

10. OUTDOOR UNIT REFRIGERANT RECOVERY METHOD

10-1. Refrigerant Recovery from Failed Outdoor Unit (Pump-Down)

This product supports refrigerant pump-down, a function which allows refrigerant to be recovered from an outdoor unit in need of repair using a normal outdoor unit in a system featuring multiple outdoor units.

10-1-1. Note for refrigerant recovery operation

When performing pump-down operation, take note of the following matters:

- Note 1:** The pump-down refrigerant recovery rate changes with outside temperature and other factors. After pump-down is completed, recover any residual gas using a refrigerant recovery device, etc., and be sure to measure the amount of recovered refrigerant. (The refrigerant recovery rate can be improved by heating the accumulator of the outdoor unit to be repaired during pump-down operation.)
- Note 2:** If pump-down has been performed, the system cannot be operated until the faulty outdoor unit is repaired.
(Continued operation would be impossible due to a refrigerant overcharge.)
- Note 3:** If outdoor PMVs 1 and 2 both happen to be faulty (unable to open) or PMV 4 fails while fully closed, the refrigerant in the heat exchangers (or sub-heat exchangers) cannot be recovered. In that case, recover any residual gas in the heat exchangers (or sub-heat exchangers) using a tube piercing valve or some other tool. After a pump-down operation, do not perform any welding until the residual gas in the heat exchangers is recovered.

10-1-2. Refrigerant recovery procedure A (Case of no outdoor unit backup operation setting)

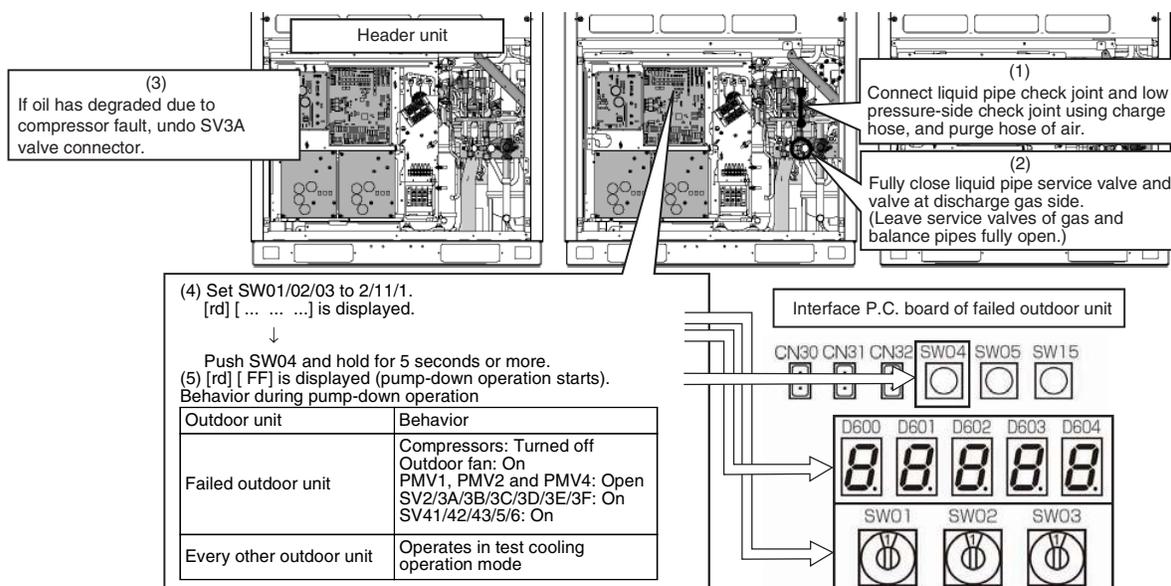
<Work procedure>

Turn on the power supply to the system at the source, but leave the system switched off. If the fault involves poor insulation of a compressor motor, remove the motor leads before the power is turned on.

