TRUCK, HEAVY, MC3, MACK – ALL TYPES

CRISP-AIR AIRCONDITIONER

MEDIUM GRADE REPAIR

This instruction is authorised for use by command of the Chief of Army. It provides direction, mandatory controls and procedures for the operation, maintenance and support of equipment. Personnel are to carry out any action required by this instruction in accordance with EMEI General A 001.

INTRODUCTION

1. This instruction details all the medium repair procedures for the Crisp-Air air conditioner, which is fitted as part of the Mack Noise Reduction modification.

2. This Repair Instruction contains procedures for removing, dismantling, repairing, assembling and installing the components of the air conditioning system. Where applicable, instructions for the adjustment, lubrication and minor servicing of these items are included.

3. It is vitally important that moisture, dirt and other foreign matter not be allowed to enter exposed components during repairs. Dirt in any system will cause almost immediate failure. Plug or protect all exposed openings including hoses, tubes and lines to prevent dirt entering the system. Use plastic plugs or covers only for this purpose. Do not use cloth or paper as plugs or covers.

ASSOCIATED PUBLICATIONS

4. For maintenance and repair procedures, refer to SAE J1628 – Technical Procedure for Using Electronic Refrigerant Leak Detectors for Service of Mobile Air Conditioning Systems.

5. Refer to the following publications for safety of personnel and prevention of damage to equipment:

- **a.** MSDS for R134a refrigerant;
- **b.** MSDS for compressor Polyalkylene Glycol (PAG) oil; and
- **c.** Defence Safety Manual.

SAFETY

WARNING

All industrial safety, work practices and equipment operating and maintenance instructions pertaining to this instruction are to be adhered to.

Chemical substances are to be stored, used and handled in accordance with Defence Safety Manual, applicable MSDS and EMEI Workshop E series.

Pressure Release

6. Before disconnecting any lines, always make sure refrigerant has been removed from the air conditioning system by recovering it with the appropriate recovery equipment.

7. When working on compressors, separate from the system, always be sure to carefully and slowly relieve internal pressure first. Internal compressor pressure can be relieved by removing the oil plug (if necessary) or by removing shipping caps/pads from both ports.

8. **Recovery of Refrigerant.** Never discharge refrigerant to the atmosphere. Always use approved refrigerant recovery/recycling equipment to capture refrigerant removed from the air conditioning system. Do not mix refrigerants in the same piece of equipment; one should be designated for R-12 and another for R134a.

Handling of R134a Refrigerant

9. Always observe the following points when handling R134a refrigerant:

- **a.** always wear eye protection;
- **b.** wear gloves;
- **c.** do not allow R134a to contact bare skin as this causes frost bite;
- **d.** do not heat containers of R134a;
- **e.** provide adequate ventilation when charging or recovering R134a, avoid breathing R134a vapour; and
- **f.** do not transfer refrigerant from cylinder to cylinder using a pump without knowing when the bottle being filled has reached 80% of its capacity, as the remaining 20% is used for thermal expansion.

Ventilation

WARNING

Refrigerants can produce poisonous gases in the presence of a flame. These gases could cause respiratory injury or death.

10. Keep refrigerants and oils away from open flames and always work in a well-ventilated area.

Avoid Use of Compressed Air

11. Do not introduce compressed air into an air conditioning system due to the danger of contamination.

R134a/PAG Oil Handling Precautions

12. Do not discharge R134a into the atmosphere. Even though its ozone depletion potential is zero, it does have global warming potential. Recovery and recycling are mandated by the relevant regulations. Use recovery equipment designated only for R134a. Never introduce another refrigerant into the R134a equipment.

13. Never mix R134a with other refrigerants or air conditioning system failure is likely to occur.

14. Use only Sanden specified PAG lubricants for R134a systems using Sanden compressors. If other lubricants are used, air conditioning system failure is likely to occur.

15. Never introduce R134a or PAG oil into a system not designed for them.

16. The Sanden specified PAG oils used in R134a systems absorb atmospheric moisture very quickly. Moisture in the air conditioning system can cause major damage or failure:

- **a.** Never leave PAG oil exposed to air for a prolonged time. Tightly reseal the oil container immediately after each use.
- **b.** During air conditioning system repair, cap all fittings as soon as opened and leave capped until just before they are to be reconnected.
- **c.** If a repair is performed on a R134a compressor or system, evacuate the system for at least 45 minutes before recharging. This is to ensure the complete removal of moisture that may have been absorbed by the PAG oil in the compressor and system.

17. When disconnecting electrical connectors, hoses and fittings, remove sufficient clamps to gain the necessary slack to avoid damage to connectors and fittings.

18. Discard all used gaskets, seals and O-rings.

19. When replenishing lubricants, use only those lubricants that are specified in this Repair Instruction.

20. Any fastenings or fittings being tightened to prescribed torques are to have dry, clean threads, unless otherwise specified. Thread sealants are to be applied to dry, clean, oil-free threads.

SPECIAL TOOLS

21. The special tools shown in Figures 1 to 7 are required to perform the maintenance tasks detailed in this document.

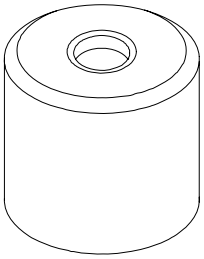


Figure 1 Armature Driver

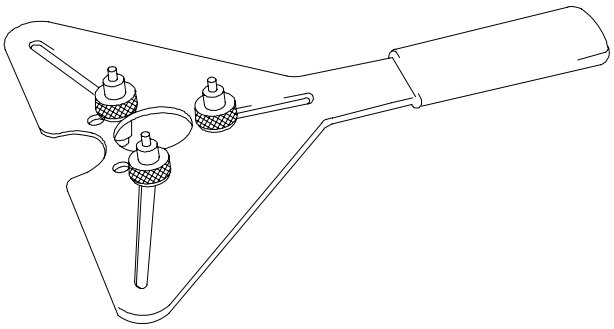


Figure 2 Armature Plate Spanner

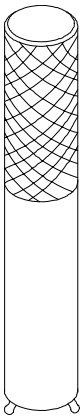


Figure 3 Lip Seal Tool

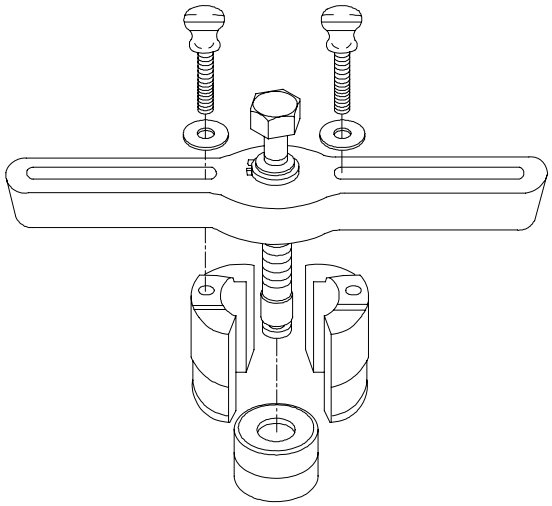


Figure 4 Rotor Puller Set

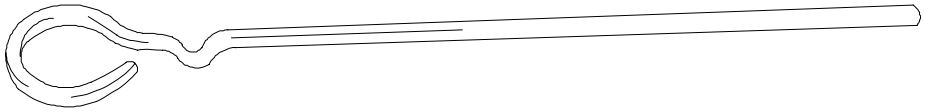


Figure 5 Compressor Oil Dipstick

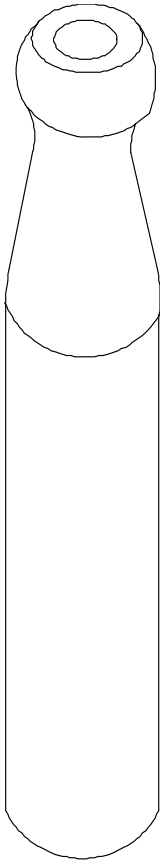


Figure 6 Shaft Seal Protector

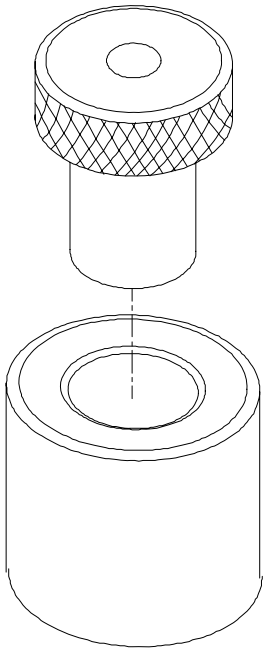


Figure 7 Rotor Installation Driver

EVACUATION AND CHARGING

22. During the repair procedures discussed in this instruction, the air conditioning system will be exposed to the atmosphere. This atmospheric air contains moisture vapour and therefore must be removed from the system prior to charging with refrigerant. Complete and effective evacuation of the air conditioning system is an essential part of the repair process. The absence of moisture is essential for an efficient air conditioning system.

23. System Evacuation and Charging. To evacuate and charge the system, proceed as follows:

a. Evacuate the system (28 inches Mercury (Hg)) for a minimum of 45 minutes to remove all moisture.

b. Examine the integrity of the system. The vacuum should be maintained for approximately 10 minutes when the pump is switched off.

c. Charge the system with 1.2 kg (±50 g) of R134a refrigerant. Observe the pressures and general operation of the system.

d. Thoroughly leak test all fittings. Ensure that the leak detection equipment is suitable for testing R134a refrigerant systems (refer Para 30).

e. Test run the system and check that the system cycles at a vent temperature of approximately +2 °C to +4 °C, depending on ambient temperature.

