

Installation Instructions for Invotech YH

High Efficiency Scroll Compressors for Air Conditioning

Safety Instructions

Invotech Scroll compressors are manufactured according to the latest Chinese Safety Standards.

Safety instructions are applicable to the products below.

These instructions should be retained throughout the lifetime of the compressor. It is strongly advised to follow these safety instructions for all of the design and operation related the compressor; also the local related rules should be obeyed.

Safety Statements

- Refrigerant compressors must be used only for their intended system.
- Only qualified and authorized HVAC or refrigeration people are permitted to install, commission and maintain this equipment.
- Electrical connections must be made by qualified electrical people.
- All valid standards and codes for installing, servicing, and maintaining electrical and refrigeration equipment must be followed.

ELECTRICAL SHOCK HAZARD

- Disconnect and lock out power supply before servicing.
- Discharge all capacitors before servicing.
- Use compressor with grounded system only.
- Pre insulated electrical terminals must be used when required.
- Refer to original equipment wiring diagrams.
- Electrical connections must be made by qualified electrical personnel.
- Failure to follow these warnings could result in serious personal injury.

PRESSURIZED SYSTEM HAZARD

- System contains refrigerant and oil under pressure.
- Remove refrigerant from both the high and low compressor sides before removing compressor.
- Use appropriate back up wrenches on rota-lock fittings when servicing.
- Never install a system and leave it unattended when it has no charge, a holding charge, or with the service valves closed without electrically locking out the system.
- Use only approved refrigerants and refrigeration oils.
- Personal safety equipment must be used.
- Failure to follow these warnings could result in serious personal injury.

BURN HAZARD

- Some area of the compressor surface may be in a very high temperature, do not touch the compressor until it is cooled down.
- Ensure that materials and wiring aren't touched high temperature areas of the compressor.
- Be cautioned when brazing system components.
- Personal safety equipment must be used.
- Failure to follow these warnings could result in serious personal injury or property damage.

Introduction

Invotech YH Scroll™ compressor with compliant scroll technology is designed for the high temperature applications (air conditioning and chiller).

Nomenclature

The YH scroll model numbers include the nominal refrigeration capacity (X100W) at standard 50HZ ARI rating conditions for high temperature (7.2/54.4°C). For additional information on this product, please refer to the online information accessible from the Invotech Scroll Technologies web site at www.invotech.cn.

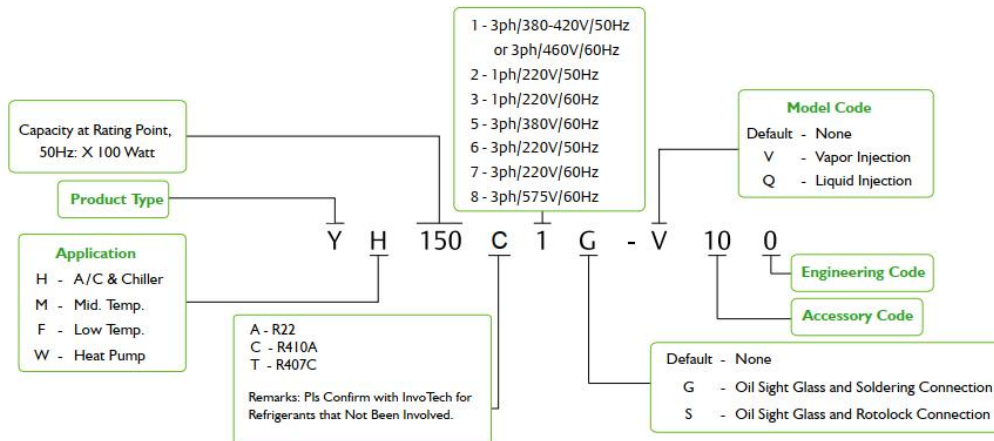


Figure 1 YH Nomenclature

Operating Envelope

The YH refrigeration scroll compressor models can be used with R22, R407C or R410A refrigerants depending on the model selected and the lubricant used.