[Setup of failed outdoor unit]

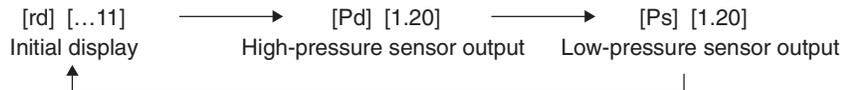
- (1) Connect the check joint of liquid pipe and the low pressure-side check joint using a charge hose, and purge the hose of air (to recover refrigerant from the liquid tank and heat exchangers).
- (2) Fully close the liquid pipe service valve and service valve at discharge gas side of the failed outdoor unit. (Leave the service valves of the suction gas and balance pipes fully open.)
- (3) If the oil is likely to have degraded due to a compressor fault, disconnect the SV3A valve connector of the failed outdoor unit (to prevent the degraded oil from flowing into other outdoor units).
- (4) Set SW01/02/03 on the interface P.C. board of the failed outdoor unit to 2/11/1. After [rd] [... ..] is displayed on the 7-segment display, push SW04 and hold for 5 seconds or more.
- (5) [rd] [... FF] will be displayed on the 7-segment display, and pump-down operation will start.

* To put the operation on hold midway, turn off the power supply to all the outdoor units, or push SW05 on the interface P.C. board.



- (6) Approx. 10 minutes after the system starts up, fully close the gas pipe service valve of the failed outdoor unit.
- (7) Push SW04 of the failed outdoor unit to have pressure data (MPa) displayed.
(The display switches each time SW04 is pushed.)

Display Example



[Selection of outdoor unit for pressure adjustment]

- (8) Of all outdoor units operating in the pump-down mode, select the one with the lowest unit No. as an outdoor unit for pressure adjustment.

Identifying Unit No.

The unit No. is the number displayed on the 7-segment display when SW01/02/03 are set to 1/1/1.

[[U#] [- - -]: # represents the unit No.)

[Setup of outdoor units other than unit for pressure adjustment and failed unit]

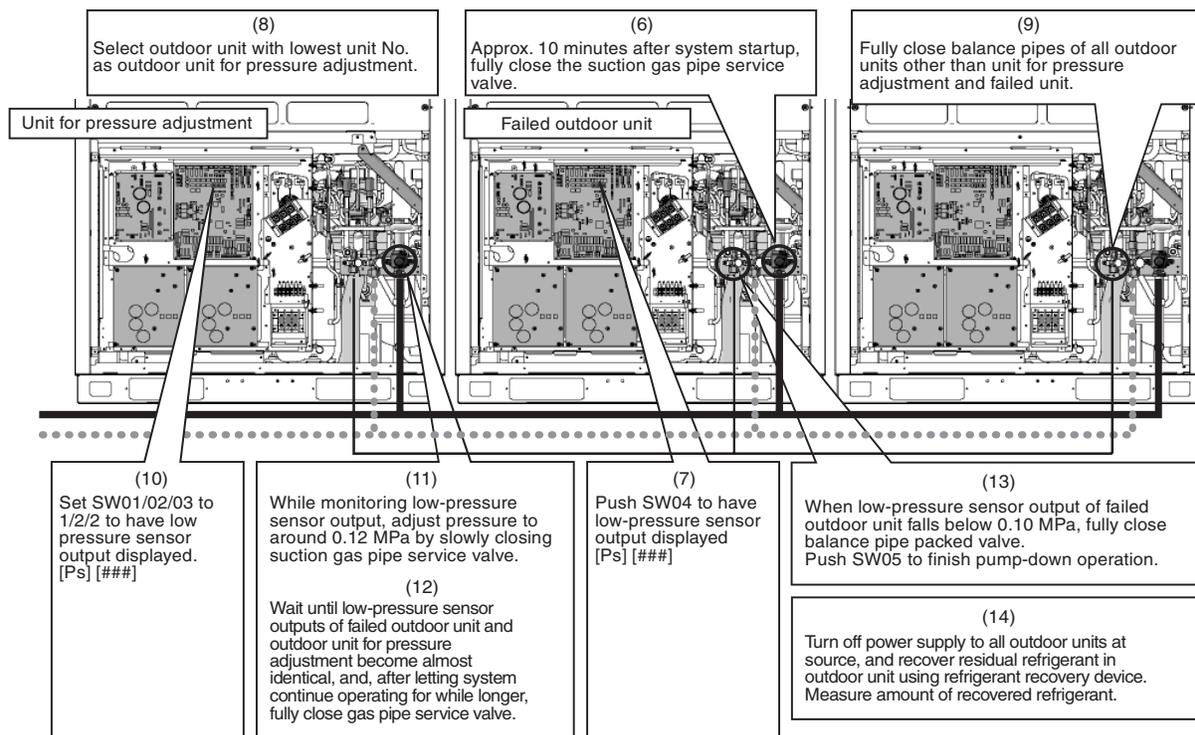
- (9) Leaving the balance pipes of the unit for pressure adjustment and the failed unit fully open, fully close the balance pipe service valves of all other outdoor units.