EVAPORATOR

24. Removal. To remove the evaporator assembly from the vehicle, proceed as follows:

a. Disconnect the drain tube at the evaporator cover.

b. Remove the roof trim cover surrounding the evaporator assembly.

c. Before disconnecting any refrigerant pipes, make sure refrigerant has been removed from the air conditioning system by recovering it with the appropriate recovery equipment.

d. Disconnect the liquid and suction pipes from the block valve.

e. Suitably support the evaporator assembly, then remove the four bolts securing the evaporator to its mounting frame. In the process, remove the harness earth wire from under the front passenger side mounting bolt.

f. Disconnect the evaporator wiring harness from the main wiring harness at the plug joint.

NOTE

Beware that residual moisture may be left in the evaporator drain tray.

g. Carefully lower the evaporator assembly from its mounting.

CAUTION

When loosening OR tightening fittings, use a spanner to hold the block valve to prevent damage to the evaporator tubing.

h. Loosen the fittings and remove the block valve.

25. Installation. To reinstall the evaporator into the vehicle, proceed as follows:

a. Refit the block valve to the evaporator assembly and secure in position by tightening the fittings. Refer to Table 3 for torque values.

b. Carefully raise the evaporator assembly to its mounting frame and loosely secure in position using the four mounting bolts. Ensure that the harness earth wire is fitted under the front passenger side mounting bolt.

c. Connect the liquid and suction pipes to the block valve and secure correctly. Refer to Table 3 for torque values.

NOTE

Ensure that new O-rings are fitted and connections are lightly oiled using refrigerant oil. In addition, ensure that the pipe connections are lined up squarely and tightened using two spanners.

d. Tighten the four evaporator mounting bolts to specifications.

e. Reconnect the evaporator wiring harness to the main wiring harness at the plug joint.

f. Refit the roof trim cover surrounding the evaporator assembly and fix in place using the screws.

g. Reconnect the drain tube to the evaporator assembly.

h. Evacuate and charge the system, as detailed at Para 23.

i. Test run the system and check that the system cycles at a vent temperature of approximately +2 °C to +4 °C.

COMPRESSOR

26. Compressor Identification. Figure 8 explains the model identification for R134a compressors.

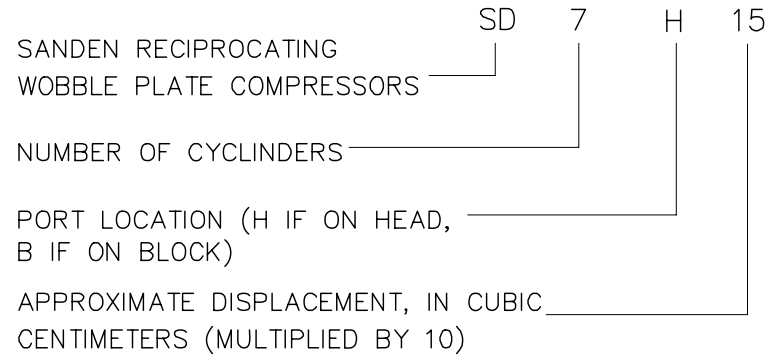


Figure 8 Compressor Model Identification

27. An identification label example is shown at Figure 9.

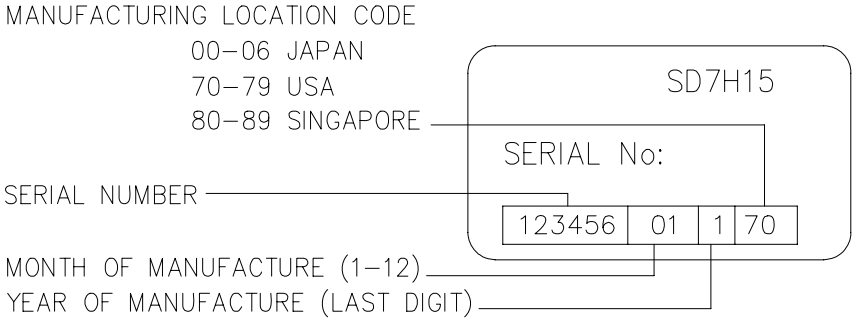


Figure 9 Identification Label

28. Specifications. Following are the correct values for belt tensioning and assembly torques.

a. Belt Tension. Tension the compressor drive belt to 121 ±5 lb (55 ±2 kgf). PolyVee tension based on 33 lb (15 kgf) per groove.

b. Assembly Torques. Tension the compressor components in accordance with the specifications detailed at Table 1.

Table 1 Assembly Torques

Item	lbf.ft	N.m
Armature retaining nut, ½ inch – 20	22.4 ± 29	30.4 ± 3.9
Armature retaining nut, M8	13.0 ± 22	17.7 ± 2.9
Cylinder head bolts, M6	25.3 ± 3 6	34.3 : ± 4.9
Cylinder head bolts, M8	10.1 ± 2.2	13.7 ± 2.9
Oil filler plug	14.5 ± 3.6	19.6 ± 4.9
Service valve	9.4 ± 2.2	12.8 ± 2.9
Service valve cap	1.7 to 4.3 in lb	0.20 to 0.49
Hose fittings:		
1 inch – 14 rotolock	26.7 ± 2.9	36.3 ± 3.9
7/8 inch Tube-0	23.9 ± 2.9	32.4 ± 3.9
7/8 inch Flare	54.9 ± 2.9	74.6 ± 3.4
3/4 inch Tube-0	17.3 ± 2.5	23.5 ± 3.4
3/4 inch Flare	37.6 ± 1.4	51.0 ± 2 0
Pad fitting bolts:		
M 10	28.9 ± 2.9	39.2 ± 3.9
3/8 inch – 24	28.9 ± 2.9	39.2 ± 3.9
M8	26.3 ± 2.9	34.3 ± 3.9
Clutch lead wire clamp screw	11 ± 3 in lb	1.3 ± 0.3
High pressure relief valve	7.2 ± 1.4	9.8 ± 2.0
Thermal protector switch clamp bolt	7.2 + 2.2 – 1.4	9.8 + 2.9 – 2.0
Clutch dust cover screws, 3 – 1/4 inch – 20	2.7 ± 0.9	3.6 ± 1.2

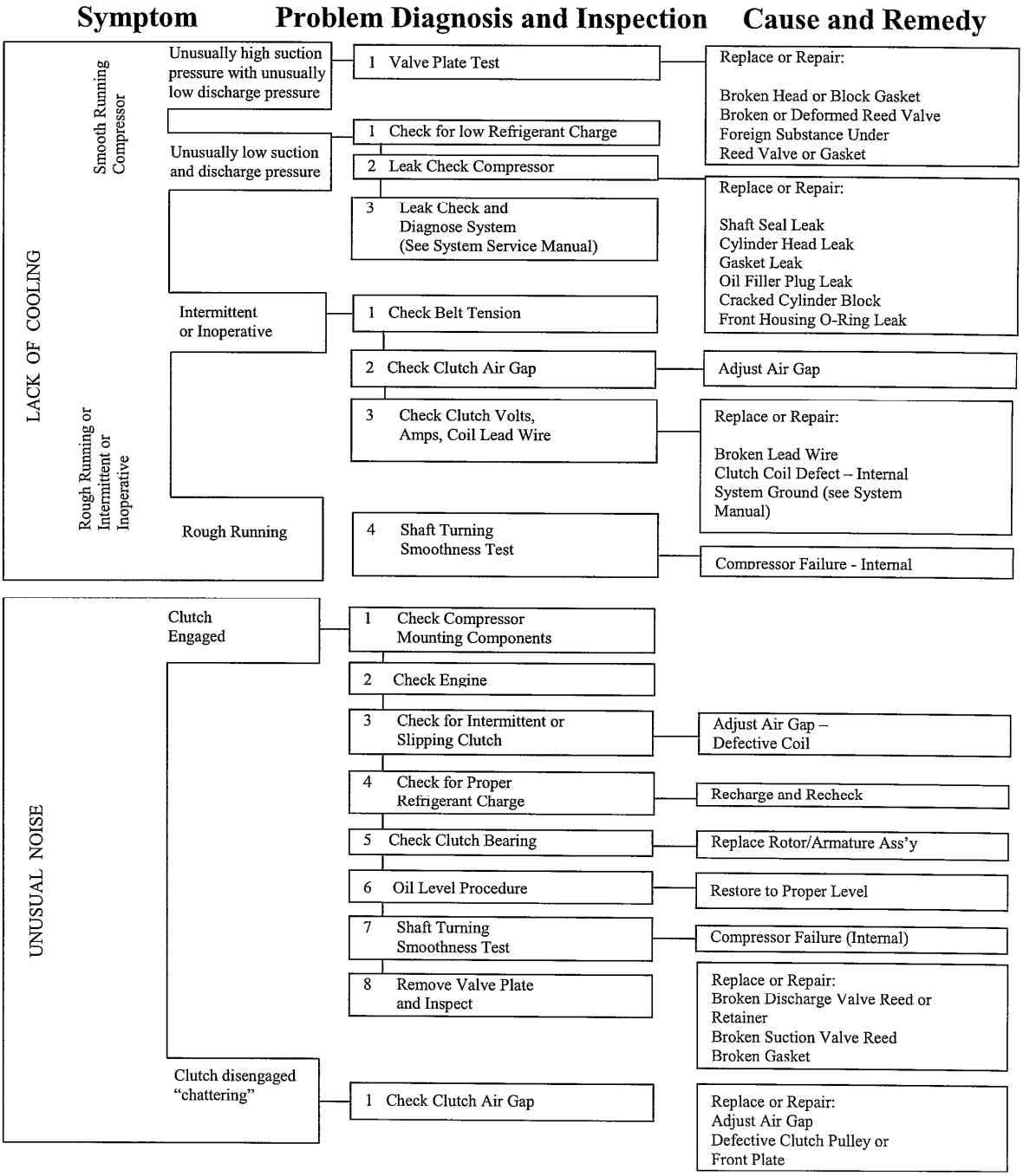


Figure 10 Troubleshooting Chart

29. Troubleshooting Procedures. Figure 10 refers specifically to the Sanden compressor. During diagnosis, follow the inspection procedures in the sequence shown until a defect is found. Then perform the repair in the 'Cause and Remedy' section of the chart. If this repair does not fully solve the problem, proceed to the next inspection step.