The YH** models are intended for high temperature refrigeration type duty. The approved operating envelopes for these models are such that they are ideally suited for applications such as room air conditioning, heat pump, chiller, etc. The models and operating envelopes are described in Figures 2.

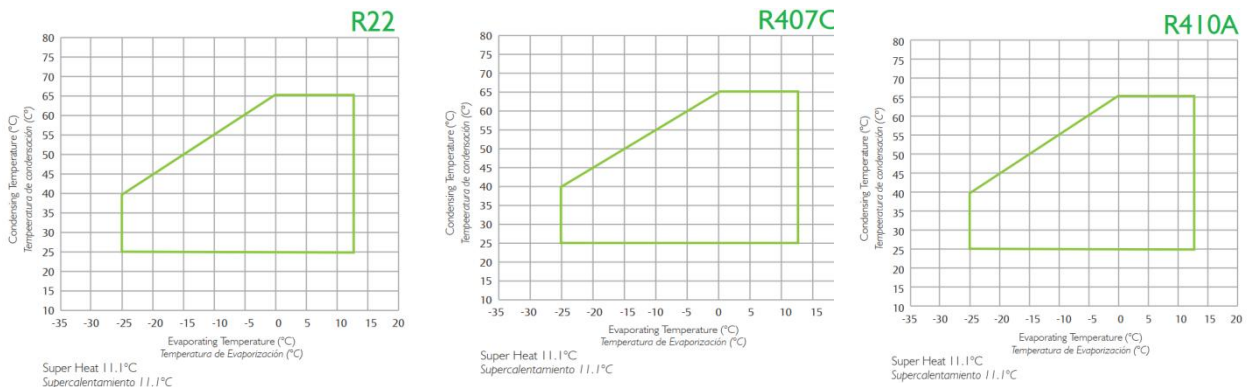


Figure2 YH** Application Envelope for R22, R407C and R410A

Accumulators

Invotech Scroll can handle liquid refrigerant in some situation such as flooded start or defrost cycle operation conditions, accumulators may not be necessary. An accumulator is suggested for the the single compressor systems when the charge limitations exceed 4.5kg (YH69** - YH200**) or 7.5kg (YH230** - YH355**). For the system allowing prolonged uncontrolled liquid return to the compressor, an accumulator is necessary to prevent liquid migration to the compressor.

Continuously liquid flood back or repeated flooded starts will dilute the oil inside the compressor, it is possible to cause the inadequate lubrication on the moving parts and wear. Proper system design should minimize the possibilities of liquid flood back to ensure maximum compressor life.

To avoid liquid refrigerant return to the compressor during the running cycle, Proper superheat at the compressor suction inlet should be maintained. Invotech recommends a minimum of 6K (Celsius) superheat for YH serials. Suction line temperature is measured on the suction line 150mm from the suction inlet.

The temperature difference between the compressor oil crankcase and the suction line, can determine whether there is liquid refrigerant returning to the compressor. We recommend that this temperature difference should be a minimum of 20 K (Celsius) during continuous operation. The thermocouple should be fixed as following place to measure oil temperature: (a) at the opposite side of the suction port;(b) be located around 50-100mm to the compressor base, (c)insulate from the ambient.

In some cases, such as defrost cycles, there will be rapid working condition changes, this temperature difference may drop rapidly for a short period of time. When the difference falls below the recommended value, our recommendation is the duration should be not exceed a maximum (continuous) time period of three minutes and should not be lower than a 10 K (Celsius) difference.

Strainer Mesh of Filters

Any filters with a mesh size finer than 30 x 30(0.6mm openings) should not be used anywhere in the system with these compressors.

Crankcase Heaters

Crankcase heaters are required for those compressors

- (a) where the system charge exceeds the charge limitation.
- (b) The system with heat pump function

The crankcase heater should be energized 24 hours before the compressor’s initial start-up or restart after long time off duration. During the normal operation, the crankcase heater should be energized when the compressor is off and de-energized when the compressor is on.