[Setup of outdoor unit for pressure adjustment]

- (10) Set SW01/02/03 on the interface P.C. board of the outdoor unit for pressure adjustment to 1/2/2.
- (11) As the low-pressure sensor output is displayed on the 7-segment display, adjust the pressure to around 0.12 MPa by slowly closing the gas pipe service valve, with checking pressure data.
- (12) Compare the low-pressure sensor outputs of the failed unit with that of the unit for pressure adjustment, and wait until the two pressure readings become almost the same. After letting the system continue operating for a while longer, fully close the gas pipe service valve of the unit for pressure adjustment.

[Setup of failed outdoor unit]

- (13) When the low-pressure sensor output of the failed outdoor unit falls below 0.10MPa, fully close the balance pipe packed valve, and push SW05 on the interface P.C. board to finish the pump-down operation.
- (14) Turn off the power supply to all the outdoor units, and recover the residual refrigerant in the outdoor unit using a refrigerant recovery device. Be sure to measure the amount of recovered refrigerant. (This is necessary to determine how much additional refrigerant will be needed after the completion of the repair.)



This is the end of the refrigerant recovery operation.

Set SW01/02/03 of the failed outdoor unit and the outdoor unit for pressure adjustment back to 1/1/1.

[Setup of the power cannot be turned on the failed outdoor unit]

If the power cannot be turned on the failed outdoor unit, the solenoid valves and PMVs of the unit cannot be turned on, so that it reduces the amount of recovered refrigerant compared to a standard pump-down operation. Recover the residual gas in the unit using a refrigerant recovery device, and be sure to measure the amount of recovered refrigerant.

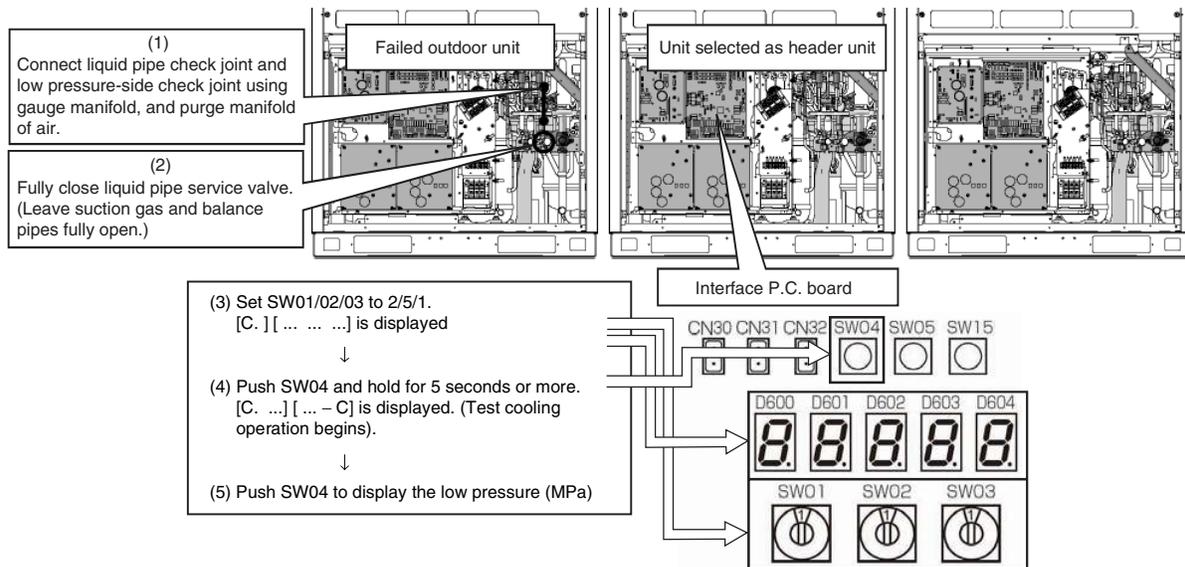
<Work procedure>

[Setup of failed outdoor unit]

- (1) Connect the liquid pipe check joint and the low pressure-side check joint using a gauge manifold, and purge the manifold of air (to recover refrigerant from the liquid tank and heat exchangers).
- (2) Fully close the liquid pipe packed valve and service valve at discharge gas side of the failed outdoor unit. (Leave the service valve of the suction gas pipe and the packed valve of the balance pipe fully open.)