Inspection Procedures

30. Leak Checking. Following are the methods of checking for leaks in the air conditioning system:

a. Visual Inspection. Although oil seepage does not necessarily indicate leakage of refrigerant, it should be considered a sign that a leak may exist. Look for the following items:

(1) Oil seepage in shaft seal area (between clutch and compressor) – repairable.

(2) Pinching or extrusion of front housing O-ring – non-repairable.

(3) Oil around cylinder head (gaskets, service valves, fittings) – repairable.

(4) Oil around oil plug – repairable.

(5) Stripped threads – non-repairable.

(6) Oil around crack in compressor body – non-repairable.

b. Soap Bubble Detection. Any leak showing up as bubbles on the compressor will require repair.

c. Workshop Type Electronic Detectors. Perform electronic leak detection as follows:

(1) Ensure that the detector being used is sensitive to R134a refrigerant. Many leak detectors intended for R-12 cannot detect R134a leaks.

(2) Use the leak detector in accordance with the manufacturer's instructions.

(3) The leak rate at any portion of the compressor should not exceed 1.0 oz/yr. Make sure that a suspected leak is an actual flow of refrigerant, not a small pocket of refrigerant trapped in a recess. Cleaning the suspect area with soap and water (never a solvent) or blowing off the area with compressed air can help confirm a suspected leak.

(4) Leak check procedure should be in accordance with SAE J1628.

d. Leak Detection Dyes. The use of leak detection dyes is not recommended by Sanden, as their chemical compositions are proprietary and their effects on Sanden oils and elastomers are unknown at this time.

31. Oil Level Measurement (in Vehicle). Oil level in the compressor should be checked when a system component has been replaced, when an oil leak is suspected or when it is specified as a diagnostic procedure. To check the compressor oil level when it is still vehicle mounted, proceed as follows:

a. Run the compressor for 10 minutes with the engine at idle.

b. Recover all refrigerant from the system; this should be done slowly, to not lose any oil.

c. Remove the oil filler plug. Using a socket wrench on the armature-retaining nut, turn the shaft clockwise until the counterweight is positioned, as shown in Figure 11.

d. Insert the oil dipstick up to the stop with the angle pointing in the direction shown in Figure 11.

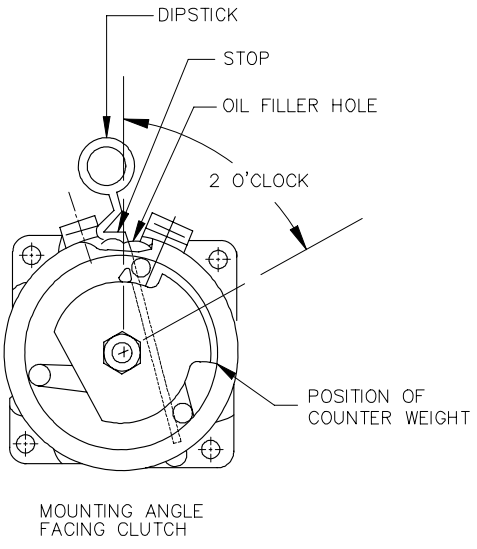


Figure 11 Oil Filler Plug Position

e. Remove the dipstick and count the number of notches covered by oil. Refer to Figure 12.

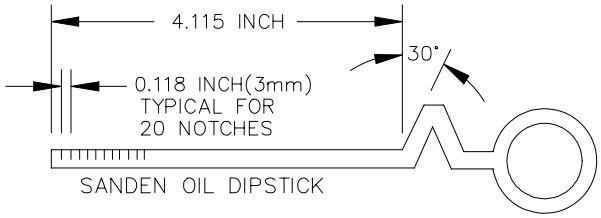


Figure 12 Sanden Oil Dipstick

f. Add or subtract oil until the oil level measures 5 to 7 notches on the dipstick.

g. Re-install the oil plug. The seat and O-ring must be clean and not damaged. Torque to 11 to 15 lbf.ft (15 to 20 N.m).

32. Shaft Turning Smoothness Inspection. To check for internal damage, proceed as follows:

a. If on vehicle, remove refrigerant from the air conditioning system and disconnect hoses and drive belt.

b. If on bench, uncap fittings.

c. Using a socket wrench on the armature-retaining nut, turn the shaft in a clockwise direction only.

d. If severe rough spots or catches are felt while turning shaft, the compressor has been damaged internally and must be replaced.

33. Clutch Inspection. To perform diagnostic inspections of the electromagnetic clutch, proceed as follows:

a. Measure the voltage at the clutch. Low voltage at the clutch may be due to poor ground or power connection, or problems with the vehicle electrical system. Check for a tight fit of the field coil retaining snap ring.

b. Measure the current draw when the clutch is engaged. Normal current should be 1.6 to 1.7 A at 24 V dc.

(1) Overcurrent. Short circuit within the field coil or in the compressor circuit.

(2) No Current. Open circuit.

(3) If a short or open circuit is found in the field coil, it must be replaced.

c. Air Gap. The compressor's clutch air gap should be 0.016 to 0.031 in (0.4 to 0.8 mm). Measure with a feeler gauge. Adjust as per Para 48.

d. Suspected Clutch Rotor Bearing Noise. To check the clutch bearing, proceed as follows:

(1) Remove drive belt.

(2) With clutch disengaged, rotate the pulley by hand. If excessive roughness or play is detected, replace the clutch rotor assembly.

34. Unusual Noise not due to Compressor. Unusual noises may be caused by components other than the compressor. To determine the cause, proceed as follows:

a. Compressor Mounting. Check for:

(1) Loose belt. Adjust the belt tension to the specifications outlined at Para 28.

(2) Broken bracket or compressor mounting lug. Replace broken component.

(3) Missing, broken or loose mounting bolts. Replace, reinstall or tighten.

(4) Flush fitting of the compressor to the bracket and to vehicle engine. Repair as required.

(5) Loose or wobbling crankshaft pulley. Check for damage to pulley, incorrect centre bolt torque or centre bolt bottoming. Repair to vehicle manufacturer's specifications.

(6) Bad idler pulley bearing. Replace if necessary.

b. Other Engine Components. Check for noise in:

(1) alternator bearing,

(2) water pump bearing,

(3) valves,

(4) timing belt or chain,

(5) power steering pump, and

(6) loose engine mount bolts.

35. Unusual Noises due to Compressor. To determine if noises are due to compressor failure, proceed as follows:

a. Suction pressure less than about 5 psig can cause unusual noise. Charge refrigerant to proper amount and test by applying heat to evaporator to increase suction pressure.

b. Clutch Bearing. Refer to Clutch Inspection at Para 33.

c. Oil Level. Insufficient oil can cause unusual noise. Refer to Oil Level Check Procedure at Para 31.

d. Valve Noise. Test for valve plate assembly failure per Valve Plate Test Procedure at Para 36.

36. Valve Plate Test. To determine if the valve plate is defective, proceed as follows:

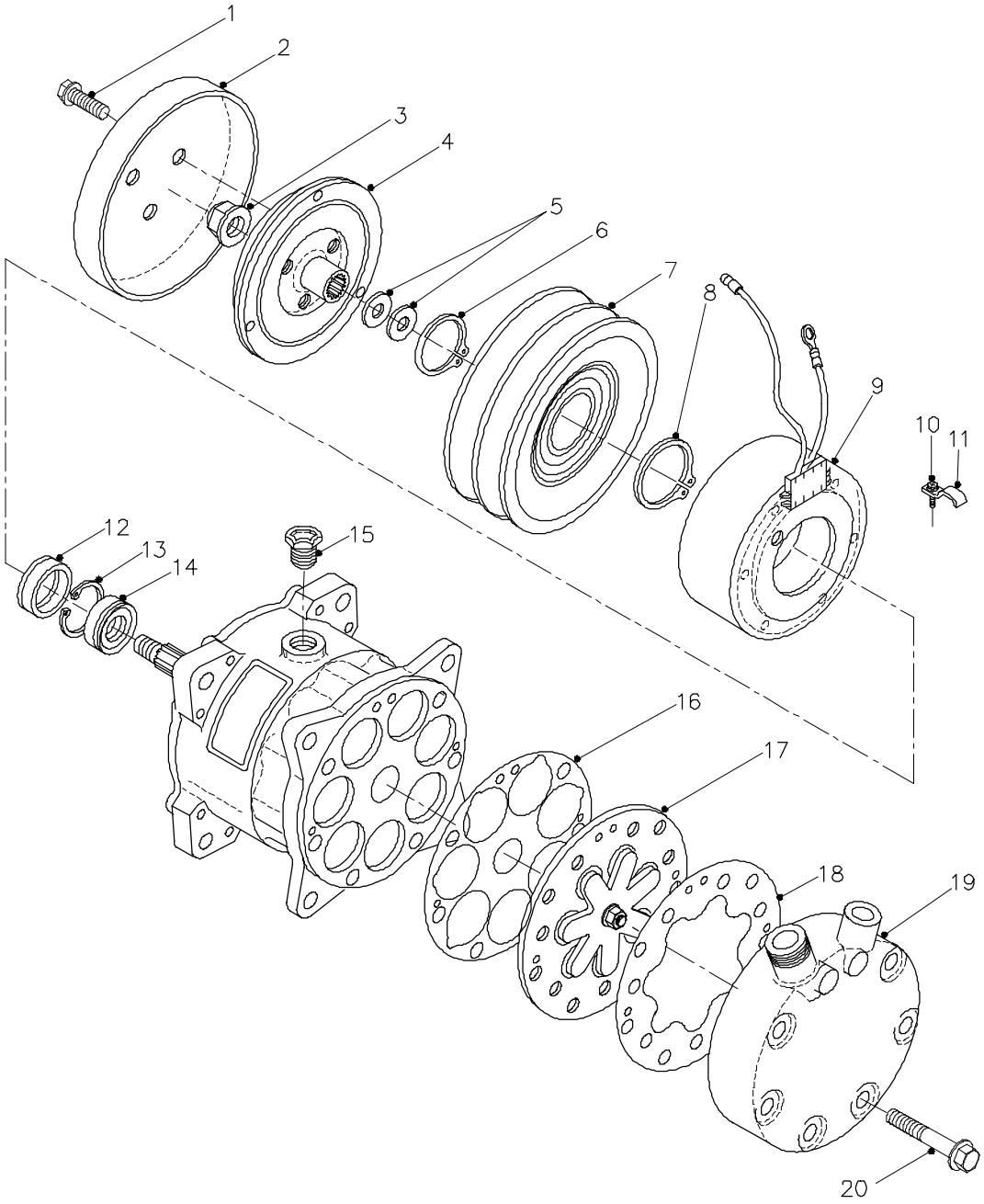
a. Suction or discharge valve breakage will cause a clacking sound at idle.