Discharge Line Thermostat

Operation above or on the left of the operation envelope can cause high compression ratios or excessive internal compressor temperatures. This will result in overheating the scrolls, causing excessive wear resulting in premature compressor failure.

If the system is designed where operation cannot guarantee to operate inside the operation envelope, then the discharge line thermostat is required in the compressor control circuit. The cut out setting for the discharge line thermostat should be 125°C or lower, it should be installed approximately 170mm from the discharge tube outlet, or approximately 130mm from the valve outlet port.

Low Ambient Cut-Out

A low ambient cut-out is not required to limit air-to-air heat pump operation. Air-to-water heat pumps must be reviewed since this configuration could possibly run outside of the approved operating envelope causing overheating or excessive wear.

Pressure Controls

Both high and low-pressure switches are required on the compressors. The suggested cut out settings see table 2 below.

Control Type	R407C	R410A	R22
Low	12 PSIG min.	30 PSIG min.	12 PSIG min.
High	400 PSIG max.	600 PSIG max.	400 PSIG max

Table 2 high and low pressure switches setting

Pump Down Recommendations

A pump down cycle for control of refrigerant migration is not recommended for YH serial scroll compressors. If it is necessary to implement a pump down cycle, a separate external check valve is suggested to be added on the discharge line.

Air Conditioning System Suction Line Noise and Vibration

Invotech Scroll compressors inherently have low sound and vibration characteristics. However, the sound and vibration characteristics differ in some respects from those of reciprocating compressors. In rare instances, these could result in unexpected sound complaints.

One difference is that the vibration characteristic of the scroll compressor, although low, includes two very close frequencies, one of which is normally isolated from the shell by the suspension of an internally suspended compressor. These frequencies, which are present in all compressors, may result in a low level "beat" frequency that may be detected as noise coming along the suction line into a house under some conditions. Elimination of the "beat" can be achieved by attenuating either of the contributing frequencies. The most important frequencies to avoid are line and twice-line frequencies for single-phase compressors and line frequency for three phase compressors. This is easily done by using one of the common combinations of design configurations described in Table 2. The scroll compressor makes both a rocking and torsional motion, and enough flexibility must be provided in the line to prevent vibration transmission into any lines attached to the unit. In a split system the most important goal is to ensure minimal vibration in all directions at the service valve to avoid transmitting vibrations to the structure to which the lines are fastened.

A second difference of the Invotech Scroll is that under some conditions the normal rotational starting motion of the compressor can transmit an "impact" noise along the suction line. This may be particularly pronounced in three-phase models due to their inherently higher starting torque. This phenomenon, like the one described previously, also results from the lack of internal suspension, and can be easily avoided by using standard suction line isolation techniques as described in Table 3.

The sound phenomena described above are not usually associated with heat pump systems because of the isolation and attenuation provided by the reversing valve and tubing bends.

Recommended Configuration	
Component	Description
Tubing Configuration	Shock loop
Service Valve	"Angled valve" fastened to unit
Suction muffler	Not required
Alternate Configuration	
Component	Description
Tubing Configuration	Shock loop
Service Valve	"Straight through" valve not fastened to unit
Suction muffler	May be required (Acts as dampening mass)

Table 3 recommended configuration

IPR Valve

Invotech three phase refrigeration scroll compressors have internal pressure relief valves, it will open when the discharge to suction differential pressure equals to its set pressure. This action will trip the motor protector.

There is no IPR valve on the single phase compressors. The motor protector will trip under the situation of high discharge pressure.

Motor Protection

Conventional inherent internal line break motor protection is provided.

Oil Types

Polyol ester lubricants must be provided for the YH**T and YH**C scroll compressors, which are used with HFC refrigerants. YH**A compressors are intended for use with R22 and are supplied with mineral oil.

