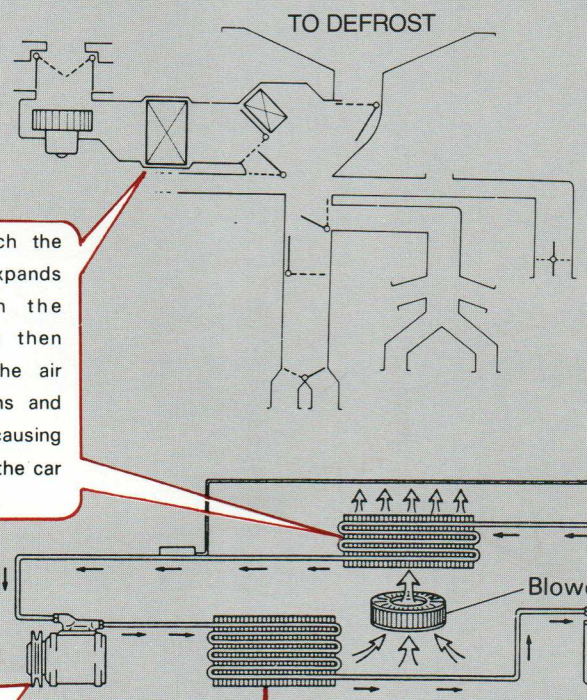
TOYOTA
SERVICE NEWS

Summer 1988 The Independents' Guide to Professional Toyota Service and Repair Bulletin 28

AIR CONDITIONING



5 EVAPORATOR, in which the released refrigerant expands and flows through the evaporator tubes. It then removes heat from the air blowing across the fins and tubes, and evaporates, causing the temperature inside the car gradually to be lowered.

4 EXPANSION VALVE meters liquid refrigerant into the evaporator cores, causing a drop in pressure and consequently drop in temperature.

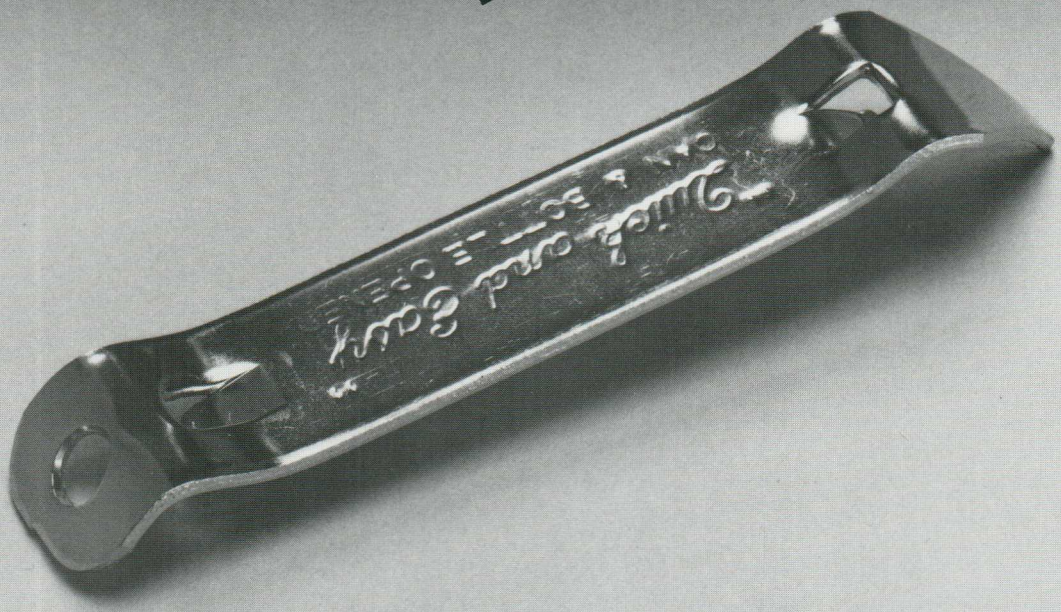
1 COMPRESSOR draws off gaseous refrigerant from the evaporator and compresses it. This causes the refrigerant gas temperature and pressure to rise rapidly.

2 CONDENSER, through which the heated refrigerant gas gives off heat to the engine cooling air. The refrigerant gas cools off and once again becomes a liquid.

3 RECEIVER removes any traces of moisture and filters out dirt in the system. It also serves as a reservoir for excessive refrigerant.

IN THIS ISSUE:

The only tool you need to clean EFI injectors



Clogged fuel injector nozzles can cause rough idling. Hesitation. Now there's an easy way to dissolve deposits that affect engine performance: Just open a can of Toyota EFI Injector Cleaner.

Pour the cleaner directly into your customer's half-full fuel tank and drive. Within an hour, the deposits will be gone. And the car will run clean. Because it is clean.

WE'VE GOT MORE FOR YOU!

TOYOTA
GENUINE PARTS

Follow label directions carefully to avoid possible damage to fuel hoses.

TOYOTA SERVICE NEWS

Summer 1988 Bulletin 28

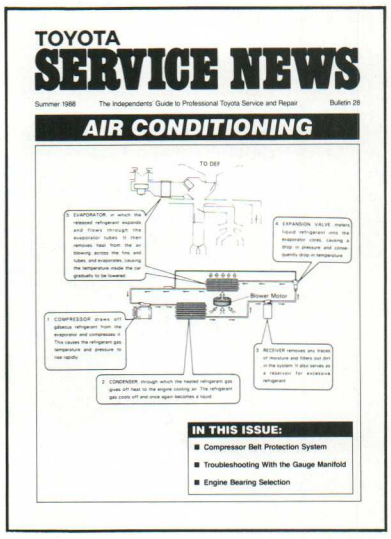
PAGE DESCRIPTION ARTICLE NO.

THIS ISSUE: AIR CONDITIONING

SERVICE TIPS

Don't get left behind!
Get ASE certified!

On the Cover



Before you service Toyota air conditioning, it helps to understand the refrigeration cycle. This issue covers the basics, and offers some techniques for troubleshooting.

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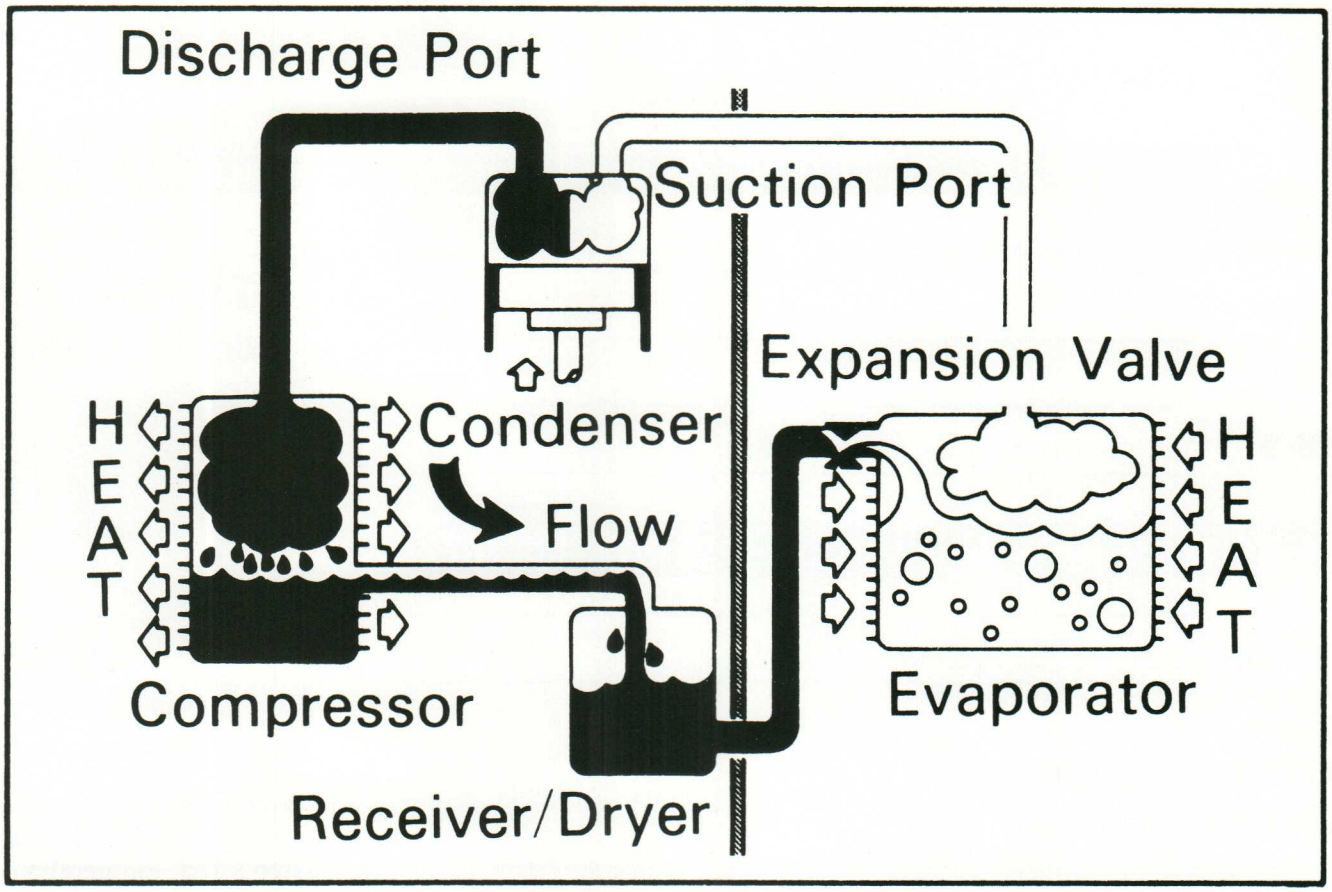
Article No. 254

GENERAL DESCRIPTION



The Refrigeration Cycle

1. The compressor discharges high-temperature, high-pressure refrigerant that contains heat absorbed from the evaporator plus heat created by the compression of the refrigerant itself.

