coupling drive key if used.

6.4 COOLING FAN

1. Remove the fan guard.
2. After the set screw and the clamping screw in the fan hub have been removed, the fan may be removed from the crankshaft by means of a puller. Tapped holes are provided for this purpose in the face of the fan hub.
3. If the fan hub has a shrink fit on the shaft, use the hydraulic removal feature incorporated into the fan hub for removal.
4. Remove the fan drive key, if so equipped.

6.5 EXTERNAL DETAILS

1. Remove the intercooler, aftercooler if so equipped, intake filters, unloader tubing, crankcase breather, side covers and oil pressure indicator.

IMPORTANT

If the compressor is equipped with an oil level float gage, remove the gage before removing the side cover to prevent damage to the float lever.

2. If the compressor is operated as an exhauster, remove the vacuum maintaining valve, crankcase evacuation tube or exhauster breather valve and filter if so equipped. Remove the vacuum inlet and discharge manifold assemblies from the heads.

6.6 CYLINDER ASSEMBLIES

1. Remove the valves from the cylinder heads and then remove the cylinder heads.
2. A Valve Plug Wrench is available for removing the valve plugs from the compressor heads. It is covered by WABCO Pc. No.653874.

IMPORTANT

Express care that the piston assembly does not fall against the rod.

3. Remove the cylinders.
4. Remove and **SCRAP** all gaskets.

IMPORTANT

When removing the various gaskets **CARE MUST BE TAKEN** so that no damage is done to the machined metal surfaces. **NO WIRE BRUSHES OR GRINDING TOOLS ARE TO BE USED WHEN REMOVING THE GASKETS.** The proper and careful use of a putty knife or an air chisel is permissible. Appropriate procedures, in accordance with the instructions of the owner/maintainer of the compressor or exhauster are to be followed in the disposal of gasket material removed during the tear down.

5. Remove the connecting rod caps, then remove the connecting rod and piston assemblies.

IMPORTANT

The connecting rod caps and the associated connecting rod work together as a "matched" set of parts. **KEEP THE CONNECTING ROD CAPS WITH THEIR MATING CONNECTING ROD AT ALL TIMES.** Remove piston from connecting rod. Scrap the rings.

6.7 CRANKCASE DISASSEMBLY

1. Remove the oil strainer by first removing the 1/2 X 4 " clamping bolt and 1/2" lock nut.
2. Remove the Oil Level Switch on compressors so equipped prior to removal of the oil pump cartridge.
3. Remove the oil pump cartridge, if so equipped. A 1/2"-13 UNC-2A bolt may be threaded into the cartridge on the oil strainer end to facilitate its removal.
4. When disassembling the crankcase assembly, it is advisable to position the crankcase so that the axis of the crankshaft is vertical and the main bearing housing faces upward.
5. If it becomes necessary to remove the oil seal with the crankshaft in place, the following procedure may be followed:
6. Drill four 0.125" diameter (3.175 mm) holes on the outside shield of the oil seal. Insert four self-tapping metal screws into the shield, then using the screws as gripping points, pry out the seal. Certain types of nail pullers have been found satisfactory for this purpose. Scrap the oil seals.
7. The following procedure should be adhered to when disassembling the crankcase. Care **MUST BE** exercised so that the oil pump plunger is not damaged.

Remove the 1/2 x 1 1/2" cap screws which secure the main bearing housing to the crankcase. Insert three 1/2"-13 UNC-2A screws into the three tapped holes in the main bearing housing. After the screws are in contact with the crankcase, gradually raise the main bearing housing by turning each screw clockwise an equal amount until the main bearing housing comes free of the bearing.

WARNING

A lifting and support mechanism capable of safely handling 3000 pounds (1360.8 kilograms) is to be used during compressor removal and installation.

8. The crankshaft may then be removed by means of a lifting device consisting of a threaded portion, such as a standard crankshaft, nut, to which has been welded a "U" shaped loop of sufficient size to permit the insertion of the hook of the lifting equipment. Tighten the nut on the crankshaft and slowly lift vertically in a straight line. It is usually necessary to rock the upper end of the crankshaft slightly back and forth at right angles to its axis until the oil pump body and the plunger comes free of the crankcase.
9. Remove the oil pump body. Complete the removal of the crankshaft from the crankcase.

WARNING

Damage to the oil pump plunger may occur if the oil pump plunger is jammed at any time during its removal.

10. Remove the oil seals from the crankcase and main bearing housing.

7.0 CLEANING, INSPECTION and REPAIRING

7.1 CLEANING

IMPORTANT

Do not use caustic cleaners on the aluminum type intercoolers, aftercoolers and pistons.

The Westinghouse Air Brake Company recommends a hot tank inhibited alkaline cleaner on the aluminum intercoolers, aftercoolers and low pressure aluminum pistons.

Clean all other serviceable metal parts to facilitate inspection. After the parts have been cleaned, they **MUST BE** completely dried. Use a low pressure jet of clean, dry air to blow the parts dry.

Make certain that all drilled oil passages in connecting rods, crankshaft, etc. are clean and free of obstructions, that the oil pressure indicator tube is not bent or damaged.

IMPORTANT

ALL gaskets, rubber parts, self-locking hardware and cotter pins ARE TO BE SCRAPPED. ONLY NEW Westinghouse Air Brake Company parts are to be used in place of the scrapped parts during the assembly procedure to permit the best fit and performance.

7.2 CONDEMNING LIMITS

Reference Table A in the Service Data section for condemning limits.

"TABLE A" includes minimum and maximum condemning limits as applied to all main wearing parts for the "3-CD" Type Air Compressors..

IMPORTANT

The dimensions given in "Table A" are based on the use of parts supplied by the Westinghouse Air Brake Company.

7.3 COMPONENT INSPECTION AND QUALIFICATION

7.3.1 CYLINDERS AND PISTONS

1. Replace any cylinder that is found to be damaged beyond repair. This may include cylinders with damaged or broken cooling ribs as determined by inspection.
2. All reusable cylinders should be refinished, preferably by honing, to eliminate any irregularities on cylinder walls. The finish on the cylinder walls after refinishing MUST BE between 20 and 40 micro-inches (0.508 and 1.016 micro meters). The crosshatch hone marks should be 35° to 45° from the horizontal for both the low pressure and the high pressure cylinders. If the cylinder is not within the limits specified in "TABLE A", the cylinder may be rebored and honed to a suitable standard oversize diameter while maintaining a finish as previously specified in item 14.3.2. A respective oversize piston MUST BE used if the cylinder is bored oversize. The oversizes for the cylinder are graduated in two steps of 0.010" (0.254 mm) each, the first oversize being 0.010" (0.254 mm) above the standard diameter. The oversize is to be stamped on the top of each cylinder flange SO that it is visible when the head is removed. Consult your Westinghouse Air Brake Company Representative for information on available oversize pistons and cylinders for specific applications.

3. When reboring a cylinder to oversize, it **MUST BE** mounted in such a manner that the new bore will be concentric with the unworn portion of the old bore at both ends. Also, the mounting flange must be perpendicular to the bore within 0.002" (0.050 mm) T.I.R. as determined by the dial indicator reading.

If the mounting flange face is not perpendicular, it may be corrected by removing the least possible amount of metal from the face of the flange while maintaining the same setting with which the cylinder was bored. Minimum cylinder lengths are specified in "TABLE A " (Service Data).

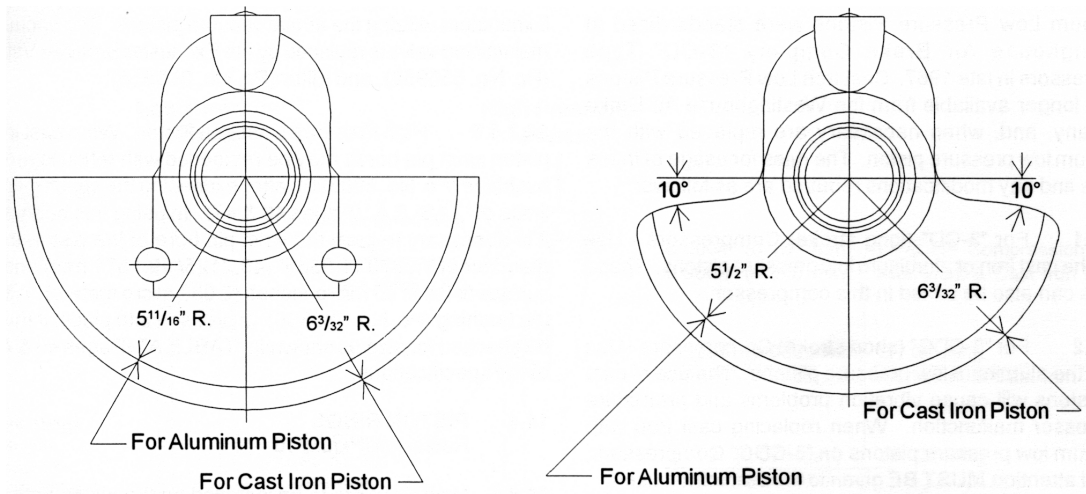
7.3.1.1 ALUMINUM AND CAST IRON PISTONS

Aluminum Low Pressure Pistons were standardized in Westinghouse Air Brake Company "3-CD" Type Compressors in late 1967. Cast Iron Low Pressure Pistons are no longer available from the Westinghouse Air Brake Company, and, when necessary are replaced with the aluminum low pressure piston. The rules for usage of these pistons and any modifications required are as follows:

- For "3-CD" (long stroke) Compressors –Use either the cast iron or aluminum low pressure pistons. These pistons can also be mixed in this compressor.
- For "3-CDC" (short stroke) Compressors –Use **ONLY** the aluminum low pressure pistons. The use of cast iron pistons will cause vibration problems and premature compressor malfunction. When replacing cast iron with aluminum low pressure pistons on "3-CDC" Compressors, special attention **MUST BE** given to the crankshaft used.
- On older "3-CDC" Type Compressors (built prior to late 1967) a modification to reduce the crankshaft balance weight is required before installing aluminum low pressure pistons, Figure 8.

WARNING

This modification is essential to limit compressor dynamic imbalance which could possibly result in a total compressor destruction and potential injury to bystanders.



3CDC Type Air Compressors Modification of Crankshafts made from Forging Pc. No. A539018 for use with LP Aluminum Piston Pc. No. A550853

3CDC Type Air Compressors Modification of Crankshafts made from Forging Pc. No. A557878 for use with LP Aluminum Piston Pc. No. A550853

Figure 8 Modification of Crankshafts for Aluminum Pistons

The required reduction in weight can be accomplished by reducing the radius of the counterweights through machining. Figure 8 covers the modification to those crankshafts which have integrally forged counterweights. The required weight reduction on integrally forged shafts is obtained by machining the 63/32" radius of the counterweights to 51/2". Figure 9 also covers the modification to these crankshafts which have pinned and welded counterweights. The required weight reduction on pinned and welded shafts is obtained by machining the 63/32" radius of the counterweights to 511/16". CARE SHOULD BE TAKEN THAT ONLY ALUMINUM LOW PRESSURE PISTONS BE UTILIZED IN COMPRESSORS CONTAINING MODIFIED CRANKSHAFTS.

- High Pressure Cast Iron Piston. Worn cast iron piston wrist pin bores may be reclaimed with teflon layered bushings (Pc. No.580390), after exceeding the condemning limits of "TABLE A" (Service Data). In using this bushing, it is necessary to bore the wrist pin bore of the piston to a diameter of 1.9375"/1.9365" (49.2125/49.1871 mm) and a surface finish of 80 micro-inches (2.032 micrometers). After the bushing (Pc. No.580390), is pressed into place, it must be checked for size as shown in "T ABLE A" (Service Data) of the specifications.

7.3.2 PISTON RINGS

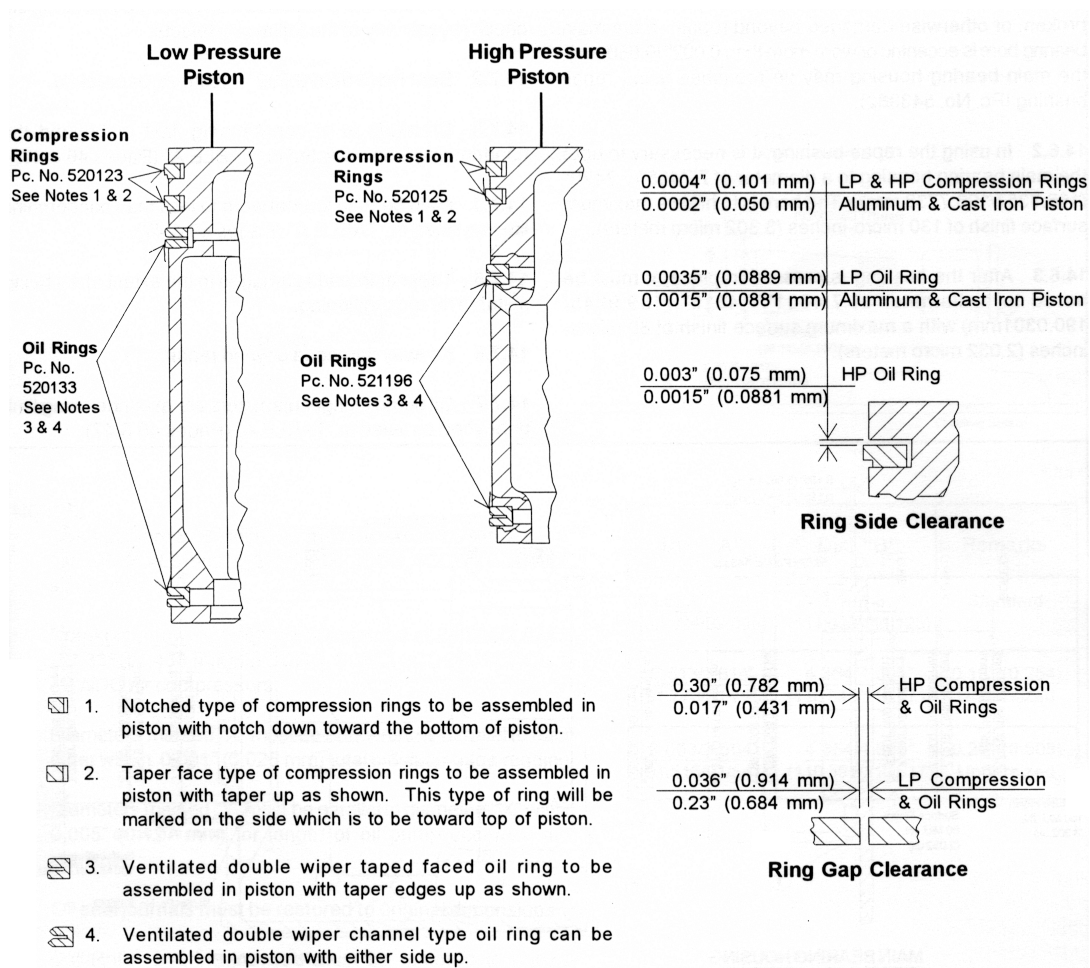


Figure 9 3CD Air Compressor Piston Ring Identification and Installation Instructions

New rings, Figure 9, are to be installed on the piston using a suitable piston ring installation tool. New standard rings are:

- H.P. Compression, (Pc. No.520125)
- H.P. Oil (Pc. No.521196)
- L.P. Compression (Pc. No.520123)
- L.P. Oil (Pc. No.520133)

The rings should be expanded just enough to clear the piston. Care must be exercised when installing the piston rings to prevent breakage or distortion. The position of the piston rings is shown in Figure 9. Consult your Westinghouse Air Brake Company Representative for information on the correct piston rings for specific applications.

