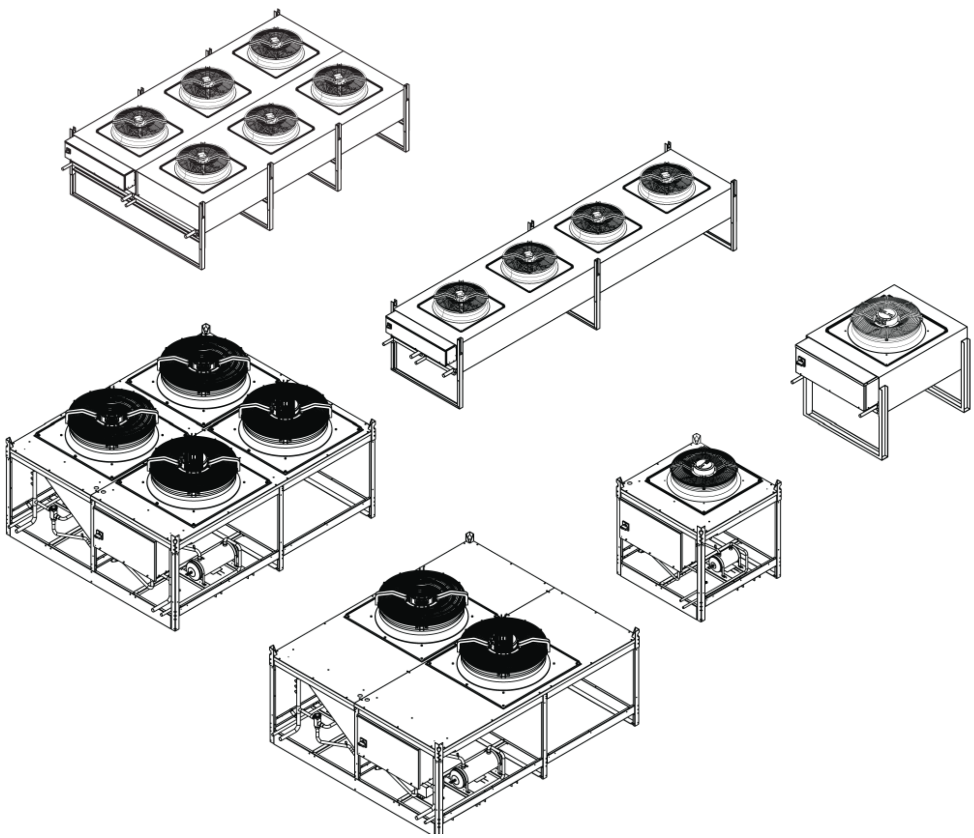

SCS Series

Installation, Operation and Maintenance Manual

Remote Air Cooled Condensers

For Indoor Cooling Systems

SCS Series Condensers

Nomenclature			
-SCS-XXX-XXX			
SCS	Capacity (1000 BTU/Hr)	Circuits	Fan Options
SCS Series Condenser	012 018 024 036	S = Single	AA - Fan Cycle Control SA - Variable Speed Control EC - Variable Speed Control (Electronically Commutated Fans)
	060 096 120 144 192	S = Single D = Dual	
	252 276 312 447 525 597 683 940 1366	D = Dual	

SCS Series Micro-Channel Condensers

Nomenclature					
SCS-MC-XXX-XXX-XX					
Condenser Section with Micro-Channel Coil	015 018	S = Single	AA - Fan Cycle Control SA - Variable Speed Control EC - Variable Speed Control (Electronically Commutated Fans) LN - Low Noise Variable Speed Control (Electronically Commutated Fans)	O - Standard F - Flooded Head Pressure Control with Receiver	1 - R407C 2 - R410A
	031 035 056 071 111	S = Single D = Dual			
	128 142 223 264 334	D = Dual			

Notice

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1.0 INTRODUCTION

1.1 General

The Remote Air Cooled Condenser is designed and manufactured by STULZ. Recognized as a world leader, STULZ provides precision cooling systems with the highest quality craftsmanship using the finest materials available in the industry. The unit will provide years of trouble free service if installed and maintained in accordance with this manual. Damage to the unit from improper installation, operation or maintenance is not covered by the warranty.

This manual contains information for installation, operation, maintenance, troubleshooting and repair. Study the instructions contained in this manual. They must be followed to avoid difficulties. Spare parts are available from STULZ to insure continuous operation. Using substitute parts or bypassing electrical or refrigeration components to continue operation is not recommended and will void the warranty. Due to technological advancements, components are subject to change without notice.

STULZ Air Cooled Condensers are designed to reject heat from refrigerant based cooling equipment. Any use beyond this is deemed to be not intended. STULZ is not liable for any damage resulting from improper use. The unit is designed to be installed outdoors unless otherwise noted on the equipment nameplate.

1.2 Product Description

STULZ Remote Air Cooled Condensers are designed to be the most efficient and reliable condensers in the industry. The unit is an air-cooled, heat rejection condenser with a vertical air discharge pattern.

The unit is self-contained in a light weight, corrosion resistant aluminum cabinet designed for mounting to a horizontal surface. The cabinet houses the condenser coil(s) and fan assembly(s). The electrical controls are in an integrally mounted, weather proof enclosure which is isolated from the rest of the equipment.

There are many cabinet sizes based on the capacity of the unit. Refer to the installation drawing supplied with your unit for the layout and dimensions of your cabinet.

-SCS condensers are highly efficient heat rejection systems. Enhanced performance -SCS-MC condensers are also available. -SCS-MC condensers are equipped with micro-channel coils which offer greater refrigerant-to-air heat transfer. The total heat rejection in BTU/hr will depend on the unit size. Refer to the unit nameplate to identify the model number of your unit. The system will consist of a single refrigeration circuit or dual circuit coil. The coil is a closed-loop refrigerant condensing heat exchanger in which refrigerant is continuously circulated by the pressure differential created by a compressor.

The compressor increases refrigerant pressure to a level sufficiently high for it to be cooled and condensed into liquid by the effect of ambient air being drawn over the condenser coil. STULZ condensers are designed to operate with either R407C or R410A refrigerant. Refer to the unit nameplate to identify the type of refrigerant to be used in your unit.

Outdoor air cooled condensers use fan cycling for low ambient head pressure control down to 0 °F (OHS only). Variable fan speed control is used for operation in low ambient temperatures down to -20 °F. Flooded head pressure control is used with fan cycling for low ambient temperatures down to -30°F.

Operation of the condenser is independent, controlled by the refrigerant pressure. It can be wired in the field for the system controller (provided with the indoor evaporator section) to enable condenser operation.

1.2.1 Capabilities and Features

- All aluminum cabinet construction
- Mounting legs
- Direct driven axial fan(s) equipped with external rotor motors
- Unit mounted, weather resistant control enclosure with lockable service disconnect switch

1.2.1.1 Safety Features

The remote air-cooled condenser is provided with a factory mounted service disconnect switch. The service disconnect switch electrically isolates the unit during routine maintenance. The handle of the switch may be locked in the "Off" position to prevent unauthorized operation. Finger guard grilles are provided on each fan to protect the operator from injury and to keep large tools or other objects from falling into the fan.

1.2.2 Application Ranges

STULZ remote air cooled condensers are designed for operation within the following ranges.

Outdoor Temperature Range	
Fixed Fan Cycling Control (OHS only)	0 °F or higher
Variable Fan Speed Control	-20 °F or higher
Flooded Head Pressure Control	-30 °F or higher

Operating Voltage	
VAC Input per unit nameplate	+/- 10%.
Max. Piping Length; Indoor Evaporator to Condenser	150 ft equivalent length
Max. Level Drop; Indoor Evaporator to Condenser	20 ft (if condenser is below the evaporator)
Storage Conditions	-30 °F to 105 °F

NOTE: Damage or malfunction to the unit due to storage or operation outside of these ranges will VOID THE WARRANTY.

1.3 Safety

1.3.1 General

STULZ Air Technology Systems, Inc. uses **NOTES** along with **CAUTION** and **WARNING** symbols throughout this manual to draw your attention to important operational and safety information.

A bold text **NOTE** marks a short message in the information to alert you to an important detail.

A bold text **CAUTION** safety alert appears with information that is important for protecting your equipment and performance. Be especially careful to read and follow all cautions that apply to your application.

A bold text **WARNING** safety alert appears with information that is important for protecting you from harm and the equipment from damage. Pay very close attention to all warnings that apply to your application.

A safety alert symbol ⚠ accompanies a general **WARNING** or **CAUTION** safety statement.

A safety alert symbol ⚡ accompanies an electrical shock hazard **WARNING** or **CAUTION** safety statement.

1.3.2 Safety Summary

The following statements are general guidelines followed by warnings and cautions applicable throughout the manual.

Prior to performing any installation, operation, maintenance or troubleshooting procedure read and understand all instructions, recommendations and guidelines contained within this manual.

CAUTIONS ⚠

All maintenance and/or repairs must be performed by a journeyman, refrigeration mechanic or an air conditioning technician.

Never lift any component over 35 pounds without help. If a lifting device is used to move a unit, ensure it can support the unit.

Do not allow the unit to swing while suspended from a lifting device. Failure to observe this warning may result in injury to personnel and damage to the equipment.

Do not allow anyone under the equipment suspended from a lifting sling.

Never work on electrical equipment unless another person who is familiar with the operation and hazards of the equipment and competent in administering first aid is nearby

When working on electrical equipment, remove all jewelry, watches, rings, etc. Keep one hand away from the equipment to reduce the hazard of current flowing through vital organs of the body.

Always disconnect the main power supply to the equipment at the main power disconnect switch before beginning work on the equipment. A lock- out tag-out procedure should be followed to ensure that power is not inadvertently reconnected.

All personnel working on or near equipment should be familiar with hazards associated with electrical maintenance. Safety placards/stickers have been placed on the unit to call attention to all personal and equipment damage hazard areas.

Ensure the unit is properly phased. Improper phasing can cause severe damage to the compressor.

Certain maintenance or cleaning procedures may call for the use and handling of chemicals, solvents, or cleansers. Always refer to the manufacturer's material Safety Data Sheet (SDS) prior to using these materials. Clean parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvents. Wash exposed skin thoroughly after contact with solvents.

Do not use cleaning solvents near open flame or excessive heat. Wear eye protection when blowing solvent from parts. The pressure-wash should not exceed 30 psig. Solvent solutions should be disposed of in accordance with local and state regulatory statutes.

WARNINGS ⚡

High voltage is used in the operation of this equipment. Death on contact may result if personnel fail to observe safety precautions.

Equipment may contain components subject to Electrostatic Discharge (ESD). Before attempting to mount or service these electronic devices, ensure you have no charge built up by touching a ground source. When possible, use a wrist- grounding strap when working on or near electronic devices.

Refrigerant (R407C or R410A) is used with this equipment. Death or serious injury may result if personnel fail to observe proper safety precautions. Great care must be exercised to prevent contact of liquid refrigerant or refrigerant gas, discharged under pressure, with any part of the body. The extremely low temperature resulting from the rapid expansion of liquid refrigerant or pressurized gas can cause sudden and irreversible tissue damage.