b. If head gasket failure occurs, discharge pressure will be low and suction pressure will be high at idle. Valve and gasket condition can be checked as follows:

(1) Connect a gauge set to suction and discharge service valves.

(2) Run the compressor for five minutes at idle and stop.

(3) Observe the time for discharge pressure and suction pressure to equalise. If less than two minutes, a valve or gasket may be damaged.



Item	Description	Item	Description	Item	Description
1	Armature Dust Cover Screw	8	Field Coil Assembly Snap Ring	15	Oil Plug
2	Armature Dust Cover	9	Field Coil Assembly	16	Block Gasket
3	Shaft Nut	10	TPS Screw	17	Valve Plate Assembly
4	Armature Plate	11	TPS Cup	18	Head Gasket
5	Clutch Shims	12	Felt Ring	19	Cylinder Head
6	Rotor Snap Ring	13	Shaft Seal Snap Ring	20	Cylinder Head Bolt
7	Rotor Assembly	14	Lip Seal with O-Ring		

Figure 13 Replaceable Parts

37. Field Replaceable Parts. The components detailed at Figure 13 are replaceable.

Repair Procedures

38. General Information. The receiver dryer must be replaced when the system is opened to the atmosphere, as the desiccant's function is to absorb moisture in the system. Atmospheric moisture will deplete this capacity. During service operations, observe the following precautions:

a. Keep dirt and foreign material from getting on or into the compressor or the air conditioning system. The area around air conditioning hose fittings should be carefully cleaned with a non-petroleum-based solvent before the connections are broken. All parts to be re-used or installed should be cleaned with a non-petroleum-based solvent and blown dry with clean compressed air or dried with lint-free cloths.

b. Trouble-free installation and operation of the compressor require:

(1) Correct pulley alignment.

(2) Correct fit of compressor mounting surfaces to the bracket and correct fit of the bracket to the engine. Clearance between compressor and bracket should not exceed 0.2 mm (0.008 in) per ear for ear-mount compressors or 0.4 mm (0.016 in) total for 2 ears.

(3) Correct torque of all mounting bolts and nuts.

(4) Correct drive belt tension.

c. Never operate the compressor at high speed or for a prolonged period of time without a sufficient refrigerant charge in the system. Probable results are overheating, internal damage and seizure.

d. If an internal repair is performed on an R134a compressor, evacuate the air conditioning system for at least 45 minutes before recharging to remove moisture that may have been absorbed by the PAG oil in the compressor.

e. Parts that require lubrication before assembly, such as O-rings, should be lubricated with clean refrigerant oil.

39. Removal. To remove the compressor from the vehicle, proceed as follows:

a. Before disconnecting any refrigerant pipes, make sure refrigerant has been removed from the air conditioning system by recovering it with the appropriate recovery equipment.

b. Disconnect the two refrigerant pipes at their connections at the top of the compressor head.

c. Remove all pipe restraining hardware and move the pipes out of the way.

d. Disconnect and remove the wiring from the compressor electromagnetic clutch.

e. Loosen the compressor drive belt adjustment fasteners and remove the drive belt.

f. Remove the four compressor mounting bolts and lift the compressor clear of the vehicle.

Compressor Oil Charging

40. Oil Retained in System Components. For reference, the amount of oil typically retained in other system components after running at 1 000 rpm compressor speed is shown in Table 2. These volumes will, of course, vary with different designs of the components and compressor speeds prior to shutdown.

Table 2 Typical Oil Amount

Component	Typical Oil Amount	
	fl oz	cc
Evaporator	2.0	60
Condenser	1.0	30
Receiver dryer	0.5	15
Hoses (normal length)	0.3	10

41. Compressor Repaired Internally and Reinstalled in the System. To charge a compressor with oil, which is to be repaired internally, proceed as follows:

a. Before any internal repair is done, drain the oil from the compressor as follows:

(1) Remove the oil plug and drain as much oil as possible into a suitable container.

(2) Remove the caps (if present) from suction and discharge ports.

(3) Drain oil from the suction and discharge ports into a suitable container while turning the shaft clockwise only with a socket wrench on the armature-retaining nut.

b. Measure and record the amount of oil drained from the compressor.

c. Inspect the oil for signs of contamination, such as discoloration or foreign material.

d. Perform repairs to the compressor.

e. Add the same amount of new oil to the compressor as was measured in Para 0.b. Ensure only Sanden SP 20 refrigerant oil is used.

f. Re-install the oil plug. The seal and O-ring must be clean and not damaged. Torque to 11 to 15 lbf.ft (15 to 20 N.m). Be careful not to cross-thread the oil plug.

g. It is recommended that the oil quantity be confirmed after re-installation of the compressor to the vehicle as per Para 31.

42. Sanden Compressor Replaced by a New Sanden Compressor of the Same Type. To charge a new Sanden compressor with oil, proceed as follows:

a. Drain oil from the old compressor; measure and record the amount as per the procedure in Para 0.

b. Drain oil from the new compressor as per the procedure in Para 0. Add new Sanden SP 20 refrigerant oil to the new compressor. Use the same quantity as removed from the old compressor in Para 42.a.

c. Re-install the oil plug. The seal and O-ring must be clean and not damaged. Torque to 11 to 15 lbf.ft (15 to 20 N.m). Be careful not to cross-thread the oil plug.

d. It is recommended that the oil quantity be confirmed after installation of the new compressor to the vehicle as per Para 31.

ELECTROMAGNETIC CLUTCH REPAIR

43. Armature Assembly Removal. To remove the armature assembly, proceed as follows (refer Figure 14):

a. Remove the armature dust cover from the armature by extracting the three securing bolts.

b. Insert pins of the armature plate spanner into the threaded holes of the armature assembly.

c. Hold the armature assembly stationary, while removing the retaining nut with a 14 mm socket wrench.

d. Remove the armature assembly.

e. Remove the armature-to-rotor air gap adjustment shims.

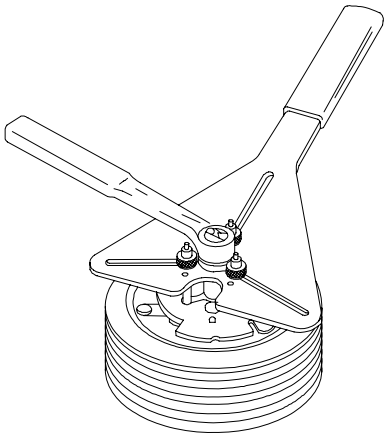


Figure 14 Armature Assembly Removal

44. Rotor Assembly Removal. To remove the rotor assembly, proceed as follows (refer Figure 15):

a. Remove the dust cover and armature assembly as described at Para 43.

b. Remove the snap ring above the rotor pulley bearing using internal snap ring pliers.

c. Remove the rotor snap ring.

d. Remove the rotor pulley assembly as follows:

(1) insert the lip of the puller jaws into the snap ring groove;

(2) place the rotor puller shaft protector (puller set) over the exposed shaft;

(3) align the thumb screws to puller jaws and finger tighten; and

(4) using a socket wrench, turn the puller centre bolt clockwise until the rotor pulley is free.

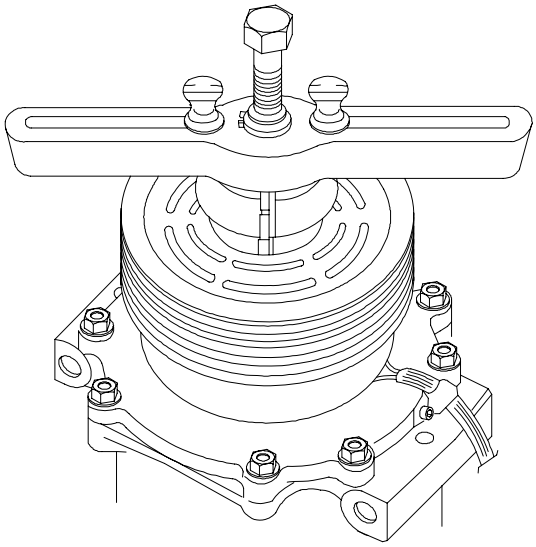


Figure 15 Rotor Assembly Removal

45. Field Coil Removal. To remove the field coil assembly, proceed as follows (refer Figure 16):

a. loosen the lead wire clamp screw with a No 2 Phillips screwdriver until the wires can be slipped out from under the clamp;

b. undo any wire connections on the compressor that would prevent removal of the field coil;

c. remove the field coil retaining snap ring; and

d. remove the field coil.