7.3.3 CRANKCASE

Reference Figure 10

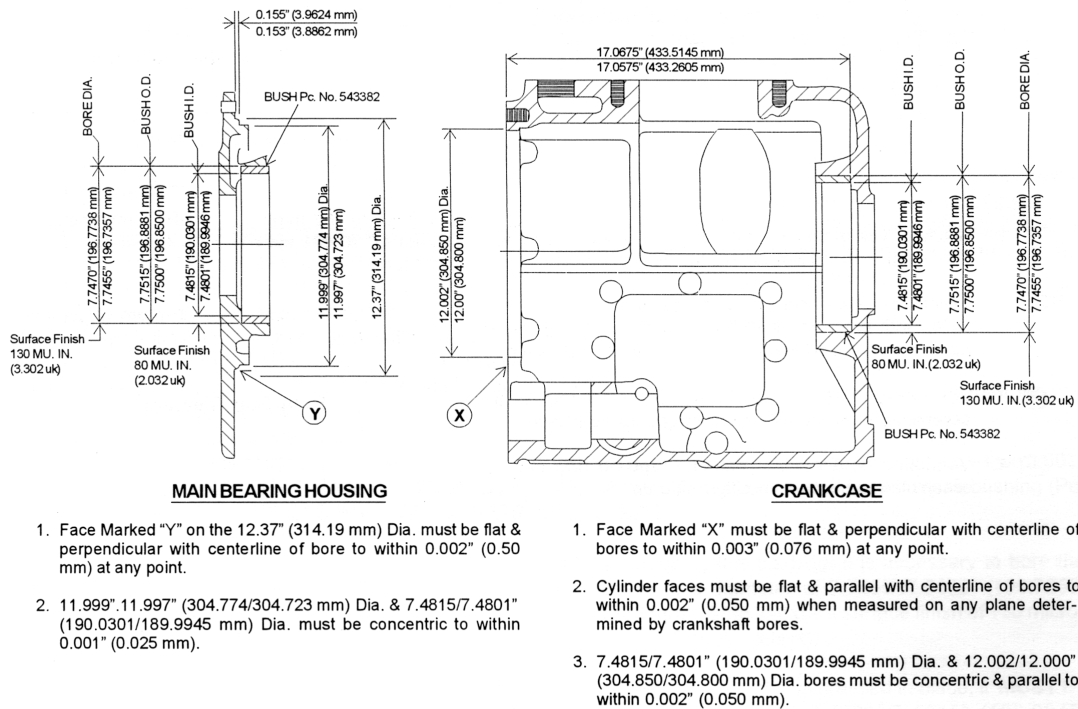


Figure 10 3CD Air Compressors – Instructions for Bushing Crankcase & Main Bearing Housing if worn in excess of 0.0021"

1. Replace the crankcase if it is damaged beyond repair.
2. If the main bearing bore is eccentric or worn more than 0.002" (0.050 mm), it may be rebushed using repair bushing (Pc. No.543382).

In using this bushing, it is necessary to bore the crankcase to a diameter of 7.7455"/7.7470" (196.7357/ 196.7738 mm). Bore to have a surface finish of 130 micro-inches (3.302 micro meters).

3. After the bushing is pressed in place, it **MUST BE** bored to a diameter of 7.4801"/7.4815" (189.9945/ 190.0301 mm) with a surface finish of 80 micro-inches (2.032 micro meters).

7.3.4 MAIN BEARING HOUSING

Reference Figure 10

1. Replace the main bearing housing if it is cracked, broken, or otherwise damaged beyond repair. If the main bearing bore is eccentric or worn more than 0.002" (0.050mm), the main bearing housing may be rebushed using repair bushing (Pc. No.543382).
2. In using the repair bushing, it is necessary to bore the main bearing housing to a diameter of 7.7455"/7.7470" (196.7357/196.7738 mm). The bore is to have a maximum surface finish of 130 micro-inches (3.302 micrometers).
3. After the bushing is pressed in place, it must be bored to a diameter of 7.4801"/7.4815" (189.9945/ 190.0301mm) with a maximum surface finish of 80 micro-inches (2.032 micrometers).

7.3.5 CRANKSHAFT

Reference Figure 11

Replace the crankshaft if an accurate and complete check reveals any of the following defects:

- Bent more than 0.002" maximum or cracked. 14.7.3 Crankpin is at condemning limit or beyond the condemning limit, as listed in "TABLE A" (Service Data).
- Main bearing journal worn to less than condemning limit as listed in "TABLE A" (Service Data).
- Taper or threads damaged to the extent of not being suitable for reconditioning.
- Keyway damaged beyond repair.
- Oil pump plunger diameters are at condemning limit or beyond as listed in "TABLE A" (Service Data).

7.3.6 FORGED STEEL CRANKSHAFTS

If reliable facilities are available, hard chrome plating or welding and subsequent regrinding to respective standard diameters is permissible on the forged steel crankshaft. Steel crankshafts can be identified by the word "PARK" forged into the shaft.

IMPORTANT

The Westinghouse Air Brake Company assumes NO responsibility for the results obtained by "reclaiming" a crankshaft by any party other than WABCO. The Westinghouse Air Brake Company assumes NO responsibility for damages to equipment or injuries which may be attributed to an equipment malfunction due to the use of a reclaimed crankshaft, nor will the Westinghouse Air Brake Company be responsible for any claims, including claims by third parties. New crankshafts may be purchased from the Westinghouse Air Brake Company's Locomotive Products Division.

7.3.7 DUCTILE IRON CRANKSHAFTS

The user may, at their own risk, reclaim a ductile iron crankshaft by applying a nickel electroplating solution of approved materials recommended by the supplier of the plating materials for this application. Chrome plating or welding may also be used.

The coating of the crankshaft MUST provide a good bond with the base metal and also provide a good bearing surface. The ground finish of the coatings are to be to Westinghouse Air Brake Company Specifications.

IMPORTANT

The Westinghouse Air Brake Company assumes NO responsibility for the results obtained by "reclaiming" a crankshaft, by any party other than WABCO. The Westinghouse Air Brake Company assumes NO responsibility for damages to equipment or injuries which may be attributed to an equipment malfunction due to the use of a reclaimed crankshaft, nor will the Westinghouse Air Brake Company be responsible for any claims, including claims by third parties. New crankshafts may be purchased from the Westinghouse Air Brake Company.

Ductile iron crankshafts can be identified by the WABCO monogram which is cast on the crank cheek of the crankshaft.

If the crankpin is worn to less than 3.621" (91.9734 mm) or if worn out of round more than 0.001" (0.025 mm), it may be ground to a definite undersize step of 0.010" (0.254 mm), or 0.020" (0.508 mm), or, if reliable facilities are available, plating or subsequent regrinding to respective standard diameter may be considered at the user's risk, if done by any party other than WABCO.

IMPORTANT

The 0.125" (3.175 mm) radius at each end of crankpin **MUST BE** maintained when grinding undersize diameters. Refer to "TABLE B" for stenciling and color coding information.

The finish of the crankpin **MUST BE** 16 micro-inches (0.4064 micro-meters) or better. A crankpin shall not be tapered more than 0.001" (0.0254 mm) nor be hourglass or barrel shaped by a like amount.

A very light polishing with crocus cloth, after grinding, should be beneficial in removing any roughness.

The crankshaft should then be stenciled for future reference in a visible location with its respective undersize letter W or Y and painted over with the color of paint as denoted in "TABLE B" (Service Data).

The crankpin throw **MUST BE** held to the following dimensions:

- "3-CD", "3-CWDL", "3-CDBL" and "3-CD" Compressors
2.81051/ 2.8145 inch (71.3867/71.4883 mm).
- "3-CDC", "3-CDCL", "3-CDCBL" and "3-CBC" Compressors
2.0605/2.0645 inch (52.3367/52.4383 mm).

The crankshaft oil seal journals, if scored, **MUST BE** refinished sufficiently to eliminate the score marks. The 3.497" to 3.503" diameter oil seal journals are to be plunged ground to 16 micro-inches (0.4064 micro meters) (RMS), maximum. No machine lead, nicks, scratches, or surface voids are permitted. The standard compressor oil seal (Pc. No.680008), may be used if the finished diameter is not less than 3.490" (88.646 mm). If the journals are worn beyond this limit, or if refinishing has taken the journals beyond this limit, the crankshaft is to be scrapped and replaced with a NEW crankshaft. If the user so desires, the user may, at user's risk, restore the finish to the original Westinghouse Air Brake Company specified dimensions by chrome plating, welding or electro plating.

The Westinghouse Air Brake Company assumes **NO** responsibility for the results obtained by any party other than WABCO.

The seat on the crankshaft on which either the old style oil relief valve (Pc. No.541791), or a blanking nut (Pc. No.540290), is seated must be refinished if scored, in order to obtain a tight seal.

The crankshaft taper must be checked and refinished if necessary .The finish of the taper must not exceed 80 micro-inches (2.032 micro meters).

7.3.8 CONNECTING RODS

Connecting rods with replaceable bearing inserts that meet dimensional and alignment specifications may be reconditioned to fit crankpins of either standard or undersize diameters.

Consult your Westinghouse Air Brake Company Representative for information on the exact bearing inserts and crankpins for specific applications.

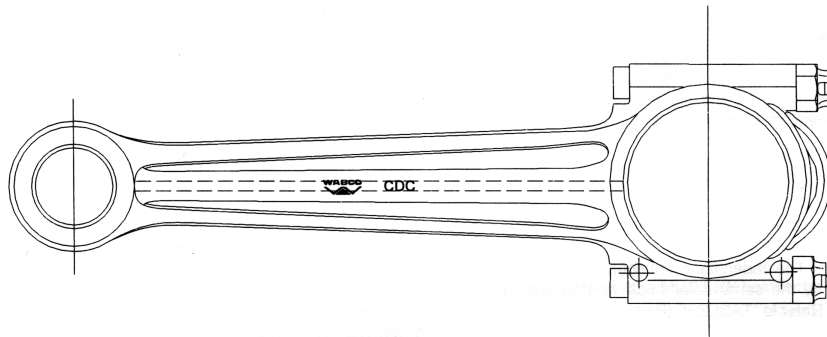
The undersize of the connecting rod should be identified by the same color code as that used for the crankpin. Refer to "TABLE B" (Service Data).

The insert bearing with the **HOLE AND OIL GROOVE MUST ALWAYS** be placed in the **ROD PART** of the bore while the plain insert **WITHOUT** the oil groove and hole **MUST BE** placed in the **CONNECTING ROD CAP** to insure lubrication for the wrist pin.

The "3-CD" Type Compressor may operate as low as 200 rpm, provided lubrication holes have been added to the connecting rods. Refer Figure 12 for modification instructions.

The connecting rod must be visually inspected before removing the insert bearing and connecting rod bushing. The satisfactory alignment of the connecting rod will be reflected by the wear patterns. If the wear pattern is straight across the bearing, no further action is required.

OLD STANDARD
Pc. No. 580081



NEW STANDARD
Pc. No. 580081

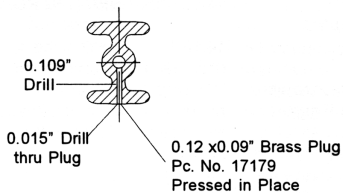
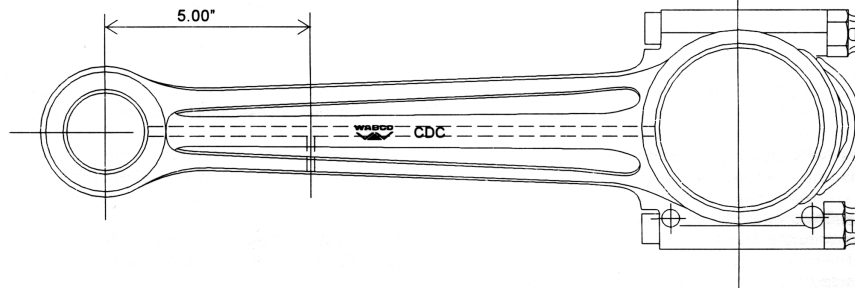
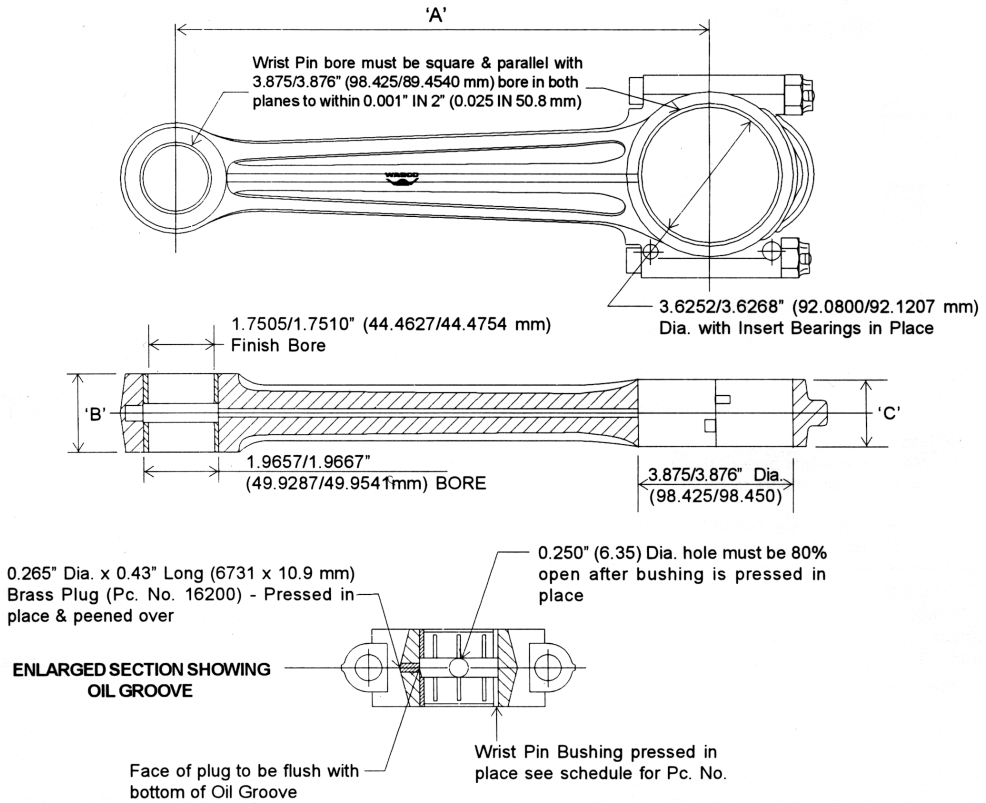


