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I.  **Looking into Compressor**

1. How the Rotary Works
2. Features of Rotary Compressor
1. How the rotary works

The compression process (illustrated Fig. I - 1) is as follow:

The cylinder volume is separated into the high and low pressure side by the vane located in the cylinder slot.
As the eccentric crankshaft rotates, the roller rotates taking the refrigerant gas into the cylinder. Compression is accomplished by action of the roller rotating within the cylinder while traveling in an orbital path.

During this process, separation of the high and low side refrigerant pressure is maintained by the vane and by the hydrodynamic sealing. The hydrodynamic sealing is dependent upon clearance, surface finish of the cylinder until design cylinder pressure is reached.

A study of a compression cycle of the rotary compressor reveals the importance of the vane in maintaining the pressure differential within the cylinder. At all times, while in operation, work is being done by the cylinder components. Suction and compression may be going on at same instant.

Fig. I - 1 How to rotary works.

Fig. I - 2 Components Assembly.
2 Features of Rotary Compressor

2.1 No suction valve (Direct suction)

As the roller makes its path around the cylinder, the vane confines the gas at one point, and the roller at another point. This direct suction minimize intake losses since the suction takes places continuously and the suction port is isolated from the discharge port by the vane and the roller. Furthermore, rotary compressors are less affected by liquid return than reciprocating compressors, since they have no suction valve.

2.2 Less heat transfer to the suction gas

The suction gas enters directly into the cylinder and is compressed before being discharged into the shell, where it flows over and around the motor windings before moving into the condenser. In reciprocating compressors, on the other hand, the suction gas enters into the shell, where it is further vaporized, contacting the hot motor windings and then taken into the cylinder. Therefore, superheat of suction gas in the compressor is higher than that of rotary compressors. Higher superheat of suction gas provides a little bit superheat causes higher discharge gas temperature.

2.3 Less re-expansion loss

Re-expansion losses are limited by the small top clearance and their inherent design. Thus, almost 100% of the available displacement is utilized.

2.4 Better motor cooling

The cool return gas enters directly into the cylinder. The vapor is compressed by the rotary pump and receives the heat of compression. The warm gas then passes over the motor to receive the heat from the windings. Even though, the vapor is warmer than it was prior to compression, it is also much more dense. This denser gas is capable of receiving greater amounts of heat per given volume than thin suction gas to cool a motor in reciprocating compressor.

2.5 Less over compression

The liquid refrigerant also undergoes into the cylinder of the rotary compressor with the suction gas, but the radius on the nose of vane facilitates this action and the vane is lifted momentarily allowing a part of the liquid to be unloaded into the low side of the cylinder. In this way, all of the liquid refrigerant can be gradually disposed of in successive compression cycles without damage. Such liquid causes excess foaming and the maximum pressure in the cylinder sometimes will reach approximately 150kg/cm²G.
2.6 Less weight and size

In the rotary compressor, the shell and motor stator are in direct contact. The shell, as a matter of fact, is shrunk fit around the stator and the mechanical portion of the pump is welded to the shell. And the suction gas enters directly into cylinder. These features can make some parts, such as In general, the weight of the rotary compressors is approx. half or three quarters of current reciprocating compressors of comparable capacity and one quarter smaller in size.

2.7 Characteristic

* Motor rotation is directly transferred through crankshaft to compression work without converting it to reciprocation process like conventional reciprocating compressor. This mechanism provides high efficiency work.

* Torque variation in single process is distributed over single rotation (360°) and results in rather smaller variation in torque, and it leads to lower motor input. (see Fig. I - 3)

* Pull-down load is smaller in rotary compressor and the motor can be smaller as much. This also contributes to higher E.E.R. (see Fig. I - 4)

* Rotary compressor sound level appears over the range of rather higher frequency band (3,000 - 6,000 Hz), which is easier to design in sound insulation.

* Rotary compressor requires less number of parts and this contributes to less failure rate as much.