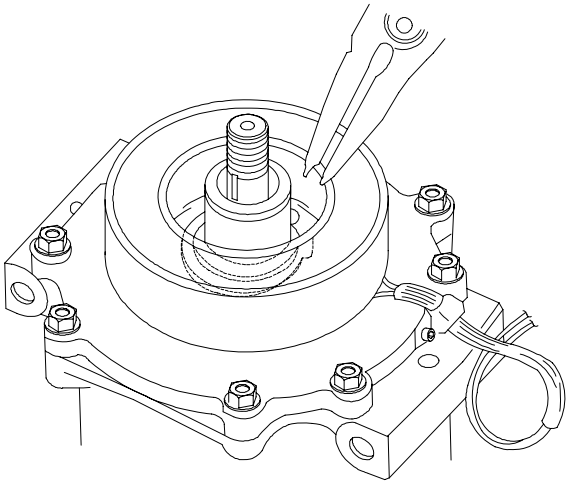


Figure 16 Field Coil Removal

46. Field Coil Installation. To install the field coil assembly, proceed as follows (refer Figure 16):

a. place the coil in position ensuring that the protrusion on the underside of the coil ring matches the hole in the front housing to prevent movement, and correctly locate the lead wires;

b. refit the field coil retaining snap ring;

c. reconnect the coil wiring; and

d. refit the lead wire clamp and secure with the screw.

47. Rotor Assembly Installation. To install the rotor assembly, proceed as follows (refer Figure 17):

a. Place the compressor on a suitable stand, supported at rear end of compressor. If the compressor must be clamped in a vice, clamp only on the mounting ears (never on the body of the compressor).

b. Set the rotor squarely over the front housing boss.

c. Place the rotor installer ring into the bearing bore. Ensure that the edge rests only on the inner race of the bearing, not on the seal, pulley or outer race of the bearing.

d. Place the driver into the ring and drive the rotor down onto the front housing with a hammer or arbor press. Drive the rotor against the front housing step. A distinct change of sound can be heard when using a hammer to install the rotor.

e. Install the rotor bearing snap ring with internal snap ring pliers.

f. Install the rotor retaining snap ring with external snap ring pliers. If a bevel is present on the snap ring, it should face up (away from the body of the compressor).

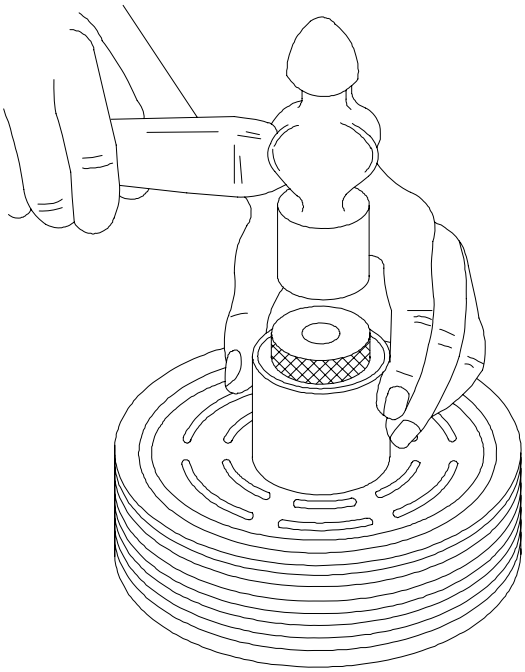


Figure 17 Rotor Assembly Installation

48. Armature Assembly Installation. To install the armature assembly, proceed as follows (refer Figure 18):

a. Install clutch shims.

NOTE

The clutch air gap is determined by shim thickness. When installing a clutch on a used compressor, try the original shims first. When installing a clutch on a compressor that has not had a clutch installed before, first try 0.04 in, 0.02 in, and 0.004 in (1.0 mm, 0.5 mm and 0.1 mm) shims.

b. Align the spline in the armature hub with the spline on the compressor shaft. Using a driver and a hammer or arbor press, drive the armature assembly down over the shaft until it bottoms on the shims. A distinct sound change will be noted if driving with a hammer.

c. Replace the retaining nut and torque to specification.

d. Check the air gap with a feeler gauge. Specification is 0.4 mm to 0.8 mm (0.016 in to 0.031 in). If the gap is not even around the clutch, gently tap down at the high spots. If the overall gap is out of specification, remove the armature assembly and change shims as necessary.

e. Replace armature dust cover and torque the three bolts to specification.

NOTE

Over tensioning of the dust cover bolts will affect the air gap setting.

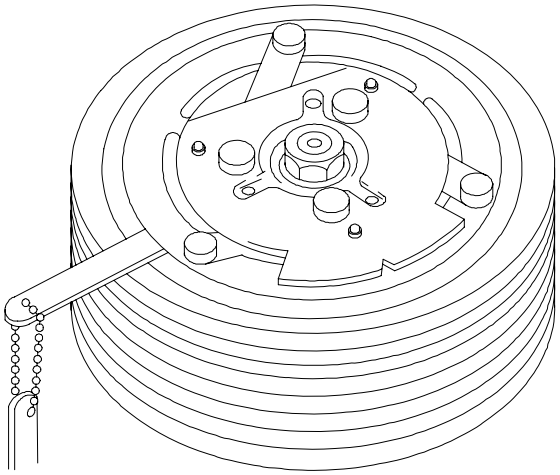


Figure 18 Armature Air Gap Adjustment

49. Compressor Shaft Seal Replacement. To replace the compressor shaft seal, proceed as follows (refer Figures 19 to Figure 22):

NOTE

The lip seal assembly and felt ring must never be reused. Always replace these components.

a. Ensure that all gas pressure inside the compressor has been relieved.

b. Remove the armature dust cover, armature assembly and clutch shims, as detailed at Para 43.

c. Insert the points of a pair of snap ring pliers into the two holes of the felt ring retainer and pry out the retainer and felt ring.

d. Remove the seal snap ring with internal snap ring pliers.

e. Use the lip seal removal and installation tool to remove the lip seal assembly. Twist the tool until the two lips on the tool engage the slots in the lip seal housing and pull the seal out with a twisting motion.

f. Clean out the shaft seal cavity thoroughly. Debris can be removed using a non-petroleum-based solvent and a lint-free cloth. The area should then be blown out with clean, dry compressed air. Make sure all foreign material is completely removed.

g. Place a shaft seal protective sleeve over the compressor shaft. Inspect the sleeve to ensure that it has no scratches and is smooth so that the lip seal will not be damaged during installation. Make sure there is no gap between the end of the sleeve and the seal surface of the shaft.

h. Engage the lips of the seal removal and installation tool with the slots in the new lip seal housing. Make sure the lip seal assembly, especially the O-ring, is clean. Dip the entire lip seal assembly, on the tool, into clean refrigerant oil. Make sure the seal assembly is completely covered with oil.

i. Install the lip seal over the shaft and press firmly to seat the seal. Twist the tool to disengage it from the seal and withdraw the tool.

j. Reinstall the shaft seal snap ring with internal snap ring pliers. The bevelled side should face up (outward/away from compressor body). Ensure that the snap ring is completely seated in the groove. It may be necessary to tap the snap ring lightly to seat it in the groove.

k. Tap a new felt ring assembly into place.

l. Install the armature assembly and dust cover, as described at Para 48. Ensure that the air gap is adjusted correctly.