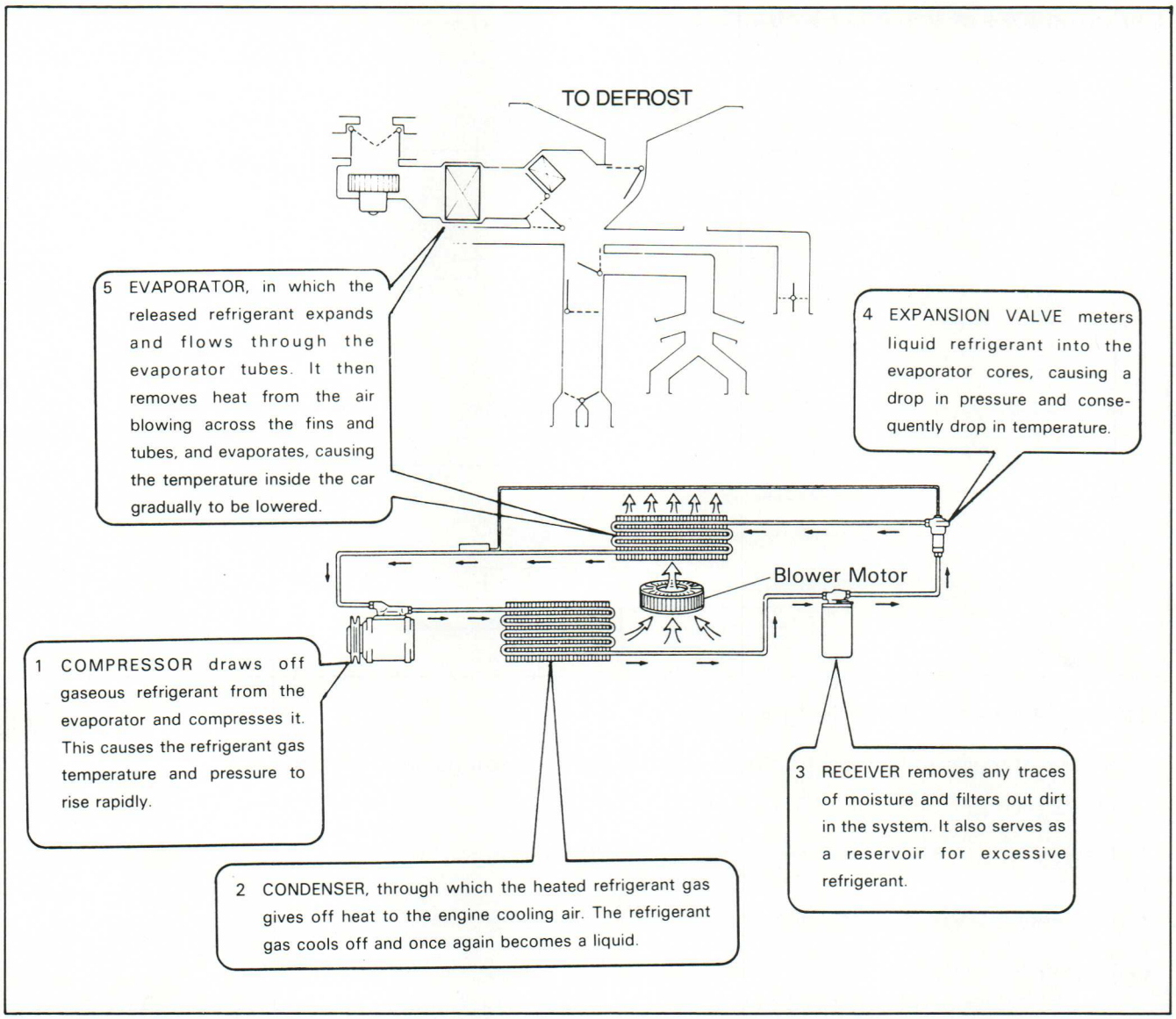
2. This gaseous refrigerant flows into the condenser, where it is condensed into liquid refrigerant.

3. The liquid refrigerant flows into the receiver, where any traces of moisture and dirt are filtered and excessive refrigerant is stored.

4. The expansion valve meters the liquid refrigerant into the evaporator core, changing it into a low-temperature, low-pressure liquid and gaseous mixture.

5. This cold refrigerant flows to the evaporator where the heat from the warm air stream passing through the evaporator core is transferred to the refrigerant. The liquid changes into gaseous refrigerant in the evaporator, and the heat-laden gaseous refrigerant is drawn into the compressor.

GENERAL DESCRIPTION (Continued)

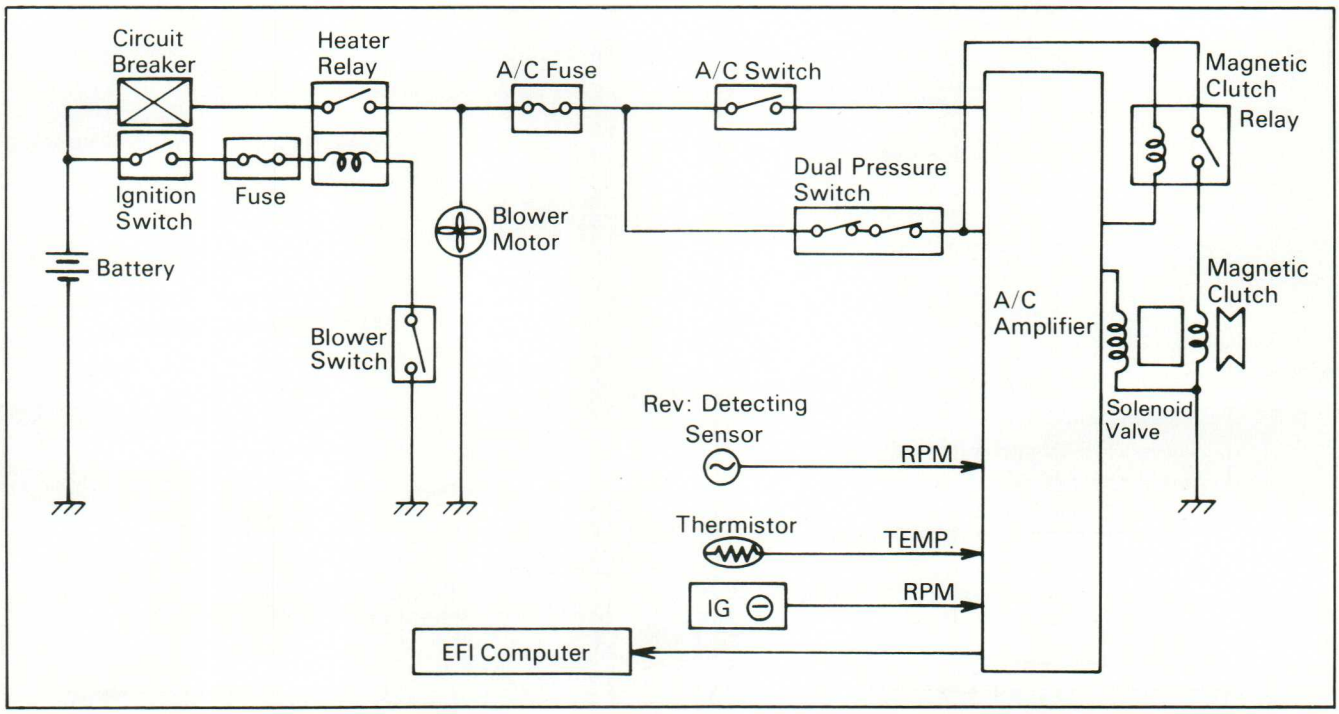


Caution:

Always wear safety glasses and gloves when doing air conditioning work. Getting R-12 refrigerant in your eyes or on your skin can cause serious physical damage from frostbite.

GENERAL DESCRIPTION (Continued)

The Principles of the A/C Electrical Circuit



How the Magnetic Clutch is Energized

The general process until magnetic clutch is energized is shown below.

① Ignition Switch "ON"

② Blower Switch "ON" ⟶ Heater Relay "ON" (Blower Motor "RUN")

③ A/C Switch "ON" ⟶ A/C amplifier "ON" (A/C Amp. Main Power Supply)

④ Dual Pressure Switch "ON":
Refrigerant Condition (2.1 kg/cm² (30 psi, 206 kPa) less than 27 kg/cm² (384 psi, 2,648 kPa)

⑤ Thermistor supplies temperature signal of evaporator to A/C amplifier.

⑥ Ignition coil supplies RPM signal of engine to A/C amplifier.

⑦ A/C amplifier supplies signal for idle-up to EFI computer
⟶ E/G Idle-Up

⑧ Magnetic Clutch Relay "ON"

⑨ Magnetic Clutch "ON"

⑩ Revolution Detecting Sensor supplies RPM signal of compressor to A/C amplifier.

If compressor is not locked, magnetic clutch is continuously energized.