* Compressor size is compact and this leaves room for flexible design of system components for higher E.E.R.
II. System Design

1. Basic Specification of Rotary Compressor
2. Selection of Compressor
3. Compressor Cooling
4. Heat Exchanger Design
5. Capillary Tube
6. Selection of Accumulator
7. Refrigerant Charge
8. Refrigerant Oil
9. Moisture Control
10. Piping Design
11. Sound Reduction
General

Under normal operating conditions, equipment designers can anticipate discharge gas with thermodynamic characteristics which are almost identical with those obtainable with reciprocating compressors: in extreme conditions, rotary compressor performance is superior to that of conventional design.

The rotary compressors can, therefore, be incorporated in existing systems and equipment without extensive engineering changes. The design procedure of equipment does not involve any special methodology except for an discharge gas cooling. If a compressor is not operated properly, it will not exhibit its best performance and also shorten its service life. In extreme cases, it may even malfunction and break down.

These operating instructions have been prepared so that the rotary compressors can be used properly and efficiently without malfunction and breakdown and they list the operation standards and handling precautions. It is recommended that you acquire a full understanding of the special properties of the compressors so that you can operate them properly.

1. Basic specification of rotary compressor

The rotary compressor is fundamentally different from the conventional reciprocating compressor in the following points. Therefore, careful design conditions are required when designing system.

<table>
<thead>
<tr>
<th>Basic items</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Reciprocating</td>
</tr>
<tr>
<td>Compressor shell pressure</td>
<td>Low side</td>
</tr>
<tr>
<td>Shell temp.</td>
<td>Low</td>
</tr>
<tr>
<td>Compressor cooling</td>
<td>Natural air cooling</td>
</tr>
<tr>
<td></td>
<td>Forced air cooling</td>
</tr>
<tr>
<td></td>
<td>Liquid injection cooling</td>
</tr>
<tr>
<td>Intake method of suction gas</td>
<td>Indirect intake to cylinder</td>
</tr>
<tr>
<td>Inside supporting structure of compressor</td>
<td>Inner supporting or suspension</td>
</tr>
</tbody>
</table>

Table II - 1. Basic specifications of rotary compressors
II. System Design

2. Selection of compressor

The experienced system engineer selects components which when assembled into the air conditioner will give the desired unit performance, especially with respect to capacity and efficiency. LG Electronics furnishes specification sheets for each of its various models. The data is provided in a manner to permit the engineer to make a direct comparison with the reciprocating compressor of the same rating or any other rotary compressor that is now in use.

3 Compressor cooling

The cooling method in LG rotary compressor is baldy type. Baldy type means no de-superheater and no liquid injection cooling. This type is available for small and medium power range because emission of heat from shell surface will do. Different from either de-superheater type or liquid injection type, special construction is not employed for cooling discharge gas, and this type is effective for unit with light load and with good heat ejection from compressor. The compressed gas of this type is discharged directly to the compressor shell and the motor is surrounded by the high temperature discharge gas. Therefore the motor winding temperature is apt to go up. LG recommends a maximum discharge gas temperature of 240°F (120°C) at maximum load / minimum voltage conditions.

4. Heat exchanger design

Heat exchanger is the major component which affects performance of room air-conditioners. Heat exchange rate is determined by its size, air volume, fin pitch and others.

4.1 Condenser

The condenser and its air moving device directly affect the compressor’s power consumption. It is therefore, advisable when operating efficiency is of primary consideration that condensing heat transfer be enhanced, consequently, the compressor’s power consumption. (see Fig. II - 1)

4.2 Evaporator

The evaporator, in conjunction with the volume of indoor air passing through it, is the other major component affecting the air conditioner’s capacity. Whenever any of the increase heat transfer, the evaporator temperature increase and an increase in unit capacity will result. (see Fig. II - 2) To summarize, in order to obtain excellent E.E.R. Increase evaporating temperature and reduce condensing temperature.
**II. System Design**

![Graphs showing refrigeration performance](image)

5. Capillary tube

5.1 General

In the refrigerating equipment using the capillary tubes, the torque for starting compressors can be minimized because the pressure between high and low side is easily balanced through the capillary tube during the compressor stoppage. Although the capillary tube flows the gas phase refrigerant better than the liquid phase refrigerant, we cannot say that it is widely effective for various operating conditions.