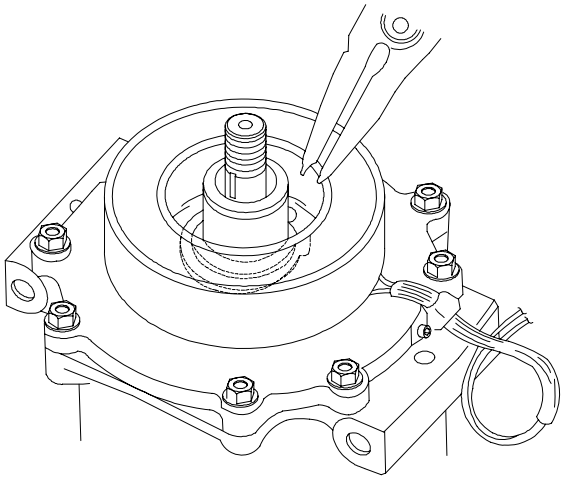


Figure 19 Felt Ring Removal

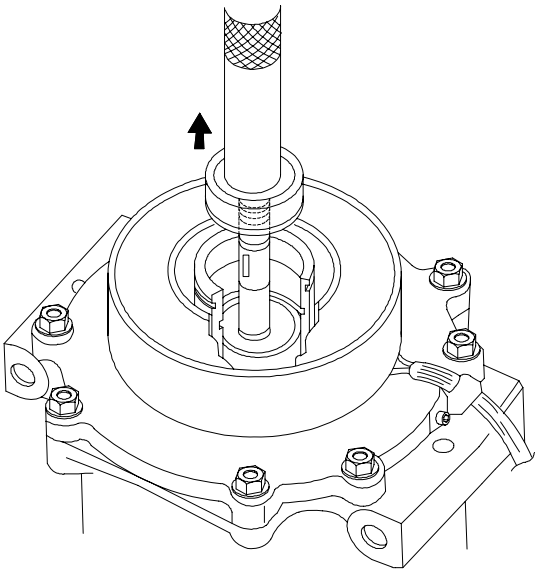


Figure 20 Lip Seal Removal

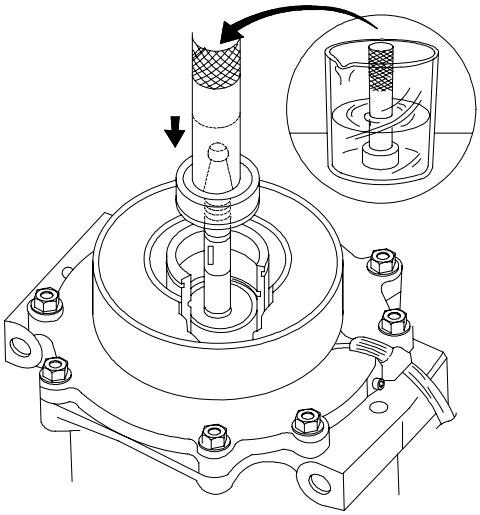


Figure 21 Lip Seal Replacement

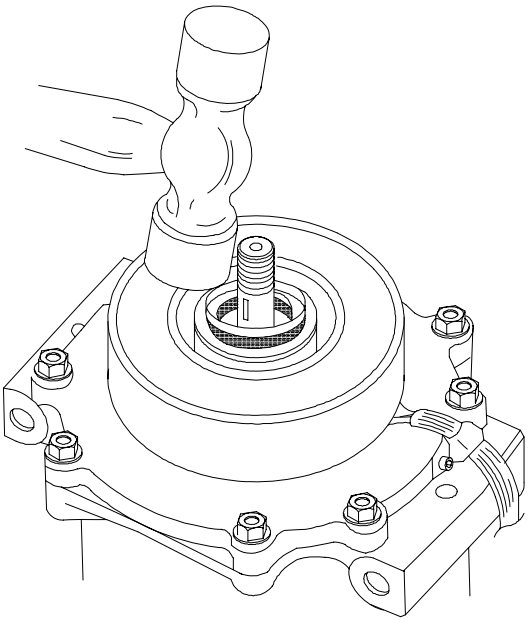


Figure 22 Felt Ring Replacement

CYLINDER HEAD/VALVE PLATE REPLACEMENT

50. Cylinder Head Removal. To remove the compressor cylinder head, proceed as follows (refer Figure 23):

a. Be sure all internal compressor pressure has been relieved.

b. Inspect the cylinder head for fitting or thread damage. Replace if damaged.

c. Remove the cylinder head bolts.

d. Use a small hammer and gasket scraper to separate the cylinder head from the valve plate. Be careful not to scratch the gasket surface of the cylinder head.

e. Carefully lift the cylinder head from the valve plate.

f. It is recommended that both the head gasket (between the cylinder head and the valve plate) and the block gasket (between the valve plate and cylinder block) be replaced any time the cylinder head is removed. However, if no servicing is required to the valve plate, it may be left in place. If the valve plate comes loose from the cylinder block, the block gasket must be replaced.

g. Carefully remove the old head gasket from the top of the valve plate with a gasket scraper. Be careful not to disturb the valve plate to cylinder block joint if the valve plate is to be left in place. If the valve plate does come loose from the cylinder block, proceed to Para 51, Valve Plate Removal, and replace the block gasket.

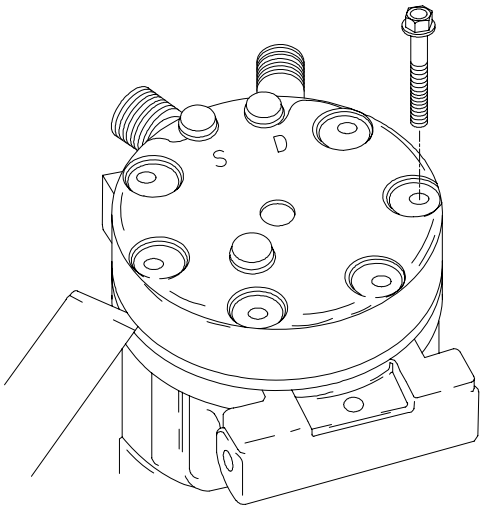


Figure 23 Cylinder Head Removal

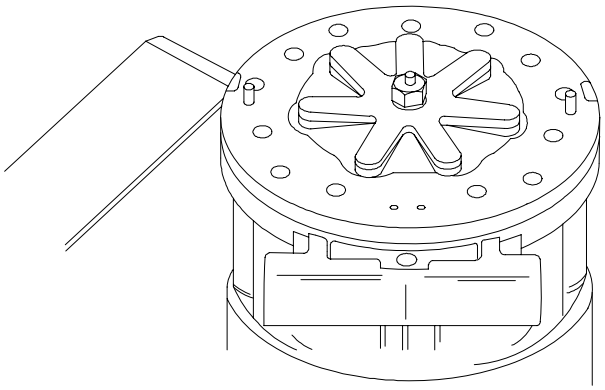


Figure 24 Valve Plate Gasket Removal

51. Valve Plate Removal. To remove the compressor valve plate, proceed as follows (refer Figure 24):

a. Using a small hammer and gasket scraper, carefully separate the valve plate from the cylinder block. Be careful not to damage the sealing surface of the cylinder block.

b. Inspect the reed valves and retainer. Replace the valve plate assembly if any component is damaged.

c. Carefully remove any gasket material remaining on the valve plate, cylinder block or cylinder head. Do not damage the sealing surfaces of the components.

52. Valve Plate and Cylinder Head Installation. To replace the compressor valve plate and cylinder head, proceed as follows (refer Figure 25 and Figure 26):

a. Coat the new block gasket with clean refrigerant oil.

b. Install the block gasket. Align the new gasket to location pin holes and orifice(s).

c. Place the valve plate on the cylinder block with the discharge valve, retainer and nut facing up (away from the cylinder block) and the location pins properly located in their holes.

d. Use a vacuum pump and small tube to remove any residual oil from each bolt hole. If this step is not performed, hydraulic pressure can be created when the cylinder head bolts are tightened. This pressure can break/crack the cylinder block.

e. Coat the head gasket with clean refrigerant oil.

f. Install the head gasket over the location pins, checking for correct orientation.

g. Install the cylinder head. All components should be installed as shown at Figure 25.

h. Install the cylinder head bolts and tighten in a star pattern in accordance with Figure 26. Torque first to approximately 14 lbf.ft (19.6 N.m), then finish by tensioning to 24 to 27 lbf.ft (32.4 to 36.3 N.m).

53. Compressor Installation. To reinstall the compressor into the vehicle, proceed as follows:

a. Ensure that the compressor is charged with the correct quantity of Sanden SP 20 refrigerant oil. Refer to Para 40.

b. Refit the compressor into its mounting bracket and secure in position using the four mounting bolts. Check the pulley alignment and correct as necessary.

c. Re-connect the two refrigerant hoses to the head of the compressor. For correct torque specifications, refer to Table 3.

d. Re-connect the electromagnetic clutch wiring.

e. Refit the drive belt and adjust the tension using the adjuster. Adjust in accordance with the details listed at Para 28.

f. Evacuate and charge the system, as detailed at Para 23.

g. Test run the system and check that the system cycles at a vent temperature of approximately +2 °C to +4 °C.

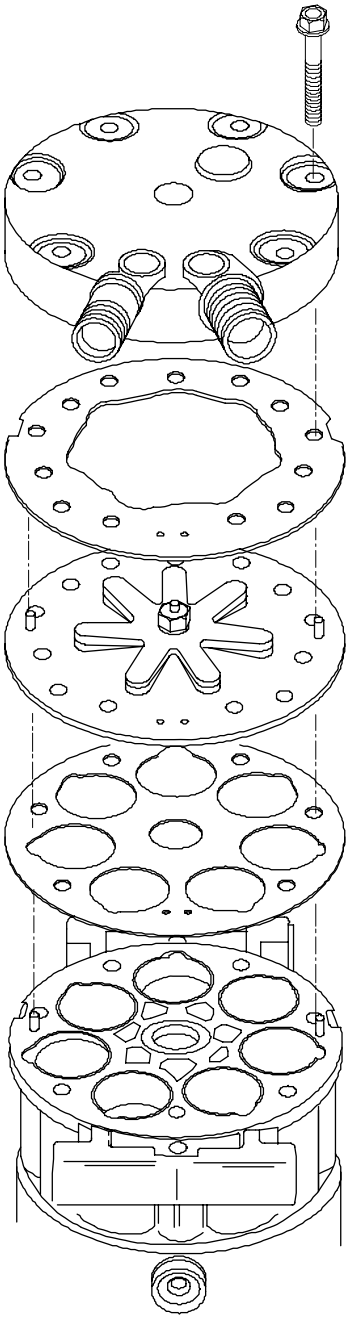


Figure 25 Cylinder Head Installation

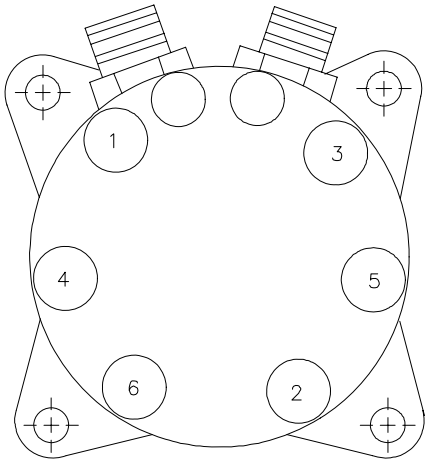


Figure 26 Head Bolt Torque Sequence

CONDENSER

54. Removal. To remove the condenser from the vehicle, proceed as follows:

a. To facilitate condenser removal, raise and secure the engine covers and tilt the driver's side mudguard forward. Support the mudguard securely.

b. Remove the five grille protection bars.

c. Before disconnecting any refrigerant pipes, make sure refrigerant has been removed from the air conditioning system by recovering it with the appropriate recovery equipment.

d. Disconnect the discharge and liquid pipes at the connections with the hoses below the condenser.

e. Disconnect the discharge and liquid pipes at their connections to the coil at the top and bottom of the condenser.

f. Remove all pipe restraining hardware and move the pipes out of the way.

g. Suitably support the condenser assembly while removing the support bracket mounting bolts and 'U' bolt nuts.

h. Remove the 'U' bolts from the condenser and grille bars.

i. Carefully remove the condenser from the vehicle.

j. Strip all mounting brackets from the condenser as required.