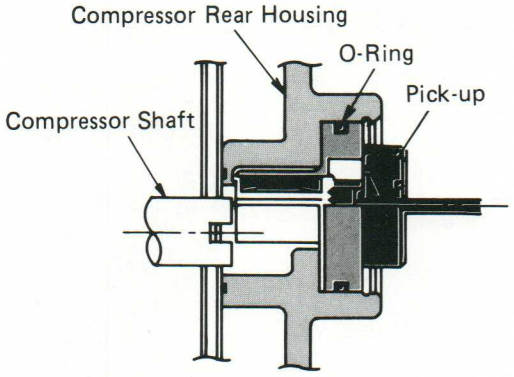
Article No. 255

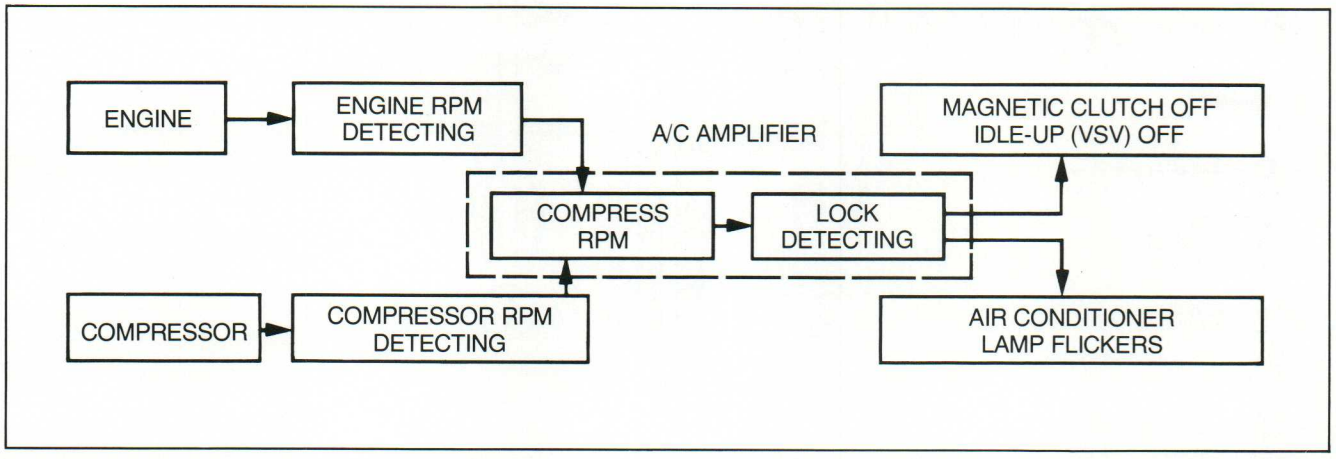
COMPRESSOR BELT PROTECTION SYSTEM (LOCK SENSOR)

The compressor belt protection system is found on the Camry, Celica, Corolla SR5/GT-S and Corolla diesel models.

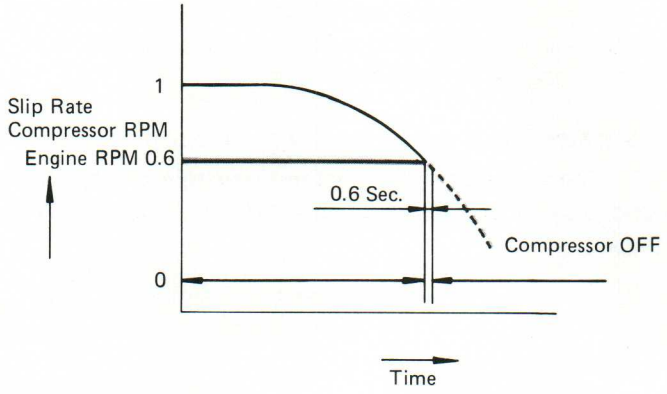
If the compressor rpm varies as a result of excessive system pressure, the compressor belt protection system acts as a safety system, preventing reduction of alternator or power steering pump output, and/or belt damage. It automatically turns off the magnetic clutch and idle-up VSV and causes the air conditioner switch lamp to blink, informing the driver that a problem exists.

A revolution sensor in the air conditioner compressor detects the engine speed from the igniter, and the compressor speed from the pickup inside the compressor. Note: some are rear housing and some are main body of the compressor.





The air conditioner amplifier compares the ratio of compressor speed to engine speed and detects the slip ratio. If it senses a drop in compressor rpm relative to engine rpm, it determines that there's a problem in the compressor or belt drive.



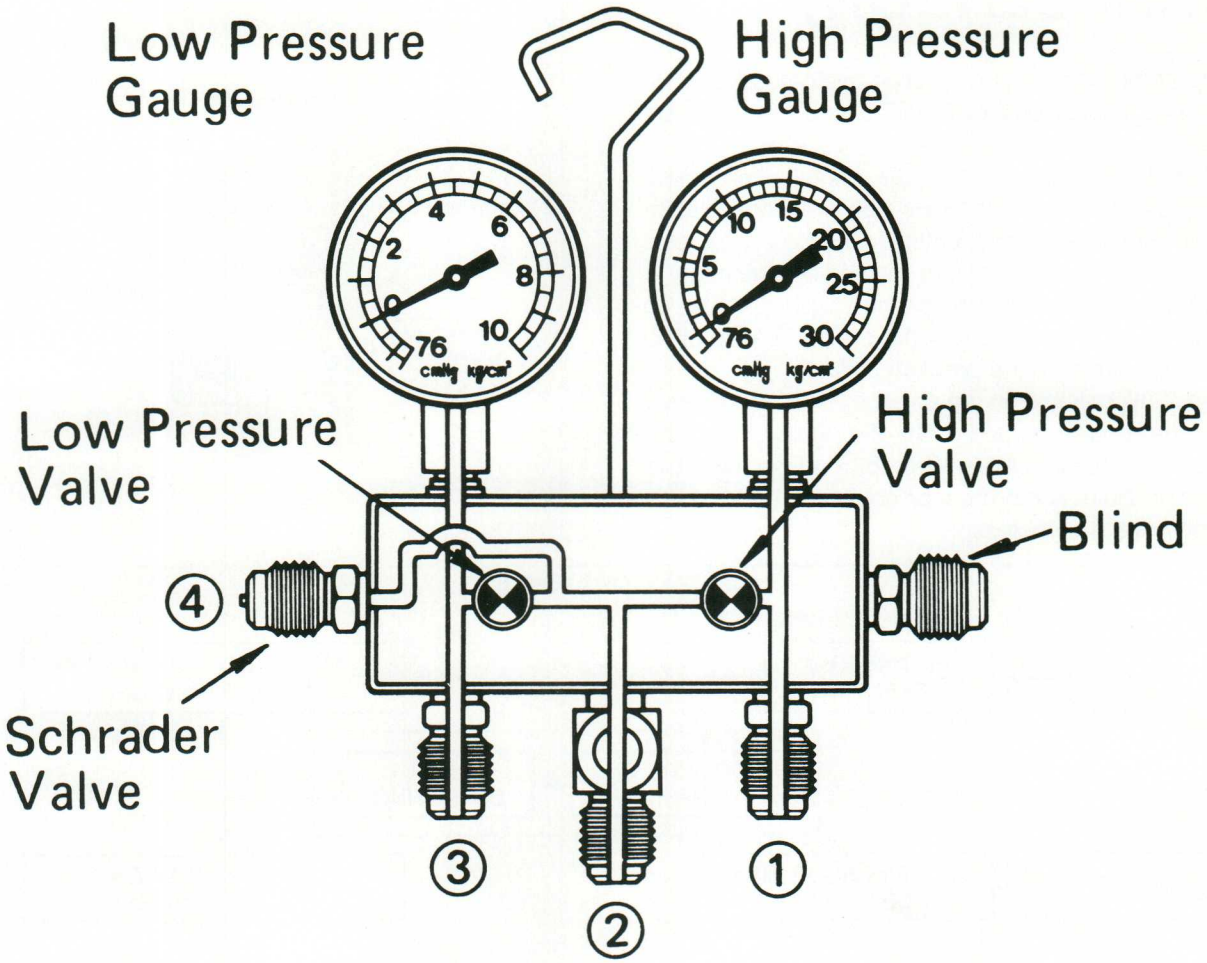
If the slip ratio stays at 0.6 or less for longer than 0.6 seconds, the magnetic clutch is switched off, the idle-up is released and the A/C lamp blinks until the ignition switch is turned off.

If a customer complains that the air conditioner sometimes works and sometimes doesn't, and the switch blinks, there are several possible causes:

- A worn or improperly adjusted multi-ribbed drive belt.
- An A/C system that's overfilled, causing a buildup of excessive head pressure under certain operating conditions.
- A break in the revolution sensor circuit.
- A drive belt that has gotten wet, slipped and caused an excessive variation in compressor/crankshaft speeds.

Article No. 256

THE GAUGE MANIFOLD



The gauge manifold is used for troubleshooting, as well as for evacuating and charging. The features, construction and handling methods outlined in this section should be studied carefully.

The knobs on the front side of the gauge manifold are the valve handles. LO indicates the low pressure valve; HI indicates the high pressure valve. Both valves can be opened and closed by a single turn of the handle.

Vacuum drawing and refrigerant charging can be done by using the connection (with valve core inside) projecting out from the left side of the gauge manifold.

(2 and 4 are always connected internally.)

Valve handles and charging hoses are differentiated by color to allow quick operation, and to avoid mixing up the high pressure and charging side.

Blind connections are provided at two places for hose storage, preventing dust or moisture from entering in the charging hoses when not in use.