But for the usual application, the engineers can have good result with the capillary tube in refrigerating operation. And the engineers have the advantage of cost saving, simplicity, stable quality comparing the expansion valve.

Size of capillary tube is determined by condensing temperature, evaporating temperature, subcool, etc.

Even if there is some variation in ambient temperature subcool should be secured to some extent at least. If not, it may cause flash gas and results in harmful effects, i.e., shortage of cooling capacity, blockage of capillary tube or abnormal sound.

5.2 Selection by calculation

- Find the mass flow rate (kg/hr) of refrigerant.
  (Refer to the each performance curve attached)

- Find the coefficient of mass flow
  (Refer to the Fig. II - 3)

  \[ \text{The coefficient of mass flow (Φ)} = \frac{\text{The mass flow rate (kg/hr)}}{\text{The mass flow rate refer to Fig. II - 4 (kg/hr)}} \]
II. System Design

• Find the inside diameter and length of capillary
(Refer to the Fig. II - 3)

Ex) Under the operating conditions as below,

The compressor model : QK182CN
Refrigerant : R-22
Condensing Temp. : 54.4 °C
Sub-cooled to 46.1 °C

Sol) Refer to the performance curve for QK182CN.

The mass flow = 70 kg/hr
The coefficient of mass flow (Φ) = \( \frac{70 \text{ (kg/hr)}}{58 \text{ (kg/hr)}} \) = 1.2

• Refer to the diagram. II - 3,
If I.D is Φ1.6mm (0.063”), length is 1.4m (55.12”)
Φ1.8mm (0.071”), length is 2.5m (98.43”)
Φ2.0mm (0.079”), length is 5.0m (196.85”)

Fig. II - 3 Coefficient of flow rate
(Critical pressure of capillary tube inlet)

Fig. II - 4 Flow rate of capillary inlet
(Critical pressure of tube inlet)
5.3 Optimum selection

It is still in question that the pre-determined capillary tube may well operate with the charging amount of refrigerant. Because it is difficult to find out the optimum selection of the capillary tube and the charging amount of refrigerant, it is necessary to repeat the test.

For simple method to test, prepare a small bomb which refrigerant is filled in and connect it to the refrigerant cycle with flexible tube. Then put the bomb on the scale and open or close the valve between the bomb and the cycle to increase or decrease the refrigerant. Checking the cooling capacity and power consumption.

The finally selected capillary tube will be cut off the cycle and after air-mass-flow characteristic test be used for purpose of the quality control of mass production.

6. Refrigerant charge

The charged volume of the refrigerant should be determined depending on respective system design.

However, when the refrigerant is over charged, it returns to the compressor excessively at start-up, which may prevent the compressor from restarting properly, causing inferior lubrication and trouble due to liquid compression.

Minimum refrigerant charge is usually required but it is necessary to secure proper subcool, cooling capacity, and discharge temperature.

As a general rule, refrigerant charge is discussed by the following formula.

\[
\frac{\text{Oil weight}}{\text{Refrigerant weight} + \text{Oil weight}} \geq 0.25
\]

When the weight ratio between the oil and the refrigerant reaches less than 0.4, the compressor may have a trouble due to the supply and the diluted oil.

7. Selection of accumulator

7.1 Selection of volume

\[
\text{Effective Volume of accumulator} \times \frac{\text{Specific Gravity of Refrigerant}}{\text{Charged Weight of Refrigerant}} \geq K
\]

※ Specific gravity of refrigerant (R22) = 1.25 (at 20°C)

<table>
<thead>
<tr>
<th>System</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Window Type (cooling only)</td>
<td></td>
</tr>
<tr>
<td>3/4 HP ↓</td>
<td>0.1</td>
</tr>
<tr>
<td>3/4 HP ↑</td>
<td>0.3</td>
</tr>
<tr>
<td>• Window Type for Heat Pump</td>
<td>0.4</td>
</tr>
<tr>
<td>• Split Type (cooling only)</td>
<td></td>
</tr>
<tr>
<td>• Split Type for Heat Pump</td>
<td>0.4</td>
</tr>
<tr>
<td>• Multi-zone Heat System</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Table. Ⅱ - 2. Select of Value “A”
### II. System Design