As a minimum, all personnel should wear thermal protective gloves and face-shield/goggles when working with refrigerant. Application of excessive heat to any component will cause extreme pressure and may result in a rupture.

Exposure of refrigerant to an open flame or a very hot surface will cause a chemical reaction that will form carbonyl chloride (hydrochloric/hydrofluoric acid); a highly poisonous and corrosive gas commonly referred to as FLUOROPHOSGENE. In its natural state, refrigerant is a colorless, odorless vapor with no toxic characteristics. It is heavier than air and will disperse rapidly in a well-ventilated area. In an unventilated area, it presents a danger of suffocation.

Always refer to the manufacturer's MSDS provided with the unit.

Avoid skin contact or inhaling fumes from any acid formed by burn out of oil and refrigerant. Wear gas mask if area is not thoroughly ventilated. Wear protective goggles or glasses to protect eyes. Wear rubber gloves to protect hands. Use care to avoid spilling compressor burnout sludge. If sludge is spilled, clean area thoroughly.

When performing soldering or de-soldering operations, make certain the refrigeration system is fully recovered and purged and dry nitrogen is flowing through the system at the rate of not less than 1–2 CFM (.03 - .06 M^3/minute).

1.4 General Design

STULZ SCS series remote air cooled condensers are housed in an aluminum frame cabinet and are rated for outdoor use. The figures that follow depict the two types of condensers and identifies the major components. Figure 1 depicts a layout of a typical -SCS condenser. Figure 2 depicts a layout of a typical -SCS-MC condenser.

1.4.1 Condenser Coil

The capacity of the condenser, indicated by the unit model number, is based on the rated capacity of the coil. In the case of dual circuit units, the model number is based on the combined capacity of both coils.

1.4.2 -SCS Condenser Coils

-SCS condenser coils are copper tube, aluminum finned coils.

1.4.3 -SCS-MC Micro-Channel Condenser Coils

-SCS-MC condenser coils are brazed all-aluminum construction with high performance fins which provide improved airflow and higher heat transfer.

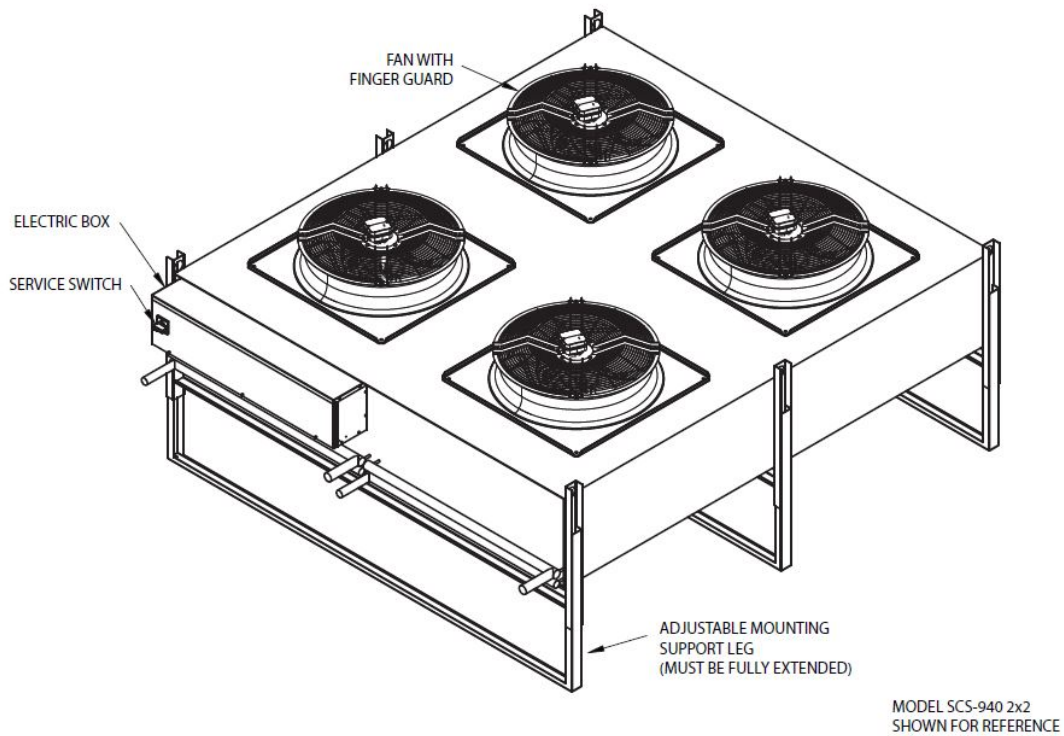


Figure 1. Typical Layout- -SCS Condenser

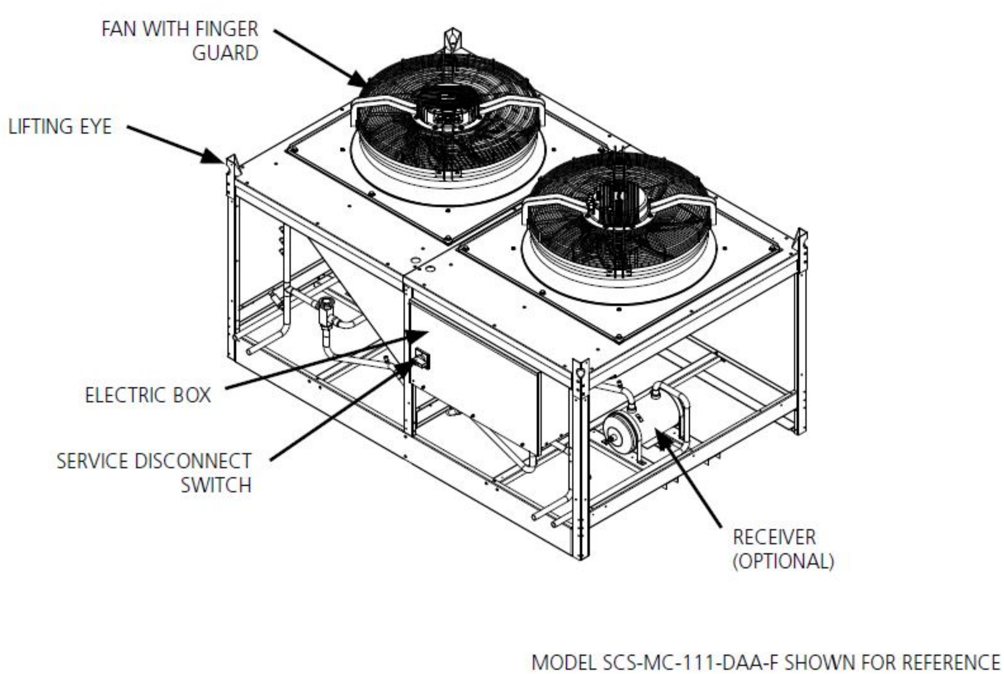


Figure 2. Typical Layout- -SCS-MC Condenser

1.4.2 Fan Assembly

The condenser is equipped with high efficiency axial type, impeller fan(s) rated for outdoor applications. The quantity of fans vary depending upon the capacity of the unit. The fan(s) use corrosion resistant, multi-blade impellers designed for high aerodynamic efficiency which results in lower power consumption, lower noise levels and longer life. Each fan uses a direct driven motor with maintenance free bearings. The fan motors are internally protected from overload.

1.4.3 Electric Box

The electrical components are protected in a weather resistant enclosure located at the header end of the unit. The electric box has a removable front access panel which is safety interlocked with the service disconnect switch, preventing the panel from being removed when the switch is in the "On" position. The switch must be turned "Off" to gain access to the electrical components.

1.4.4 Receiver (Optional)

Receivers are furnished for air cooled condensers using flooded head pressure control for low ambient temperature conditions. The optional receivers are equipped with pressure relief valves and heater pads.

Receivers for SCS condensers are mounted to a coated steel base frame which may be attached to a suitable foundation next to the condenser (see Figure 7). A head pressure control valve may be shipped loose for field installation to the receiver if one is not already provided in the indoor A/C unit.

The STULZ SCS-MC condenser design differs in that receivers are integrally mounted to the condenser Frame (See Figure 2). For -30 °F applications a head pressure control valve is factory installed and piped to the receiver.

1.5 Head Pressure Controls

1.5.1 Condenser Fan Cycling (AA Models)

Used for outdoor installations where ambient condenser air inlet temperatures are 0 °F or higher, a condenser fan cycling switch monitors refrigerant discharge pressure and turns on the condenser fan as required to maintain allowable condenser pressures. This is a high-pressure differential control switch with SPST contacts and an automatic reset. The switch activates the condenser fan contactor to maintain condensing temperature when the discharge pressure rises. See Table 1 on page 6 for the fan cycling pressure control settings.

NOTE: It may be necessary to alter the fan cycling control settings on a case by case basis. This is due, in part, to site specific heat loads and varying BTU capacities of indoor evaporator (A/C) units. Contact STULZ Product Support for assistance.

On single circuit condensers, each fan is controlled with its own fan cycling switch. Multiple fans are staged to operate sequentially as discharge pressure rises. The primary fan (closest to the header) turns on 1st as described above. If pressure continues to rise, adjacent fan(s) are set to turn on in sequential increments with the fan located furthest from the header turning on last. Conversely, as discharge pressure drops, the fans drop out sequentially in reverse order. .

Dual Circuit condensers employ a fan cycling pressure control switch for each refrigeration circuit. For smaller model condensers, two control switches (one per refrigeration circuit) are adjusted to the same pressure setpoint and are wired in parallel to operate a single fan. If either control switch senses a rise in pressure, the fan will turn on. On dual circuit units with multiple fans, operation of each additional fan requires two paralleled pressure control switches (one for each refrigeration circuit). Each set of paralleled switches will be set to the same pressure such that the adjacent fans begin operating at sequentially higher pressure increments. For larger model micro-channel condensers (SCS-MC-111 through SCS-MC-334) the fan cycling pressure control switches are not in parallel. The control switches operate the fan(s) assigned to each refrigeration circuit independently.

1.5.2 Variable Condenser Fan Speed (SA Models)

Used for outdoor installations where ambient condenser air inlet temperatures may fall to -20°F, a variable speed condenser fan motor controller is used to maintain head pressure. The fan speed control is a continual modulation of the motor's speed. The condenser fan speed controller monitors the refrigerant discharge pressure and as discharge pressure rises, the fan speed increases. The condenser fan speed varies as required to maintain allowable condenser pressures. The fan speed controller is set to maintain the correct condensing pressure. See Table 2 for the variable fan speed pressure control settings.

When used on systems with multiple condenser fans, variable fan speed control is used only on the first fan which is closest to the header. Additional fans use pressure fan cycling control as described in Section 1.5.1, to assist the variable speed fan to maintain proper head pressure.