Construction and Handling Method

The accompanying diagrams illustrate the opening and closing operations of the low and high pressure valves.

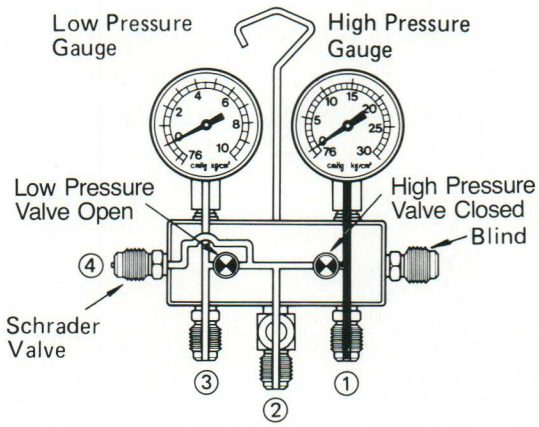
THE GAUGE MANIFOLD (Continued)

1. When the low pressure valve (LO) is open and the high pressure valve (HI) is closed:

③ ← ② → Low pressure side gauge
④

(Valve core opened)

① ← → High pressure side gauge

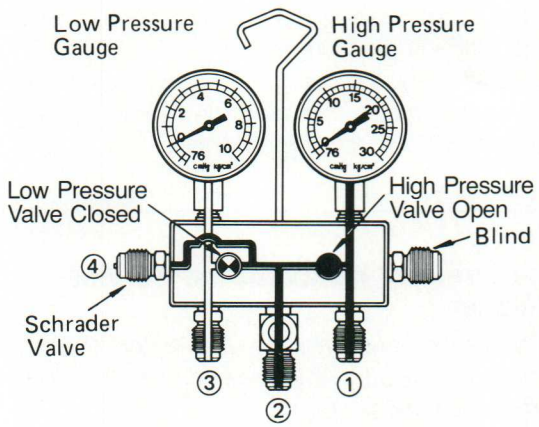


2. When the low pressure valve (LO) is closed and the high pressure valve (HI) is open:

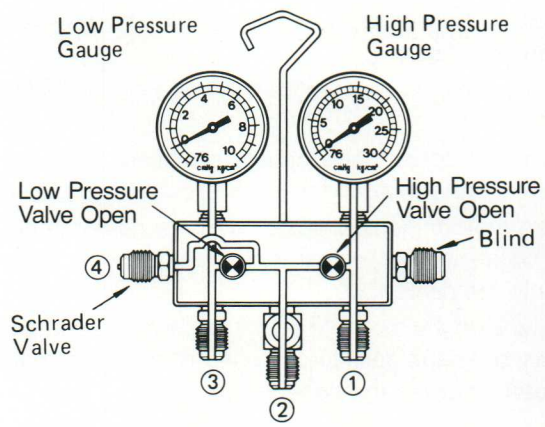
③ ← → Low pressure side gauge

① ← ② → High pressure side gauge
④

(Valve core opened)



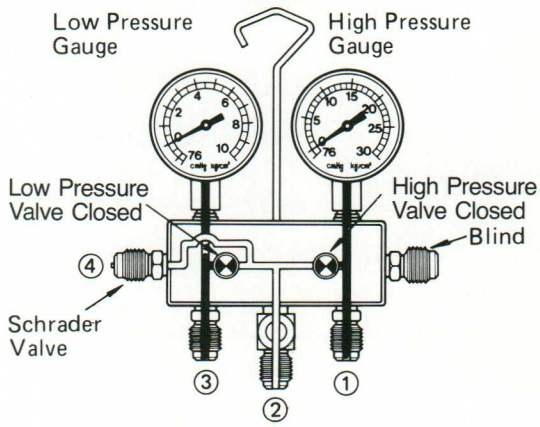
3. When both the low pressure valve (LO) and the high pressure valve (HI) are open: All passages are open.



THE GAUGE MANIFOLD (Continued)

4. When both the low pressure valve (LO) and the high pressure valve (HI) are closed:

③ ——— Low pressure side gauge
① ——— High pressure side gauge



Attach service can to (2)

Charging Hoses

Hoses are differentiated by colors — red, green and blue. As a rule, the blue hose is used at the low pressure side, the green hose at the charging hose, and the red hose at the high pressure side.

After finishing the charging of refrigerant gas into the refrigerating cycle, the charging hose should be disconnected in the following manner:

1. Loosen the nut of the charging hose being disconnected. At the same time, hold the coupling to keep its valve core opening pin pressed against the valve core in the mating connection.

2. When the nut is completely unscrewed, simultaneously remove the charging hose *and* open the manifold valve. IMPORTANT: This helps protect the fingers from frostbite.

Procedures for Handling the Service Can Valve

The service can valve is used when charging the refrigerant contained in a service can into the refrigerant system. Follow these steps:

1. Before using the service can handle, confirm that it is the type in which a packing can be used. Turn the handle and raise up the needle. The disc must be raised up at this time.

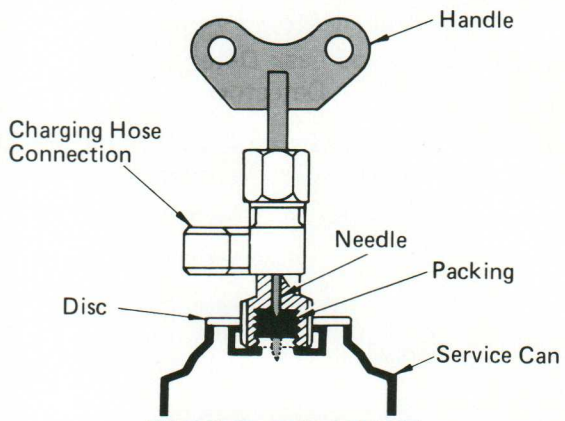
2. Screw the service can valve onto the sevice can. Tighten the disc.

3. Connect the green hose from the gauge manifold to the valve.

4. Turn the service can handle clockwise to lower the needle. Open a hole in the service can sealing cover.

5. Turn the handle counterclockwise to raise the needle up. This allows the refrigerant to pass through the valve and into the center hose.

6. Make sure the manifold gauge low side valve is closed. Slightly open the service can hose fitting at the manifold to bleed air out of the hose.



SERVICE CAN VALVE

7. Open the manifold low side valve and charge the system. (NOTE: If charging is to be stopped part way, turning the handle fully clockwise stops the flow of gas. You can also shut it off at the gauge manifold.)

Article No. 257

TROUBLESHOOTING WITH THE GAUGE MANIFOLD

Checking the Refrigeration System with the Gauge Manifold

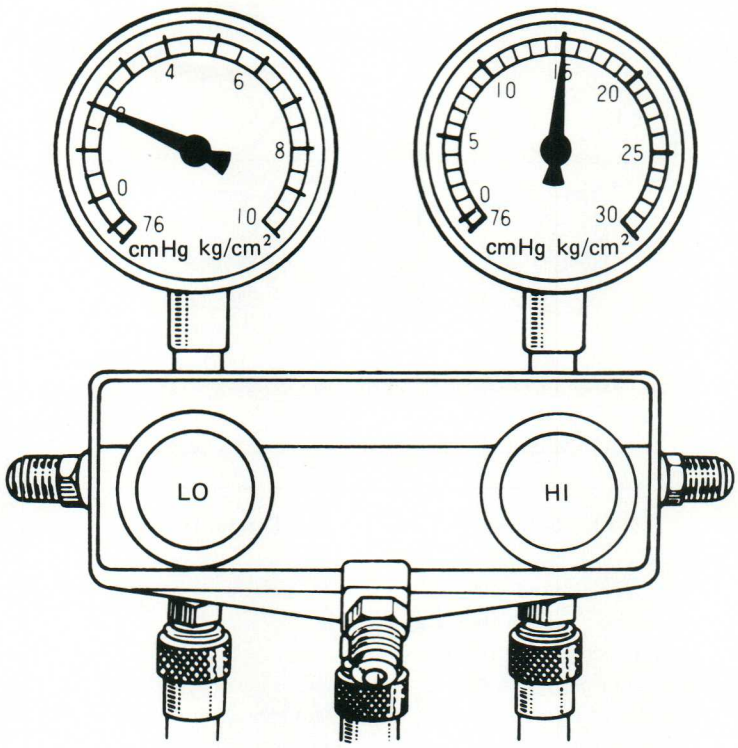
In this method, possible trouble is located by using a gauge manifold.

Before you can obtain an accurate read from the gauge manifold, you must:

- Make sure the temperature at the air inlet is 86 - 95 degrees F (30 - 35 degrees C)
- Get the engine running at 2,000 rpm
- Set the blower speed at high
- Set the temperature control lever at cool

Note: The gauge indications may vary slightly due to ambient temperature conditions.