55. Cleaning and Inspection. The coil fins of the removed condenser can be cleaned by hosing or applying low-pressure compressed air from the rear. Damaged or flattened fins can be straightened by 'combing' using a suitable fin-combing tool.

56. Installation. To reinstall the condenser into the vehicle, proceed as follows:

a. Lay the condenser on a flat surface with the pipe fittings to the left-hand side.

b. Attach both top and bottom mounting brackets to either side of the condenser.

c. Attach condenser brackets to either side of the condenser.

d. Attach two grille bars to the condenser assembly using the four 'U' bolts.

e. Carefully install the condenser assembly to the vehicle, inserting the grille bars and loosely securing the support brackets to the shroud using existing bolts on both sides.

f. Attach the discharge and liquid pipes at their connections at the top and bottom of the condenser and to the existing system pipework below the condenser. For correct torque specifications, refer to Table 3.

NOTE

Ensure that new O-rings are fitted and connections are lightly oiled using refrigerant oil. In addition, ensure that the pipe connections are lined up squarely and tightened using two spanners.

g. Adjust the condenser assembly to a neat fit then secure by tightening side support bolts and the grille 'U' bolts.

h. Install all pipe restraining hardware to secure the pipes in position.

i. Evacuate and charge the system, as detailed at Para 23.

j. Test run the system and check that the system cycles at a vent temperature of approximately +2 °C to +4 °C.

k. Return and secure the mudguard and engine covers to their lowered positions.

RECEIVER DRYER

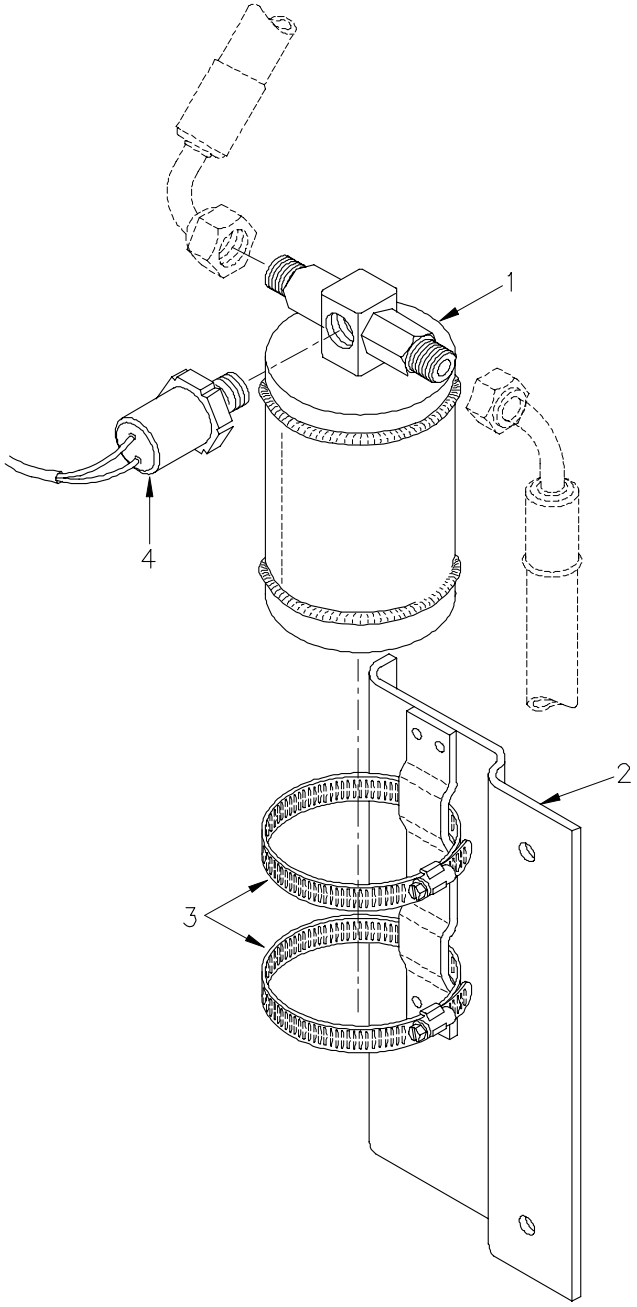


Figure 27 Receiver Dryer and Mounting

57. Removal. To remove the dryer from the vehicle, proceed as follows (refer to Figure 27):

a. Before disconnecting any refrigerant pipes, ensure refrigerant has been removed from the air conditioning system by recovering it with the appropriate recovery equipment.

b. Disconnect the two refrigerant hoses from the dryer.

c. Disconnect the wiring to the pressure switch.

d. Loosen the two worm drive hose clamps and remove the dryer from the vehicle.

e. Remove the pressure switch if the dryer is to be replaced.

NOTE

The dryer must be replaced when the system is opened to the atmosphere, as the desiccant's function is to absorb moisture in the system. Atmospheric moisture will deplete this capacity.

58. Installation. To reinstall the dryer into the vehicle, proceed as follows:

a. Mount the dryer in its position at the radiator surround bracket and loosely secure in position using the two worm drive hose clamps.

b. Re-connect the two refrigerant hoses to the dryer. For correct torque specifications, refer to Table 3.

c. Secure the dryer by tightening the two worm drive hose clamps.

d. Refit the pressure switch and reconnect its wiring.

e. Evacuate and charge the system, as detailed at Para 23.

f. Test run the system and check that the system cycles at a vent temperature of approximately +2 °C to +4 °C.

ELECTRICAL SYSTEM

Introduction

59. The electrical system, fed by the truck's 24 V power source, is provided to supply and control the compressor's electromagnetic clutch, the evaporator's fan, pressure switches and other components of the air conditioner system. Refer to Figure 28. The system is protected by two 15 A fuses.

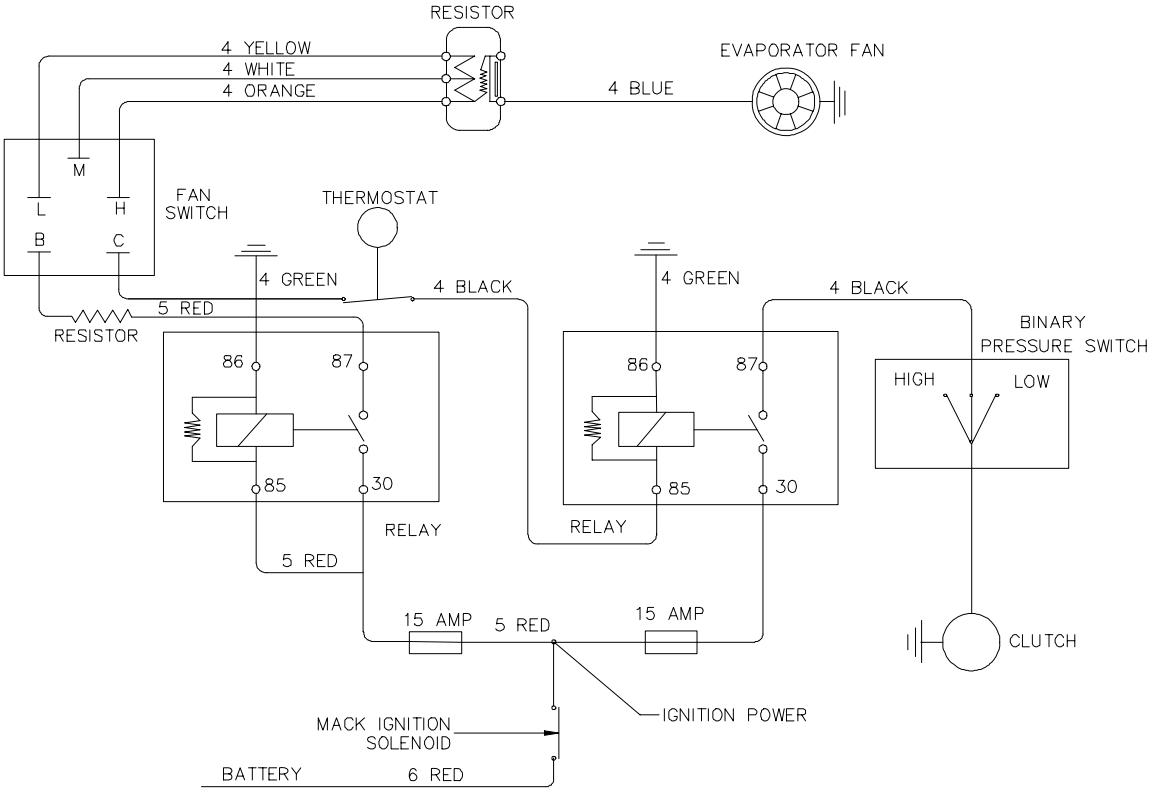


Figure 28 Air Conditioner Wiring Diagram

Wiring Harnesses

60. Wiring harnesses should be checked for chafing, loose or unbound insulation and security of terminals and connecting plugs. In addition, check the harness securing ties and clamps for serviceability.