Table 1. Fan Cycling Pressure Control Settings

Refrigerant Type	1st Fan		2nd Fan		3rd Fan		4th Fan	
	Cut-in	Cut-out	Cut-in	Cut-out	Cut-in	Cut-out	Cut-in	Cut-out
R407C	320 psig	240 psig	330 psig	250 psig	340 psig	260 psig	345 psig	265 psig
R410A	440 psig	330 psig	460 psig	345 psig	475 psig	355 psig	485 psig	375 psig

Table 2. Variable Fan Speed Control Settings

Refrigerant Type	1st Fan (Variable)		2nd Fan		3rd Fan		4th Fan	
	Range (psig) Min.	Range (psig) Max.	Cut-in	Cut-out	Cut-in	Cut-out	Cut-in	Cut-out
R407C	240	315	325 psig	255 psig	340 psig	260 psig	345 psig	265 psig
R410A	340	440	460 psig	355 psig	475 psig	365 psig	485 psig	375 psig

1.5.3 Flooded Head Pressure Control

Used for outdoor installations where ambient condenser air inlet temperatures may fall to -30°F, flooded head pressure control is used to maintain head pressure during the low ambient temperature conditions. A head pressure control valve and a receiver are used in the refrigeration circuit to back up liquid refrigerant into the condenser coil. The head pressure control valve is a 3-way modulating valve controlled by the discharge pressure (see Figure 3). The head pressure control valve and the receiver may be located with the RCU or with the indoor evaporator unit.

When the A/C unit begins to operate, the discharge pressure rises. When the pressure reaches the "1st Fan" pressure control setting (Table 1), the condenser fan is cycled on as described in 1.5.1. If multiple fans are used, they will operate by pressure fan cycling.

When ambient temperature drops, the discharge pressure drops also. When the discharge pressure drops, the head pressure control valve diverts discharge gas away from the condenser to the receiver. Liquid flow from the condenser is restricted, causing liquid to back up in the condenser.

Flooding the condenser reduces the area available for condensing. The desired result is to increase the pressure into the condenser, maintaining a minimum discharge pressure during low ambient operation thus ensuring proper condensing temperature. The head pressure control valve requires no adjustment.

This method of controlling head pressure allows the condenser fan to run continuously. While the fan is running, the flooded head pressure control valve modulates the amount of discharge gas entering the receiver. As the pressure increases, the valve diverts more discharge gas to the condenser, allowing more liquid to flow from the condenser to the receiver.

When using this method of head pressure regulation there must be enough refrigerant in the system to ensure an adequate charge at the lowest expected ambient temperature in which the system will be operating. A receiver is used to store the extra refrigerant when the condenser is not utilizing it.

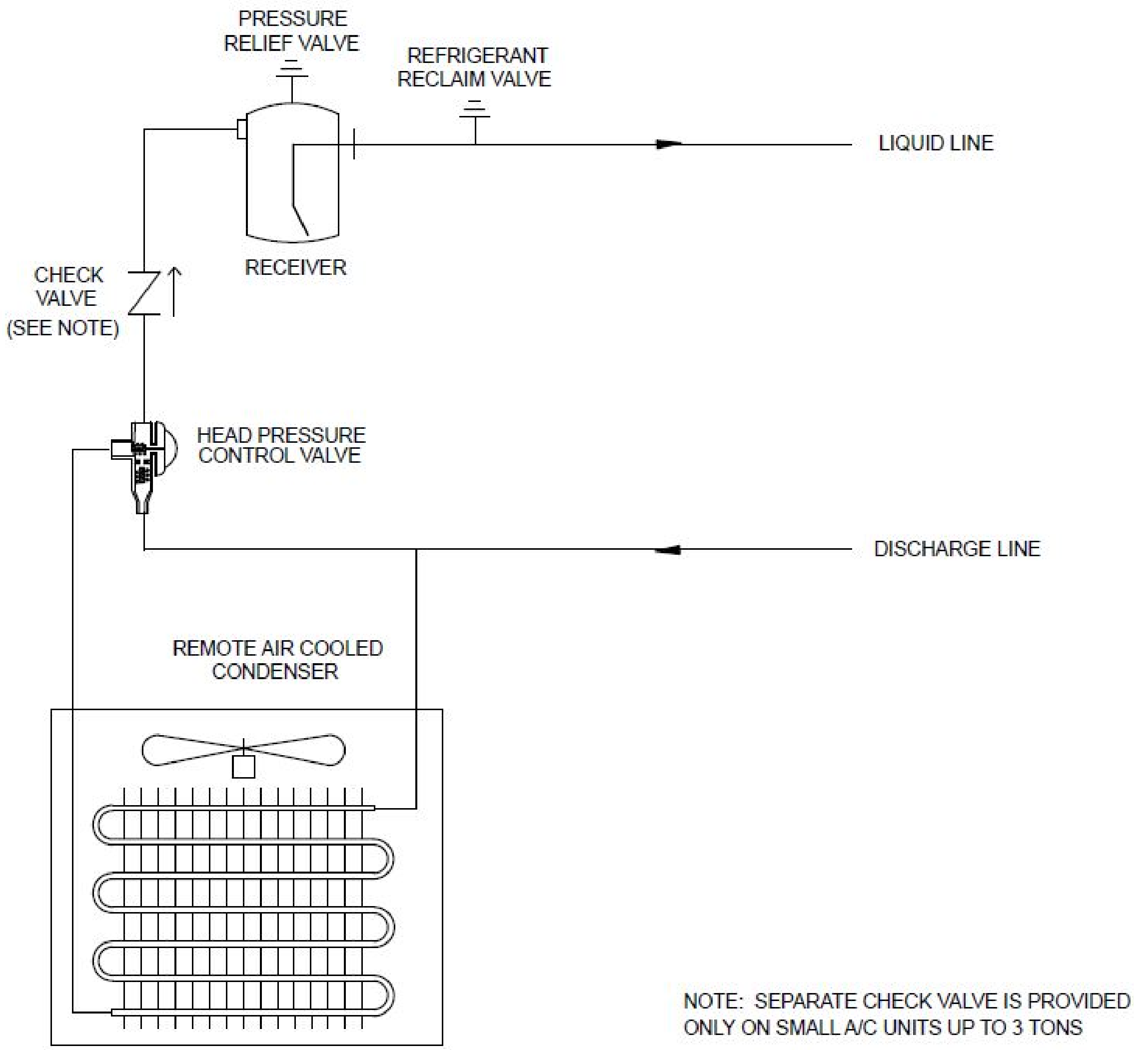


Figure 3. Flooded Head Pressure Control Diagram

2.0 INSTALLATION

2.1 Receiving the Equipment

Your system has been tested and inspected prior to shipment. To ensure that your equipment is received in excellent condition, make a visual inspection of the equipment immediately upon delivery. Carefully remove the shipping container and all protective packaging. Open the electric box and thoroughly inspect the unit for any signs of transit-incurred damage. If there is shipping damage, it must be noted on the freight carrier's delivery forms before signing for the equipment. Any freight claims must be done through the freight carrier.

STULZ ships all equipment FOB factory. STULZ is not liable for any equipment damage while in transit. STULZ can assist in the claim filing process with the freight carrier. Should any damage be present, notify STULZ Product Support prior to attempting any repairs. Refer to Section 5.0of this manual for instructions.

Check the equipment against the packing slip to see if the shipment is complete. Report any discrepancies to the appropriate authority.

A Data Package has been sent with your unit. It contains this manual, system drawings, applicable SDS's and other appropriate instructions based on the configuration of your unit and options selected. The data package has been shipped with your unit in a clear plastic bag. These documents need to be kept with the unit for future reference.

2.2 Site Preparation

Our Air Cooled Condensers are designed with easy service access in mind. Install the condenser in a secure location where it cannot be tampered with and the main power disconnect switch cannot be inadvertently turned Off. Allow access to the unit for routine operation, servicing and for necessary maintenance. The components on outdoor condensers are accessed through the top by removing the fan assembly panel.

The electric box is accessed at the header end of the unit. Locate the unit where the fan(s) are not likely to draw dirt and debris into the coil fins. Refer to the installation drawing provided with your unit forthe dimensions.

NOTE: Working clearance requirements need to be established prior to mounting the unit. Refer to local and national electrical codes.

CAUTION ⚠

The condenser must be kept level to operate properly.

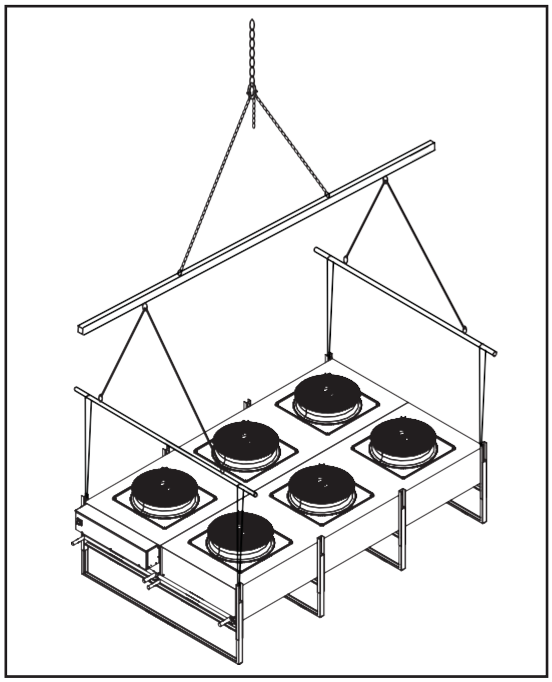
2.3 Rigging

The unit must be lifted vertically and kept in a level position. Move the unit with a suitable device such as a forklift or attach an overhead lifting sling. The unit may be lifted with an overhead sling attached to the top of the mounting support legs. Use an appropriate lifting device that has the capacity to safely handle the weight of the equipment. A weight table is provided on the installation drawing supplied with your unit. If using an overhead lifting device, use spreader bars that exceed the cabinet width to avoid crushing the sides of the unit.

Remote condensers are shipped on a skid to facilitate moving prior to installation. The unit should always be stored in a dry location prior to installation. To prevent damage when lifting the unit, all available lifting eyes on the cabinet must be used.

CAUTION ⚠

Ensure the mounting legs are fully extended when the unit is raised.



CAUTION ⚠

Take care not to damage the exposed coil fins on the underside of the cabinet when moving the unit.

2.4 Mounting and Placement

Outdoor, air cooled condensers are designed for mounting to a flat surface. Condenser(s) must not be near steam, hot air or fume exhausts. Avoid overhead obstructions. Ensure the unit is not located above or near noise sensitive areas. If possible, make use of terrain features such as trees and buildings to provide a shaded location. This will minimize the solar load on the unit. Avoid ground level sites that are accessible to the public.

Ensure the mounting location can support the weight of the equipment. Refer to the installation drawing for the non-charged system weight.

When installing the unit on a roof, ensure the weight is adequately distributed to the load bearing points. For ground mounted units, install a concrete slab as shown in Figure 4. The slab should extend below the frost line and be at least 2 inches higher than the surrounding grade. The slab should extend at least 2 inches beyond the outer profile of the condenser on all sides.

Ensure the condenser legs are fully extended to optimize air flow. Secure the unit with fasteners (field supplied by others) to prevent the system from moving during operation. To reduce the vibration transmission to the mounting surface it is recommended that vibration isolators (field supplied by others) be inserted between the mounting rails and the base as shown in Figure 4.