POE must be handled carefully and the proper protective equipment (gloves, eye protection, etc.) must be used when handling POE lubricant. POE must not come into contact with any surface or materials that might be harmed by POE, including without limitation, certain polymers (e.g. PVC/CPVC and polycarbonate).

The system with POE oil should not be open to the air more than 3 minutes. Don't remove the suction/discharge plugs until the compressor is ready to be brazing.

Oil Charges

The initial oil charge is 1.4L (YH69** - YH150**), the re-charge volume is 1.25L; The initial oil charge is 1.6L (YH175** - YH200**), the re-charge volume is 1.4L; The initial oil charge is 2.7L (YH230** - YH355**), the re-charge volume is 2.6L.

Compressor Tubing and Mounting

Compressor mounting must be selected based on application. Consideration must be given to sound reduction and tubing reliability. Some tubing geometry or "shock loops" may be required to reduce vibration transferred from the compressor to external tubing.

Tandem Scroll Compressors

A three-phase unit with a charge over charge limitation must have crankcase heaters added to both compressors. Tighten to 14 NM for the bolts mounting the compressor on the rail. Holes in the mounting rails may be used to mount isolation grommets under the entire tandem.

A discharge check valve must be placed in the common discharge line. Both compressors must be at the same level to prevent oil from migrating to the lowest compressor through the oil equalization line.

Compressors may be individually cycled. Individual compressors should not be replaced in the field. The entire tandem compressor unit must be replaced if it becomes necessary to replace one compressor. Individual compressors configured for tandem usage may not be available for field replacement.

Mounting

The use of standard soft grommets is not recommended for most refrigeration scroll parallel installations. These softer mounts allow for excessive movement that will result in tube breakage, unless the entire system is properly designed.

Condensing Unit Mounting, for Invotech YH refrigeration scroll condensing unit applications, soft mounts are recommended.

Tubing Considerations

Proper tube design must be taken into consideration when designing the tubing connecting the scroll to the remaining system. The tubing should provide enough "flexibility" to allow normal starting and stopping of the compressor without exerting excessive stress on the tube joints. In addition, it is desirable to design tubing with a natural frequency away from the normal running frequency of the compressor. Failure to do this can result in tube resonance and unacceptable tubing life. Figure 4 shows examples of acceptable tubing configurations.

The examples are intended only as guidelines to depict the need for flexibility in tube designs. In order to properly determine if a design is appropriate for a given application, samples should be tested and evaluated for stress under various conditions of use including voltage, frequency, and load fluctuations, and shipping vibration. The guidelines above may be helpful; however, testing should be performed for each system designed.

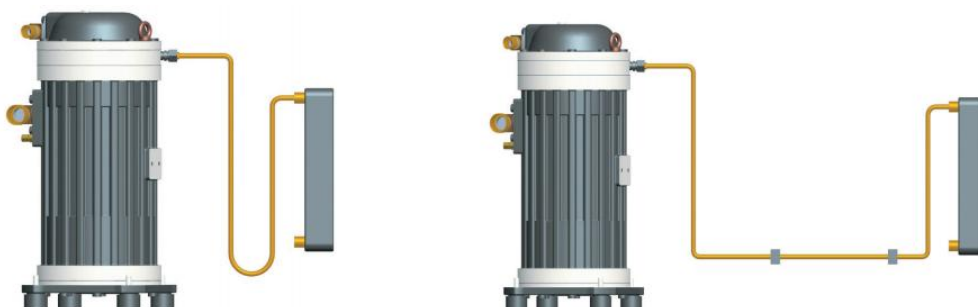


Figure 4 Typically Suction Line Arrangements

Notes: The above tubing configurations are guidelines to minimize tube stress
Follow similar guidelines for suction/discharge tube and oil return tube as needed.
The length of the tube from compressor discharge port should be made as short as possible (e.g. 50mm or less) but still insuring a proper braze joint.
The vertical part of tube should be longer than 200mm and less than 500mm.
If a run of over 500mm on the horizontal tube is required, intermediate clamps may be necessary (refer the right figure).
Do not hang weights on tubing (e.g. filter drier on suction tubing) except after clamps or close to the header.
The above tube recommendations are based on “no elbow joints”. The use of continuous tubing is preferred.