Normally Functioning Refrigeration System



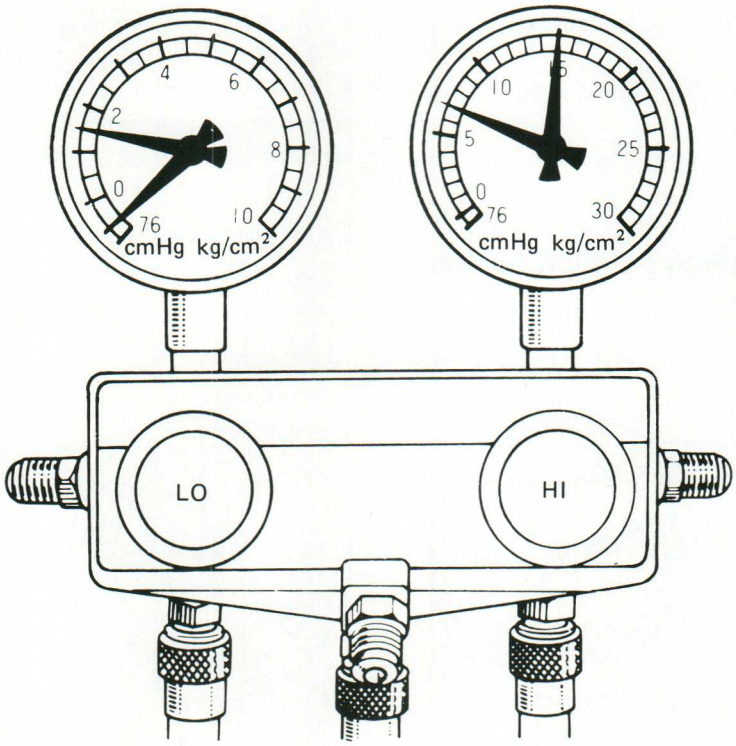
Gauge reading:

- Low pressure side: 1.5-2.0 kg/cm² (21-28 psi; 147-196 kPa)
- High pressure side: 14.5-15.0 kg/cm² (206-213 psi; 1,422-1,471 kPa)

TROUBLESHOOTING WITH THE GAUGE MANIFOLD (Continued)

Moisture Present in Refrigeration System

Condition: Periodically cools and then fails to cool.

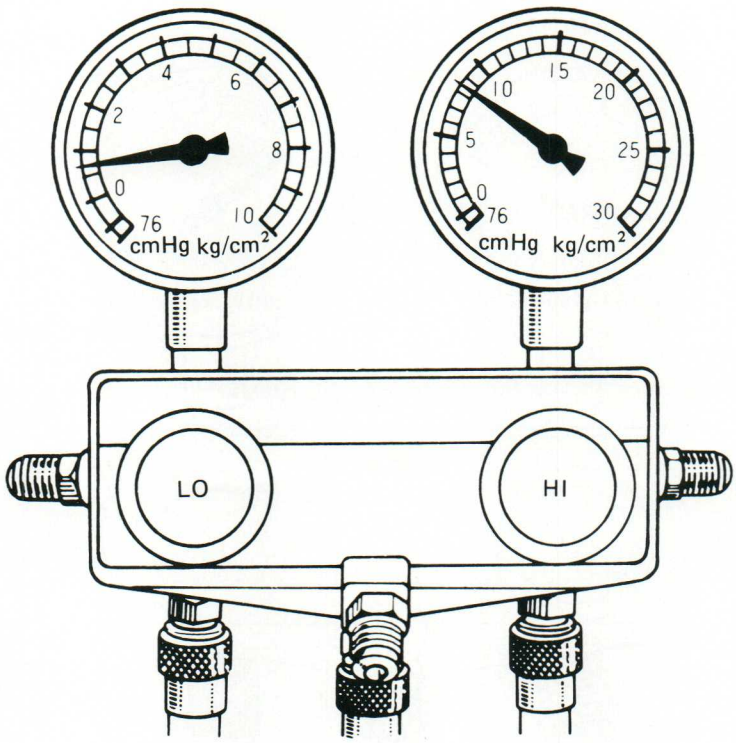


Symptom seen in refrigeration system	Probable cause	Diagnosis	Remedy
During operation, pressure on low pressure side sometimes becomes a vacuum and sometimes normal	Moisture entered in refrigeration system freezes at expansion valve orifice and temporarily stops cycle, but normal state is restored after a time when the ice melts	Drier in oversaturated state ↓ Moisture in refrigeration system freezes at expansion valve orifice and blocks circulation of refrigerant	(1) Replace receiver and drier (2) Remove moisture in cycle through repeated vacuum purging method (3) Charge new refrigerant to proper amount

TROUBLESHOOTING WITH THE GAUGE MANIFOLD (Continued)

Insufficient Refrigerant

Condition: Insufficient cooling.

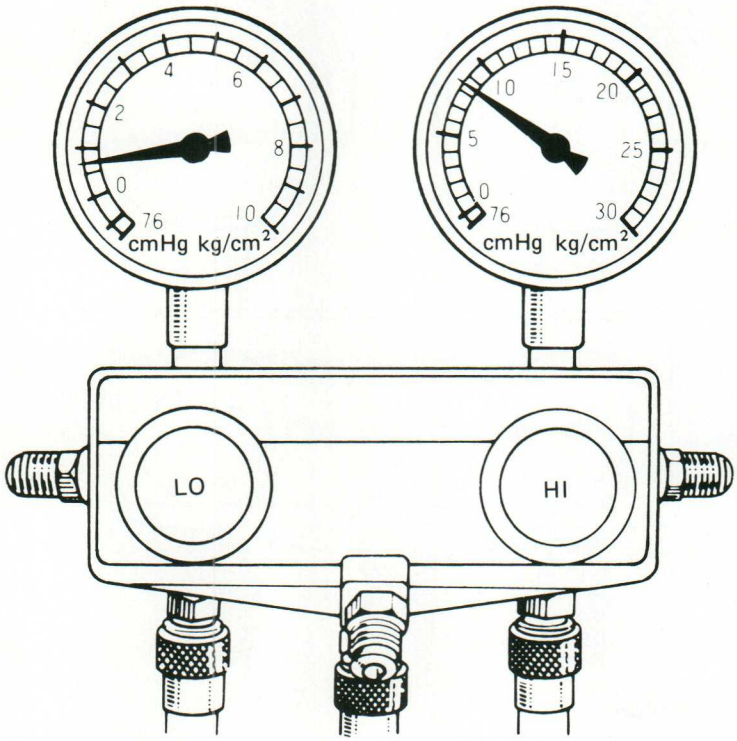


Symptom seen in refrigeration system	Probable cause	Diagnosis	Remedy
Pressure low on both low and high pressure sides Bubbles seen in sight glass Insufficient cooling performance	Gas leakage at some place in refrigeration system	Insufficient refrigerant in system ↓ Refrigerant leaking	Check with leak detector repair Charge refrigerant to proper amount

TROUBLESHOOTING WITH THE GAUGE MANIFOLD (Continued)

Poor Circulation of Refrigerant

Condition: Insufficient cooling.

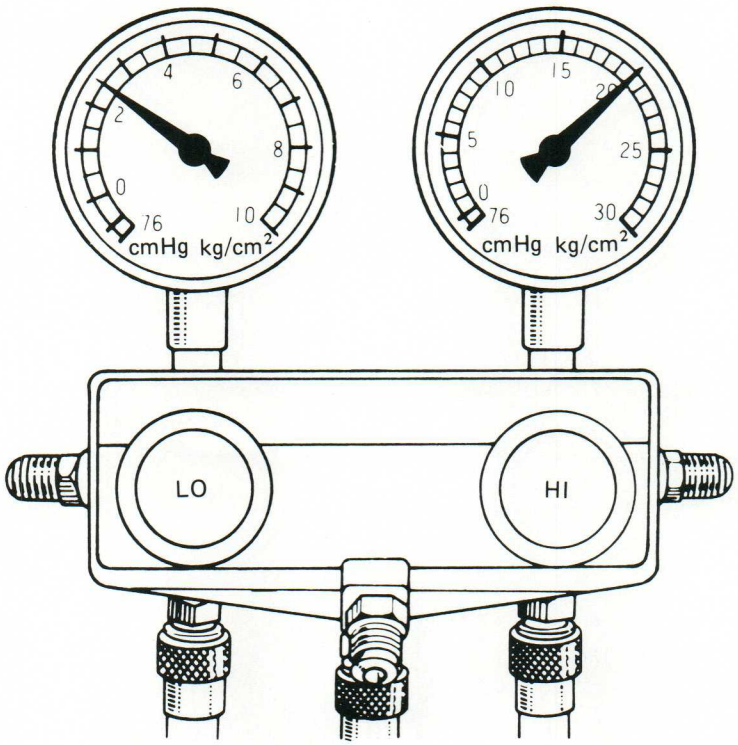


Symptom seen in refrigeration system	Probable cause	Diagnosis	Remedy
Pressure low on both low and high pressure sides Frost on tubes from receiver to unit	Refrigerant flow obstructed by dirt in receiver	Receiver clogged	Replace receiver

TROUBLESHOOTING WITH THE GAUGE MANIFOLD (Continued)

Refrigerant Overcharge or Insufficient Cooling of Condenser

Condition: Does not cool sufficiently.