Figure 12 3CD Air Compressors Connecting Rod Modification for Lubrication Holes

7.3.9 CONNECTING ROD WRIST PIN BUSHING REPLACEMENT

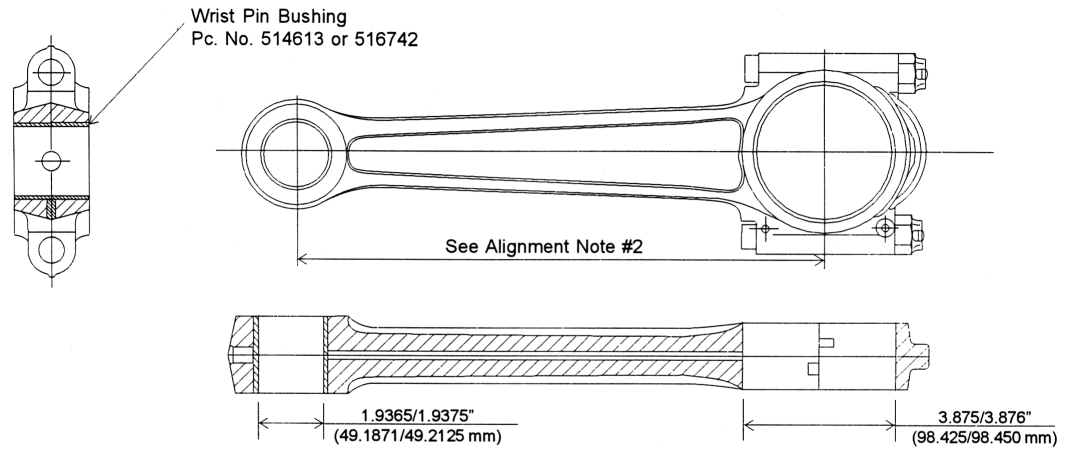
Instructions for the replacement of bronze wrist pin bushings in connecting rods are shown in Figure 13. Connecting rods which were originally equipped with teflon layered bushings require only a direct replacement with a new teflon layered bushing. Condemning limits for the wrist pin bore and the connecting rod must be as specified in "TABLE A" (Service Data) for the teflon layered bushed connecting rods and for the bronze bushed connecting rods.



COMPRESSOR TYPE	Dimension 'A'	Dimension 'B'	Dimension 'C'	Bush Pc. No.
2CD, 2CB, 2CDB & 2CBU	13.745/13.750" (349.123/349.250)	1.558/1.568" (39.573/39.827)	2.112/2.114" (53.644/53.695)	516742
4CD2UC, 6CD4UC & 6CDX4UC	13.745/13.750" (349.123/349.250)	1.558/1.568" (39.573/39.827)	2.112/2.114" (53.644/53.695)	516742
3CD, 3CB, 3CDB, 3CWD, 3CDL, 3CDBL, 3CWDL, 6CD, 6CB & 6CD3UC	13.745/13.750" (349.123/349.250)	1.995/2.005" (50.673/50.927)	1.744/1.746" (44.297/44.348)	514613
3CDC, 3CDCL, 3CDBL, 3CDCU & 3CDCUA	14.495/14.50" (368.173/368.300)	1.995/2.005" (50.673/50.927)	1.744/1.746" (44.297/44.348)	514613

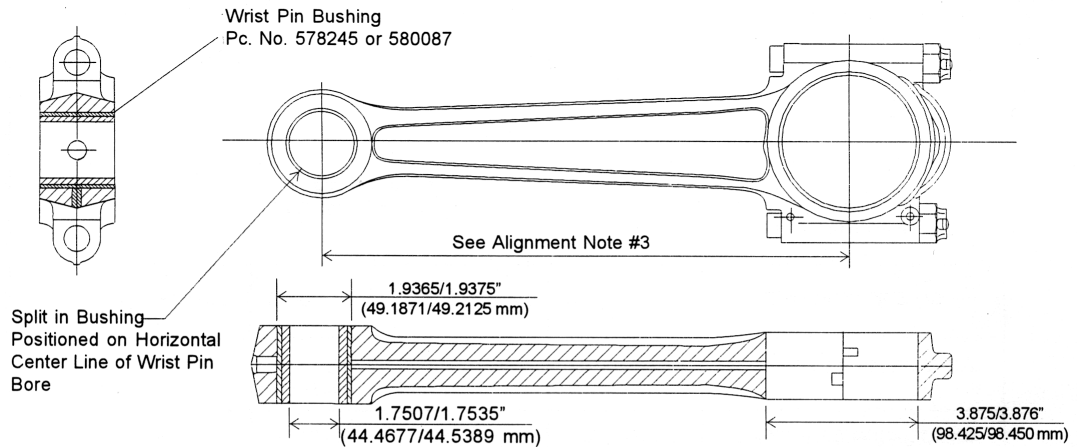
Figure 13 3CD Air Compressors Connecting Rod Bronze Wrist Pin Bushing Replacement

See Figure 14, for installation instructions for modifying previous bronze bushed connecting rods for teflon layered bushing installation.



NOTES:

1. Machine wrist pin bore of bronze bushing to 1.9365/1.9375" dia. (49.1871/49.2125 mm). Surface finish of bore to be 80 mu. in max (0.0020 mm).
2. 1.9365/1.9375" dia. (49.1871/49.2125 mm) bushing bore must be square and parallel to 3.875/3.876" (98.425/98.450 mm) dia. in both planes to within 0.001" in 2.00" (0.0254 mm in 50.8 mm)



NOTES:

1. Press bushing (Pc. No. 578245 or 580087) into connecting rod so that the oil hole in bushing and connecting rod are aligned
2. Check bushing bore to 1.7507/1.7535" dia. (44.4677/44.5389 mm) dimension. If bore is less than 1.7507" (44.4677 mm) ream to size. Bushing teflon coating must not be scuffed.
3. 1.7507/1.7535" (44.4677/44.5389 mm) wrist pin bore must be square and parallel to 3.875/3.876" (98.425/98.450 mm) dia. in both planes to within 0.001" in 2.00" (0.25 mm in 50.8 mm).

Figure 14 CD Type Air Compressors Connecting Rod Bushing Installation (Teflon Layered)

7.3.10 PROCEDURE FOR CHECKING ALIGNMENT OF CONNECTING ROD

Should a visual inspection of the used insert bearing reveal an uneven wear pattern the rod must be checked for alignment.

With the piston removed from the connecting rod, insert the wrist pin into the connecting rod at the wrist pin end. Insert a 3.624" (92.05 mm) diameter pin into the crankpin end of the connecting rod and tighten the connecting rod cap securely to the pin with 100 to 150 foot-pounds torque (135.1/202.7 Nm) for castle nuts.

Place the pin at the crankpin end of the connecting rod between a pair of "V" blocks on a flat checking surface as shown in Figure 15. With the connecting rod perpendicular to the checking surface, check the distance from the checking surface to the highest point at both ends of the wrist pin. This check should be made with a dial indicator. The reading from the checking surface to both ends of the wrist pin **MUST BE** within 0.001" (0.025 mm) for every 6" (152.4 mm) length of wrist pin.

Turn the wrist pin end of the connecting rod downward until the connecting rod is horizontal to the checking surface. With the connecting rod in this position, check the distance from the checking surface to the highest point at both ends of the wrist pin. This check should be made with a dial indicator. The readings from the checking surface to both ends of the wrist pin **MUST BE** within 0.001" (0.025 mm) for every 6" (152.4 mm) length of wrist pin.

All connecting rod bearings on the same crankpin **MUST BE** of the same degree of standard size or undersize.

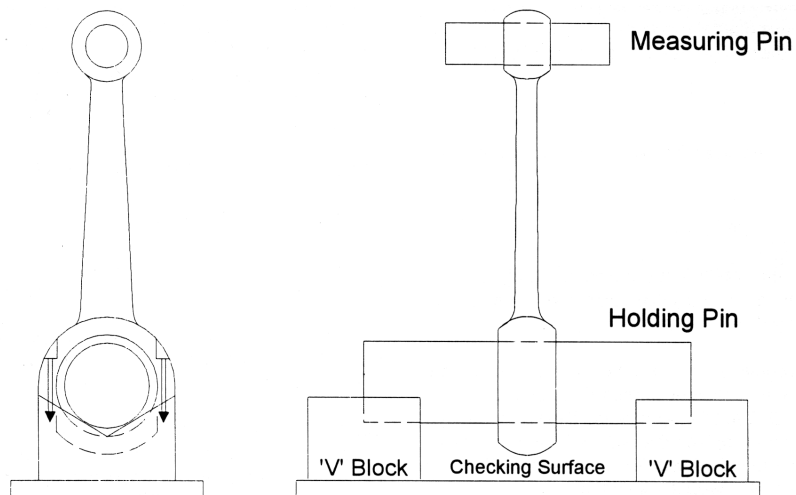


Figure 15 CD Type Air Compressors Connecting Rod Arrangement for Checking Alignment

7.3.11 CONNECTING ROD TO CRANKPIN FIT

The fit of the connecting rod on the crankpin is designed for insert bearings made to specifications of the Westinghouse Air Brake Company. Always use NEW insert bearings for wear adjustments. Cover the crankpin with a film of oil before placing the connecting rod and cap in place. Always use new insert bearings (Pc. No.540589).

Connecting rod caps **MUST BE** fitted with bolt (Pc. No.514617), castle nut (Pc. No.68770), and cotter pin (Pc. No.522772), which are available from the Westinghouse Air Brake Company. The correct torquing method is to torque the castle nuts evenly to 100 foot-pounds (135.1 Nm.); then continue torquing the nuts until the new cotter pin can be inserted through the slot in the nuts and drilled hole in the bolts.

CAUTION

DO NOT EXCEED 150 foot-pounds (202 Nm.) torque.

7.3.12 OIL PUMP -CARTRIDGE STYLE

1. Replace the oil pump plunger and oil pump body if worn beyond the limits in "TABLE A" (Service Data).
2. The oil pump cartridge located in the oil pump body must be removed and the inlet valve, discharge valve and oil pressure relief valve inspected. Replace the complete cartridge (Pc. No.566790) if any valve seat is worn or grooved.
3. The discharge valve (Pc. No.540281) must be replaced if worn.
4. The poppet style inlet valve must be inspected to assure that it has a good sealing surface with the inlet valve seat inside the cartridge. **REPLACE** the valve spring retainer (Pc. No.540280) if worn. **REPLACE** the inlet valve spring (Pc. No.540279).
5. The oil pressure relief valve located in the end of the cartridge must be removed for inspection. The valve (Pc. No.540281) must not be worn. **REPLACE** if necessary. Also **REPLACE** the oil pressure relief valve spring (Pc. No. 540282).
6. The older "3-CD" Type Air Compressors and Exhausters utilizing the uniflow style oil pump plunger assembly **MUST BE** within the wear limits as shown in Figure 16. The oil pump plunger and body must meet the dimensions specified in "TABLE A" (Service Data).

The oil pressure relief valve used with the uniflow type oil pump is located in the crankshaft. Refer to Figure 6.

Inspect the body of the relief valve to be sure that:

- The head flange is smooth and free from defects or damage.
- The threads are not damaged.
- The valve bore is not worn or excessively grooved.
- The valve seat is free of defects and that it is no wider than 0.040".
- The retaining ring groove is not worn or damaged. The ring groove diameter is to be 0.870" maximum. The width of the ring groove is not to exceed 0.074".
- Inspect the valve.
- Replace the valve if it is worn or if the sealing face is grooved.
- Inspect the spring seat.
- Replace the spring seat if the retaining ring lip is worn or damaged, or if the valve stop portion is peeled over or damaged.

A conversion kit (Pc. No.541430) , is available for replacing uniflow style oil pumps with cartridge type oil pumps on "3-CD" Type Compressors. If the cartridge type oil pump is used to replace the uniflow type oil pump, the relief valve in the crankshaft MUST BE removed and the proper blanking nut (Pc. No.540290), inserted.

7.3.13 OIL PRESSURE INDICATOR

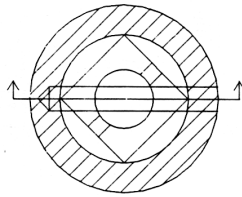
The Oil Pressure Indicator MUST BE inspected and be within the limits as specified in "TABLE A", (Service Data). Replace the body and/or the piston if worn beyond limits as specified in "TABLE A" (Service Data), or if scored. Replace Piston O-Ring (Pc. No.574422) and the Piston Stem O-Ring (Pc. No.567090).

7.3.14 OIL LEVEL GAGE-FLOAT TYPE

The Oil Level Gage MUST BE inspected to determine whether it is working properly. Replace the complete assembly if worn, broken or inoperative.

A New Oil Level Gage Dipstick can be used as a replacement for the Float Type Oil Level Gages without modification to the compressor crankcase.

Consult your Westinghouse Air Brake Company Representative for ordering and/or specific installation information concerning the Oil Level Gage Dipsticks.



Dimension from end of Oil Pump Plunger to bottom of ball for new assembly is 0.271" (6.883 mm).