Fusite

Fusite pin orientation for single-phase and three-phase refrigeration scroll compressors are shown in Figure 5 and inside the terminal box.

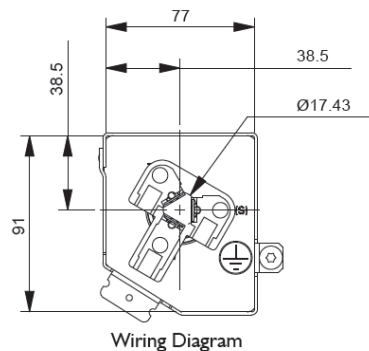


Figure 5 Motor terminal connections

Electrical Connection

The orientation of the electrical connections on the Scroll compressors is shown in Figure 5.

Shell Temperature

System component failure may cause the top shell and discharge line to briefly reach temperatures above 150°C. Wiring or other materials, which could be damaged by these temperatures, should not come in contact with the shell.

Connection Fittings

Scroll compressors are provided with either braze connections or roto-lock adapters depending on the bill of material selected.

All YH models have copper plated steel suction and discharge fittings for a more rugged, leak resistant connection.

See section on New Installation (see Figure 6) for suggestions on how to properly braze these fittings.

Three-Phase Rotation Direction

Scroll compressors are directional dependent: i.e., they will compress in one rotational direction only. On single phase compressors, this is not an issue since they will only start and run in the proper direction (except as described in the Labeled Brief Power Interruptions). Three-phase scrolls, however, will rotate in either direction depending on the power of the phasing. So there is a 50/50 chance of connected power being “backwards.” Contractors should be warned of this. Appropriate instructions or notices should be provided by the Original Equipment Manufacturer.

Verification of proper rotation can be made by observing that the suction pressure drops and the discharge pressure rises when the compressor is energized. Additionally, if operated in reverse the compressor is noisier and its current draw is substantially reduced compared to tabulated values.

Although operation of scroll in reverse direction for brief periods of time is not harmful, continued

operation could result in failure.

All three-phase compressors are wired identically internally. Once the correct phasing is determined for a specific system or installation, connecting properly phased power leads to the same fusite terminals will maintain the proper rotation.

Brief Power Interruptions

Brief power interruptions (less than 0.5 second) may result in powered reverse rotation of single-phase refrigeration scroll compressors. High-pressure discharge gas expands backward through the scrolls at power interruption causing the scroll to orbit in the reverse direction. If power is reapplied while this reversal is occurring, the compressor may continue to run noisily in the reverse direction for several minutes until the compressor internal protector trips. This has no negative effect on durability. When the protector resets, the compressor will start and run normally.

Invotech recommend the use of a timer which can sense brief power interruptions and lock the compressor out of operation for two minutes.

No time delay is required on three phase models to prevent reverse rotation due to power interruptions

Deep Vacuum Operation

Do not run a refrigeration scroll compressor in a vacuum. Failure to heed this advice can result in permanent damage to the compressor.

A low-pressure control is required for protection against vacuum operation. See the section on pressure controls for the proper set points. Never by-pass the low pressure switch.

Scroll compressors (as with any refrigeration compressor) should never be used to evacuate refrigeration or air conditioning systems.

System Evacuation

An important step in effectively cleaning a system before operation is proper evacuation. Air is very detrimental to refrigeration systems and must be removed before start up and after field service. Blowing out lines with dry nitrogen may remove a major part of the air from a system, but if air is trapped in the compressor during installation it is practically impossible to remove from the compressor crankcase by purging with nitrogen.

New compressors are shipped with a dry air holding charge, and must be evacuated before being put in the system.