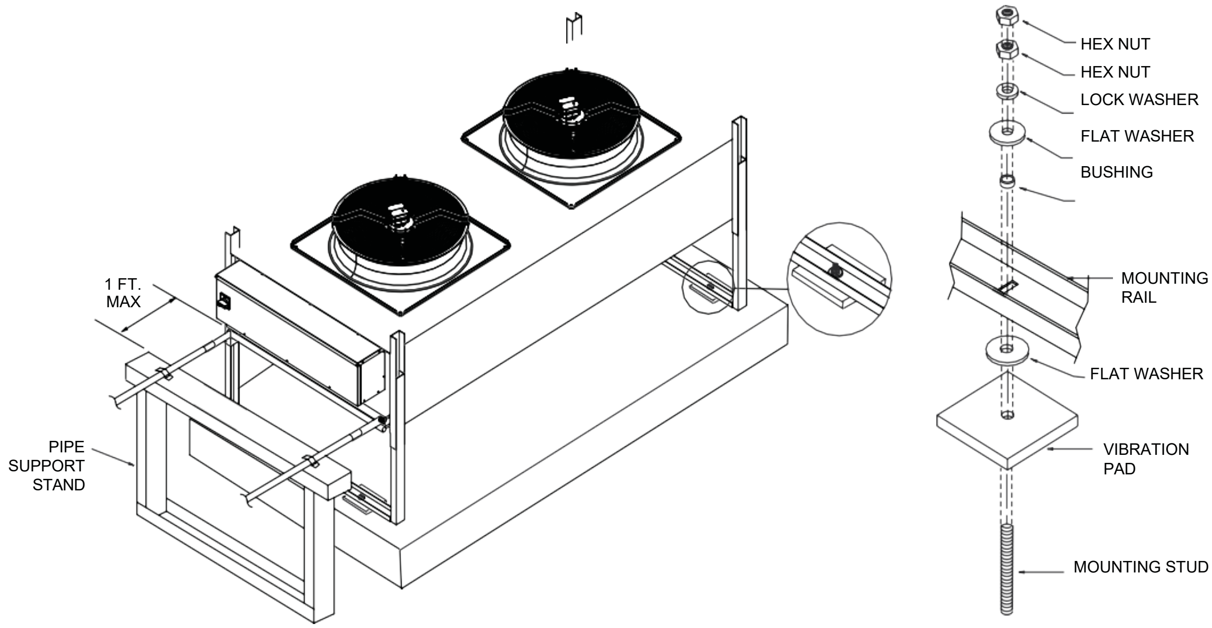


Figure 4. Ground Mounting

The clearance around the unit to the nearest wall or obstruction should be at least 1 time's (1×) the unit's width to ensure adequate airflow to the coil(s) (see Figure 5 and Figure 6). Space multiple units at least 2 times (2×) the unit's width when placing them side by side. Ensure hot exhaust air is not directed toward the air inlet of an adjacent unit. When placing units end to end, allow at least 4 feet of space between units. Avoid areas where heavy snow will accumulate at air inlet and outlet openings.

If the unit(s) are surrounded by three walls or if they are in a pit, space them at least 2 times (2×) the unit's width from the nearest walls (see Figure 6). The top of the unit must be equal to the height of the walls or the pit. A stack may be used, if necessary, to extend the air discharge. The height of the extension must not exceed 10 feet.

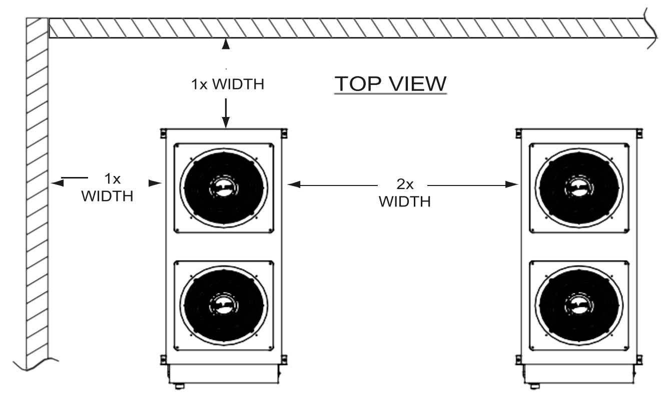


Figure 5. Side Clearance

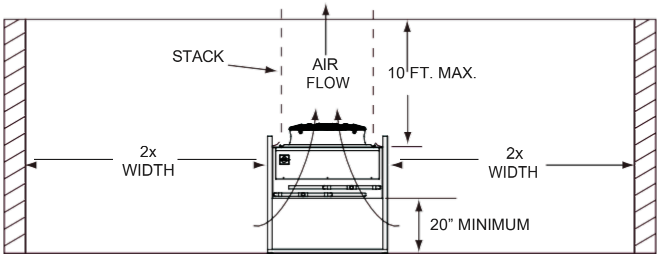


Figure 6. Walled Areas or Pits

2.4.1 Receiver

Receivers are provided as an option for systems utilizing flooded head pressure control. Receivers for SCS condensers are provided on a separate mounting base frame. Position optional SCS receiver(s) as close as possible to the condenser inlet/outlet pipe stubs. Secure the receiver base frame to the foundation using the mounting holes in the base. (Receivers for SCS-MC condensers are factory mounted to the condenser frame.)

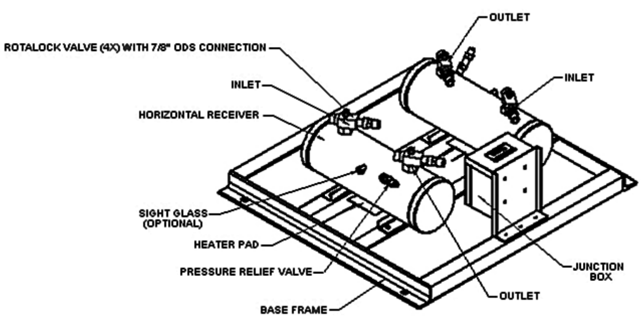


Figure 7. Receiver Assembly

2.4.1.1 Head Pressure Control Valve

For SCS condensers, the head pressure control valve (HPCV) is shipped loose for field installation. The head pressure control valve is to be located at the condenser and brazed in line with the piping between the condenser and receiver. Refer to section 2.5.2. For SCS-MC condensers, the HPCV is factory piped to the receiver.

2.5 Refrigerant Piping

Split air cooled systems require a field installed copper discharge line and copper liquid line between the condenser and the evaporator. Dual circuited condensers will require two sets of piping. Refer to the refrigeration diagram provided with your unit for piping details.

Provide a permanent stand or support brace for the inlet/outlet pipes within one foot of the condenser header to prevent undue stress on soldered connections (see Figure 4). The refrigerant piping should be isolated by vibration isolating supports. Provide supports (clamps or hangers) as necessary every 5 to 10 feet along piping runs to minimize vibration and noise transmission. When sealing openings in walls use a soft flexible material to pack around the piping

to reduce vibration transmission and prevent pipe damage.

All refrigerant piping should be installed with high temperature soldered joints. Use standard refrigeration practices for piping supports, leak testing, dehydration and charging of the refrigeration circuits.

NOTE: Refer to the Copeland Applications Data Guide for more detailed information regarding installation of refrigerant piping.

The condenser is shipped with a dry nitrogen holding charge which must be removed before piping and charging the system. All refrigeration piping should be installed with high temperature brazed joints. Use standard refrigeration practices for piping, leak testing, dehydration and charging of the refrigeration circuits. For copper to copper brazing (piping liquid line or discharge line), phosphorous alloy containing a minimum of 15% silver is recommended. General purpose silver brazing alloy with 45% silver is recommended for brazing dissimilar metals.

Wrap wet rags around the pipes between the areas to be soldered and any nearby refrigeration components (such as the optional head pressure control valve) to keep excessive heat from traveling through the pipe and causing damage. Clear all pipe connections of debris and prep connections for soldering. Use only "L" or "K" grade refrigerant copper piping. Be careful not to allow solder/piping debris to get inside refrigerant lines. Dry nitrogen should be flowing through the tubing while soldering at a rate of not less than 1–2 CFM (0.03–0.6 M^3/minute).

2.5.1 Refrigerant Line Sizing

The following general guidelines may be used to assist in determining the size of the refrigerant lines between the evaporator section and the remote air cooled condenser.

NOTE: Refrigerant piping between the indoor evaporator and condenser must not exceed 150 feet (total equivalent length). The maximum level drop from the indoor evaporator to the condenser must not exceed 20 feet.

Refrigerant lines for split systems must be sized according to the piping distance between the evaporator and the condenser with consideration to elevation changes. Each valve, fitting and bend in the refrigerant line must also be considered in this calculation. Refer to Table 3 for standard equivalent lengths, in feet, of straight pipe.

Table 3. Pipe Equivalent Lengths

Equivalent Length (ft) of Straight Pipe						
OD (In.) Line Size	Globe Valve	Angle Valve	90° Elbow	45° Elbow	Tee Line	Tee Branch
1/2	9.0	5.0	0.9	0.4	0.6	2.0
5/8	12	6.0	1.0	0.5	0.8	2.5
7/8	15	8.0	1.5	0.7	1.0	3.5
1-1/8	22	12	1.8	0.9	1.5	4.5
1-3/8	28	15	2.4	1.2	1.8	6.0
1-5/8	35	17	2.8	1.4	2.0	7.0
2-1/8	45	22	3.9	1.8	3.0	10

Refer to the installation manual provided with the A/C system for tables showing the recommended liquid line and discharge line sizes for the A/C system you are installing.

Things to consider when sizing refrigerant piping are the varying BTU capacities of indoor evaporators and the equivalent length of pipe needed between the remote condenser and the evaporator.

If the pressure drop is too high, the capacity of the compressor decreases, and the power required increases. An excessive refrigerant charge will be applied if the volume of the piping is too large. Refrigerant line sizing for discharge and liquid lines should create no more than a 2–3 °F pressure drop (1 °F = 4.75 psi).

NOTE: The size of the condenser pipe connections does not indicate the size of the refrigerant lines to be used. In cases where the pipe size doesn't match the size of the connection, reducing fittings must be used to transition between the connection and the pipe.

2.5.1.1 Discharge Line

Since refrigerant may condense during "Off" cycles, all vertical discharge risers should be designed to prevent liquid refrigerant from flowing back into the compressor. If a condenser is installed above the evaporator, the discharge line should include a shallow P-trap at the lowest point in the piping (see Figure 8).

The highest point in the discharge line should be above the condenser coil. Install an inverted trap at the condenser inlet to prevent liquid refrigerant from flowing backwards into the hot gas riser during off cycles. Shallow P-traps must be included in the discharge line for every 20 feet of vertical rise. All horizontal refrigerant lines should be pitched in the direction of flow at least 1/4" per 10 feet.

Discharge line velocities must be a minimum of 500 fpm for horizontal runs and 1,000 fpm for vertical risers to ensure oil is returned to the compressor at both full and partial load operating conditions.

It's important that the discharge line is sized with a certain degree of pressure drop. This will ensure the refrigerant flows at a velocity high enough for the refrigerant vapor to carry the oil with it to the condenser and to prevent the oil from returning to the compressor.