When this dimension reduces to less than 0.225" (5.715 mm) the plunger must be scrapped.

Condemning Gage (Pc. No. 553632) should be used for checking this dimension.

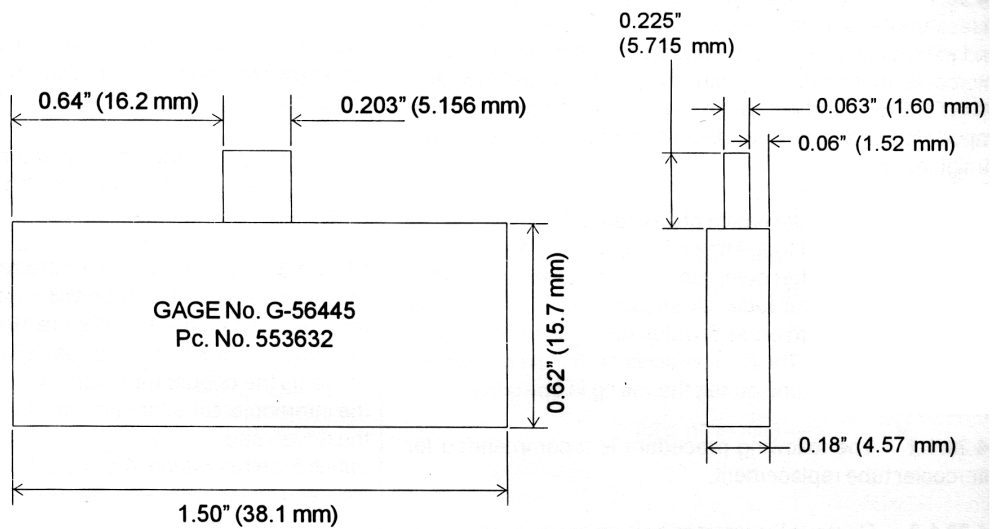
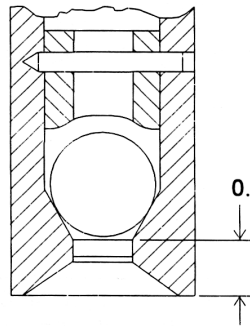


Figure 16 3CD Type Air Compressors Oil Pump Plunger Check Valve Seat Limit and Condemning Gage.

7.3.15 MAIN BEARINGS

Ball and spherical roller bearings **MUST BE** washed in aliphatic solvents (mineral spirits), completely dried by blowing with a low pressure jet of clean, dry air, and then examined carefully. If worn, pitted, damaged, or otherwise unserviceable, the bearing(s) **MUST BE** replaced.

If there is any question as to whether the bearing is serviceable or not, it is to be replaced. If a careful examination reveals that the bearing is in serviceable condition, the bearing is to be lubricated with oil immediately after examination and then wrapped in Volatile Corrosion Inhibitor (VCI) paper.

7.3.16 CYLINDER HEADS

Use a caustic type cleaner or other suitable cleaning solution that is capable of removing attached carbon. After the cylinder heads have been cleaned, they **MUST BE** dried completely. Use a low pressure jet of clean dry air to blow the cylinder heads dry.

Inspect the heads for damage. The cylinder heads may be reused if they are free of damage. If cracked, cut, broken, excessively worn, or damaged in any way, the head is to be **SCRAPPED** and replaced with a **NEW** Westinghouse Air Brake Company part.

Valve seats must be visually inspected for nicks and cracks.

7.3.17 VALVES

7.3.17.1 Old Style Discharge Valve Pc. No.566430

IMPORTANT

The Older Style Discharge Valve (Pc. No.566430), is now obsolete and no longer available. This obsolete valve is to be replaced with the **NEW** Style Discharge Valve (Pc. No.578773).

7.3.17.2 Old Style Inlet Valve Pc. No.514645

IMPORTANT

The Older Style Inlet Valve (Pc. No.514645), is now obsolete and no longer available. This obsolete valve is to be replaced with a Conversion Combination Kit (Pc. No.592512). This Conversion Combination Kit (Pc. No.592512), consists of a **NEW** Standard Inlet Valve with unloader (Pc. No.680001), and an Unloader Spring (Pc. No.592097). Valve (Pc. No. 680002) does not include the unloader and is used only in vacuum cylinder heads.

7.3.18 UNLOADER

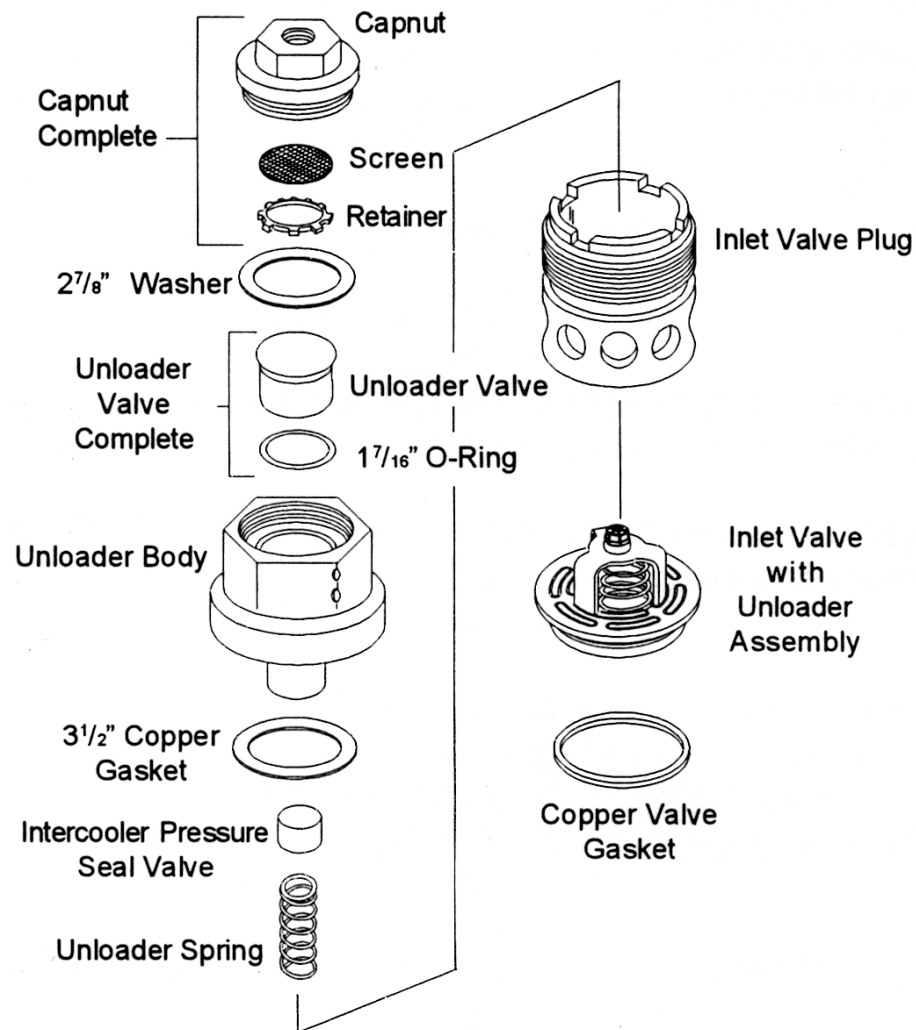


Figure 17 CD Type Air Compressors Unloader Assembly

The components of the different vintage of unloader valve, Figure 17, are not interchangeable. Exercise care when cleaning and assembling these parts so that a mix-up does not occur.

After disassembling and cleaning the unloader valve parts with mineral spirits and drying them completely by blowing with a jet of clean, dry air, inspect the unloader valve and valve seat for any nicks and grooves that can affect the sealing surface.

The present standard unloader valve complete (Pc. No.651188), is a direct replacement for the previous standard unloader valve complete (Pc. No.514667). The O- ring (Pc. No.593179), need only be replaced upon overhaul. No lapping is necessary with the latest design unloader valve. Present standard WABCO inlet valves (Pc. No. 680001), utilize an unloader spring (Pc. No.592097), for unloading purposes. Inspect the spring for cracks.

Inspect the intercooler pressure seal valve (Pc. No.563202) for nicks or cracks. Lap if necessary inside the unloader body (Pc. No.514657).

7.3.19 INTERCOOLERS -(Copper Finned Tube Type)

The finned copper tubing intercooler should be disassembled and the tubes should be cleaned internally and externally, or should be replaced. When cleaning the intercooler tubes externally, all loose paint and foreign matter **MUST BE** removed in order to maintain the efficiency of this important cooling device. Bent fins must be reasonably straightened.

The replacement of an intercooler tube requires the use of a special tools, shown in Figure 18, that permit the driving of the intercooler tube into the cast iron header without distorting the tube. A second tool is used to flare the hard brass ferrules before inserting inside the intercooler tube. The flare prevents the ferrule from falling into the intercooler tube during the rolling in operation.

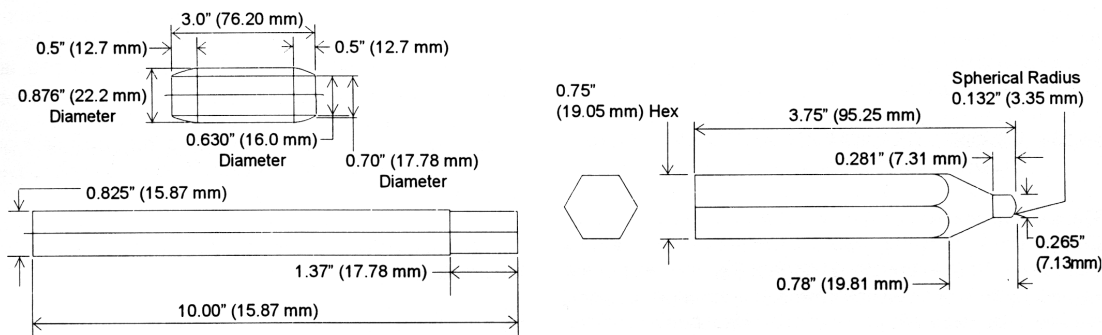


Figure 18 CD Type Compressors Intercooler Tube Replacement Tools

The following procedure is recommended for intercooler tube replacement:

1. Remove the intercooler tube assembly from the top and bottom headers and riser.
2. A wide sharp chisel is used to cut the intercooler tube level with the cast iron headers. No burrs must remain to facilitate removal.

3. Drive the intercooler tube and ferrule remnant out of the cast iron header from the outside of the casting inward.
4. Insert one end of the replacement tube in the cast iron header. The tube will be at a slight angle at this time. Apply the drive tool (Figure 19) to the opposite end of the tube. The sliding member slides over the tube and prevents the copper tube from swelling when driven. Drive the intercooler tube far enough into the cast iron header on the driven end. A few of the fins on the intercooler tube will bunch together during this operation. Space the intercooler tube equidistant between the headers.
5. Hard brass ferrules (Pc. No.517660) **MUST BE** flared with a tapered drive tool before inserting in the inside of the intercooler tube.
6. "C" clamp a flat steel plate on one end of the cast iron header. This prevents the intercooler tube from being forced above the clamping surface during the rolling operation.
7. Insert the ferrule inside the intercooler tube and roll in place. It is usually necessary to insert a screwdriver against the tube and pry outward against the next tube to prevent the intercooler tube from rotating during the initial rolling operation. This operation is necessary only on one end.
8. Remove the steel plate and insert the ferrule inside the intercooler tube. Roll in place.
9. The finned copper tube intercooler **MUST BE** reassembled and the inlet and discharge flanges blocked off with approximately 1/2" (12.7 mm) steel plates with holes drilled to match the intercooler flange. There must be no leakage present with 75 psig (517.24 kPa) in the intercooler.

7.3.20 ALUMINUM INTERCOOLERS AND TCIS

Aluminum intercoolers must be tested at 75 psig (517.24 kPa). If an intercooler shows signs of leakage it must be scrapped and replaced with NEW O.E.M. parts.

Disassemble the Thermostatically Controlled Intercooler System. The thermostat (Pc. No.653515), 0- ring (Pc. No.653927), and seal (Pc. No.653518) and high temperature indicator (Pc. No. 6540106) must be replaced with new parts at the 6 year (72 months) maintenance cycle.

7.3.21 RAPID UNLOADER (Purge Valve)

7.3.21.1 Removal

1. Remove all pilot air tube connections to the purge valve.
2. Remove the acorn nut and lock washer from the heater assembly to disconnect the heater from the purge valve.
3. Remove the purge valve from the intercooler by removing two 3/8" screws.
4. Remove the 3/8" flange gasket from the intercooler flange. SCRAP the gasket.
5. Visually inspect the exposed mounting face of the purge valve and its mounting flange on the bottom of the intercooler to be sure it is clean and free of damage.

7.3.21.2 Disassembly

1. Remove the four socket head cap screws (20-1) and lock washers (20-2) that secure the square cap (20- 3) to the body (20-8). SCRAP O-ring (20-4). Refer to Figure 19.
2. Remove cup seal (20-5) from the top of the piston and SCRAP cup seal.
3. Remove hex cap plug (20-15) from the body (20-8). SCRAP O-ring (20-14).
4. Remove spring (20-13) and seat assembly (20-9, 10, 11 & 12) from body (20-8).
5. Remove stop nut (20-12) from purge valve stem (20-9).

6. Remove seat washer (20-11) and seat (20-1 0) from purge valve stem (20-9). SCRAP Teflon seat (20-1 0).
7. Remove piston (20-6) from body (20-8). SCRAP O-ring (20-7).

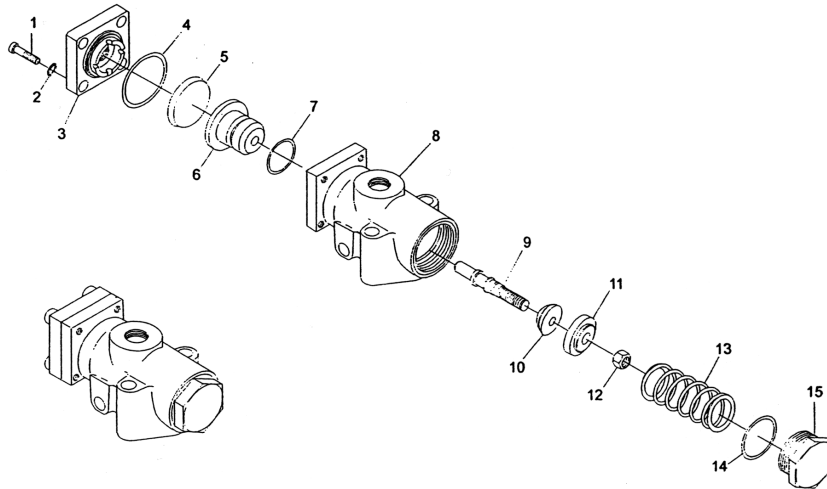


Figure 19 Purge Valve

7.3.22 CLEANING AND INSPECTION

7.3.22.1 Non-reusable Parts

All O-rings, cup seals, and Teflon seats are to be **SCRAPPED** and replaced with **NEW** Westinghouse Air Brake Company parts.