Triple evacuation of the system or compressor, as required, is strongly recommended (twice to 1500 microns and finally to 500 microns), breaking the vacuum each time with 30 PSIG dry nitrogen. The vacuum pump must be connected to both the high and low sides of the system through properly sized coactions, since restrictive service connections may make the process so slow as to be unacceptable, or may lead to false readings because of pressure drop through the fittings.

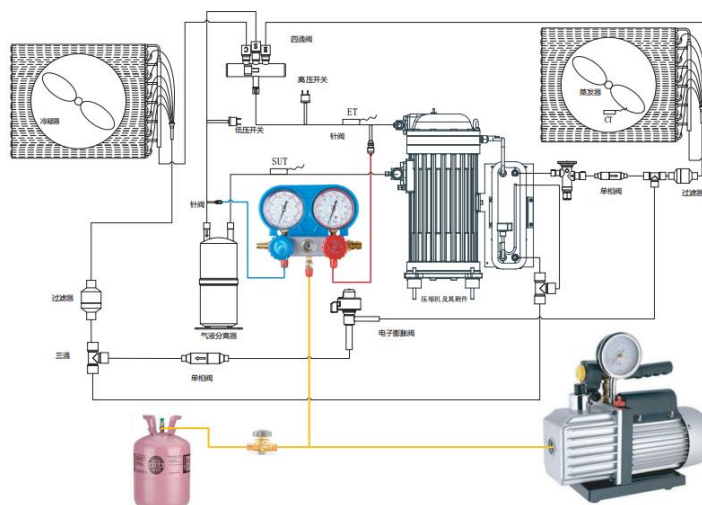


Figure 6 Connection for the system evacuation and charging

Charging Process

Do not power on the compressor before charging refrigerant.

Use the scale to control charge quantity. One liquid drier is recommended to connect between refrigerant cylinder and manifold to prevent moisture into system during charging. Connect refrigerant cylinder to both high and low side of the refrigeration system, power on the solenoid valve if possible (do not power on the compressor at this time). Invert refrigerant cylinder if needed to ensure only liquid can be charged into both high and low sides. Charge the refrigerant to the system as much as needed (at least 70% of total needed). Disconnect the high side charge port, turn on the compressor, and continue charge the liquid from the low side until the refrigerant is enough for the system.

Never close the suction service valve when compressor is running.

Unbrazing System Components

If the refrigerant charge is removed from a scroll unit by bleeding the high side only, it is sometimes possible for the scrolls to seal, preventing pressure equalization through the compressor. This may leave the low side shell and suction line tubing pressurized. If a brazing torch is then applied to the low side, the pressurized refrigerant and oil mixture could ignite as it escapes and contacts the brazing flame. It is important to check both the high and low sides with manifold gauges before un-brazing. In the case of an assembly line repair, remove the refrigerant from both the high and low sides. Instructions should be provided in appropriate product literatures and assembly areas.

High Potential (Hi-pot) Testing

Invotech scroll compressors are located the motor at the lower part of the compressor. As a result when liquid refrigerant is within the compressor shell the motor can be immersed in liquid refrigerant to a greater extent than with compressors with the motor mounted at the upper part of the compressor. When compressors are Hi-pot tested and liquid refrigerant is in the shell, they can show higher levels of leakage current than compressors with the motor on top because of the higher electrical conductivity of liquid refrigerant than refrigerant vapor and oil. This phenomenon can occur with any compressor when the motor is immersed in refrigerant. The level of current leakage does not present any safety issue. To lower the current leakage reading the system should be operated for a brief period of time to redistribute the refrigerant to a more normal configuration and the system Hi-pot tested again. Under no circumstances should the Hi-pot or Meg-ohm test be performed while the compressor is under a vacuum.

Invotech Scroll Functional Check

Refrigeration scroll compressors do not have internal suction valves. It is not necessary to perform functional compressor tests to check how low the compressor will pull suction pressure. This type of test may damage a scroll compressor. The following diagnostic procedure should be used to evaluate whether an Invotech Scroll compressor is functioning properly.