Compressor discharge pressure is always higher than condensing pressure due to the line pressure drop. The line pressure drop also causes a change in the refrigerant saturation temperature. The discharge line needs to be sized so the pressure drop won't cause a corresponding change in saturation temperature exceeding 2 °F.

Discharge piping is typically sized for a total line pressure drop of 5 psi (+/- 50%), which results in only a 1/2% to 1% reduction in compressor capacity. Pressure drops greater than 10 psi will impair system performance.

Figure 8 depicts a typical piping diagram when the condenser is located at a higher level than the indoor evaporator. In this situation, it's especially important to size the discharge line properly. If the discharge line is sized correctly for full load operation, the velocity of the gas may be too low during minimum load conditions to carry the refrigerant oil vertically through the discharge line to the condenser coil.

Decreasing the size of the discharge line will increase the refrigerant velocity, however, it will also restrict the flow of refrigerant at full load conditions creating an excessive refrigerant pressure drop.

To remedy this, dual risers may be used as shown in Figure 9 Discharge riser #1 should be sized to allow the refrigerant gas to flow at a sufficient velocity during minimum load conditions to carry the oil.

Riser #2 should be sized in such way that the inside diameter of riser #1 and #2 will together have a combined area allowing for a flow velocity that's suitable to carry the refrigerant oil to the condenser during peak load conditions.

Use a trap between the 2 risers so riser #2 will be sealed off when the trap fills with oil during partial load operation, thus diverting the flow of refrigerant to riser #1.

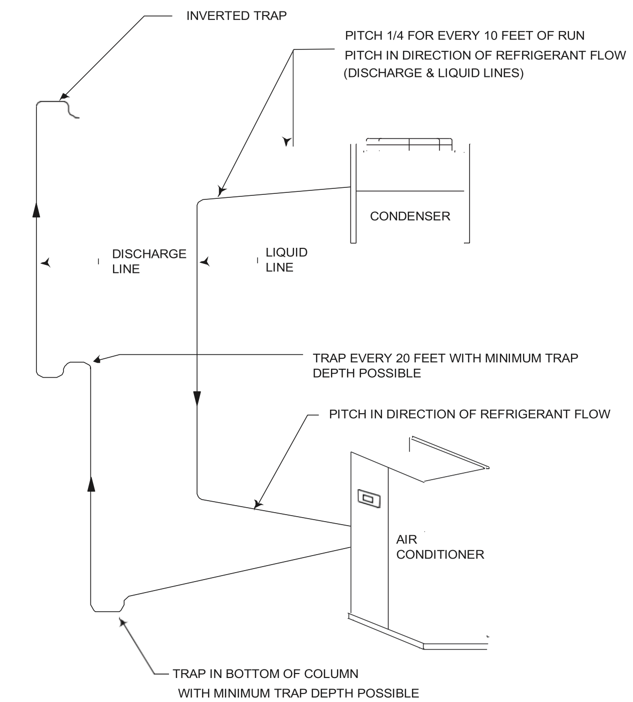


Figure 8. Piping Installation

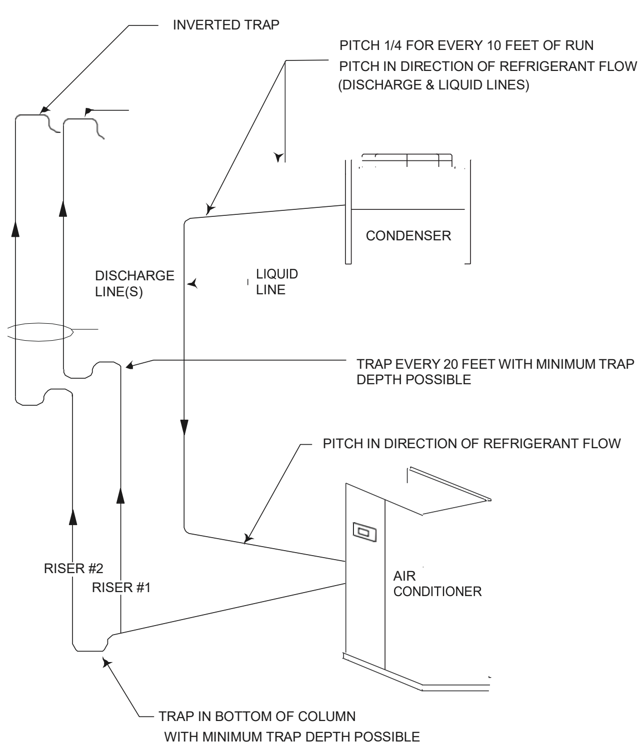


Figure 9. Dual Riser Piping

2.5.1.2 Liquid Line

The velocity of refrigerant in the liquid line is less critical because liquid refrigerant and oil are mixed thoroughly in the liquid state. The main concern when sizing the liquid line is to maintain a solid head of liquid refrigerant entering the thermostatic expansion valve (TXV). If the refrigerant pressure falls below its saturation temperature, a portion of the liquid refrigerant may change into vapor. Vapor will cause flashing and prevent the TXV from functioning properly. As flashing begins, the rate of pressure loss increases.

The liquid refrigerant is sub-cooled slightly below its saturation temperature. Sub-cooling must be sufficient to allow the necessary pressure drop without approaching a saturation condition where gas flashing could occur. Under normal operation the refrigerant is sufficiently cooled as it leaves the condenser to allow for normal line pressure drops. Liquid line size is to be selected based on a pressure drop equivalent to 2 °F sub-cooling.

Operating liquid line velocities should be less than 300 fpm to avoid liquid hammering during solenoid operation.

If the condenser is installed below the evaporator section, the installer must observe the pressure changes that occur if the elevation change. See Table 4 that follows for the vertical pressure drops for the two types of refrigerant used.

Table 4. Pressure Drops

Refrigerant Type	Pressure Drop in PSI/ft (Risers)
R407C	0.47
R410A	0.43

NOTE: When a receiver is used with the equipment, it should be below the level of the condenser. The liquid line from the condenser to the receiver should be liberally sized to allow the refrigerant to freely flow from the condenser to the receiver. The total refrigerant line pressure drop must not exceed 14 psig across the condenser and the interconnecting piping to the evaporator and condenser sections.

2.5.2 Head Pressure Control Valve Installation (SCS condenser only)

Refer to the refrigeration diagram provided with your unit and see Figure 3 for details on piping the head pressure control valve to the condenser and receiver.

2.5.3 Receiver Pipe Installation (SCS condenser only)

Receiver inlets and outlets are equipped with RotoLock valves that must have brazed pipe connections. It is important to remove the valve from the adapter on the receiver before brazing the refrigerant piping to it. Wrap wet rags around the valve body to prevent the internal parts from being damaged by the heat.

After brazing the pipe to the valve, remove and replace the Teflon O-ring in the RotoLock adapter with the new one which is cable-tied to the valve. When re-attaching the valve to the receiver, apply thread lock to the adapter threads to prevent it from vibrating loose. Tighten the valve to the receiver and check it for leaks when performing the steps in 2.7.3 Preparing System for Charging on page 17.

2.6 Utility Connections

2.6.1 Main Power and Control Wiring

Systems equipped with a remote condenser require field wiring (see Figure 10). The installer must provide main power wiring to the remote condenser control box. The condenser is provided with main power and control terminal positions for connection of the field wiring (supplied by others). Additional conductors may be necessary depending on options selected.

Verify that the main power supply coincides with the voltage, phase and frequency information specified on the system nameplate (see Figure 11). The supply voltage measured at the unit must be within ±10% of the voltage specified on the nameplate. The nameplate also provides the full load amps (FLA), the current that the unit will draw under full design load, the minimum circuit ampacity (MCA) for wire sizing, and the maximum fuse or HACR (Heating, Air Conditioning, Refrigeration) breaker size (MAX FUSE/CKT BKR) for circuit protection. The unit's nameplate is located inside the electrical box.

Pilot holes or electrical knock-outs for the conduit are in the bottom of the electric box. A label stating MAIN POWER INPUT is nearby. The main power wires are terminated at the line side of the service disconnect switch located within the electric box. A separate equipment ground lug is provided within the electrical box for termination of the earth ground wire.

WARNINGS

High voltage is used in the operation of this equipment. Death on contact may result if personnel fail to observe safety precautions.

The control transformer supplied with the equipment is sized and selected based upon the expected load for the system.

CAUTION

Do not connect any additional loads to the system control transformer. Connecting additional loads to the factory supplied control transformer may result in overloading of the transformer.

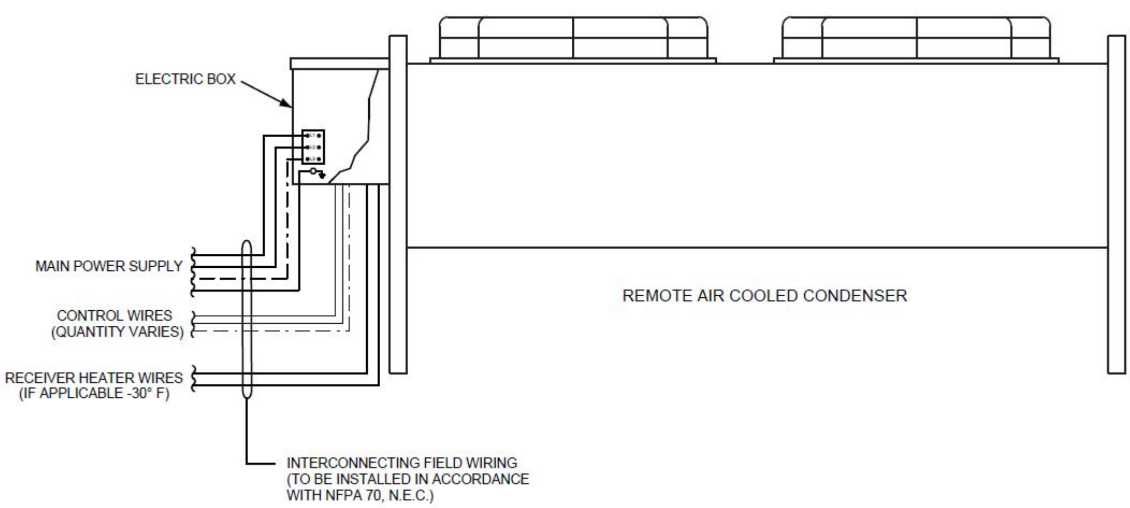


Figure 10. Field Wiring


Manufactured By

STULZ

STULZ Air Technology Systems, Inc.
Frederick, Maryland, USA
www.stulz-ats.com
Cage Code OB716
Tel: (301) 620-2033
Fax: (301) 620-1396

Sales Order Number:
Model Number:
Item Number:
Serial Number:

Electrical Data:
SCCR: kA RMS Symmetrical
Voltage: Phase: Hz:
No. Wires: (Including Ground)
FLA: MCA:
Max Fuse / Ckt. Bkr (HACR type per NEC): A
Condenser Motor (1): HP: FLA:
Condenser Motor (2): HP: FLA:
Condenser Motor (3): HP: FLA:
Condenser Motor (4): HP: FLA:
Condenser Motor (5): HP: FLA:
Condenser Motor (6): HP: FLA:
Coil Design Pressure:
Maximum Coil Pressure:
Minimum Clearance for All Sides: 40 in.
Remote Condenser Type:
Suitable for Outdoor Use Only
Date of Manufacture:
Q.A. Acceptance:

Figure 11. Sample Nameplate

CAUTION

Improper wire connections will result in the reverse rotation of the fan. To correct this problem, exchange any two of the incoming main power wires at the main power circuit breaker. Do NOT rewire the unit's individual components.