7.3.22.2 Remaining Parts

- Wash all remaining parts in a cleaning solvent as described in Section 7.3.21.2.
- After the parts are cleaned they **MUST BE** dried completely. A low pressure jet of clean dry air to blow the parts dry may be used.
- Inspect the parts and replace any part that is excessively worn or damaged in any way.

7.3.23 ASSEMBLY – PURGE VALVE

1. Coat the surface of O-ring (20-7) with Number 2 Silicon Grease meeting Westinghouse Air Brake Company Specification M-07680-02. Also fill the O-ring groove of the piston (20-6).
2. Install the NEW, lubricated O-ring (20-7) into the lubricated ring groove of the piston (20-6).
3. Install the lubricated piston/O-ring assembly into the purge valve body (20-8).
4. Install the purge valve seat (20a-10) into the seat washer (20-11).
5. Install the purge valve seat and seat washer assembly over the purge valve stem (20-9). Secure assembly with stop nut (20-12). Complete assembly by inserting the purge valve stem (20-9) into the piston (20-6) inside the body (20-8).
6. Install the spring (20-13) over the seat washer (20-11).
7. Install lubricated O-ring (20-14) over the Hex Cap Plug (20-15).
8. Install the Hex Cap Plug with O-ring into body (20-8) and tighten securely.
9. Lubricate the cup seal (20-5) and piston bore inside the body (20-8) using Westinghouse Air Brake Company Specification M-07680-02.
10. Install the lubricated cup seal (20-5) inside the lubricated piston bore.
11. Install O-ring (20-4) in body (20-8).
12. Install square cap (20-3) onto the body (20- 8) using four socket head cap screws (20-1) and lock washers (20-2) and tighten securely.

7.3.24 TESTING –PURGE VALVE

- After the purge valve is assembled **BUT BEFORE** it is returned to service it **MUST PASS** a series of tests following the Westinghouse Air Brake Test Specification.
- Contact your Westinghouse Air Brake Company Representative if additional information is required.

7.3.25 ALUMINUM AFTERCOOLERS

The aluminum aftercooler cores must be tested at 150 psig (517.24 kPa). Aluminum aftercoolers that show signs of leakage must be scrapped and replaced with new O.E.M. parts.

7.3.26 SAFETY VALVES

The relief valves and safety valves used on the intercooler, aftercooler, and discharge pipe must be tested in accordance with the following WABCO Test Specifications.

- A-1 Intercooler Relief Valve
Pc. No. 564072
WABCO Test Specification T-2625-0
- A-1 Intercooler Relief Valve set at 75 psig
Pc. No. 654153
WABCO Test Specification T-2625-0
- E-1 Safety Valve
Pc. No. 10526-0060
WABCO Test Specification T-2174-0
- J-1 Safety Valve
Pc. No. 558296-0180 & Pc. No. 558290-0175
WABCO Test Specification T-2668-0

7.3.27 CRANKCASE BREATHER

The metallic filter (Pc. No.540223) in the crankcase breather must be replaced to avoid disintegration due to fatigue. The breather valve diaphragm (Pc. No.575308) must also be replaced. All other breather parts must be replaced if necessary .

8.0 ASSEMBLY

8.1 CRANKSHAFT INSTALLATION

1. On the 3CD Type compressors, exhausters or combination compressor-exhausters, assemble the oil pressure relief valve in the crankshaft, if so equipped, and tighten securely.
2. When installing the parts of the crankcase and crankshaft assembly, the procedure outlined below should be followed.
3. Install the oil pressure indicator tube in place inside the crankcase.
4. Heat the main bearings to a temperature of approximately 200° F (93.3° C) and place one on the crankcase end of the crankshaft. Allow the bearing to cool on crankshaft before proceeding.

WARNING

Insulated gloves must be worn and extreme care taken to prevent burns to hands, face, and other parts of body from hot bearings.

5. Place the crankcase in a vertical position with the face of the main bearing housing upward. Apply a lifting device to the main bearing end of the crankshaft. Lower the crankshaft into the crankcase until the main bearing seats in its bore inside the crankcase. Install the oil pump plunger over the crankshaft and with the oil pump body over the oil pump plunger, slightly rock the upper end of the crankshaft back and forth at right angles to its axis until the oil pump body seats inside the crankcase.
6. Place the other main bearing onto the crankshaft using the method described in 15.1.4. On motor driven compressors the spherical roller bearing is applied to this side of the shaft.
7. Install a NEW main bearing housing gasket (Pc. No.591705), and place the main bearing housing in position, tap it lightly if necessary, and then, taking the necessary precaution not to damage the main bearing, apply cap screws and tighten uniformly. (See Section 14.26 for Torque Values).
8. Rotate the crankshaft to insure that main bearings turn freely. Tapping the bearing housing near the oil seal bore may relieve resistance to movement.
9. Place the crankcase in its normal upright position resting on its base.

NOTE

The crankshaft must rotate freely before continuing with the assembling procedure.

8.2 CRANKSHAFT OIL SEALS

Always install new crankshaft oil seals (Pc. No.680008), when the crankshaft has been removed from the compressor. The seals should always be replaced if there is any indication of oil leakage. Refer to Figure 20.

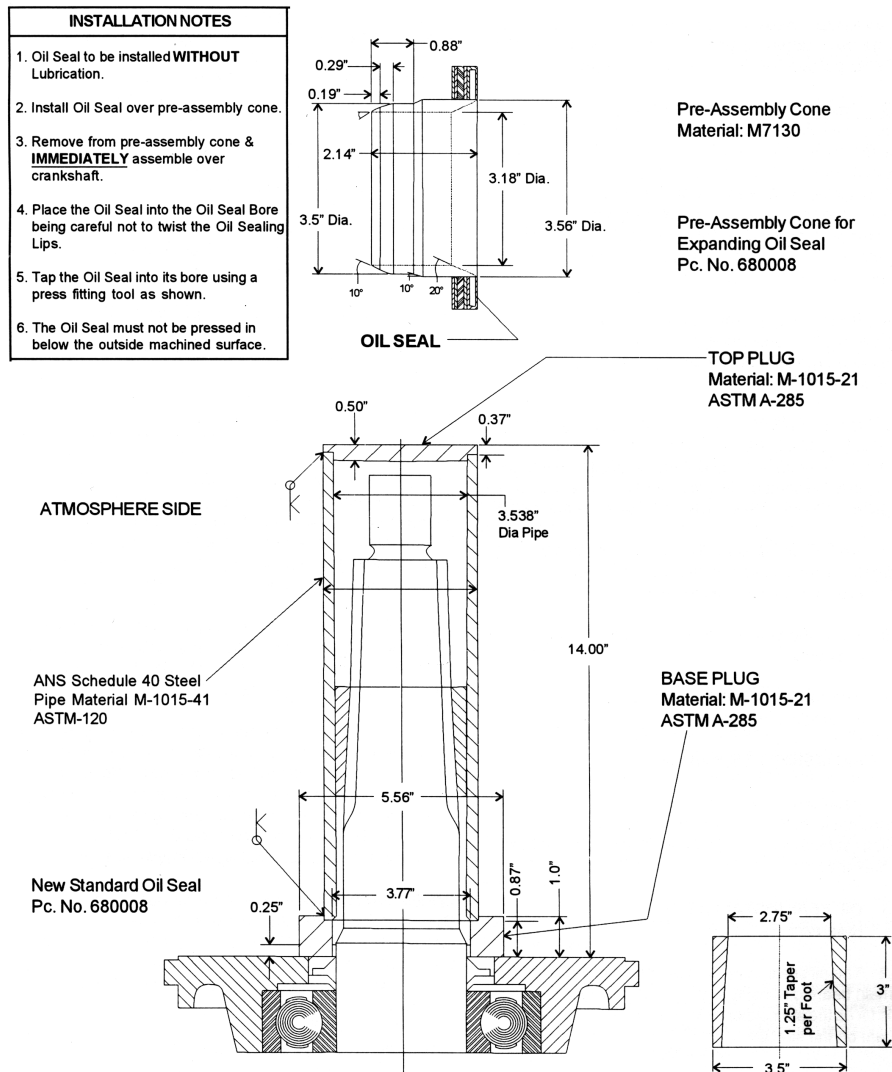


Figure 20 Oil Seal Installation Tools

1. The oil seals must be assembled in the crankcase and main bearing housing with two lips facing inward (only one lip faces the atmospheric side). Install the oil seal without lubricant on the seal lips.
2. When installing an oil seal, care must be exercised to insure that the seal is not damaged by the keyway or shoulder of the crankshaft.
3. Prior to installing an oil seal on a shaft, the seal should be "stretched" by first installing it over a 3.562" (90.475 mm) preassembly cone. This will enable and help prevent damage occurred when assembling over keyways and shoulders.
4. After "stretching" the seal, assemble the seal in place over the shaft by hand. Move the seal into position at the crankcase bore, being careful not to twist the inward facing seal lips so as to face outward. With the seal O.D. against the crankcase bore, place the tool over the crankshaft against the oil seal and tap the tool until the oil seal is flush with the outside machined surface.

8.3 CYLINDERS AND PISTON ASSEMBLY

Apply a liberal amount of oil to all mating parts before assembly.

The cylinders are first mounted to the crankcase using (2) new low pressure cylinder gaskets (Pc. No.514630) and (1) one new high pressure cylinder gasket, (Pc. No. 514627). Aluminum pistons must be heated to 110° F (43.3° C) before inserting the wrist pin through the piston - connecting rod assembly. The rings are installed as shown in Figure 8. Make certain the piston ring gaps are not aligned. Using the proper ring compressor tool, lower the piston -connecting rod assembly into the cylinder.

Care must be taken when lowering the piston assembly into the cylinder so as not to damage the piston rings, cylinders and the crankpin of the crankshaft. See Figure 21 for low and high pressure ring compressor tools.

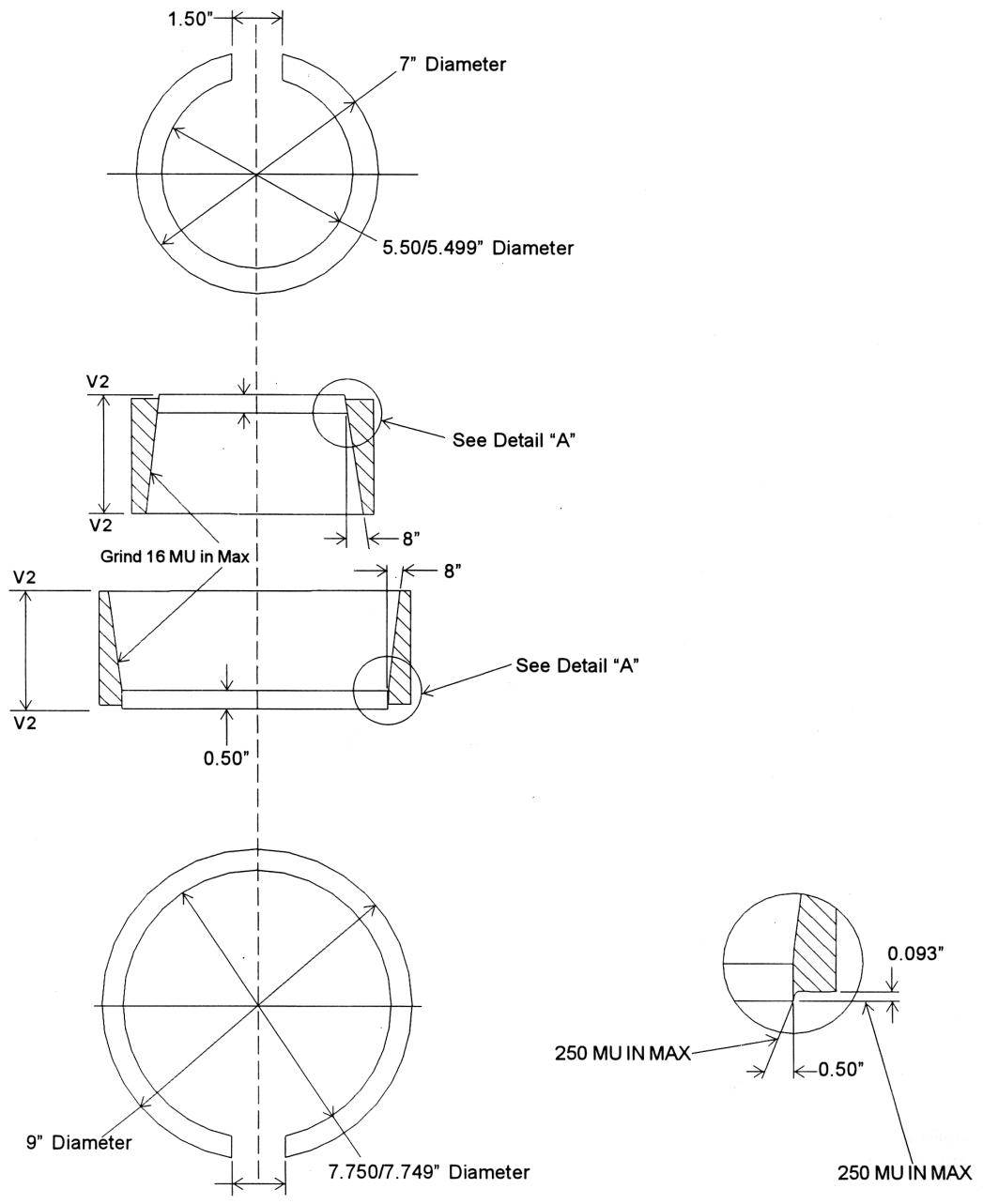


Figure 21 Low and High Pressure Piston Rings

When placing the connecting rod caps in position for assembling, make certain that the lettering stenciled on the cap agrees with the stenciling on the rod as the rod and cap are machined as a matched set. Cover the crankpin with a film of oil before placing the connecting rod and the cap in place. Install new insert bearing set (Pc. No.540589) in the rod and cap before assembling the crankshaft.