1. Verify proper unit voltage.
2. Normal motor winding continuity and short to ground checks will determine if the inherent overload motor protector has opened or if an internal short to ground has developed. If the protector has opened, the compressor must cool sufficiently to reset.
3. With service gauges connected to suction and discharge pressure fittings, turn on the compressor. If suction pressure falls below normal levels, the system is either low on charge or there is a flow blockage.

4a. Single-Phase Compressors

If the suction pressure does not drop and the discharge pressure does not raise to normal levels the compressor is faulty.

4b. Three-Phase Compressors

If the suction pressure does not drop and the discharge pressure does not rise, reverse any two of the compressor power leads and reapply power to make sure the compressor was not wired to run in the reverse direction.

The compressor current draw must be compared to published compressor performance curves at the compressor operating conditions (pressures and voltages). Significant deviations ($\pm 15\%$) from published values may indicate a faulty compressor.

New Installation

- The copper-coated steel suction, discharge, and injection tubes on scroll compressors can be brazed in approximately the same manner as any copper tube.
- Recommended brazing material - Any Silfos material is recommended, preferably with a minimum of 5% silver. However, 2% silver or even lower is acceptable if the technician has the excellent operation skills.
- Use of a dry nitrogen purge to eliminate possibility of carbon buildup on internal tube surfaces is recommended. Wet rag is recommended to use to avoid the overheating of the painting and other parts not requiring brazing.
- Be sure process tube fitting I.D. and process tube O.D. are clean prior to assembly.
- Remove the discharge plug at first, then remove the suction plug.
- Apply heat in Area 1. As tube approaches brazing temperature, move torch flame to Area 2.
- Heat Area 2 until braze temperature is attained, moving torch up and down and rotating around tube as necessary to heat tube evenly. Add braze material to the joint while moving torch around circumference.
- After braze material flows around joint, move torch to heat Area 3. This will draw the braze material down into the joint. The time spent heating Area 3 should be minimal.
- As with any brazed joint, overheating may be detrimental to the final result.

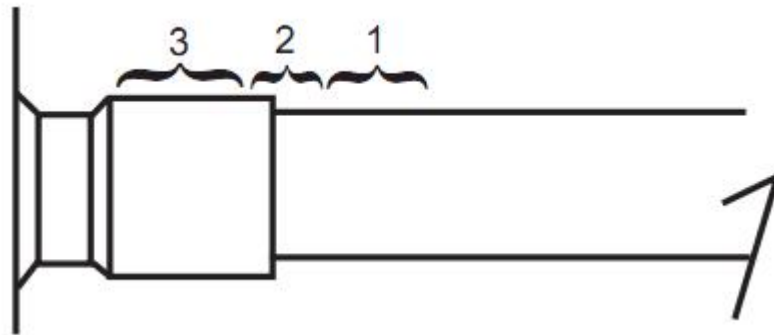


Figure 8 Scroll tubing Brazing

Field Service To Disconnect:

- Recover refrigerant from both the high and low side of the system. Cut tube near compressor.

To reconnect:

- Recommended brazing materials - Silfos with minimum 5% silver or silver braze material with flux.
- Reinsert tubing fitting.
- Heat tube uniformly in Area 1, moving slowly to Area 2. When joint reaches brazing temperature, apply brazing material.
- Heat joint uniformly around the circumference to flow braze material completely around the joint.
- Slowly move torch in Area 3 to draw braze material into the joint.
- Do not overheat joint.

Compressor Replacement after Motor Burn

In the case of a motor burn, the majority of contaminated oil will be removed with the compressor. The rest of the oil is cleaned through use of suction and liquid line filter dryers. A 100% activated alumina suction filter drier is recommended but must be removed after 72 hours. It is highly recommended that the suction accumulator be replaced if the system contains one. This is because the accumulator oil return orifice or screen may be plugged with debris or may become plugged shortly after a compressor failure. This will result in starvation of oil to the replacement compressor and a second failure.

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