[Setup of unit selected as header unit (hereafter "header outdoor unit")]

- (3) Set SW01/02/03 on the interface P.C. board of the header outdoor unit to 2/5/1. After [C.] [... ..] is displayed on the 7-segment display, push SW04 and hold for 5 seconds or more.
- (4) After [C. ...] [... - C] is displayed on the 7-segment display, the system starts operating in the test cooling operation mode.
- (5) Set SW01/02/03 on the interface P.C. board of the header outdoor unit to 1/2/2 to have the low-pressure sensor output (MPa) displayed on the 7-segment display.



- (6) Approx. 10 minutes after the system starts up, fully close the suction gas pipe service valve of the failed outdoor unit.

[Setup of outdoor unit for pressure adjustment]

- (7) Select the header unit as the unit for pressure adjustment.

[Setup of outdoor units other than header unit and failed unit]

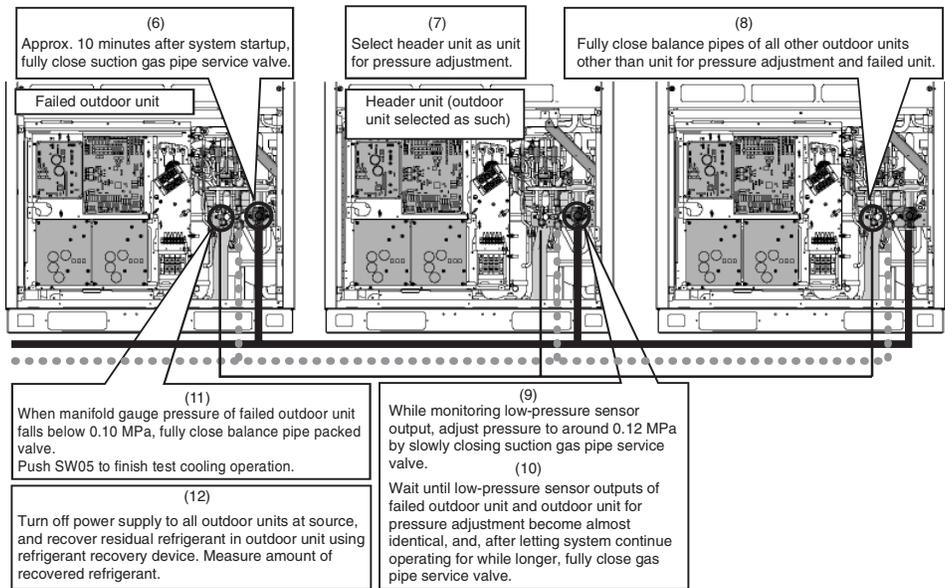
- (8) Leaving the balance pipes of the unit for pressure adjustment and the failed unit fully open, fully close the balance pipe packed valves of all other outdoor units.

[Setup of header unit]

- (9) While monitoring the low-pressure sensor output, adjust the pressure to around 0.12 MPa by slowly closing the suction gas pipe service valve.
- (10) Compare the manifold gauge pressure of the failed unit with the low-pressure sensor output of the header unit, and wait until the two pressure readings become almost identical. After letting the system continue operating for a while longer, fully close the suction gas pipe service valve of the unit for pressure adjustment.

[Setup of failed outdoor unit]

- (11) When the manifold gauge pressure of the failed outdoor unit falls below 0.10 MPa, fully close the balance pipe packed valve, and push SW05 on the interface P.C. board to finish the test cooling operation.
- (12) Turn off the power supply to all the outdoor units, and recover the residual refrigerant in the outdoor unit using a refrigerant recovery device. Be sure to measure the amount of recovered refrigerant. (This is necessary to determine how much additional refrigerant will be needed after the completion of the repair.)



This is the end of the refrigerant recovery operation.
Set SW01/02/03 of the header unit back to 1/1/1.

10-2. How to Operate System While Failed Outdoor Unit Being Repaired

<Outline>

After refrigerant is recovered from the failed outdoor unit through a pump-down operation, the overall amount of refrigerant held by the system becomes excessive, and this makes it impossible to operate the remaining outdoor units even though they are not faulty. However, operation is still possible if the system-wide amount of refrigerant is adjusted in accordance with the procedure described below.