IMPORTANT

The connecting rod bolt and nut must be tightened according to the following procedure: Torque the castle nuts evenly to 100 ft.-lbs. (135.1 Nm.); then continue torquing the nuts until a new cotter pin (Pc. No.522772), can be inserted through the slot in the nut and the drilled hole in the bolt.

CAUTION

DO NOT EXCEED 150 foot-pounds (202 Nm.) torque. Observe that the compressor crankshaft turns freely after all of the connecting rod bolts have been torqued and the piston doesn't extend above the cylinder.

8.4 CYLINDER HEAD ASSEMBLY

1. Assemble the cylinder heads to the cylinders using new gaskets (Pc. No.514651).
2. Install the inlet and discharge valves in the heads using new copper valve gaskets (Pc. No.514644). Apply anti seize compound to both sides of the gasket.
3. Install and torque the valve plugs to 300 ft.-lbs. (496.8 Nm.) maximum. Coat the valve plug threads with anti-seize compound.
4. Compressors must have copper sealing gaskets on the valve caps, unloader cap nuts and unloader bodies. Apply anti-seize compound to both sides of the copper gaskets (Pc. No.592600 and Pc. No.558371).
5. The NEW STANDARD unloader assembly is installed with components arranged as per Figure 17.
6. Torque the unloader body assembly and discharge valve caps to 200 ft.-lbs. (271.16 Nm.).
7. Connect the unloader tubing to the heads to complete the assembly.

8.5 OIL PUMP CARTRIDGE ASSEMBLY and SIDE COVERS

1. The oil pump cartridge is assembled as per Figure 6.
2. Install the oil pump cartridge into the oil pump body in the bottom of the crankcase.
3. It is important that the roll pin in the cartridge body fits inside the slot in the oil pump body.
4. Install a NEW oil pump strainer screen (Pc. No. 517745), into the oil strainer body (Pc. No.540287), using retaining ring (Pc. No.517744).
5. Install the oil pump strainer complete inside the oil pump body using a 1/2X 4" hex head cap screw (Pc. No. 584610), and 1/2" lock nut (Pc. No.580862).
6. Install (2) NEW side cover gaskets (Pc. No.564866). Install the plain side covers using the 3/8 x 3/4" hex head cap screw (Pc. No.587946). Install the side cover with the oil fill elbow, dipstick or oil level float gage using the 3/8 x 11/8" hex head cap screw (Pc. No.15784). Take care not to bend the oil level float gage on compressors so equipped.

8.6 INTERCOOLER, AFTERCOOLER AND FAN ASSEMBLY

8.6.1 INSTALLATION OF INTERCOOLER ASSEMBLY

8.6.1.1 Non Aftercooled Compressor Intercooler

1. Install new flange gasket (Pc. No.514650) onto the low pressure cylinder head over the existing studs. Install risers (Pc. Nos. 590337 & 580335) to the low pressure head discharge using 1/2" nuts (Pc. No.502365). Tighten the nuts finger tight.
2. Install the center header (Pc. No.580336) to the high pressure head inlet using a new flange gasket (Pc. No. 514650) and 1/2" screws (Pc. No.514281). Tighten finger tight.
3. Position an intercooler core (Pc. No.581130) between the center header and a riser and secure together using new flange gaskets (Pc. No.514650), 1/2" screws (Pc. No. 514281), and 1/2" lock washers (Pc. No.514281). Tighten finger tight. Repeat this procedure for the other intercooler core.

4. Torque all connections to 50 ft.-lbs. (67.9 Nm.) beginning at the high pressure head/center header joint and working towards the low pressure head/riser joints.
5. Secure the bottom intercooler brackets to the crankcase using 1/2" screws (Pc. No.584840).
6. Install relief valve (valves) into tapped hole (holes) in the center header and tighten.

8.6.1.2 Aftercooled Compressor Intercooler Components

1. Install new flange gasket (Pc. No.514650) onto the low pressure cylinder head over the existing studs. Install risers (Pc. Nos. 651033 & 651034) to the low pressure head discharge using 1/2" nuts (Pc. No.502365). Tighten the nuts finger tight.
2. Install the center header (Pc. No.651 032) to the high pressure head inlet using a new flange gasket (Pc. No. 514650) and 1/2" screws (Pc. No.583810). Tighten finger tight.
3. 17.2.3 Position an intercooler core (Pc. No.651 029) between the center header and a riser and secure together using new flange gaskets (Pc. No.514650), 1/2" screws (Pc. No.583510), and 1/2" lock washers (Pc. No.514281). Tighten finger tight. Repeat this procedure for the other intercooler core.
4. Torque all connections to 50 ft.-lbs. (67.9 Nm.) beginning at the high pressure head/center header joint and working towards the low pressure head/riser joints.
5. Install relief valve into the tapped hole in the center header and tighten.

8.6.1.3 Thermostatically Controlled Intercooler Assembly

1. Install a new seal (Pc. No.653518) into the bottom bore of the Thermostat By-Pass Valve Housing (Pc. No. 653513). Install a new o-ring (Pc. No.653927) into the counter bore in the top of the Thermostat By-Pass Valve Housing. Install a new thermostat (Pc. No.653515) through the top of the bypass housing such that the large circular section passes through the seal and the flange rests inside the o-ring. Exercise care not to tear the seal or o-ring during the assembly process.
2. Place the high pressure inlet manifold onto the top of the Thermostat By-Pass Valve Housing and gasket and secure with 112" screws (Pc. No.11760) and tighten to 20 ft.- lbs. (27.12 Nm.).
3. Coat the heater cartridge and mating bore in the purge valve with thermal joint compound M-O7349- 00. Install the heater into the purge valve, install the acorn nut onto the heater cartridge and torque to 35 inch-pounds.
4. Install a new flange gasket (Pc. No.93839) into the rapid unloader seat in the bottom of the intercooler. Assemble the rapid unloader onto the gasket/intercooler flange and secure with 318" bolts and lock washers. Torque the bolts to 20 ft. lbs. (27.12 Nm.)
5. Assemble the Thermostat By-Pass Valve Housing/ manifold to the top flange of the intercooler (Pc. No.653512) using a new flange gasket (Pc. No.514650) and 112" screws (Pc. No.58381 0). Tighten finger tight.
6. Place a new flange gasket (Pc. No.514650) over the studs on the low pressure heads. Assemble the intercooler By-Pass Manifold over the low pressure head studs and to the bottom of the Thermostat By-Pass Valve Housing using a new gasket (Pc. No.653517), 318" screws (Pc. No.584541) and 112" nuts (Pc. No.502365). Tighten the 318" screws to 20 ft.-lbs. (27.12 Nm.). Assemble the By-Pass Manifold to the intercooler flange utilizing a new flange gasket (Pc. No.514650). Tighten the remaining hardware finger tight.
7. Assemble the intercooler connector (Pc. No.652637) to the remaining low pressure head studs. Assemble the connector to the intercooler using a flange gasket (Pc. No. 514650) and 112" screws (Pc. No.583810). Tighten finger tight.

8. With the intercooler assembly on the compressor torque the remaining hardware to 50 ft.-lbs. (67.9 Nm.). Torque the manifold to high pressure head connection first, followed by the bypass housing to intercooler connection, the intercooler to manifold, connector to intercooler then finally the connections at the low pressure heads.
9. Connect the rapid unloader pilot air tube to the rapid unloader and the unloader fitting on the low pressure head.
10. 17.3.7 Install a 75 psig pressure setting relief valve (Pc No 654153) into the tapped hole in the bypass manifold and tighten.
11. Install new high temperature indicator (Pc. No. 654006) into the tapped hole on top of the high pressure inlet manifold.

8.6.1.4 One Piece Intercooler Assembly

1. Assemble the intercooler (Pc. No.653078) to the high pressure head using a new flange gasket (Pc. No 514650) and screws (Pc. No.58381 0). Tighten finger tight.
2. Install new flange gaskets (Pc. No.514650) over the studs of the low pressure heads.
3. Assemble the right and left connectors (Pc. No 652637 and 652638) over the low pressure head studs. Fasten the connectors with nuts (Pc. No.502365). Tighter finger tight.
4. Install new flange gaskets (Pc. No.514650) between the connectors and intercooler inlet flanges and fasten with screws (Pc. No.58381 0). Tighten finger tight.
5. Torque all connections to 50 ft.-lbs. (67.9 Nm. beginning at the high pressure head/intercooler joint am working to the low pressure head/connector joints.
6. Install relief valve into the tapped hole in the center header and tighten.

8.6.2 INSTALLATION OF AFTERCOOLER COMPONENTS

8.6.2.1 Installation Of Non By-Pass Aftercooler

1. Attach aftercooler brackets (Pc. No.650793) to crankcase with 112" screws (Pc. No.584840) (4 REQD).
2. Slide aftercooler core (Pc. No.650792) into aftercooler brackets (Pc. No.650973) through the side.
3. Fasten top of aftercooler (Pc. No.650972) into aftercooler brackets (Pc. No.650973) and bottom of intercooler assembly with 3/8 x 11/2" screws (Pc. No.581 064 (4 REQD).
4. Fasten bottom of aftercooler to aftercooler brackets with 3/8 x 1118" screws (Pc. No.534357) (4 REQD), and 3/8" stop nuts (Pc. No.589357) (4 REQD).

8.6.2.2 Installation Of High Pressure Discharge Pipe

1. Attach inlet side of high pressure discharge pipe (Pc. No.651031) with NEW flange gasket (Pc. No.514650) to high pressure discharge flange of high pressure cylinder with 1/2 x 13/8" screws (Pc. No.11760) (4 REQD).
2. Attach discharge side of high pressure discharge pipe (Pc. No.651 031) with NEW flange gasket (Pc. No. 514650) to top inlet flange connection of aftercooler (Pc. 650972) with 1/2 x 11/2" screws (Pc. No.584543) (4 REQD) and 1/2" lock washers (Pc. No.514281) (4 REQD). When all parts are assembled, tighten all cap screws to 50 ft.-lbs. (67.9 Nm.) and 3/8" screws to 20 ft.-lbs. (27.12 Nm.).
3. Install J-1 Safety Valve (Pc. No.558296-0180) into high pressure discharge pipe (Pc. No.651031), if so equipped. TIGHTEN SECURELY.

8.6.2.3 Installation Of By-Pass Aftercooler

1. Attach aftercooler brackets (Pc. No.650973) to crankcase with 1/2" screws (Pc. No.584840).
2. Slide aftercooler core (Pc. No.653765) into aftercooler brackets through the side.
3. Fasten the top of the aftercooler and bottom of the intercooler to the aftercooler brackets using 3/8" screws (Pc. No.581064) and nuts (Pc. No.589357). Tighten finger tight.
4. Fasten the bottom of the aftercooler to the aftercooler brackets using 3/8" screws (Pc. No.534357) and nuts (Pc. No.589357). Tighten finger tight.
5. Assemble the header (Pc. No.653766) to the high pressure head using a new flange gasket (Pc. No.514650) and 1/2" screws (Pc. No.582810). The header should be mounted such that the 1/2" diameter hole is facing left (towards the aftercooler's discharge side). Tighten finger tight. Install a safety valve (Pc. No.558296-0180), into the header if so equipped.
6. Attach the discharge pipe (Pc. No.653767) to the header using a new flange gasket (Pc. No.514650) and screws (Pc. No.579623). Tighten finger tight. Attach opposite end of the discharge pipe to the aftercooler inlet using a new flange gasket (Pc. No.514650) and screws (Pc. No.584544) with lock washers (Pc. No.514281) .Tighten finger tight.

7. Attach the bypass pipe (Pc. No.653764) to the header (side with 1/2" hole) with a new flange gasket (Pc. No. 514650) and screws (Pc. No.579623). Tighten finger tight. Attach the opposite end of the bypass pipe to the aftercooler using a new flange gasket (Pc. No.514650), screws (Pc. No.584544) and lock washers (Pc. No.514281). Tighten finger tight.
8. Torque all 1/2" hardware to 50 ft.-lbs. (67.9 N.m.). Begin torquing the hardware at the high pressure head and work towards the aftercooler. Torque the 3/8" hardware to 20 ft.-lbs. (27.12 Nm.).

8.7 FAN HUB FITTING

1. The fan hub should have at least a 75% fit on the compressor crankshaft. Before heating the hub for mounting check the taper fit as follows.
2. Lightly cover the bore of the hub with a suitable blueing compound.
3. Snap the cold fan hub on the crankshaft. Remove the hub and inspect the blueing that has been transferred to the crankshaft. If at least 75% of the crankshaft shows traces of blueing the fit is satisfactory .If not the crankshaft taper must be dressed very lightly using 400 emery cloth. Repeat tests until the 75% minimum fit is achieved.

8.7.1 FAN HUB MOUNTING WITH HYDRAULIC REMOVAL FEATURE

1. Clean the fan hub bore and crankshaft with alcohol.
2. Trial mount the hub on the shaft and record a depth measurement from the end of the shaft to the hub face.
3. Heat the fan hub to 300° F (149° C) above the crankshaft temperature.
4. Quickly mount the hub to the shaft and snap it into position.
5. Measure the hub advance on the crankshaft. Proper advance is 0.045 to 0.055 inches. Allow to cool to room temperature.
6. Assemble nut on the end of the compressor crankshaft and torque to 500 ft.-lbs (670.9 Nm.). Torque set screws on the nut to 20 ft.-lbs (27.12 Nm.).

8.8 INSTALLATION OF FAN ASSEMBLY

1. Attach fan blades to fan hub with 3/8 x 2" hex head caps crews (Pc. 584542) and 3/8" locknuts (Pc. 671337). Torque all 3/8" nuts to 30 ft.-lbs (40.68 Nm.).
2. Attach top of fan guard assembly to intercooler assembly center header with 3/8" X 11/2" hex head capscrews (Pc. No.581 064) (2 REQD), and 3/8" elastic stop nuts (Pc. No.589357) (2 REQD).
3. Attach bottom of fan guard assembly to intercooler brackets or aftercooler brackets (Pc. No.650973) with 3/8" X 11/4" hex head caps crews (Pc. No.584541) (4 REQD) and 3/8" elastic stop nuts (Pc. No.589357) (4 REQD). Torque hardware to 20 ft.-lbs. (27.12 Nm.).