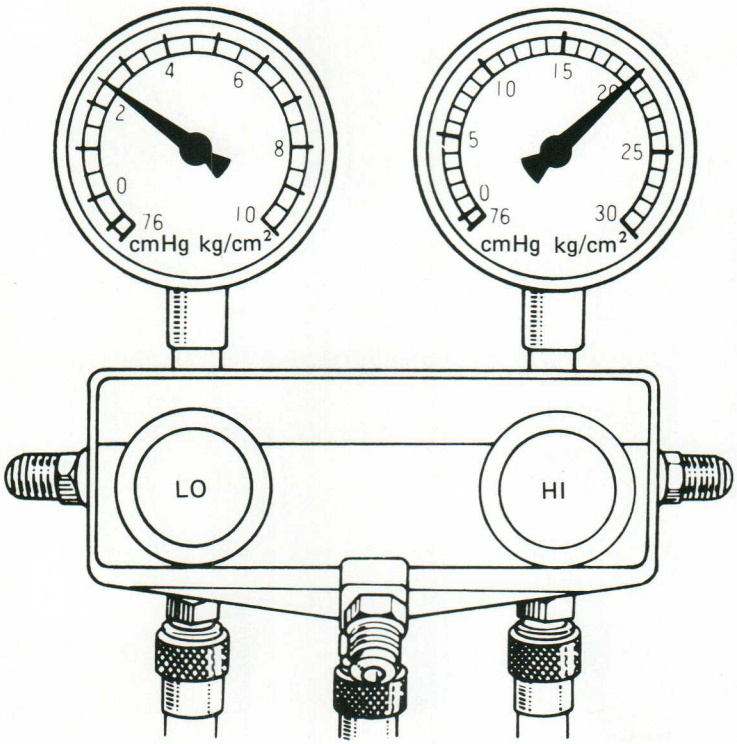


Symptom seen in refrigeration system	Probable cause	Diagnosis	Remedy
Pressures too high on both low and high pressure sides	Unable to develop sufficient performance due to excessive refrigerant in system Condenser cooling insufficient	Excessive refrigerant in cycle → refrigerant overcharged Condenser cooling insufficient → condenser fins clogged or fan motor faulty	(1) Clean condenser (2) Check fan motor operation (3) If (1) and (2) are in normal state, check amount of refrigerant *Note:* Vent out refrigerant through gauge manifold low pressure side by gradually opening valve.

TROUBLESHOOTING WITH THE GAUGE MANIFOLD (Continued)

Expansion Valve Improperly Mounted/Heat Sensing Tube Defective (Opens Too Wide)

Condition: Insufficient cooling.

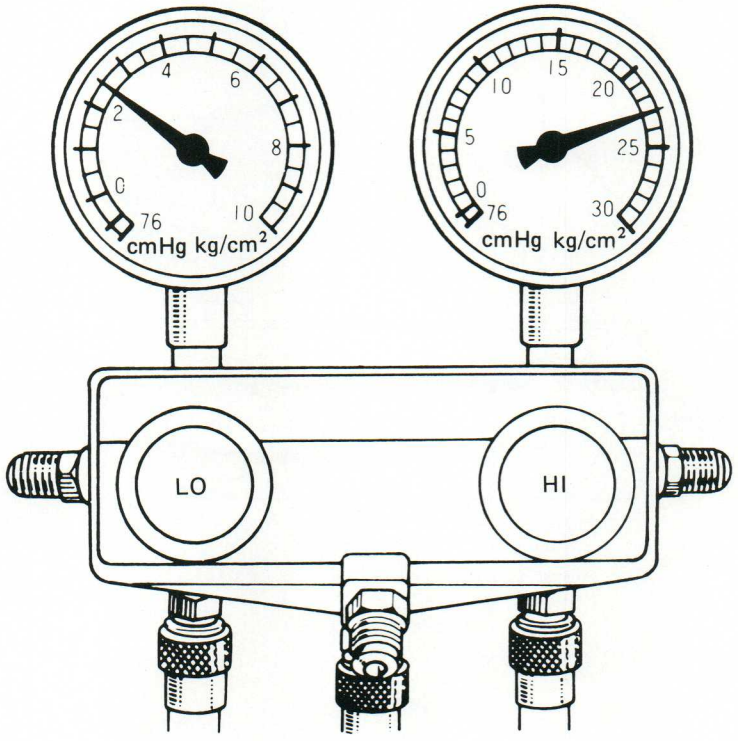


Symptom seen in refrigeration system	Probable cause	Diagnosis	Remedy
Pressures too high on both low and high pressure sides Frost or large amount of dew on piping at low pressure side	Trouble in expansion valve or heat sensing tube not installed correctly Refrigerant flow out of adjustment	Excessive refrigerant in low pressure piping ↓ Expansion valve opened too wide	(1) Check heat sensing tube installed condition (2) If (1) is normal, test expansion valve in unit form Replace if defective

TROUBLESHOOTING WITH THE GAUGE MANIFOLD (Continued)

Air Present in Refrigeration System

Condition: Does not cool down sufficiently. **NOTE:** These gauge indications are shown when the refrigeration system has been opened and the refrigerant charged without vacuum purging.

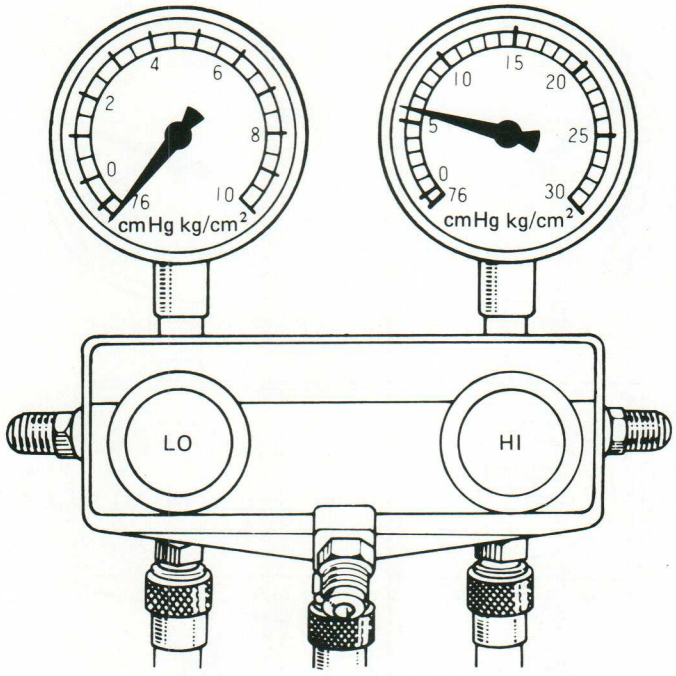


Symptom seen in refrigeration system	Probable cause	Diagnosis	Remedy
Pressures too high on both low and high pressure sides	Air entered in refrigeration system	Air present in refrigeration system ↓ Insufficient vacuum purging	(1) Replace receiver and drier (2) Check compressor oil to see if dirty or insufficient (3) Vacuum purge and charge new refrigerant

TROUBLESHOOTING WITH THE GAUGE MANIFOLD (Continued)

Refrigerant Does Not Circulate

Condition: Does not cool (cools from time to time in some cases).

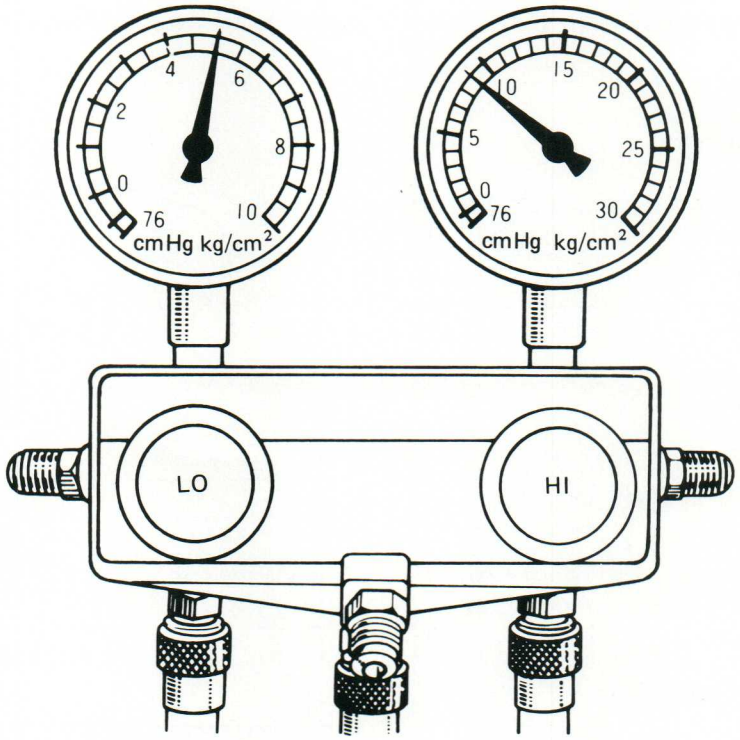


Symptom seen in refrigeration system	Probable cause	Diagnosis	Remedy
Vacuum indicated on low pressure side, very low pressure indicated on high pressure side Frost or dew seen on piping before and after receiver and drier or expansion valve	Refrigerant flow obstructed by moisture or dirt in refrigerant freezing or adhering to expansion valve orifice Refrigerant flow obstructed by gas leakage from expansion valve heat sensing tube	Expansion valve orifice clogged ↓ Refrigerant does not flow	Allow to stand for some time and then restart operation to determine if trouble is caused by moisture or dirt. If caused by moisture, refer to procedures step 2 on page 5-3. If caused by dirt, remove expansion valve and clean off dirt by blowing with air. If unable to remove dirt, replace valve. Vacuum purge and charge new refrigerant to proper amount. For gas leakage from heat sensing tube, replace expansion valve.

TROUBLESHOOTING WITH THE GAUGE MANIFOLD (Continued)

Defective Compression

Condition: Does not cool.