1. Charged weight of refrigerant: 1000g (for Split type Heat pump)  
   Effective Volume of Accumulator: 480 cc Min.

2. Charged weight of refrigerant: 800g (for Split type Heat pump)  
   Effective Volume of Accumulator: 384 cc Min.

#### 7.2 Effective Volume of Accumulator for LG Rotary Compressor

<table>
<thead>
<tr>
<th>Specification (㎜)</th>
<th>Effective Volume</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Φ31.8 × L 168</td>
<td>41 cc</td>
<td>QA Series</td>
</tr>
<tr>
<td>Φ50.8 × L 200</td>
<td>140 cc</td>
<td>QB &amp; QK Series</td>
</tr>
<tr>
<td>Φ50.8 × L 220</td>
<td>176 cc</td>
<td>QB &amp; QK Series</td>
</tr>
<tr>
<td>Φ65.0 × L 221</td>
<td>380 cc</td>
<td>QB &amp; QK &amp; QJ Series</td>
</tr>
<tr>
<td>Φ65.0 × L 263</td>
<td>450 cc</td>
<td>QB &amp; QK &amp; QJ Series</td>
</tr>
<tr>
<td>Φ75.0 × L 229</td>
<td>490 cc</td>
<td>QB &amp; QK &amp; QJ Series</td>
</tr>
<tr>
<td>Φ75.0 × L 259</td>
<td>560 cc</td>
<td>QP Series</td>
</tr>
<tr>
<td>Φ75.0 × L 292</td>
<td>670 cc</td>
<td>QP Series</td>
</tr>
</tbody>
</table>

Table. II-3. Effective Volume of Accumulators

#### 7.3 Accumulator Volume for Refrigerant Charging Amount

<table>
<thead>
<tr>
<th>Refrigerant Charge (g)</th>
<th>Window Type</th>
<th>• Window Type for H/Pump</th>
<th>• Split Type for H/Pump</th>
<th>• Multi-zone Heat</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3/4HP ↓</td>
<td>3/4HP ↑</td>
<td></td>
<td></td>
</tr>
<tr>
<td>~ 300</td>
<td>20 cc</td>
<td>72 cc</td>
<td>96 cc</td>
<td>144 cc</td>
</tr>
<tr>
<td>300 ~ 400</td>
<td>24 cc</td>
<td>96 cc</td>
<td>128 cc</td>
<td>192 cc</td>
</tr>
<tr>
<td>400 ~ 500</td>
<td>32 cc</td>
<td>120 cc</td>
<td>160 cc</td>
<td>240 cc</td>
</tr>
<tr>
<td>500 ~ 600</td>
<td>40 cc</td>
<td>144 cc</td>
<td>192 cc</td>
<td>288 cc</td>
</tr>
<tr>
<td>600 ~ 700</td>
<td>48 cc</td>
<td>168 cc</td>
<td>224 cc</td>
<td>336 cc</td>
</tr>
<tr>
<td>700 ~ 800</td>
<td>56 cc</td>
<td>192 cc</td>
<td>256 cc</td>
<td>384 cc</td>
</tr>
<tr>
<td>800 ~ 900</td>
<td>216 cc</td>
<td>288 cc</td>
<td>320 cc</td>
<td>423 cc</td>
</tr>
<tr>
<td>900 ~ 1000</td>
<td>240 cc</td>
<td></td>
<td>480 cc</td>
<td></td>
</tr>
<tr>
<td>1000 ~ 1100</td>
<td>264 cc</td>
<td></td>
<td>352 cc</td>
<td>528 cc</td>
</tr>
<tr>
<td>1100 ~ 1200</td>
<td>288 cc</td>
<td></td>
<td>384 cc</td>
<td>576 cc</td>
</tr>
<tr>
<td>1200 ~ 1300</td>
<td>312 cc</td>
<td></td>
<td>416 cc</td>
<td>624 cc</td>
</tr>
<tr>
<td>1300 ~ 1400</td>
<td>336 cc</td>
<td></td>
<td>448 cc</td>
<td></td>
</tr>
<tr>
<td>1400 ~ 1500</td>
<td>360 cc</td>
<td></td>
<td>480 cc</td>
<td></td>
</tr>
<tr>
<td>1500 ~ 1600</td>
<td>384 cc</td>
<td></td>
<td>512 cc</td>
<td></td>
</tr>
<tr>
<td>1600 ~ 1700</td>
<td>408 cc</td>
<td></td>
<td>544 cc</td>
<td></td>
</tr>
<tr>
<td>1700 ~ 1800</td>
<td>432 cc</td>
<td></td>
<td>576 cc</td>
<td></td>
</tr>
<tr>
<td>1800 ~ 1900</td>
<td>456 cc</td>
<td></td>
<td>608 cc</td>
<td></td>
</tr>
<tr>
<td>1900 ~ 2000</td>
<td>480 cc</td>
<td></td>
<td>640 cc</td>
<td></td>
</tr>
</tbody>
</table>