<Work procedure>

- (1) Follow the steps specified in “10-1. Refrigerant Recovery from Failed Outdoor Unit (Pump-Down)”.
- (2) Adjust the amount of refrigerant held by the system by removing some of it using a refrigerant recovery device, etc.
Determine the amount of refrigerant to be removed according to the capacity of the failed outdoor unit. (See the table below.)

Example: If a 10HP outdoor unit is under repair in a 30HP system:

Amount of refrigerant required by system as it was initially (30HP in capacity) = 35.5kg

Amount of refrigerant required by system with available outdoor units only (20HP in capacity) = 25.5kg

Amount of refrigerant to be removed from system = 35.5 – 25.5 = 10kg

- (3) Set up the outdoor unit from which refrigerant has been recovered in the manner described in “9-3. Outdoor Unit Backup Operation Setting”.
This completes the procedure.

System capacity (HP)	Outdoor unit combination			Amount of refrigerant (kg)
8	8			13.0
10	10			14.0
12	12			19.0
14	14			21.0
16	8	8		22.0
18	10	8		23.5
20	10	10		25.5
22	12	10		29.5
24	14	10		30.5
26	14	12		33.0
28	14	14		34.0
30	10	10	10	35.5
32	12	10	10	38.0
34	14	10	10	39.0
36	12	12	12	41.0
38	14	12	12	42.5
40	14	14	12	44.0
42	14	14	14	45.5

10-3. Work procedure after Repair

When vacuuming in the repaired outdoor unit, follow the procedure described below.

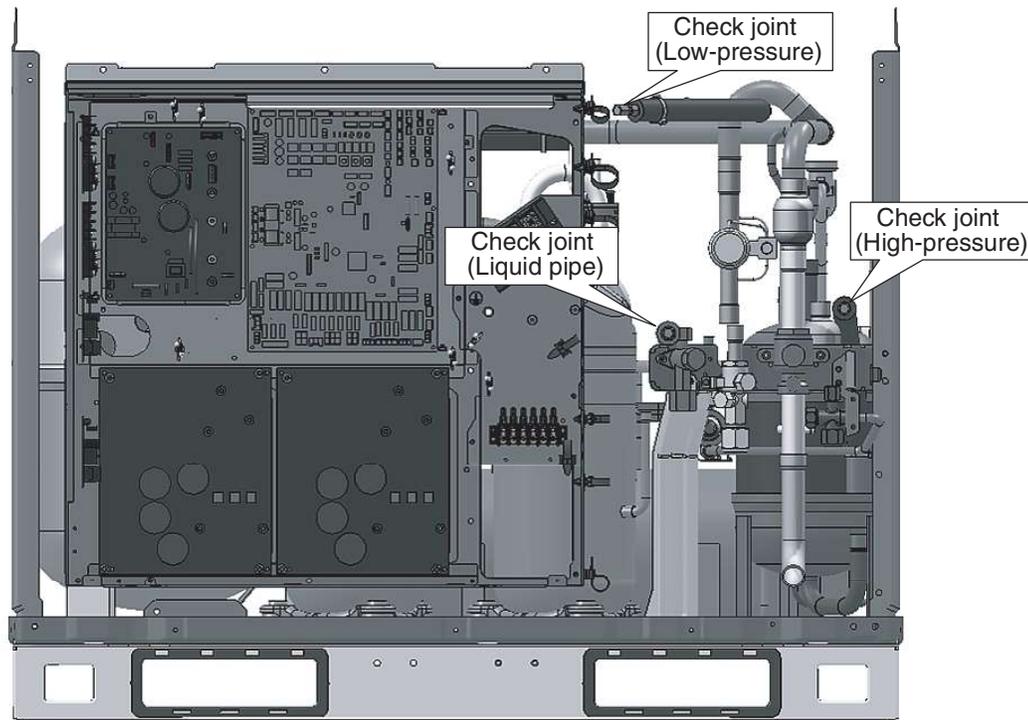
<Work procedure>

(1) Fully open PMV1 and 2 and PMV4 in accordance with the table below.