8.8.1 FANS WITH ONE PIECE MOLDED FAN

1. Assemble the fan onto the fan hub assuring that the fan is fully seated against the hub.
2. Install six screws and lock washers (size depends on application). Torque the screws to the appropriate torque values as noted in Section 14.26.

8.9 INSTALLATION OF DRIVE MOTOR

Install compressor drive motor according to the EMD specifications. Consult your EMD representative for further assistance.

9.0 WEAR-IN and TESTS

Compressors which have been reconditioned and have undergone major repairs such as covered by the preceding instructions must be subjected to a reasonable wear-in period.

The compressor, after being properly and completely assembled with WABCO APPROVED AIR INLET FILTERS and with the crankcase filled the appropriate lubricating oil for the anticipated operating conditions, see paragraph 3.2, should be placed on a suitable test stand. This test stand should be equipped with a motor of sufficient horsepower (Service Data) preferably of the variable speed type, to which the compressor can be mechanically coupled.

During the entire breaking-in period, the air filters must be in position to prevent damage due to entrance of foreign particles.

Due to the temperatures developed during break-in, auxiliary fan cooling is to be provided with a fan capacity of approximately 4100 cu. ft./min. (116.1 cubic meters/min.) per minute at an average velocity of 2000 cu. ft./min. (656 cubic meters/min.).

With the compressor arranged on the test stand, make the connection from the compressor discharge port to the pressure reservoir. With the globe valve open and the 17164" (6.7 46mm) orifice disc (Pc. No.520439), in the orifice holder, operate the compressor according to the wear in schedule shown in item 18.5.

9.1 WEAR-IN SCHEDULE

Reference the Wear-In Schedule in the Service Data section.

1. The oil pressure should be checked at frequent intervals during the test run and must never be less than 15 psig (103.42 kPa) at any of the above test speeds. Install a test gage in the tapped hole provided in the oil pressure indicator body or flange if so equipped.
2. Remove test gage at completion of tests and replace proper pipe plug.

NOTE

The test gage will indicate the actual oil pressure as well as check the accuracy of the oil pressure indicator. If the indicator stem fails to extend approximately 3/4" (19.05 mm) beyond the cap at an oil pressure of 15 psig, (103.42kPa), shims 1/16" thick (1.5875 mm) (Pc. No.562559), and 1/32 thick (0.7937 mm) (Pc. No.562560), may be added or removed as required from between the indicator piston and spring.

3. If any parts such as pistons, cylinders, rings, wrist pins, connecting rods or bearings are replaced, all tests must be repeated.

9.2 COMPRESSOR CAPACITY TEST

1. After the compressor is completely reassembled, it must be operated again at maximum speed and pressure for a period of not less than one-half hour against 100 psig (689.47 kPa) to regain its normal operating temperature.
2. The capacity test should then be made in accordance with the arrangement for testing as shown in Figure 22.

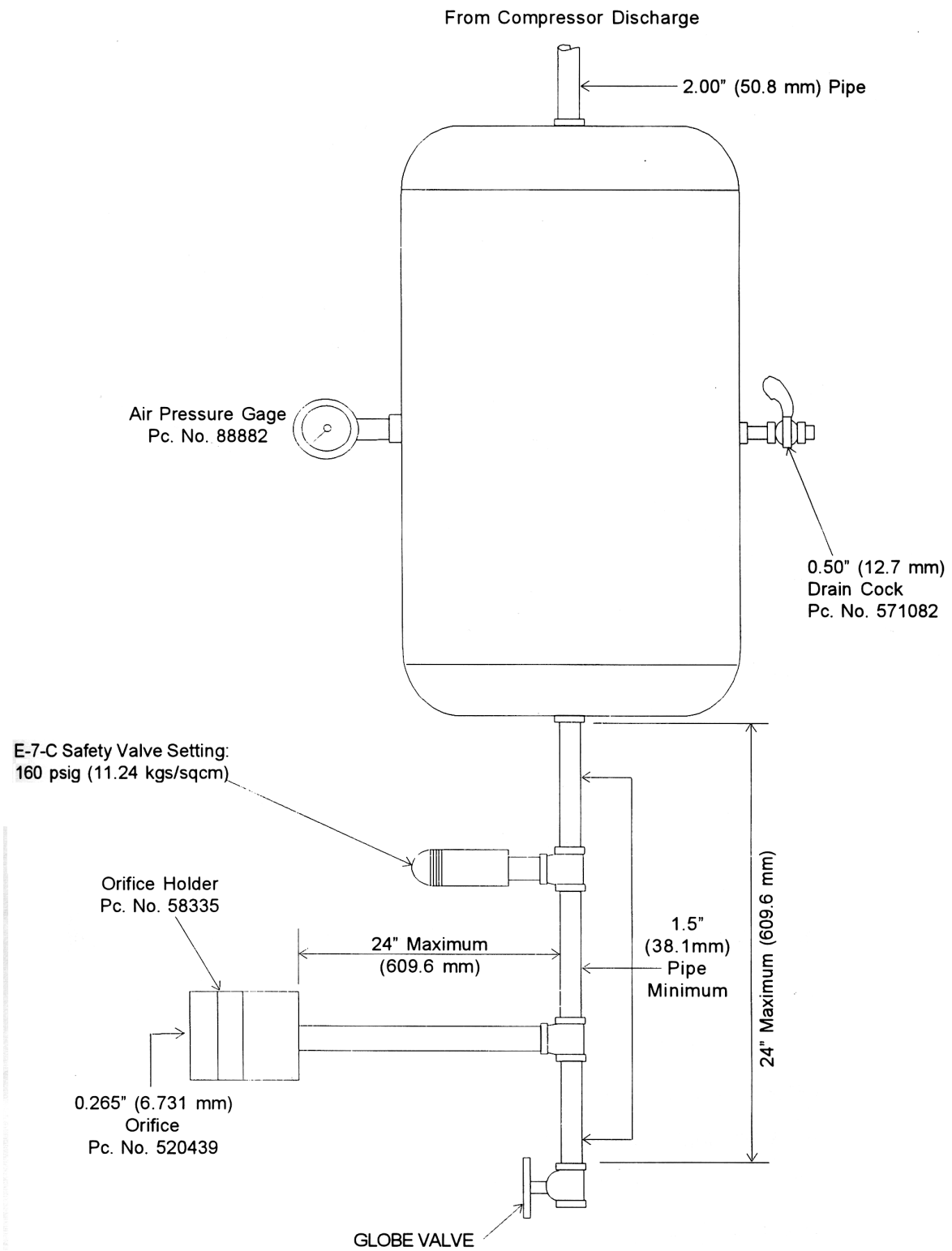


Figure 22 Compressor Capacity Test Arrangement

3. The 17/64" diameter orifice (6.7468 mm) as indicated on for each compressor must be in the orifice holder for the capacity test.

4. Operate the compressor at 400 rpm or higher, then close the globe valve. Observe pressure on the reservoir gage. After the pressure is balanced, it should be compared with the pressure at the respective speed as shown on the speed versus pressure curve shown in Figure 25 to Figure 28 in the Service Data Section.

10.0 COMPRESSOR INSTALLATION

10.1 INSTALLATION AND ALIGNMENT OF COMPRESSOR WITH DIESEL ENGINE

Installation of a new compressor or one being installed after overhauling requires careful consideration as regards proper alignment with the diesel engine when direct mechanical drive is involved. Regardless of the effort being made in properly repairing or rebuilding a compressor and the good workmanship applied, it cannot be expected to give satisfactory and reasonably long service life if not properly aligned and coupled to the diesel engine drive shaft. Use proper lifting mechanism capable of handling a minimum of 3000 lbs. (1360.8 kilograms) during this installation.

The alignment should be checked with a dial indicator in order to insure proper coupling.

For detailed procedure and installation values when installing the coupling, reference should be made to the locomotive builders instruction manual for the compressor drive system.

10.2 INSTALLATION OF MOTOR DRIVEN COMPRESSOR

Install the compressor drive motor according to EMD specifications. Electrical hookups must be according to the application specific electrical schematic or serious damage may occur to the motor. Consult your EMD representative for further assistance.

11.0 PREPARATION OF COMPRESSORS FOR DEAD STORAGE

To prepare compressor for dead storage, the following procedure is recommended.

1. With the compressor stopped, remove the compressor inlet filters from the inlet flange of each of the low pressure cylinders.
2. Start the compressor and run at approximately 500 RPM.

WARNING

An explosion can occur if the rust prevention oil is introduced into the compressor unit too rapidly. To minimize the possibility of personal injury from such an event, use only an oil container having a nozzle (outlet) diameter of 0.25 inches.

3. While the compressor is hot and running, slowly pour approximately 2 ounces of anti-rust lubricant into each of the low pressure cylinder head inlet flanges.
4. Stop the compressor.
5. Seal off the compressor inlet filter openings and high pressure discharge opening.

12.0 TROUBLESHOOTING

Use the following troubleshooting chart to resolve most common compressor problems.

Troubleshooting Guide											POSSIBLE CAUSE		
PROBLEMS													
Compressor won't unload	Compressor makes knocking noise	Low oil pressure	Oil comes out crankcase breather	Excessive carboning of valves	Oil seals leak	Compressor passes excessive oil	Noisy valves	Intercooler passes excessive oil	Intercooler relief valve pops, intercooler pressure too high greater than 50 psig	Intercooler pressure too low - less than 40 psig	Air comes out of the unloader vent when the compressor is loaded	Air comes out of the unloader body vent for more than 30 seconds when unloaded	Intercooler pressure increases while the compressor is off with no unloaded air applied
✓									✓		✓		Defective unloader line, obstructed, insufficient unloader line pressure
✓									✓		✓		Unloader valve ring or o-ring defective, excessive unloader valve clearance
	✓	✓			✓								Excessive wear of: insert bearings, shaft, wrist pin bushing, or oil pump plunger
	✓												Foreign material in oil pump cartridge check valves
		✓	✓	✓		✓							Wrong finish on cylinder walls, cylinder worn
							✓						Valve not seated - defective copper gasket, valve plug not fully engaged
									✓				Leaking intercooler, gaskets, intercooler drains open
		✓											Oil strainer screen dirty
		✓											Dirty/obstruction in oil indicator line
		✓											Pressure gage defective
	✓						✓	✓	✓				Broken valve
													Dirty or defective inlet air filters
	✓	✓		✓		✓							Wrong oil
		✓											Low oil level
			✓	✓		✓			✓				Worn or broken piston rings
			✓	✓	✓	✓							Defective crankcase breather
								✓		✓		✓	Defective high pressure inlet valves
									✓			✓	Defective low pressure valves
								✓		✓		✓	Defective high pressure discharge valves
									✓		✓		Intercooler pressure seal valve not seated
			✓					✓					Dirty or obstructed intercoolers

Figure 23 Troubleshooting Guide

13.0 SERVICE DATA

13.1 REFERENCES

Alignment of Locomotive Rotating Equipment M.I. 1753F

Lubricant Specifications M.I. 1756E

13.2 TORQUE VALUES

The following torque limits are recommended when tightening the nuts and bolts on the compressor:

TORQUE VALUES CHART	
Part	Torque
5/8" bolts & nuts	90 ft.-lbs. (122.94 Nm.)
1/2" bolts & nuts	50 ft.-lbs. (67.9 Nm.)
3/8" bolts & nuts	20 ft.-lbs. (27.12 Nm.)
5/16" bolts & nuts	11 ft.-lbs. (14.91 Nm.)
1/4" bolts & nuts	5.5 ft.-lbs. (7.45 Nm.)
Connecting Rod Castle Nuts	100 - 150 ft.-lbs. (135.6- 203.4 Nm.)
Valve Plugs (Cages)	300 ft.-lbs. (406.8 Nm.)
Valve Cap Nuts (Inlet & Discharge)	200 ft.-lbs. (271 Nm.)
Unloader Cap Nut	200 ft.-lbs. (271 Nm.)
Unloader Body	200 ft.-lbs. (271 Nm.)
Coupling Nut	500 ft.-lbs. (678 Nm.)

13.3 GENERAL SPECIFICATIONS

GENERAL SPECIFICATIONS 3CD and 3CDC Type Air Compressors		
	3CD Type	3CDC Type
Rated Speed	1000 RPM	1100 RPM
Displacement at Rated Speed	307 CFM (8694.24 liters/min)	247.5 CFM (7009.2 liters/min)
Low Pressure Cylinder, Number & Diameter	(2) 7.75" Dia. (196.85 mm)	(2) 7.75" Dia. (196.85 mm)
High Pressure Cylinder, Number & Diameter	(1) 5.50" Dia. (139.70 mm)	(1) 5.50" Dia. (139.70 mm)
Number of Compression Rings per Piston	(2)	(2)
Number of Oil Rings per Piston	(2)	(2)
Stroke	5 ⁵ / ₈ " (142.875 mm)	4 ¹ / ₈ " (104.775 mm)
Number of Main Bearings	(2)	(2)
Type of Main Bearings	Conrad Type Single Row Ball	Conrad Type Single Row Ball
Crankpin Journal Lubrication	Pressure	Pressure
Wrist Pin Lubrication	Pressure	Pressure
Oil Pump Type	Fixed displacement plunger replaceable cartridge	Fixed displacement plunger replaceable cartridge
Oil Capacity - Quarts (Liters) Large Crankcase Small Crankcase	65 Quarts (61.5 Liters) 13 Quarts (12.3 Liters)	65 Quarts (61.5 Liters) 13 Quarts (12.3 Liters)
Compressor BHP @ Maximum Rated Speed & 140 psig (20.305 kPa) less Crankshaft Mounted Fan (3) Valve Heads (4) Valve Heads	80 65	63 60
Cooling	Fan (Depending on Applications)	Fan (Depending on Applications)
Intercooler Pressure	45 psig (6.526 kPa)	43 (6.236 kPa)
Oil Pressure (Minimum)	15 psig (2.175 kPa)	15 psig (2.175 kPa)
Valve Type	Plate or Disc-Spring Loaded	Plate or Disc-Spring Loaded
Dry Weight: with Small Crankcase with Large Crankcase with Small Crankcase & Aftercooler with Large Crankcase & Aftercooler with Large Crankcase & Aftercooler By-Pass	1162 lbs. (527.05 Kgs.) 1397 lbs. (633.67 Kgs.) --- --- ---	1162 lbs. (527.05 kgs.) 1397 lbs. (633.67 kgs.) 1360 lbs. (616.89 kgs.) 1640 lbs. (743.86 kgs.) 1735 lbs. (786.95 kgs.)