Table. II-4. Refrigerant Charging Amount
8. Refrigerant oil

In order to maintain a high degree of reliability, a refrigeration oil which is specially developed for the rotary compressor is used. Therefore, no other type of oil must be used. LG rotary compressor is charged with SUNISO 4GS grade.

9. Moisture control & Dehydration

9.1 Effects of moisture

If moisture resides in the system, it may cause the undesirable results as below.

1) The freezing blockage of capillary tube, expansion valve.
2) Metal corrosion and sludge.
3) Valve fracture.
4) Copper plating.
5) Deterioration of insulation material.

9.2 Moisture control

In the case of R-22, if the minimum temperature of low pressure side is -10℃, the saturated solution of moisture into the refrigerant is 400 PPM. (Refer to the Fig. II - 5)

For example, the system is charged with R-22 650g,

\[ 650g \times 400\text{PPM} = 0.26g \text{ (260mg)} \]

Therefore, you must try to control the total moisture in the whole system below 260mg (including compressor).

Generally, the moisture in the compressor itself is controlled below 100mg in the production line by the dehydration equipment.

![Fig. II - 5. Moisture content in the Refrigerant](image-url)

(For liquid refrigerant)
10. Piping design

Piping design piping properly so that it will not cause breakage of piping in transportation, at compressor start-up, stop or dying compressor operation. The following points should be borne in mind when designing and determining the piping.

10.1 Piping form

Vibration in the circumferential direction of the rotary compressor is larger than that of conventional reciprocating compressor. Therefore, a loop should be provided for the refrigerant piping to avoid stress concentration at the inlet/outlet of the compressor. The illustrations (see Fig. II - 6) are example of recommended piping design.

Fig. II - 6. Recommended Piping Design

10.2 Distance of piping

The pipe which connects a compressor to the refrigeration cycle, especially lead wire, shall not being contacted together with having proper distance. Normal distance for piping is as following. (See Table. II - 5)

<table>
<thead>
<tr>
<th></th>
<th>Distance of piping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moving parts</td>
<td>Min. 12.7 mm</td>
</tr>
<tr>
<td>(Compressor, fan..)</td>
<td></td>
</tr>
<tr>
<td>Non-Moving parts</td>
<td>Min. 9.5 mm</td>
</tr>
</tbody>
</table>

Table. II - 5. Distance of Piping
II. System Design

10.3 Vibration of piping

For proper design, fatigue strength of the piping at start and stop, during operation and transportation of the compressor should be held within the general limitations. These limits are determined by the following S-N curve for copper. (See Fig. II - 7.)

![S-N Curve for Copper](image)

<table>
<thead>
<tr>
<th>Number of Bending Frequency (10^x)</th>
<th>Stress (㎏/㎠)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10^5</td>
<td>8</td>
</tr>
<tr>
<td>10^6</td>
<td>7</td>
</tr>
<tr>
<td>10^7</td>
<td>6</td>
</tr>
<tr>
<td>10^8</td>
<td>5</td>
</tr>
<tr>
<td>10^9</td>
<td>4</td>
</tr>
<tr>
<td>10^10</td>
<td>3</td>
</tr>
</tbody>
</table>

Table II - 6. Piping Stress

<table>
<thead>
<tr>
<th>Condition</th>
<th>Stress Limitation (㎏/㎟)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON / OFF</td>
<td>Max. 3.0</td>
</tr>
<tr>
<td>Operation</td>
<td>Max. 1.5</td>
</tr>
</tbody>
</table>

10.4 Vibration of piping concerned stress of piping shall be 0.8mm Max.

![Vibration of piping](image)

10-5. Practical check point in design

If the bending radius is much smaller, keep the bending point as far away from the brazing section as possible because the combination of increased torsion stress and deterioration of strength due to brazing is apt to cause stress concentration.