Note: PMV full-opening operation via short-circuiting of the CN30 pins is automatically undone after 2 minutes, causing the valves to fully close. To maintain fully open state, turn off the power switch of the outdoor unit within 2 minutes of the short-circuiting of the CN30 pins.

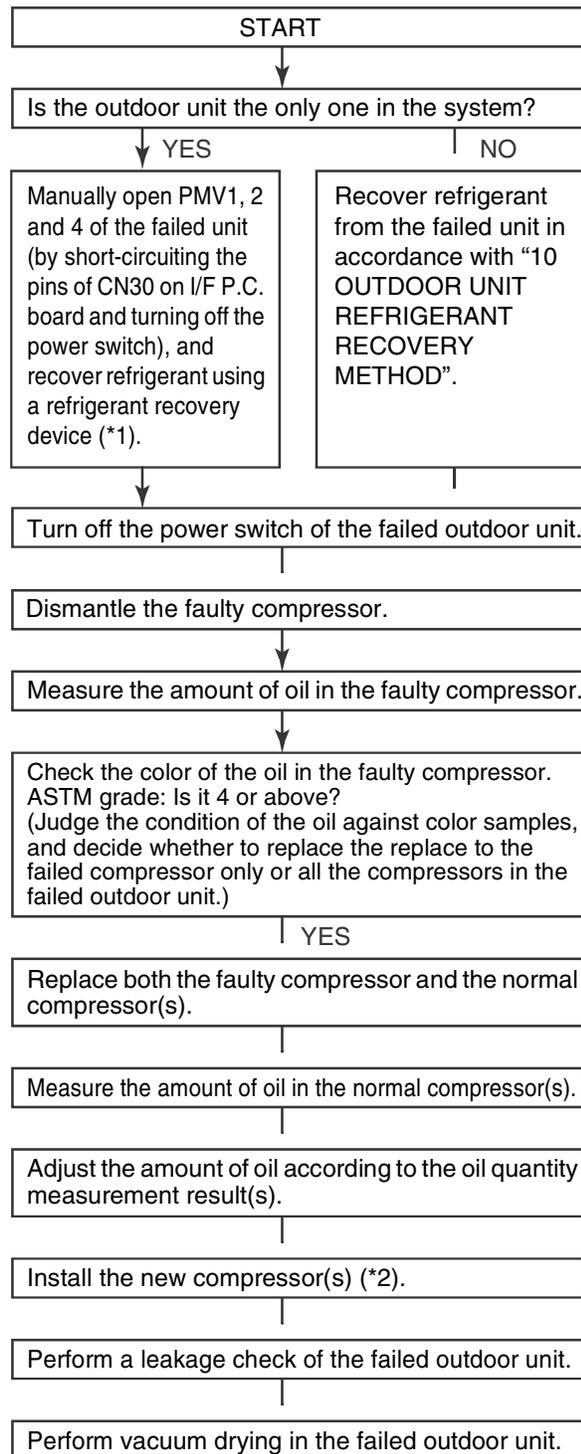
SW12				CN30	PMV operation
Bit 1	Bit 2	Bit 3	Bit 4		
OFF	OFF	OFF	OFF	Short-circuit	PMV1 and 2 fully open for 2 minutes.
OFF	ON	OFF	OFF	Short-circuit	PMV4 fully opens for 2 minutes.

(2) Be sure to perform vacuuming in from the three check joints shown in the diagram below (liquid pipe, discharge pipe and suction pipe).



11. REPLACING COMPRESSORS

11-1. Compressor Replacement Procedure (Outline)



⚠ WARNING

In situations such as indoor unit relocation and repairs, it is not possible to recover all the refrigerant held by the system in the outdoor units. It could cause a serious accident, such as blow out or injury. Be sure to perform refrigerant recovery using a refrigerant recovery device.

⚠ WARNING

When detaching a pipe by heating with a burner a welded joint, take care as any oil left in the piping may burn in a momentary flash of fire when the weld filler metal melts.

*1 The full-opening of PMV1, 2 and 4 via short-circuiting of the CN30 pins is automatically undone after 2 minutes, causing the valves to fully close. To maintain fully open state, turn off the power switch of the outdoor unit within 2 minutes.

*2 The SHRM-i (4 series) and the SHRM (2 series) use different types of compressors. Be sure to check the service part code.