* The direct electric motor driven compressor uses one conrad style ball bearing and one spherical roller type bearing.

Figure 24 General Specifications 3CD and 3CDC Type air compressors

TABLE "A"
3CD Type Air Compressors

	Condemning Limit	
	INCHES	MILLIMETERS
Low Pressure Cylinder:		
Diameter	7.754 Max	196.951 Max
Length	12.3135 Min	312.7629 Min
High Pressure Cylinder:		
Diameter	5.504 Max	139.801 Max
Length	11.189 Min	284.2006 Min
Low Pressure Aluminum Pistons:		
Diameter	7.740 Min	196.596 Min
Compressor Ring Groove Width	0.1915 Max	4.8641 Max
Oil Ring Groove Width	0.2535 Max	6.4389 Max
Wrist Pin Bushing Diameter	1.7565 Max	44.6151 Max
	1.7507 Min	44.4678 Min
Wrist Pin Diameter	1.7485Min	44.4119 Min
Connecting Rod:		
Crankpin Bore with Inserts	3.6308 Max	92.2223 Max
Wrist Bore Brushed	1.7565 Max	44.6151 Max
	1.7507 Min	44.4678 Min
Main Bearings:		
Bore Diameter	7.4835 Max	190.0809 Max
Crankshaft:		
Main Bearing Journal	3.5433 Min	89.90 Min
End Play	0.060 Max	1.524 Max
	0.015 Min	0.981 Min
Crankpin Diameter	3.621 Min	91.9734 Min
Oil Pump Journal Diameter	4.373 Min	111.0742 Min
Oil Pump:		
Crankcase Oil Pump Body Bore Diameter	2.2525 Max	57.2135 Max
Oil Pump Body Diameter	2.2465 Min	57.0611 Min
Oil Pump Plunger Diameter	1.062 Max	26.9748 Max
Oil Pump Plunger Bore Diameter	4.378 Max	11.2012 Max
Perpendicularity of Oil Pump Plunger Large Bore to Plunger Diameter	0.002	0.0508

**TABLE "A" Continued
3CD Type Air Compressors**

	Condemning Limit	
	INCHES	MILLIMETERS
Oil Pressure Indicator:		
Piston Stem Diameter	0.239Min	6.0706 Min
Body Bore Piston Diameter	0.990 Min	25.146 Min
	0.995 Max	25.273 Max
Cap Nut Bore Diameter	0.243	6.1722
Unloaders:		
Unloader Valve Diameter	1.370 Min	34.798 Min
Unloader Valve Bushing Diameter	1.377 Max	34.9758 Max
Intercooler Pressure Seal Valve Diameter	0.869 Min	22.0726 Min
Intercooler Pressure Seal Bore Diameter	0.878 Max	22.3012 Max

13.4 PERFORMANCE DATA

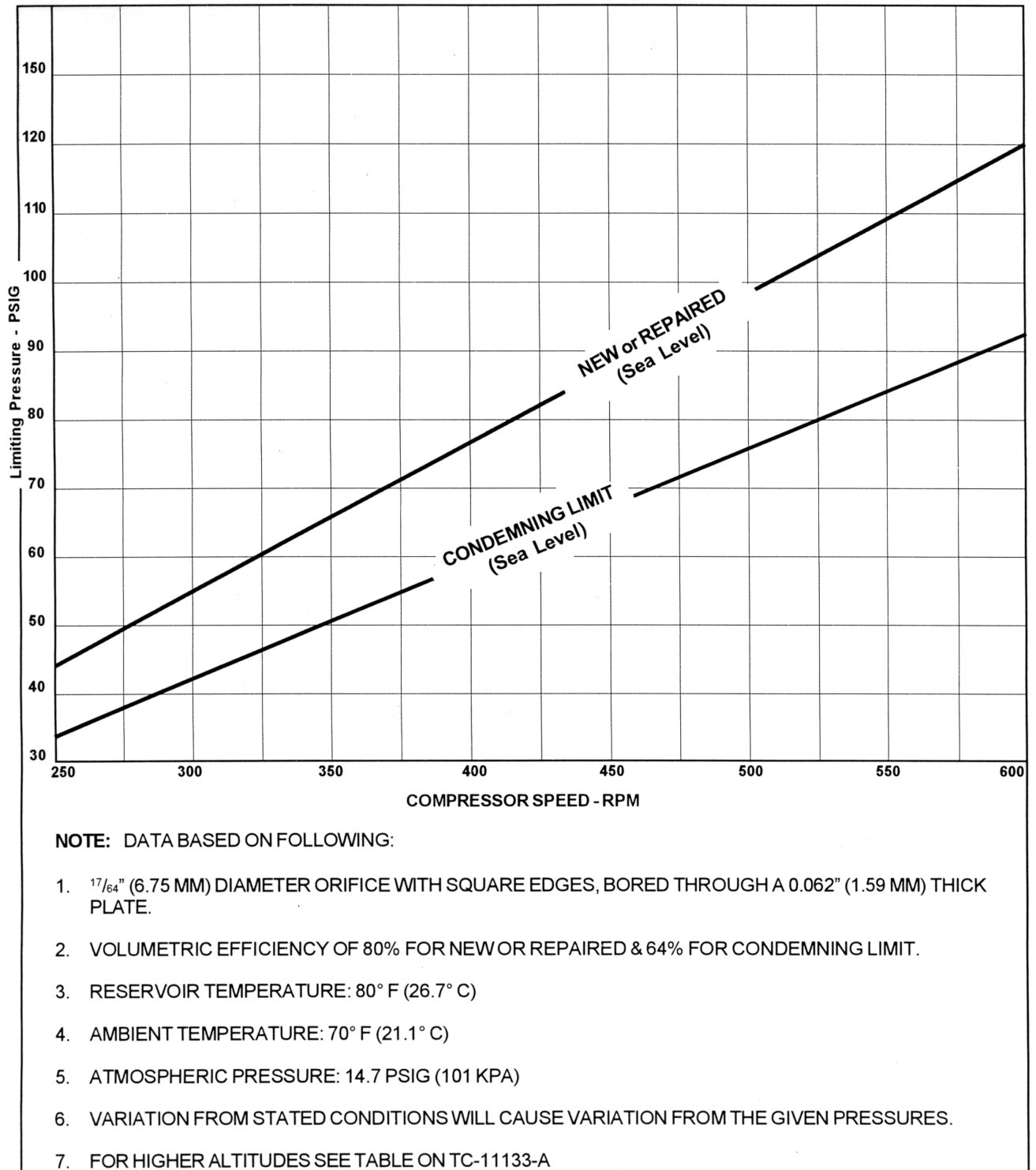


Figure 25 3CD Type Air Compressors Limiting Pressures vs. Speed Sea Level Conditions

3CDC TYPE AIR COMPRESSORS

Pressures (psig) to be Maintained at Various Elevations Above Sea Level										
New Or Repaired Compressor	RPM	0	1000	2000	3000	4000	5000	6000	7000	8000
	250	44	42	41	39	38	36	35	34	33
	300	55	53	51	49	47	45	44	42	41
	400	78	75	72	69	67	64	62	60	58
	500	99	95	91	88	85	82	79	76	74
	600	120	115	111	107	103	99	96	93	89
Condemning Limits	250	32	31	30	28	27	26	26	25	24
	300	41	39	38	37	35	34	33	32	31
	400	53	57	55	53	51	49	47	45	44
	500	76	73	70	68	65	63	61	59	57
	600	93	89	86	83	80	77	74	72	69
Pressures (kPa) to be Maintained at Various Elevations Above Sea Level										
New Or Repaired Compressor	RPM	0	304.8	609.5	914.4	1219.2	1524	1828.8	2133.6	2438.4
	250	303	290	283	269	262	248	241	234	228
	300	379	365	352	339	324	310	303	290	283
	400	538	517	496	476	462	441	428	414	400
	500	683	655	627	607	586	565	545	524	510
	600	827	793	765	738	70	683	662	641	614
Condemning Limits	250	221	214	207	193	186	179	179	172	166
	300	283	269	262	255	241	234	228	221	214
	400	407	393	379	365	352	338	324	310	303
	500	524	503	483	469	448	434	421	407	393
	600	641	614	593	572	552	531	510	496	476

Figure 26 3CDC Type Air Compressors Limiting Pressures vs. Speed Elevations Above Sea Level

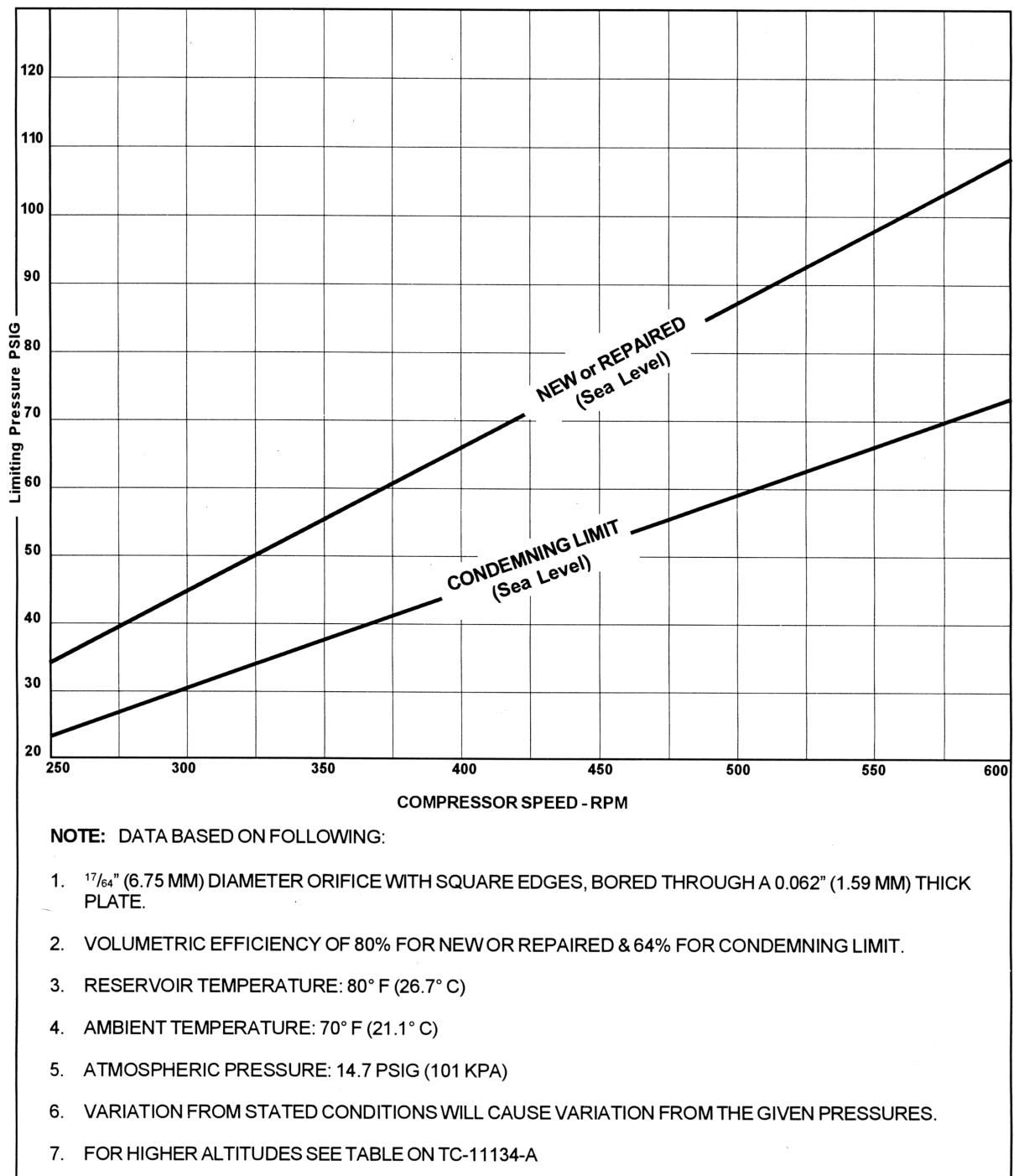


Figure 27 3CDC Type Air Compressors Limiting Pressures vs. Speed Sea Level Conditions

3CDC TYPE AIR COMPRESSORS

Pressures (psig) to be Maintained at Various Elevations Above Sea Level

	RPM	0	1000	2000	3000	4000	5000	6000	7000	8000
	New Or Repaired Compressor	250	34	33	31	30	29	28	27	25
300		42	40	39	38	36	35	33	31	29
400		60	58	55	53	51	49	47	44	41
500		78	75	72	69	67	64	62	58	53
600		96	92	89	85	82	79	76	71	65
Condemning Limits	250	24	23	22	21	20	20	19	18	16
	300	31	30	29	28	26	25	25	23	21
	400	45	43	42	40	38	37	36	33	31
	500	60	58	55	53	51	49	47	44	41
	600	73	70	67	65	62	60	58	54	50

Pressures (kPa) to be Maintained at Various Elevations Above Sea Level

	RPM	0	304.8	609.5	914.4	1219.2	1524	1828.8	2133.6	2438.4
	New Or Repaired Compressor	250	234	228	214	207	200	193	186	172
300		290	276	269	255	248	231	228	214	200
400		414	400	379	365	352	338	324	303	283
500		583	517	496	476	462	441	428	400	365
600		662	634	614	586	565	545	524	490	448
Condemning Limits	250	166	128	152	145	138	138	124	124	110
	300	214	207	200	193	179	172	172	159	145
	400	310	297	290	276	262	255	248	228	214
	500	414	400	379	365	352	338	324	303	283
	600	503	483	483	462	448	428	400	372	345

Figure 28 3CDC Type Air Compressors Limiting Pressures vs. Speed Elevations Above Seal Level

13.5 WEAR IN SCHEDULE

WEAR IN SCHEDULE			
RPM	TIME (Hours)	PRESSURE PSI	REMARKS
500	-	Atmosphere	
500	1 1/2	140 (965.51 kPa)	Soap flanges & discharge valve cap nuts
1000	1/2	140-125 (965.51 kPa – 862.06 kPa)	Check to see if compressor loads & unloads
1000	1 1/2	140 (965.51 kPa)	Continuous duty - volumetric efficiency test conducted in last half hour
WARNING: STATED MINIMUM AND MAXIMUM ARE NOT TO BE EXCEEDED OR COMPRESSOR DAMAGE AND PERSONAL INJURY MAY RESULT!			

Figure 29 Wear In Schedule

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