Symptom seen in refrigeration system	Probable cause	Diagnosis	Remedy
Pressure too high on low pressure side Pressure too low at high pressure side	Internal leak in compressor	Compression defective ↓ Valve leaking or broken, sliding parts (piston, cylinder, gasket, connecting rod, etc.)	Replace compressor

Article No. 258

ENGINE BEARING SELECTION

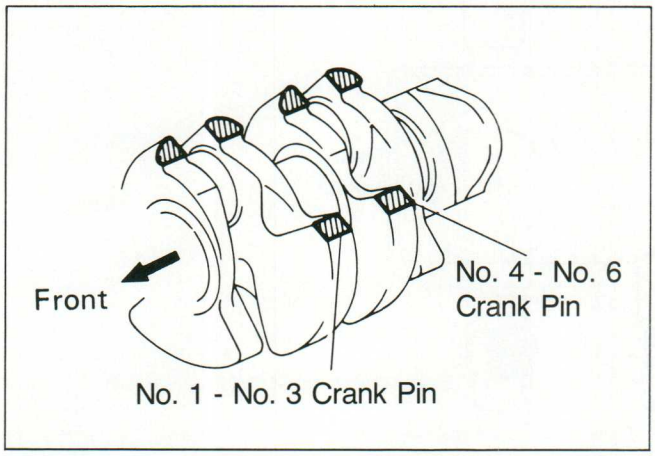
This article describes the procedure for selecting connecting rod bearings and main bearings for 5M-GE and 7M-GE engines built since 1982, including those with the new style (select fit) design, built since 1984.

Select fit engines are manufactured with extremely close tolerances. During manufacturing, the block is machined, precisely measured and stamped with code numbers. In some engines, the crankshaft is also measured and marked.

By using these code numbers, you can rebuild an engine to the original close factory tolerances. The bearings are available individually, rather than in sets.

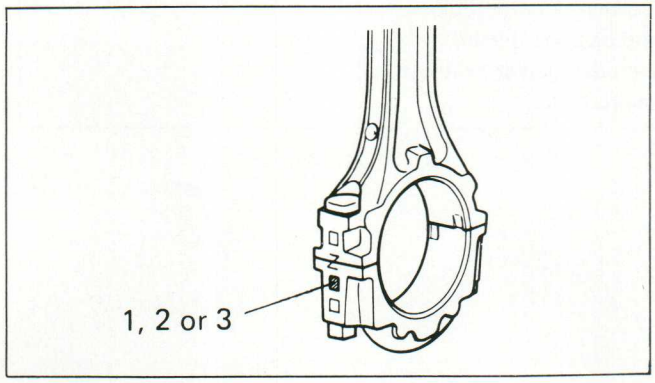
Connecting Rod Bearings

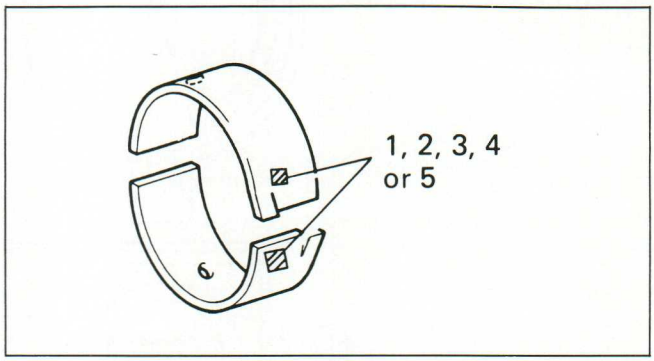
1. Locate the rod bearing size numbers on the crankshaft counterweights, as shown in the illustration. The crankshaft number will be 0, 1 or 2.



2. Find the rod sizing number on each connecting rod cap. The rod number will be 1, 2 or 3. Be sure to use the number that appears in the location illustrated; the rod is imprinted with other numbers unrelated to bearing size.

3. Add the crankshaft number and the connecting rod cap number to get the correct bearing number. It will be 1, 2, 3, 4 or 5, as the charts below indicate.





Rod cap No.	1	1	2	1	2	3	2	3	3
Crankshaft No.	0	1	0	2	1	0	2	1	2
Bearing No.	1	2	2	3	3	3	4	4	5

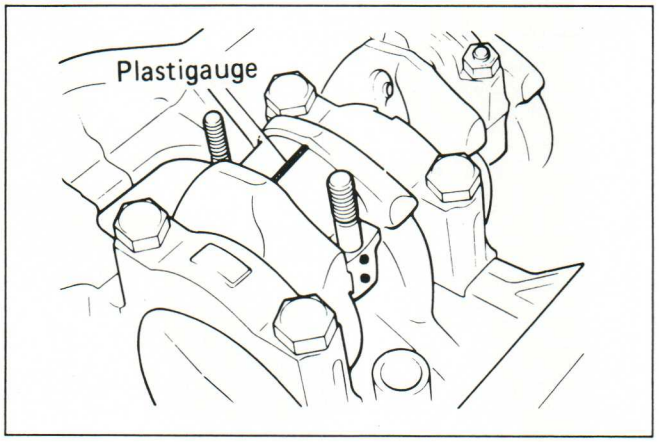
Example: Rod cap No. 2, Crankshaft No. 1 = Bearing No. 3

mm (in.)

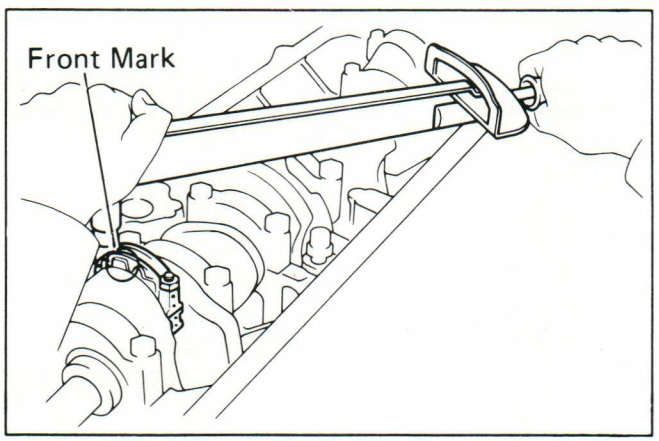
Size	Big End Inner Diameter	Crank Pin Diameter	Bearing Center Wall Thickness
0	–	51.993 – 52.000 (2.0470 – 2.0472)	–
1	55.015 – 55.025 (2.1659 – 2.1663)	51.985 – 51.992 (2.0466 – 2.0469)	1.490 – 1.495 (0.0587 – 0.0589)
2	55.026 – 55.035 (2.1664–2.1667)	51.976 – 51.984 (2.0463 – 2.0466)	1.496 – 1.500 (0.0589 – 0.0591)
3	55.036 – 55.045 (2.1668 – 2.1671)	–	1.501 – 1.505 (0.0591 – 0.0593)
4	–	–	1.506 – 1.510 (0.0593 – 0.0594)
5	–	–	1.511 – 1.515 (0.0595 – 0.0596)
U/S 0.25	55.015 – 55.045 (2.1659 – 2.1671)	51.725 – 51.735 (2.0364 – 2.0368)	1.622 – 1.632 (0.0639 – 0.0643)

ENGINE BEARING SELECTION (Continued)

4. After replacing the bearing, check the oil clearance by laying a strip of plastigauge across the crankshaft pin.



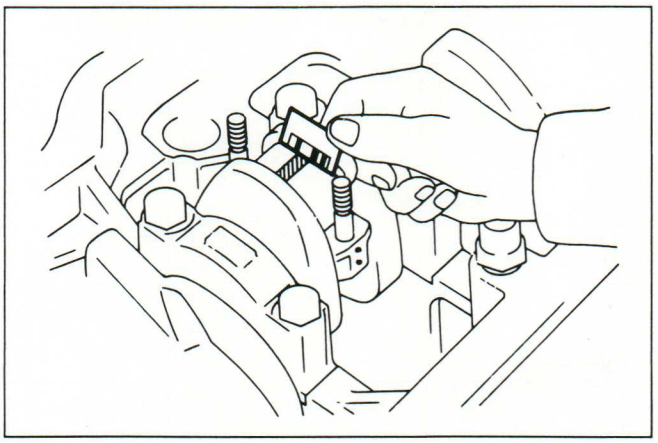
5. Align the rod and cap marks and fit on the cap. Torque the rod cap nuts to 47 ft-lb (650 kg-cm). **Note:** Do not turn the crankshaft.



6. Remove the rod cap and measure the plastigauge at its widest point.

Standard clearance: 0.0008-0.0021 inches (0.021-0.053 mm)

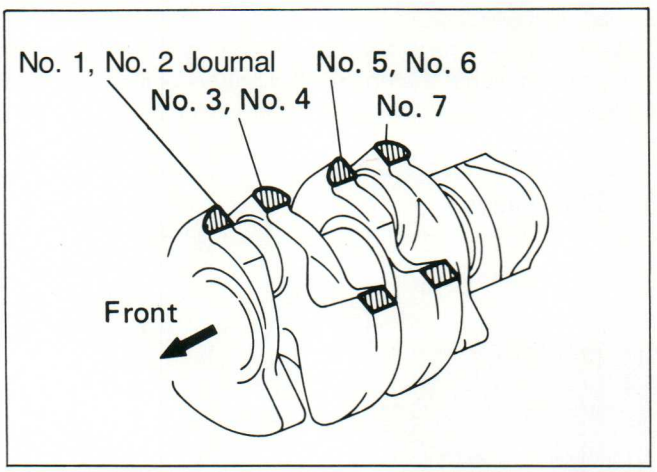
Maximum clearance: 0.0031 inches (0.08 mm)



If oil clearance is not within specification, select a different size bearing and recheck. If you cannot obtain correct clearance with any of the five bearings, the crankshaft must be replaced or ground.