This flowchart only shows the standard compressor

Replace the faulty compressor only.

replacement procedure. Since the situation can differ site by site, perform the task in accordance with the following judgment criteria:

- (1) New compressors are charged with 1900cc of oil per unit.
- (2) The amount of oil held by an outdoor unit is as shown below.
- (3) When a compressor is dismantled, it usually

	MAP0804*, 1004*	MAP1204*, 1404*
Amount of oil	4300cc	6700cc

contains 800-1400cc oil.

The amount of oil held by an oil separator is usually 0-1000cc for MAP0804*, MAP1004* and 0-1500cc for MAP1204* and MAP1404*.

Refrigerant charging

END

11-2. Replacement of Compressors

<Checking color of oil in faulty compressor>

- Lay the faulty compressor down, draw a small amount of oil via the oil equalization pipe, and check its color against color samples.
- Determine the number of compressors to be replaced according to the color checking result.
ASTM grade: Below 4 → Replace the faulty compressor only.
ASTM grade: 4 or above → Replace both the faulty compressor and the normal compressor(s).

WARNING

When detaching a pipe by heating with a burner a welded joint, take care as any oil left in the piping may burn in a momentary flash of fire when the weld filler metal melts.

[When replacing faulty compressor only]

<Adjusting amount of oil in new compressor> (1900cc at shipment)

- Perform the adjustment on the basis of how much oil the faulty compressor contained, A [cc], by following the steps below.

1 Amount of oil in faulty compressor A [cc]: $0 \leq A < 1000$

- (1) Adjust the amount of oil in the new compressor to 1000cc.
(Lay the new compressor down and draw 900 [cc] of oil via the oil-equalization pipe.)

Notes:

- Do not draw more than 900 [cc] of oil as it may cause damage to the compressor.
- If the faulty compressor contained 500cc or less, there may have been a problem with the oil equalization circuit, etc. Perform checks in accordance with “11-3. Check Procedure to Search Cause of Compressor Oil Shortage”.

2 Amount of oil in faulty compressor A [cc]: $1000 \leq A < 1900$

- (1) Adjust the amount of oil in the new compressor to A cc.
(Lay the new compressor down and draw $(1900 - A)$ [cc] of oil via the oil equalization pipe.)

3 Amount of oil in faulty compressor A [cc]: $1900 \leq A$

- (1) Adjust the amount of oil in the new compressor to A cc.
(Insert a hose into the discharge pipe or oil equalization pipe of the new compressor and inject $(A-1900)$ [cc] of oil using a funnel, etc.)

[When replacing normal as well as faulty compressor] - applicable to MMY-MAP0804* and 1004*

<Dismantling normal compressor>

- Dismantle the normal compressor in the same way as the faulty compressor.

Note:

- Be sure to insulate the removed compressor leads using insulation tape, etc.

 **WARNING**

When detaching a pipe by heating with a burner a welded joint, take care as any oil left in the piping may burn in a momentary flash of fire when the weld filler metal melts.

<Measuring amount of oil in normal compressor>

- As was the case with the faulty compressor, measure the amount of oil contained by placing the compressor on a scale.

Amount of oil in normal compressor: $B \text{ [cc]} = (\text{Weight of compressor as it was dismantled (kg)} - 22.7) \times 1042$
(Specific volume of oil: 1042 [cc/kg])

Note:

- When a compressor is empty, it weighs 22.7kg.

<Adjusting amount of oil in new compressors>

- Perform the adjustment on the basis of how much oil the faulty compressor contained, A [cc], and how much oil the normal compressor contained, B [cc], by following the steps below.

1 Combined amount of oil in faulty and normal compressors A+B [cc]: 0 A+B < 2000

(1) Adjust the amount of oil in the two new compressors to 1000cc each (total 2000cc).

- Lay the compressors down and draw 900 [cc] of oil from each of them via their oil equalization pipes.

Notes:

- Do not draw more than 900 [cc] of oil from a compressor as it may cause damage.

• If the faulty compressor contained 500cc or less, there may have been a problem with the oil equalization circuit, etc. Perform checks in accordance with "11-3. Check Procedure to Search Cause of Compressor Oil Shortage".

2 Combined amount of oil in faulty and normal compressors A+B [cc]: 2000 A+B < 3800

(1) Adjust the amount of oil in the two new compressors to $(A+B)/2$ cc each.

- Lay the compressors down and draw $[3800-(A+B)]/2$ [cc] of oil from each of them via their oil equalization pipes.