Identify the options that were purchased with your system to confirm which field connections are required. The number of control conductors needed will vary depending on the options and type of control method being used. Refer to the electrical drawing supplied with your unit to determine the total number of interconnecting conductors required for your equipment and for the proper wire terminations.

2.6.1.1 Condenser Enable Feature

As an option, the installer may wire a 2-conductor control cable between the A/C system and the condenser, so the system controller may enable the condenser to operate only when the compressor is running. You must remove the jumper (X2:1-X2:2) from the remote condenser terminal board (see the condenser wiring diagram). Wire 24 VAC control conductors from the terminal board within the A/C unit to the remote condenser terminal board. If control wires aren't installed (and the jumper remains in place), the condenser is always enabled and will turn on and off based on the condenser's pressure control switch setting(s).

The condenser enable feature may be used in high ambient temperature locations to prevent the condenser from running unnecessarily. In some cases, outdoor temperature conditions may raise refrigerant line pressures high enough to cause the condenser fans to start operating even if the compressor isn't on.

2.6.1.2 Receiver Heater Wiring

If separate base frame mounted receiver(s) are used for SCS condensers, it will be necessary to provide a 2-conductor cable for the heating pad(s). Connect the wires from the terminals inside the junction box on the receiver base (see Figure 7) to the terminal block in the condenser electric box. Drill an entrance hole in the condenser electric box or use an available knock-out if furnished. See the wiring diagram for the correct wire terminal positions.

2.7 System Charging

Refrigerant charging pressures vary depending on the type of refrigerant used in the unit. Before charging, check the unit nameplate to confirm the type of refrigerant to use. Tables are provided in Section 2.8 showing the temperature/pressure characteristics for R407C and R410A.

2.7.1 R407C/R410A Refrigerant

R407C and R410A are blended refrigerants recognized for being safer for the environment. These refrigerants contain no chlorine, the component in HCFC's that destroys the earth's ozone layer. However, the same care should be taken to prevent leakage because R407C and R410A can contribute to the greenhouse effect if released. If the refrigerant gas is released in an enclosed space, it can suffocate.

Refrigerants that are multi-component blends have component parts with different volatilities that result in a change in composition and saturation temperature as evaporation and condensation occur. Typically, the composition of R407C vapor is different than that of R407C liquid within a contained system. The composition of liquid R407C refrigerant remains relatively constant, however, the refrigerant vapor tends to separate into its component parts even when circulating.

Refrigerant R410A is similar to R407C in that it is a blended refrigerant that consists of component parts, however, the component parts of R410A refrigerant have the same composition at various operating temperature/pressures in the liquid phase and gas phase reducing the temperature glide effect experienced with R407C. R410A operates at higher pressures than R407C, which must be considered when checking the operating temperatures/pressures while charging or troubleshooting the system.

2.7.2 Estimating Refrigerant Charge

When charging a system with R407C or R410A refrigerant it will be necessary to weigh in the refrigerant. Calculate the amount of refrigerant needed by adding the amount of refrigerant required for the A/C unit (shown in the A/C unit IOM provided separately) plus the refrigerant for the condenser (Table 5 and Table 6) plus the refrigerant piping (Table 7).

Table 5 and Table 6 may be used to estimate the minimum amount of R407C or R410A refrigerant needed to charge SCS or SCS-MC condensers by model number. In cases of dual circuited condensers, divide the total weight (lb) shown by 2 to determine the amount of refrigerant needed for each circuit. The values shown in Table 5 and Table 6 are conservative for the purpose of preventing the system from being overcharged.

Table 5. SCS Condenser Refrigerant Charge Weights (lb)

SCS Model Number	R407C Charge (Condenser Less Receiver)	R407C Charge (Condenser with Receiver)	R410A Charge (Condenser Less Receiver)	R410A Charge (Condenser with Receiver)
	-20°F Ambient & Higher	-30°F Ambient	-20°F Ambient & Higher	-30°F Ambient
012-S	0.6	2.7	0.5	2.6
018-S	0.6	2.7	0.5	2.6
024-S	1.3	5.4	1.0	5.2
036-S	1.9	8.1	1.5	7.8
060-S	2.8	12.2	2.2	11.7
060-D*	2.8	12.2	2.2	11.7
096-S	3.6	15.7	2.8	15.1
096-D*	3.6	15.7	2.8	15.1
120-S	5.4	23.6	4.2	22.7
120-D*	5.4	23.6	4.2	22.7
144-S	7.2	31.4	5.6	30.2
144-D*	7.2	31.4	5.6	30.2
192-S	8.2	35.9	6.4	34.5
192-D*	8.2	35.9	6.4	34.5
252-S	8.2	35.9	6.4	34.5
252-D*	8.2	35.9	6.4	34.5
276-D*	12.4	53.8	9.7	51.7
312-D*	12.4	53.8	9.7	51.7
447-D*	16.5	71.8	12.9	69.0
525-D*	18.4	80.1	14.4	77.0
597-D*	18.4	80.1	14.4	77.0
683-D*	24.6	106.9	19.2	102.8
940-D*	32.6	141.9	25.5	136.5
1366-D*	49.1	213.7	38.4	205.6

* Dual refrigeration circuits.

Table 6. SCS-MC Condenser Refrigerant Charge Weights (lb)

SCS Model Number	R407C Charge (Condenser Less Receiver)	R407C Charge (Condenser With Receiver)	R410A Charge (Condenser Less Receiver)	R410A Charge (Condenser With Receiver)
	-20°F Ambient & Higher	-30°F Ambient	-20°F Ambient & Higher	-30°F Ambient
015-S	0.8	4.4	0.8	4.0
018-S	0.9	4.5	1.0	4.2
031-S	1.3	6.9	1.3	6.4
031-D*	1.6	8.8	1.6	8.0
035-S	2.0	11.8	2.1	11.0
035-D*	2.6	13.8	2.6	12.8
056-S	2.0	11.8	2.1	11.0
056-D*	2.6	13.8	2.6	12.8
071-S	3.8	19.1	3.9	17.8
071-D*	4.8	24.4	4.8	22.6
111-S	3.8	19.1	3.9	17.8
111-D*	4.8	24.4	4.8	22.6
128-D*	5.8	36.4	6.0	33.8
142-D*	7.6	38.2	7.8	35.6
223-D*	7.6	38.2	7.8	35.6
264-D*	10.4	41.0	10.8	38.6
334-D*	10.4	41.0	10.8	38.6

* Dual refrigeration circuits.

Table 7. Weight of Refrigerant (lb/100 ft of Type L Tubing)

Line Size O.D.	Liquid Line 105 °F		Discharge Line 140 °F Condensing	
	R407C	R410A	R407C	R410A
1/2	6.51	5.88	0.87	1.27
5/8	10.46	9.44	1.40	2.03
7/8	21.73	19.62	2.91	4.22
1 1/8	37.04	33.44	4.95	7.20
1 3/8	56.43	50.95	7.55	10.97
1 5/8	79.87	72.11	10.68	15.53
2 1/8	175.32	158.29	23.44	34.09

Example: Estimate the amount of refrigerant required for a system using R407C refrigerant consisting of a 5 ton A/C unit connected with a 1/2" x 30 foot liquid line and 7/8" x 30 foot discharge line to a SCS-060-SAA -30 °F condenser with flooded head pressure control and receiver.

A/C Unit	=	5.2 lbs.
+ Condenser w/Receiver	=	12.2 lbs.
+ ½ Liquid Line 30 x 6.51 / 100	=	1.953 lbs.
+7/8" Discharge Line 30 x 6.51 / 100	=	0.873 lbs.
Estimated Refrigerant Charge	=	20.226 lbs.
Round off to the nearest lb>	=	20 lbs.

2.7.3 Preparing System for Charging

1. With all the system piping connections made, perform a dry nitrogen leak detection test on the system. Using dry nitrogen only, pressurize the system to 150 psig. Ensure all service and solenoid valves are energized open and that no part of the system is isolated from the pressurized nitrogen (liquid, suction or discharge lines and reheat coil).
2. Since there is no refrigerant in the system to detect at this point, leaks may be detected by observing if there's been a change in the standing pressure after 12 hours. A significant drop in pressure indicates a leak in the system that needs to be repaired. After the system is determined to be free of leaks, you may evacuate the system.

EVACUATE THE SYSTEM

CAUTION ⚠

A proper vacuum must be drawn on the refrigerant system to remove moisture prior to charging. If this is not done the refrigerant charge will combine with moisture in the pipes to form an acid that will eventually lead to compressor failure. A triple evacuation procedure with dry nitrogen is recommended especially for systems with newly installed refrigerant piping.

NOTE: A vacuum pump should be used that can evacuate the entire volume of the A/C system, including newly installed or existing piping. It is essential to use a well maintained pump that is in good operating condition. Always ensure it contains clean, fresh oil. Change the oil in the pump every 20 minutes to maintain its ability to remove moisture.

NOTE: Use high quality hoses ensuring they are free of defects and don't leak. It is recommended to use copper tubing instead of hoses if possible due to the low vacuum that must be attained when evacuating the system. The use of short, large diameter hoses helps reduce evacuation time.

3. After ensuring there are no leaks, relieve pressure and evacuate the entire system while maintaining all the solenoids and hot gas reheat valves open. Pull an initial vacuum of 1500 microns or lower using the suction and discharge service ports and the service port of the receiver (if applicable).

   NOTE: When pulling a vacuum, the Schrader valves will unnecessarily restrict the openings, increasing the evacuation time. During the evacuation process it is recommended to remove the Schrader valve cores with a Schrader valve removal tool and draw the vacuum through the port on the removal tool.

4. If you cannot evacuate the system below 1500 microns, close the vacuum pump isolation valve and perform a rate-of-rise test by observing the standing pressure overtime. If the pressure rises slowly (up to 200 microns in 15 minutes) it indicates moisture is in the system that still needs to be boiled off. Proceed to step #5. If the pressure rises rapidly up to atmospheric pressure (more than 50 microns per minute) it indicates a leak that wasn't detected during step #2. In this case troubleshoot the entire system for leaks and repair them. Then begin the initial evacuation process again starting at step #3.
5. If no leaks are detected after the initial vacuum, release the vacuum and pressurize the system with 2-3 lb of dry nitrogen. Allow the system to stand for two hours with the dry nitrogen charge. This gives time for the nitrogen molecules to disperse in the system absorbing moisture.
6. After two hours, release the pressure. Then turn on the vacuum pump and evacuate the system a second time down to 1500 microns or less. Close the vacuum pump isolation valve and pressurize the system again with dry nitrogen and allow the system to stand for two hours as in step #5.
7. After two hours release the pressure. Turn on the vacuum pump and complete the process of evacuating the system, this time with a goal of achieving a 250-micron vacuum or less. Close the vacuum pump isolation valve. When you can hold the vacuum at 500 microns or lower for at least 2 hours with no significant rise in pressure, the system is ready to charge.