Main Bearings

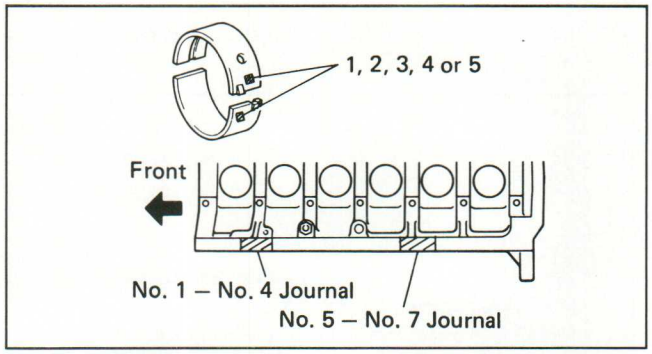
1. Find the size numbers on the crankshaft counterweights. The location is indicated in the illustration. The number will be 0, 1 or 2.



2. Find the size numbers on the oil pan mating surface of the block, as illustrated. The number will be 1, 2 or 3.

ENGINE BEARING SELECTION (Continued)

3. Add the crankshaft number to the number on the block to get the correct main bearing number. It will be 1, 2, 3, 4 or 5, as the charts below indicate.



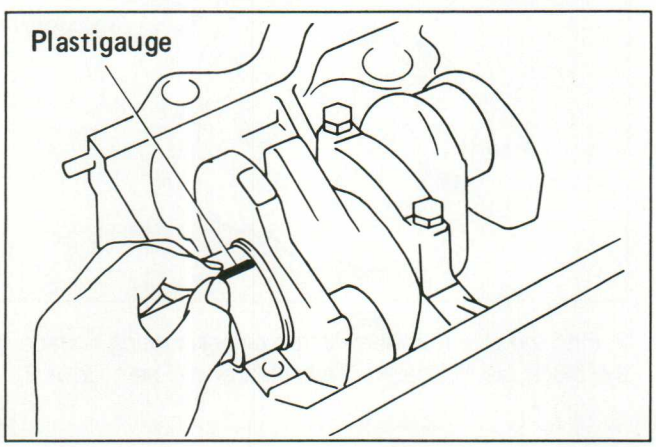
Cylinder Block	No.	1	2	1	3	2	1	3	2	3
Crankshaft	No.	0	0	1	0	1	2	1	2	2
Bearing	No.	1	2	2	3	3	3	4	4	5

Example: Cylinder Block No. 2, Crankshaft No. 1 = Bearing No. 3

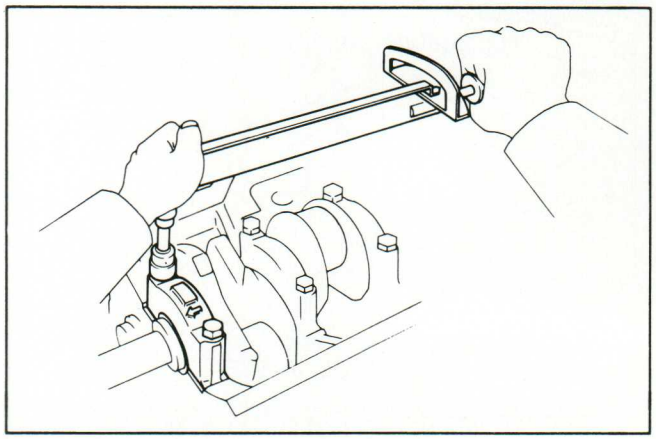
mm (in.)

Size	Cylinder Block Main Journal Bore	Main Journal Diameter	Bearing Center Wall Thickness
0	–	60.007 – 60.012 (2.3625 – 2.3627)	–
1	64.024 – 64.030 (2.5206 – 2.5209)	60.001 – 60.006 (2.3622 – 2.3624)	1.984 – 1.988 (0.0781 – 0.0783)
2	64.031 – 64.036 (2.5209 – 2.5211)	59.994 – 60.000 (2.3620 – 2.3622)	1.989 – 1.992 (0.0783 – 0.0784)
3	64.037 – 64.042 (2.5211 – 2.5213)	–	1.993 – 1.996 (0.0785 – 0.0766)
4	–	–	1.997 – 2.000 (0.0786 – 0.0787)
5	–	–	2.001 – 2.004 (0.0788 – 0.0789)
U/S 0.25	64.022 – 64.046 (2.5205 – 2.5215)	59.730 – 59.740 (2.3516 – 2.3520)	2.123 – 2.133 (0.0836 – 0.0840)

4. Install the main bearing on the cylinder block and crankshaft. Lay a strip of plastigauge across the main journals.



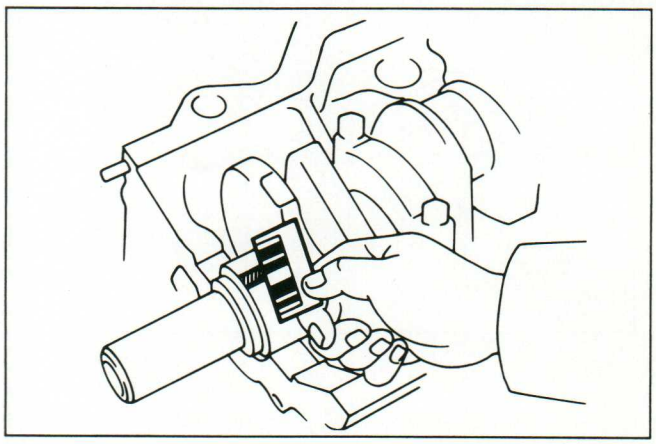
5. Install the main bearing caps and torque the cap bolts to 75 ft-lb (1,040 kg-cm). **Note:** Do not turn the crankshaft.



6. Remove the main bearing caps. Measure the plastigauge at its widest point.

Standard clearance: 0.0013-0.0023 inches (0.034-0.058 mm)

Maximum clearance: 0.0031 inches (0.08 mm)



If the clearance is not within specifications, select another size bearing and recheck the oil clearance. If the proper clearance cannot be obtained, the crankshaft must be replaced or ground.

"The Toyota STAR Cabinet helped me solve my wait problem."

"Wait loss. That's what happens when your customer goes somewhere else because *you* don't have the part you need to fix his car. It happened to me, and believe me, it's painful.

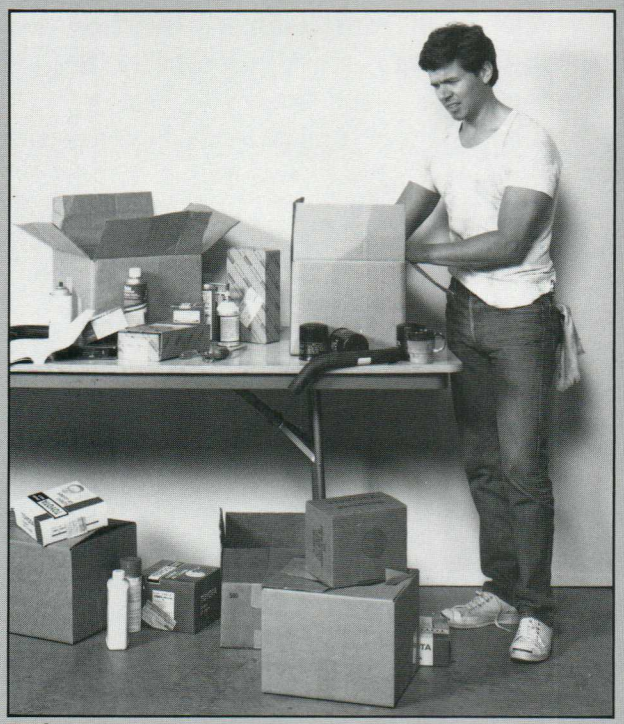
"Then my Toyota STAR Dealer showed me what the STAR Cabinet could do for my business. Now I can stock the fast-moving Toyota Genuine Parts my shop needs.

"The inventory is tailored to *my* business, and it's restocked regularly – with no delivery charge. That means parts are within reach, or a phone call away.

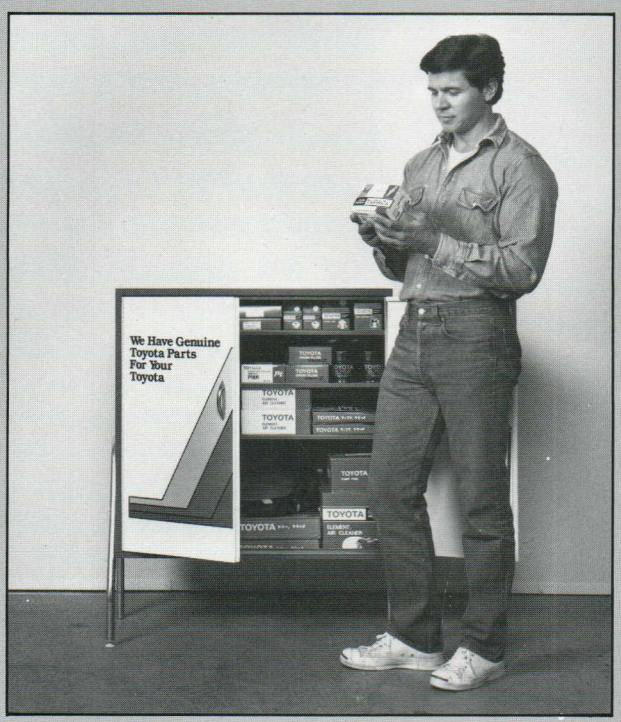
"The STAR Cabinet is attractive, too. It can hang on the wall or sit on the floor, and the shelves are adjustable. It even comes with a security lock.

"It's just one of many services my Toyota STAR dealer offers.

"Now my customers are satisfied. And so am I."



Before



After

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