![Bending of Pipe](image)

<table>
<thead>
<tr>
<th>3-1. Bending of Pipe</th>
<th>3-2. Connection of Piping</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \frac{\beta}{\alpha} &lt; 1.3 )</td>
<td>Easy to Break</td>
</tr>
<tr>
<td>Copper tube</td>
<td>Brazing</td>
</tr>
</tbody>
</table>

Fig. II - 9. Bending of Pipe
11. Sound reduction

11.1. Reduction of compressor noise and vibration

11.1.1. As most of noise caused by the rotary compressor are those of high frequency 2,000 ~ 6,000 Hz, they can be insulated by effectively noise absorbing partition.

11.1.2. When the air conditioning unit causes noise of 200 ~ 500 Hz due to the vibration of the rotary compressor, the following noise insulation required.

① Check the piping resonance.
② Check the compressor mounting condition.

11.2. Fan noise reduction

11.2.1. Air flow resistance shall be reduced in accordance with following improvements.

① Size up front surface of heat exchanger. (Indoor)
② Reduce pressure loss of air filter. (Indoor)
③ Improve inlet grille, flapper and air outlet. (Indoor)
④ Keep suitable clearance between heat exchanger and fan. (Indoor)
III. Application

1. General limitations
2. Compressor Installation
3. Interconnecting Tube
4. Electrical Components and Wiring
5. General Cautions
### III. Application

If the compressor is not applied correctly, not only its insufficient performance will be obtained but also its life will be shortened and trouble will result. Please confirm that the following items are fulfilled before application.

#### 1. General limitations

<table>
<thead>
<tr>
<th>Items</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refrigerant</td>
<td>R22</td>
</tr>
<tr>
<td>Evaporation Temp.</td>
<td>(-10^\circ C \sim +12^\circ C) ((14^\circ F \sim +53.6^\circ F)) 2.58 ~ 6.34 kg/cm²G (36.7 ~ 90.2 psiG)</td>
</tr>
<tr>
<td>Condensing Temp.</td>
<td>(65^\circ C) ((149^\circ F)) 26.51 kg/cm²G (376.9 psi) under transient conditions such as start up and defrost transition the compressor may operate outside (Max. 28.5 kg/cm²G) this envelope for short periods</td>
</tr>
<tr>
<td>Compression Ratio.</td>
<td>6 Max. except very short period such as pull-down</td>
</tr>
<tr>
<td>Winding Temp.</td>
<td>(120^\circ C) ((248^\circ F)) Max.</td>
</tr>
<tr>
<td>Shell Bottom Temp.</td>
<td>(100^\circ C) ((212^\circ F)) Max. (\Delta T) (Temp. difference) = Bottom Temp. - Condensing Temp.</td>
</tr>
<tr>
<td>Discharge gas Temp.</td>
<td>(115^\circ C) ((239^\circ F)) Max.</td>
</tr>
<tr>
<td>Suction gas Temp.</td>
<td>Superheat 0.5°C (0.9°F) Min.</td>
</tr>
<tr>
<td>Liquid subcool</td>
<td>Sufficient liquid subcool is preferred</td>
</tr>
<tr>
<td>Running Voltage</td>
<td>90% ~ 110% of rated voltage at compressor terminal</td>
</tr>
<tr>
<td>Starting Voltage</td>
<td>85% of rated voltage at compressor terminal</td>
</tr>
<tr>
<td>On-Off Frequency</td>
<td>6 times / hr off period should be at least 3 minutes so that the Hi and Low pressure can be balanced for restart.</td>
</tr>
<tr>
<td>Refrigerant Charge</td>
<td>(\frac{\text{Oil weight}}{\text{Oil weight + Refrigerant weight}} \geq 0.25)</td>
</tr>
<tr>
<td>Vibration of piping (Recommended)</td>
<td>Displacement of 0.03” (0.8 mm) Max.</td>
</tr>
<tr>
<td>Stress of Piping (Recommended)</td>
<td>At start-up and stop : 3.0 kg/mm² Max. (4263 psi) During operating : 1.5 kg/mm² Max. (2132 psi)</td>
</tr>
<tr>
<td>Stress of Clearance (Recommended)</td>
<td>Between adjustment moving parts and piping : 12.7 mm Min. (0.5 inch) Between no-moving parts and piping : 9.5 mm Min. (0.37 inch)</td>
</tr>
<tr>
<td>Tilt in Operation</td>
<td>The allowable tilt of the compressor in operation shall be 5°C or less.</td>
</tr>
</tbody>
</table>