3 Combined amount of oil in faulty and normal compressors A+B [cc]: 3800 A+B

(1) Adjust the amount of oil in the two new compressors to $(A+B)/2$ cc each.

(Insert a hose into the discharge pipe or oil equalization pipe of each compressor and inject $(A+B)/2-1900$ [cc] of oil using a funnel, etc.)

[When replacing normal as well as faulty compressors] - applicable to MMY-MAP1204* and 1404*

<Dismantling normal compressors>

- Dismantle the normal compressors in the same way as the faulty compressor.

Note:

- Be sure to insulate the removed compressor leads using insulation tape, etc.

WARNING

When detaching a pipe by heating with a burner a welded joint, take care as any oil left in the piping may burn in a momentary flash of fire when the weld filler metal melts.

<Measuring amounts of oil in normal compressors>

- As was the case with the faulty compressor, measure the amount of oil contained by placing each compressor on a scale.

Amount of oil in normal compressor: B, C [cc] = (Weight of compressor as it was dismantled (kg) - 22.7) × 1042
(Specific volume of oil: 1042 [cc/kg])

Note:

- When a compressor is empty, it weighs 22.7kg.

<Adjusting amount of oil in new compressors>

- Perform the adjustment on the basis of how much oil the faulty compressor contained, A [cc], and how much oil the normal compressors contained, B and C [cc], by following the steps below.

1 Combined amount of oil in faulty compressor and two normal compressors

A+B+C [cc]: 0 A+B+C < 3000

(1) Adjust the amount of oil in the three new compressors to 1000cc each (total 3000cc).

- Lay the compressors down and draw 900 [cc] of oil from each of them via their oil equalization pipes.

Notes:

- Do not draw more than 900 [cc] of oil from a compressor as it may cause damage.

• If the faulty compressor contained 500cc or less, there may have been a problem with the oil equalization circuit, etc. Perform checks in accordance with "11-3. Check Procedure to Search Cause of Compressor Oil Shortage".

2 Combined amount of oil in faulty compressor and two normal compressors

A+B+C [cc]: 3000 A+B+C < 5700

(1) Adjust the amount of oil in the three new compressors to (A+B+C)/3 cc each.

- Lay the compressors down and draw [5700-(A+B+C)]/3 [cc] of oil from each of them via their oil equalization pipes.

3 Combined amount of oil in faulty compressor and two normal compressors

A+B+C [cc]: 5700 ≤ A+B+C

(1) Adjust the amount of oil in the three new compressors to (A+B+C)/3 cc each.

(Insert a hose into the discharge pipe or oil equalization pipe of each compressor and inject (A+B+C)/3-1900 [cc] of oil using a funnel, etc.)

<Installing compressor>

- Install a compressor by following the dismantling procedure in reverse.

! WARNING

The dismantling process may have loosened compressor leads and faston connectors. Prior to installation, therefore, tighten them a little with a pair of pliers, and verify that they are tight after reconnection.

Notes:

- Although a compressor is provided with only two hexagonal bolts, it is standard.
- The tightening torque of the hexagonal bolts, used to mount the compressor, is 200kg/cm.
- If oil has been drawn from the accumulator, repair the cut pipe through pinching and brazing.

<Vacuum-pumping>

(Single outdoor unit system)

- Before performing vacuum-pumping, fully open PMV1, 2 and 4. If they are closed, the heat exchangers of the outdoor unit cannot be vacuum-pumped.
- Connect a vacuum pump consecutively to the check joints placed in the liquid and discharge pipes and on the high-pressure side of the suction pipe, and turn it on.
- Operate the vacuum drying until the vacuum gauge indicates 1 mmHg.

<Method to fully open PMV manually>

- (1) Turn on the power switch of the outdoor unit.
- (2) With the Bits 1 and 2 of SW12 set to off, short-circuit the pins of CN30.
- (3) Disconnect the connectors of PMV1 and 2 from the I/F P.C. board.
- (4) With the Bits 1 and 2 of SW12 set to off and on, respectively, short-circuit the pins of CN30.
- (5) Disconnect the connector of PMV4 from the I/F P.C. board
- (6) Turn off the power switch of the outdoor unit.

<Refrigerant charging>

- Inject the same amount of refrigerant as the recovered residual refrigerant via the charging port of the liquid-side service valve.