8. Replace the Schrader valve cores if you removed them during the evacuation steps. You may now introduce the refrigerant charge through the Schrader valves.

2.7.4 Refrigerant Charging Procedures

R407C and R410A refrigerant must be weighed in when performing the charge. Ensure an adequate supply of refrigerant is available before beginning. Referring to Section 2.7.2, calculate the minimum amount of refrigerant needed for your system.

When charging a system using a blended refrigerant, it is essential that the composition of the refrigerant is maintained. To ensure correct composition, introduce the refrigerant (R407C or R410A) into the system in liquid form rather than vapor form. Cylinders which are not provided with dip tubes should be inverted to allow only liquid refrigerant to charge the system. Keeping the temperature of the cylinder below 85 °F will help to maintain the correct refrigerant composition while the cylinder is emptied.

CAUTION ⚠

POE oil is used in systems with R407C or R410A refrigerant. POE oil quickly absorbs moisture when exposed to air. High POE oil moisture levels react with refrigerant to form acid which results in system contamination. Keep the entire system sealed as much as possible and minimize exposure of the POE oil to outside air.

NOTE: Refrigerant charging must be performed by a qualified air conditioning technician. STULZ recommends using the services of our Field Service Department to assist in start-up and commissioning. We have assembled a highly qualified team of experienced industry professionals who provide expert start-up services anywhere in the world.

They will ensure your equipment is correctly installed and is operating properly. This will help to ensure your unit provides years of trouble free service while operating at its highest efficiency. They will also enter the necessary Information for you on the Warranty Registration and Start-up Checklist and ensure it is filed with STULZ for your warranty protection.

WARNING

If refrigerant gas is released in an enclosed area, it may accumulate in low areas and near the floor displacing available oxygen. If a major leak occurs, there is a risk of asphyxiation. In such case the area should be immediately evacuated and ventilated. Personnel should remain away from the area until it is determined to be safe.

INITIAL SYSTEM CHARGE

Follow the step by step instructions below to charge systems using R407C and R410A refrigerant. The initial charge will be performed by introducing liquid refrigerant (R407C or R410A) to the discharge side of the compressor or an available liquid line port with the A/C unit turned Off.

1. Bleed air from hoses and break the vacuum by supplying liquid refrigerant (R407C or R410A) to the discharge port near the compressor until the pressure is equalized. This holding charge allows the low pressure switch to hold enabling the compressor to operate throughout the process of charging the system.

FINE TUNING THE SYSTEM CHARGE

Once the initial charge is completed, additional refrigerant will need to be added with the unit running until the superheat temperature can be maintained between 12–15 °F.

CAUTION ⚠

An adequate heat load must be supplied to ensure a proper charge.

2. Disconnect the refrigerant cylinder from the discharge side of the compressor and connect it to the suction side.
3. Start the A/C system and use the system controller to lower the room temperature setpoint 3–5 °F below actual room temperature thus ensuring cooling remains on as the unit is charged.

When fine tuning the charge during low ambient conditions it will be necessary to restrict the airflow across the condenser coil to raise the pressure. The fan closest to the header must be running. Refrigerant R407C operates at a lower pressure than R410A. When fine tuning the charge, ensure the pressures are correct for the type of refrigerant used. Refer to the tables in section 2.8 for the operating temperatures and pressures for the type of refrigerant used in your system.

2.7.4.1 0 °F Fan Cycling and -20 °F Variable Speed Control

The following instructions are for charging systems provided with condenser fan cycling or variable fan speed control during low ambient conditions using R407C or R410A refrigerant.

1. Block off the intake air to the condenser with cardboard until a constant discharge pressure can be obtained. This will lower the possibility of overcharging (for units with fan cycling only).
   a. R407C Refrigerant - Allow the discharge pressure to rise to 325–350 psig and hold it constant.
   b. R410A Refrigerant - Allow the discharge pressure to rise to 445–480 psig and hold it constant.
2. Slowly meter liquid refrigerant through the suction side while watching the pressure gauges and monitoring superheat and sub-cooling temperatures.

CAUTION ⚠

Add liquid refrigerant slowly to prevent the refrigerant oil from washing out of the compressor.

3. Take a superheat temperature reading near the feeler bulb from the thermostatic expansion valve with the temperature measuring device being well insulated. The ideal superheat temperature is 12–15 °F. Maximum allowable superheat temperature is 20 °F.
4. While monitoring the pressure, take a sub-cooling temperature reading on the output side of the condenser. The sub-cooling temperature should be 10–20 °F.
5. If necessary, (slowly) add liquid refrigerant to the suction side to achieve the sub-cooling temperature.
6. If the unit has hot gas reheat (optional), the previous steps are still followed except the hot gas reheat valve must be open to allow refrigerant to flow into the reheat coil to obtain the proper amount of refrigerant charge. This can be done by using the system controller to enable a call for dehumidification (lower the humidity setpoint). This process may need to be repeated several times. After cycling the system through the hot gas reheat cycle, recheck the system charge with the system only in the Cooling mode.

CAUTION ⚠

Remove the blockage to the air intake of the condenser.

7. Fill out the applicable sections of Warranty Registration and Start-Up Checklist.

2.7.4.2 -30 °F Flooded Head Pressure Control

NOTE: For units using flooded head pressure control, a receiver is used to store the refrigerant during the time the condenser is not utilizing the extra refrigerant charge.

NOTE: It is important not to exceed 80% of the total condenser and receiver volume to allow room for expansion.

The most accurate way to determine the total system refrigerant charge is by calculating it as discussed in Section 2.7.2. This procedure will assist in charging a flooded system to achieve proper operation during low ambient conditions.

Perform the initial system charge as described in Section 2.7.4, steps 1 – 3. Energize all solenoids, hot gas bypass, hot gas reheat, etc. The condenser fan nearest the condenser header should be operating continuously. If not change the fan control setting to force continuous operation. All other fans, if additional fans exist, should be off during this time.

The head pressure control valve setting is printed on the valve. This setting is the lowest head pressure that will be maintained during unit operation. Add refrigerant to the system (slowly metering). Charge the unit until you reach the HGBP valve setting if applicable.

Set up the HGBP valve and disable the solenoid after adjusting. Slowly continue to meter in refrigerant until you reach the head pressure control valve setting printed on the valve (225 psig for R407C; 290 psig for R410A).

All other low ambient controls should not be enabled during the final charging procedure, deenergize the solenoids to prevent operation.

It is best to under charge the system and operate the unit in the cooling mode to achieve this, otherwise you may add refrigerant above the valve setting and then will be unable to test the head pressure control valve operation.

The head pressure control valve modulates to maintain system head pressure; you will witness this if the above procedure is strictly followed. Under low ambient conditions with the header fan functioning, the head pressure will lower during operation. The valve will not allow the pressure to drive below the printed setting on the valve.

Check the system superheat and sub-cooling temperatures. They should be within the specifications in Section 2.7.4.1 (steps 3 and 4).

Turn the unit off for 15–30 minutes. Restart the system and observe the operating pressures. The suction pressure should not dip or drive below the low pressure switch setting.

2.7.4.2.1 Checking the Charge

To ensure you are not over charged, set up the condenser fan to maintain pressure (320 psig for R407C; 440 psig for

R410A) or your summer maximum operating head pressure. Hold the pressure steady at this setting. You should observe that cycling "Off" on head pressure will not occur now or during warmer temperatures.

If a refrigerant level sight glass is included on the side of the receiver (optional), it may be used to assist in charging the air conditioning system. The proper charge can be confirmed by viewing the level of refrigerant in the receiver while the unit is running at an elevated discharge pressure (320 psig for R407C; 440 psig for R410A).

Add refrigerant charge until the refrigerant appears in the sight glass indicating the receiver is 80% filled. When the level of refrigerant in the receiver reaches the sight glass, the unit is fully charged.

CAUTION ⚠

Remove the blockage to the air intake of the condenser.

2.7.4.2.2 Final Adjustment

Now you may adjust the condenser fan settings to assist with low ambient control. The following settings have proven effective:

R407C Refrigerant

Fan 1 - 320 psig cut-in; 240 psig cut-out

Fan 2 - 330 cut-in; 250 cutout

Fan 3 - 340 cut-in; 260 cutout Fan

Fan 4 - 345 cut-in; 265 cutout

EC Fan (Fan 1 on SCS Condenser) - 240 psig start; 65 psig differential

R410A Refrigerant

Fan 1 - 440 psig cut-in; 330 psig cut-out

Fan 2 - 460 cut-in; 355 cutout

Fan 3 - 475 cut-in; 365 cut-out

Fan 4 - 485 cut-in; 375 cutout

EC Fan (Fan 1 on SCS Condenser) - 340 psig start; 100 psig differential

Fill out the applicable sections of the Warranty Registration and Start-Up Checklist.

2.8 Refrigerant Characteristics

2.8.1 Pressure/Temperature Settings

Table 8 is provided to assist with the normal settings of the system for R407C and R410A refrigerant. Where applicable, minimum and maximum settings are given along with normal operating pressures.

NOTE: The operating pressures for R410A refrigerator significantly higher than R407C.

Table 8. Refrigerant Pressure/Temperature Settings

Refrigerant Pressure/Temperature Settings			
	Normal	Min.	Max.
Sub-cooling °F	10	5	20
Superheat °F	15	10	20
Design Condensing Temp. @ 95 °F Ambient	125	105	140
Suction Pressure (psig)- R407C	70	55	85
Suction Pressure (psig)- R410A	130	105	155
Fan Cycling Control- Fan On (psig)- R407C	320	240	340
Fan Cycling Control- Fan On (psig)- R410A	440	330	480
Fan Speed Control (psig)- R407C	320	-	-
Fan Speed Control (psig)- R410A	440	-	-

2.8.2 Saturated Refrigerant Pressure Tables

The following refrigerant vapor pressure tables are provided for reference for R407C and R410Arefrigerant.

R410A Refrigerant	
Tempera -ture (°F)	Pressure (psid)
Saturated Evaporating Temperature	
20	78.4
22	81.9
24	85.5
26	89.2
28	93.1
30	97.0
32	101
34	105
36	109
38	114
40	118
42	123
44	128
46	133
48	137
50	143
55	155
60	170
65	185
70	201
75	218
80	236
85	255
90	274
95	295
100	318
105	341
110	365
115	391
120	418
125	446
130	477
135	508
140	541

R410A Refrigerant	
Tempera -ture (°F)	Pressure (psid)
Saturated Evaporating Temperature	
Dew Point Saturated Vapor	
20	37.9
22	40.1
24	42.3
26	44.7
28	47.1
30	49.6
32	52.1
34	54.8
36	57.5
38	60.3
40	63.2
42	66.1
44	69.2
46	72.3
48	75.5
Bubble Point Saturated Vapor	
50	78.8
95	209
100	78.8
Saturated Condensing	
105	225
110	242
115	279
120	298
125	319
130	341
135	363
140	387

1. The refrigerant then flows to the condenser coil. The high temperature, high-pressure gas from the compressor is cooled by the flow of air through the condenser coil and is condensed into a high-pressure liquid.
2. For cold weather applications using flooded head pressure control, the low temperature high-pressure liquid refrigerant flows to a receiver. The receiver acts as a storage tank for the liquid refrigerant that is not in circulation.
3. The refrigerant flows through a liquid sight glass. This device shows the presence of air, moisture and the condition of the refrigerant in the system.
4. The low temperature high pressure liquid refrigerant then flows to the evaporator where it removes heat and evaporates back into a gas.
5. The refrigerant gas is then drawn back to the compressor and the cycle is repeated.