If additional amount of refrigerant is to be used, the specifications of the compressor (Accumulator - volume & oil quantity) and cycle specification shall be determined through deliberation.

* This specifications are subject to change without notice.
Ⅲ. Application

2. Compressor installation

LG recommend the following mounting arrangement. (See Fig. Ⅲ-1.)

The weld bolts through the unit’s bottom pan pass through the entire length of the grommet.
The weld bolts should have either a shoulder (unthreaded portion) or a separate cylindrical sleeve assembled on to them to prevent the compression of the grommet by the hold-down locknut.

Notice: The location of the weld bolts and their perpendicularity to the unit’s bottom pan must be maintained.

![Diagram of Compressor Installation](image)

Fig.Ⅲ-1. Mounting arrangement

3. Interconnecting tube

Care should be taken in the design and production of the suction and discharge lines. It is also important that compressor vibration is not carried through them to the evaporator and condenser where it can be amplified and transmitted to the surrounding ambient. There is no absolute tubing design that will satisfy all possible unit variations.

Generally you should keep the points in mind which stated in article 8.1 and 8.2.
You should be careful not to allow infiltration of foreign matters, moisture and other harmful particles into the refrigeration circuit.
4. Electrical components and wiring

4.1 Overload protector

On compressors not having an internal motor protector, it is especially important that the correct external overload protector is wired into the electrical circuit. The overload protector matches the compressor motor to safeguard it against burnout during a locked rotor condition or when the motor is excessively overloaded.

So LG recommend you should not attempt to substitute overload protectors that designated by compressor manufacturer. If you try to select the overload protectors by your own way, please contact with rotary compressor design section of LG.

4.2 Running capacitor

The running capacitor has also been specified by the motor manufacturer and compressor manufacturer for optimum starting, motor efficiency.

For areas where the voltage is low, the engineer may consider using a running capacitor with a 5 microfarads higher rating than specified for improved starting and rundown.

The general inspection of the running capacitor may be done as followings:

* Using a tester
  1) Disconnect the wires connected to the capacitor terminals and short-circuit the terminals.
  2) Contact the tester to the capacitor terminals with the tester setting to resistance-measurement range. (approx. 500 kilo-ohms)
  3) The tester is successful if the tester’s indicator moves first toward 0 Ω and then returns to ∞ Ω.

* Using a megger tester

Measure the insulation between the capacitor casing and each terminal. The result is good if the insulation resistance of the capacitor is one MΩ or more. After conducting the insulation test, be sure to short-circuit the capacitor terminals in order to discharge them.
5. General cautions

5.1 Care should be taken not to impair the control parts when the compressor is handled.

5.2 Do not leave the compressor open in the atmosphere for more than 15 minutes after removing the plugs.
   Do not operate the compressor in the atmosphere either.

5.3 Make sure that the compressor is holding nitrogen gas. Compressor is shipped from the factory with the nitrogen gas at a pressure of 15 psiG (1 kg/cm²G) after leak test at 426 psiG (30 kg/cm²G).

5.4 Evacuate the refrigeration circuit to at least 750 mmHg with a compound gauge for 30 minutes.

5.5 The compressors may be damaged by replenishment of liquid refrigerant to the low side due to the "washing away" of lubricant oil. Therefore, initial refrigerant should be charged into the unit from the high side process tube of the unit. Never charge it from the low side and suction line. The additional charge of the refrigerant to an operating unit must be done from the low side in the gas phase only.