61. If continuity tests reveal wiring problems, harnesses can be repaired by removing insulation tape or conduit and replacing damaged wires. Ensure that the same gauge and colour wires are used to maintain serviceability and traceability.

Compressor Electromagnetic Clutch

62. Refer Para 33.

Thermostat

63. Check that the thermostat operates in the range of -2 °C ±1.5 °C. The thermostat differential range is 3.5 °C ~ 6 °C. Check the thermostat for open circuit.

Evaporator Blower

64. The blower is driven by a single-speed, sealed, series wound, single 100 W, 24 V motor and is rated at:

- **a.** full speed: 400 CFM – 188 l/sec;
- **b.** med speed: 280 CFM – 132 l/sec; and
- **c.** low speed: 210 CFM – 100 l/sec.

65. Check blower operation.

Binary Pressure Switch

66. The receiver dryer's pressure switch is connected in series with the electromagnetic clutch of the compressor to protect the compressor when there is too much or insufficient pressure to run the system safely. Check the switch for open circuit.

Relays and Fuses at Kysor Panel

67. Two 4-pin relays and two 15 A fuses are located at the Kysor alarm panel in the passenger's foot well. Check for open circuit.

HOSES AND PIPING

General

68. Correct installation of hose and pipe fittings is critical if leaks and joint problems are to be avoided. A diagram, showing the system piping, is shown at Figure 30. The following information is designed to be of assistance when fitting air conditioning systems:

- **a.** All fittings should be lightly oiled with the appropriate refrigerant oil on both the O-ring sealing area and the thread of the nut; the O-ring itself should be well oiled.
- **b.** Always make sure that the fitting is lined up square to its mating connection. Never attempt to tighten while the fitting or pipe is at an angle.
- **c.** Always use two spanners to tighten the nut after finger tightening to avoid damage to the pipe or fitting.
- **d.** Always use a new O-ring when connecting pipe fittings; never reuse O-rings.
- **e.** Before disconnecting any refrigerant pipes, make sure refrigerant has been removed from the air conditioning system by recovering it with the appropriate recovery equipment.
- **f.** After reconnecting refrigerant pipes, evacuate and charge the system, as detailed at Para 23.
- **g.** After system repairs, always test run the system and check that the system cycles at a vent temperature of approximately +2 °C to +4 °C.

Pipe Fittings Torque Specifications

69. Table 3 details the torque specifications for varying size fittings in the air conditioning system.

Table 3 Pipe Fittings Torque Specifications

Fitting Size	Nominal Tube Size	Steel/Aluminium Fittings
No. 6	3/8 inch	13 N.m (9 lbf.ft)
No. 8	1/2 inch	20 N.m (14 lbf.ft)
No. 10	5/8 inch	30 N.m (21 lbf.ft)
No. 12	3/4 inch	40 N.m (28 lbf.ft)
Tube O-ring Fittings (Compressor Head)		90 N.m (64 lbf.ft)

SYSTEM DIAGNOSIS

70. Table 4 details the procedures to be followed to rectify faults in the system.

71. **Preliminary Checks.** Before servicing or diagnosing an air conditioning system, check the following:

a. Carry out a visual check, looking for hose damage and chafing.

b. Listen for abnormal noises that would indicate a problem with any of the air conditioning components.

c. Ensure that the condenser cooling fins are not blocked with obstructions, such as insects, and that the fins are straight.

d. Check that the engine and its radiator are not overheating.

e. Inspect drive belts for correct tension and damage.

f. Check that the compressor cycles on and off.

g. Check that the evaporator drain hose is not blocked or kinked.

h. Check that the air vents open fully.

i. Check that the blower fan works correctly at all speeds.

j. Check for refrigerant leaks as described at Para 30.

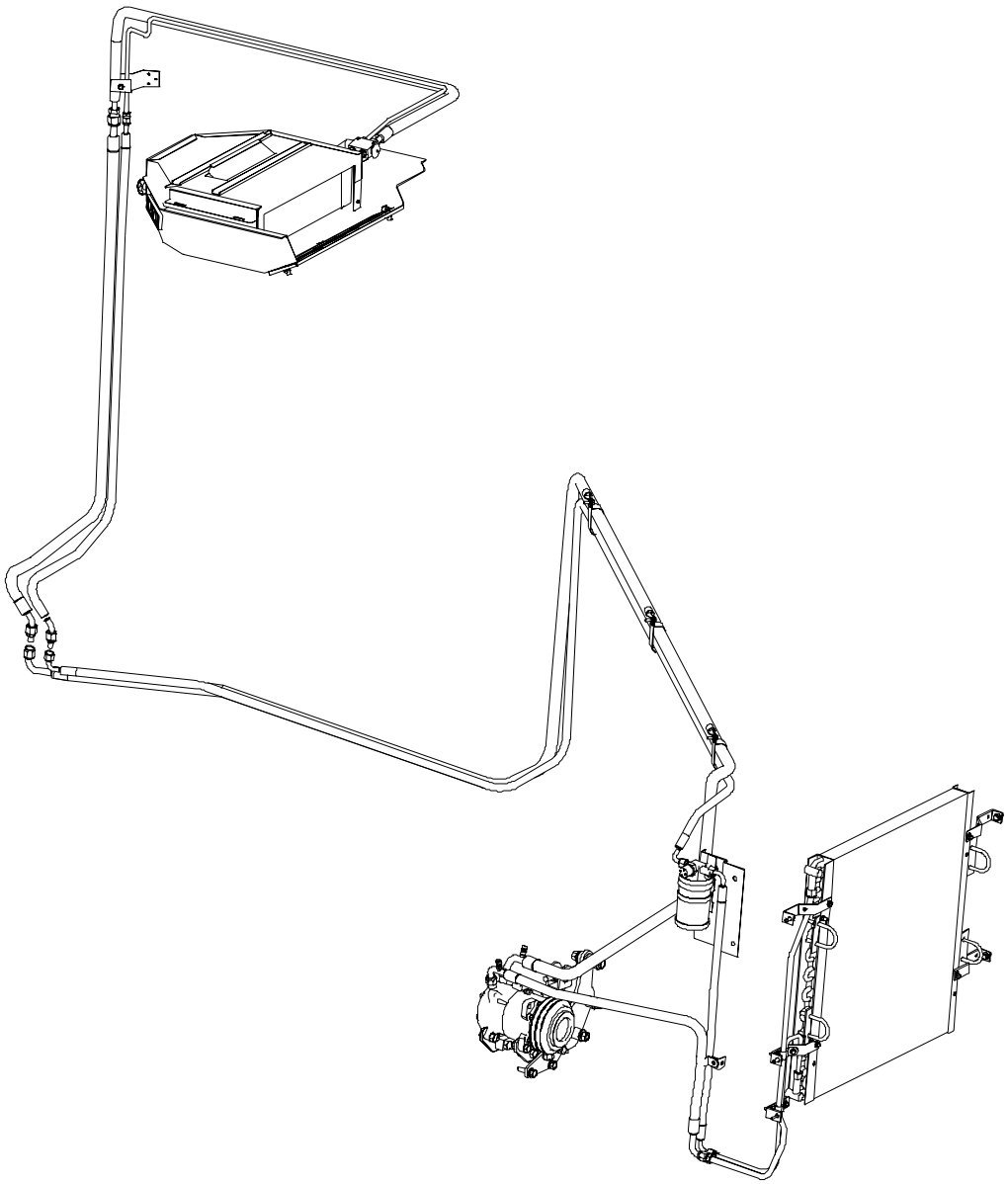


Figure 30 System Piping

Table 4 System Diagnosis

Symptom/Checks		Probable Cause	Action
1	General information and checks	When removing and replacing any parts that require discharging the refrigerant circuit, the receiver dryer must be replaced.	
		Always install new O-rings and lubricate O-rings with refrigerant oil.	
		Low pressure cuts out at 200 kPa approx. High pressure cuts out at 2 200 kPa approx.	
		Test engine running at 1 200 rpm approx. Fan control on low speed. Compressor clutch should cycle at 4 °C to 5 °C.	
2	No cooling compressor, clutch not engaging	Fit pressure gauges to system: system low, or system out of refrigerant	Check air conditioning system for leak and repair as necessary.
		Pressure switch open circuit	Replace pressure switch if faulty. Recover refrigerant. Replace receiver dryer. Replace O-rings. Evacuate and recharge to specified amount.
3	Wiring check	Blown fuse	Replace.
		Air conditioning switch open circuit	Replace.
		Thermostat open circuit	Replace.
		Relay open circuit	Replace.
		Thermal switch open circuit	Replace.
4	Insufficient cooling and suction discharge pressure abnormally high	Condenser blocked with dirt and debris	Thoroughly clean condenser.
		Engine fan inoperable	Check fan drive belt. Check fan rotates freely.
		Excessive refrigerant in system	Recover refrigerant and recharge to specified amount.
		Heater left on	Turn the heater off.
		Fresh air flap open	Check and adjust fresh air flap opens and closes.
5	Insufficient cooling and suction discharge pressure abnormally low	Insufficient refrigerant in system Excessive bubbles in sight glass	Check system for leaks. Repair as necessary. Recharge system to specified amount.
6	Low pressure gauge indicates vacuum	Blocked or defective expansion valve	Replace the valve.

END

Distribution List: **VEH G 50.0 – Code 3** (Maint Code)
(Sponsor: CGSVSPO, Medium/Heavy B Vehicles)
(Authority: ECO CGSVSPO 32/11)