5.6 Do not bend the pipe which is attached to the compressor.

5.7 Note the identification of compressor terminals marked on the terminal cover.

5.8 The discharge gas pressure should not be permitted to exceed 298 psiG (21 kg/cm²G) during the first 10 minutes after the start of operation.

5.9 Compressor should be operated with a slant not more than 5 degree in any direction.

5.10 Do not use compressor its own for vacuum evacuation.

5.11 Do not apply current in vacuum condition.

5.12 Check against water infiltration into compressor terminals.
IV. Trouble Shooting

1. Trouble Shooting
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<table>
<thead>
<tr>
<th>Trouble</th>
<th>Probable cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Compressor will not run</strong></td>
<td>1. Line disconnect switch open. 2. Wiring improper or loose. 3. Fuse removed or blown. 4. Overload protector tripped. 5. Control stuck in open position. 6. Low voltage to unit. 7. Compressor motor has a wiring open or shorted. 8. Internal mechanical trouble in compressor.</td>
<td>1. Close start or disconnect switch. 2. Check wiring against diagram. 3. Replace fuse. 4. Refer to electric section. 5. Repair or replace control. 6. Determine reason and correct. 7. Replace compressor. 8. Replace compressor.</td>
</tr>
<tr>
<td><strong>Compressor starts and runs, at short cycles on overload.</strong></td>
<td>1. Over current passing through overload protector. 2. Low voltage to unit. 3. Overload protector defective. 4. Run capacitor defective. 5. Excessive discharge pressure. 6. Suction pressure too high. 7. Compressor too hot-return gas too hot. 8. Compressor motor has a wiring shorted.</td>
<td>1. Check wiring diagram. 2. Determine reason and correct. 3. Check current, replace protector. 4. Determine reason and replace. 5. Check ventilation, restrictions in cooling medium, restrictions in refrigeration system. 6. Check for possibility of misapplication. 7. Check refrigerant charge, add it necessary. 8. Replace compressor.</td>
</tr>
<tr>
<td><strong>Unit runs but short cycles on</strong></td>
<td>1. Overload protector. 2. Thermostat. 3. Over refrigerant charge. 4. Liquid line solenoid leaking. 5. Restriction in expansion device.</td>
<td>1. Check current, replace protector. 2. Differential set too close-widen. 3. Reduce refrigerant charge. 4. Replace. 5. Replace device.</td>
</tr>
<tr>
<td><strong>Unit operates long or continuously</strong></td>
<td>1. Shortage of refrigerant. 2. Control contacts stuck or frozen closed. 3. Air conditioned space has excessive load or poor insulation. 4. Evaporator coil iced. 5. Dirty condenser. 6. Dirty filter.</td>
<td>1. Fix leak, and charge. 2. Clean contacts or replace control. 3. Determine fault and correct. 4. Defrost. 5. Clean condenser. 6. Clean or replace.</td>
</tr>
<tr>
<td><strong>Run capacitor open, shorted, or blown</strong></td>
<td>1. Improper capacitor. 2. Excessively high line voltage.</td>
<td>1. Determine correct size. and replace. 2. Determine reason and correct.</td>
</tr>
<tr>
<td><strong>Suction line Frosted or sweating</strong></td>
<td>1. Expansion valve passing excess refrigerant or is oversized. 2. Expansion valve stock open. 3. Evaporator fan not running. 4. Overcharge of refrigerant.</td>
<td>1. Readjust valve or replace with smaller valve. 2. Clean valve of foreign particles, replace if necessary. 3. Determine reason and correct. 4. Correct charge.</td>
</tr>
<tr>
<td><strong>Unit noisy</strong></td>
<td>1. Loose parts or mountings. 2. Tubing rattle. 3. Bent fan blade causing vibration. 4. Fan motor bearings worn.</td>
<td>1. Find and tighten. 2. Reform to be free of contact. 3. Replace blade. 4. Replace motor.</td>
</tr>
</tbody>
</table>