The refrigeration circuit must be tested at start-up.

3.0 START-UP/COMMISSIONING

3.1 Operation

For new installations, ensure the unit is ready to operate by going through the Checklist for Completed Installation, located in Appendix A, prior to start-up.

NOTE: A Warranty Registration and Start-Up Checklist is provided with the unit data package. It should be completed during start-up and sent to STULZ. This checklist should be used as a guideline for items that need to be confirmed during start-up.

CAUTION ⚠

Start-up must be performed by a qualified journeyman, refrigeration mechanic or an air conditioning technician. up. Refer to the separate controller operation instructions sent in the data package with your unit.

Test cooling operation by adjusting the temperature setpoint at the system controller. The compressor should come on and the suction line temperature should gradually drop.

Ensure the fan(s) are rotating correctly and freely without any unusual noise.

Operational Description

When used with a STULZ indoor evaporator unit, the A/C system compressor starts then the condenser fan(s) start. Operation of the condenser fans is dependent on the head pressure control method used. See the descriptions for head pressure control in Section 1.5.

Remote air cooled condensers may be configured for stand-alone operation. In this case the fans begin operating when power is turned on.

Refrigerant flowing from the evaporator in the form of a low pressure gas, enters the compressor where it is compressed into a high temperature, high pressure gas

4.0 MAINTENANCE AND REPAIRS

4.1 Periodic General Maintenance Systematic, periodic general maintenance of the condenser is recommended for optimum system performance. General maintenance should include, but is not limited to the following:

1. Tighten electrical connections.
2. Clean the interior of the unit.
3. Inspect the unit's components visually.

Use copies of the Periodic General Maintenance Checklist in this manual (see Appendix A) to record periodic general maintenance inspections. For assistance, contact STULZ Product Support. Ensure your adherence to all safety statements while performing any type of maintenance.

CAUTION

All maintenance and/or repairs must be performed by a journeyman, refrigeration mechanic or an air conditioning technician.

WARNINGS

Turn off power to the unit at the main power disconnect switch unless you are performing tests that require power. To prevent personal injury, stay clear of rotating components because automatic controls may start them unexpectedly. With power and controls energized, the fans could begin operating automatically at any time.

Hazardous voltage will still be present even with the unit turned off at the controller. To isolate the unit for maintenance, always turn off power at the main power disconnect switch prior to performing any service or repairs.

This unit employs high voltage equipment with rotating components. Exercise extreme care to avoid accidents and ensure proper operation.

4.1.1 General

Maintenance access to the condenser is through the removable fan assembly panel on top of the unit. Examine the areas around the air inlet and outlet grills, fans, motors and coils. Use a vacuum cleaner with a soft bristle brush to clean dirt from components.

Clean the coil of all debris that will inhibit airflow. This can be done with a vacuum cleaner, soft brush and compressed air or a mild, neutral PH detergent may be used if needed. Chemical coil cleaners not specifically formulated for micro-channel coils are not recommended.

Check for bent or damaged coil fins and repair as necessary. On outdoor units, do not permit snow to accumulate on or around the unit in the winter. Check all refrigerant lines and capillaries for vibration isolation and support as necessary. Check all refrigerant lines for signs of leaks.

1. Examine all wiring for signs of chafing, loose connections or other obvious damage (quarterly).
2. Examine brackets, motor mounts and hardware for loose or missing parts or other damage (quarterly).
3. Clean accumulations of dust and dirt from all interior and exterior surfaces (quarterly).

NOTE: Fan motors have permanently sealed bearings, therefore, no lubrication is required.

4.2 Field Service

It may be necessary to perform repairs on the refrigeration system. If field repairs are necessary, the following procedures apply:

NOTE: Do not attempt to make repairs without the proper tools.

4.2.1 Leak Detection

Several methods can be used to detect a leak in the refrigeration system. The most modern and easiest method is to use an electronic leak detector. Follow the manufacturer's directions and any leak can be quickly located. A second method is to use soap bubbles. Apply a solution of soapy water with a brush or sponge to the joints and connections in the refrigerant lines. A leak in the lines will cause bubbles to form.

4.2.2 Leak Repair

When a leak is located, properly reclaim the remaining refrigerant charge before attempting repairs. Adjacent piping must be thoroughly cleaned by removing all paint, dirt and oily film. Use wire brush, sandcloth or sandpaper and wipe the area with clean, dry cloths. Protect nearby parts from heat damage by wrapping with water-soaked cloths

4.2.3 Refrigerant Piping

When replacing components within the cabinet, the following consumable materials are recommended: When brazing copper-to-copper connections (piping liquid line or suction line), use a phosphorus copper brazing alloy with 15% silver. General purpose silver brazing alloy with 45% silver is to be used for copper-to-brass or copper-to steel.

For liquid line repairs at the drier, strainer, sight glass, or expansion valve, use a 95% tin to 5% antimony solder with flux. When component replacement is complete, remove all traces of flux. After any repair, pressure check the system, checking for leaks prior to recharging the system.

All electrical connections should be checked to be sure that they are tight and properly made. Check all switches, contactors and wiring. Contactors should be examined and replaced if the contact pads are worn or pitted.

4.3 Troubleshooting

Turn off all power to the unit before conducting any troubleshooting procedures unless the procedure specifically requires the system to operate. For troubleshooting purposes, the system may be operated with the electric box open by using a pair of channel lock pliers to turn the shaft of the main power disconnect switch to the "On" position. When the switch is turned on, high voltage will be present inside the box. Exercise caution to prevent injury. Keep hands, clothing and tools clear of the electrical terminals and rotating components. Verify that your footing is stable.

WARNING

This equipment should be serviced and repaired by a journeyman or a qualified refrigeration technician only.

4.2.4 Electrical System

Symptom	Probable Cause	Recommendation
Unit Fails to Start	Incorrect phasing or voltage.	Correct phase or voltage input.
	Power failure	Check power source, power input and fuses. Check control cables and connections.
	Overload protection tripped	Check pressure/temperature operating switches and motor. Replace as needed
Control is Erratic	Wiring improperly connected or broken.	Check wiring against schematic diagram
Condenser Head Pressure Too High		
	Low condenser airflow. (Indicated by excessive warm air leaving the condenser fan).	Open air passages. Clean coil. Check con- denser fan(s).
	Overcharge of refrigerant	Reclaim excess refrigerant from system
	Condenser fan not operating	Check main voltage power source to unit. Check fan motor, contractor, fan cycling switch or fan speed controller. Check pressure/temperature operating switches and motor. Replace if needed.
Condenser Fan not Operating	Non-condensable gas or air in the system	Reclaim system, pull 500-micron vacuum and recharge. Install new drier/strainer.
Condenser Head Pressure Too Low	Loss of refrigerant (indicated by bubbles in sight glass).	Locate and repair leak. Recharge system.
	Condenser fan controls not set properly	Adjust or repair controls.

Symptom	Probable Cause	Recommendation
Head Pressure Too High	Low condenser airflow. (Indicated by excessive warm air leaving the condenser fan).	Open air passages. Clean coil. Check condenser fan(s).
	Air or other non-condensable gas in system	Reclaim system and recharge. Install a new drier strainer.
	Overcharge of refrigerant	Reclaim excess refrigerant from system
	Condenser fan not on.	Check main voltage power source to unit. Check fan, contactor, fan cycling switch or fan speed controller
Erratic Fan Operation	Dirty or blocked condenser coil.	Clean coil or remove blockage

5.0 PRODUCT SUPPORT

STULZ Product Support offers technical support and parts as well as these services:

- Performance Evaluations
- Start-up Assistance
- Training

STULZ recommends using our Field Service Department to perform start-up and commissioning. They will ensure your equipment is correctly installed and operating properly. This will help to ensure your unit provides years of trouble free service while operating at its highest efficiency.

5.1 Technical Support

The STULZ Technical Support Department is dedicated to the prompt reply and solution to any problem encountered with a unit. Should a problem develop that cannot be resolved, you may call (888) 529-1266 Monday through Friday from 8:00 a.m. to 5:00 p.m. ESDT. If a problem occurs after business hours, provide your name and telephone number. One of our service technicians will return your call.

When calling to obtain support, it is important to have the following information readily available, (this information is found on the unit's nameplate):

- Unit Serial Number
- Unit Model Number
- STULZ Sales Order Number
- Description of Problem

5.2 Obtaining Warranty Parts

For parts warranty inquiries, call our Technical Support Department at (888) 529-1266 Monday through Friday from 8:00 a.m. to 5:00 p.m. EST.

A service technician at STULZ will assist in troubleshooting the system over the phone with a field service technician to determine the defect of the part. If it is determined that the part may be defective a replacement part will be sent via UPS ground.

If the customer requests that warranty part(s) be sent by any other method than UPS ground, the customer is responsible for the shipping charges. If you do not have established credit with STULZ you must give a freight carrier account number.

A written (or faxed) purchase order is required on warranty parts and must be received prior to 2:00 p.m. for same day shipment. The purchase order must contain the following items:

- Purchase Order Number
- Date of Order
- STULZ Stated Part Price
- Billing Address
- Shipping Address
- Telephone and Fax Numbers
- Contact Name
- Unit Model Number
- Serial Number

The customer is responsible for the shipping cost incurred for returning the defective part(s) back to STULZ. Return of defective part(s) must be within 30 days at which time an evaluation of the part(s) is conducted. If the part is found to have a manufacturing defect a credit will be issued.

When returning defective part(s) complete the Return Material Authorization (RMA) Form and the address label received with the replacement part.

5.3 Obtaining Spare/Replacement Parts

Spare and replacement parts requests are to be made through Product Support by:

Fax: (301) 620-2606
Phone: (888) 529-1266
E-mail: (parts@stulz-ats.com)

Quotes are given for specified listed parts for a specific unit.

STULZ accepts Visa and MasterCard. STULZ may extend credit to its customers; a credit application must be prepared and approved (this process could take one week).

A 25% minimum restocking charge will be applied on returned stocked parts that were sold as spare/replacement parts. If the returned part is not a stocked item, a 50% restocking charge may be applied.

A Return Material Authorization Number is required when returning parts. To receive credit for returned repair or replacement parts, the parts must be returned to STULZ within 30 days of the purchase date.

Spare part sales over 30 days old will be considered final and the parts will remain the sole property of the ordering party.

Checklists

Installation Checklist

#	Y/N	Tasks	Comments
1		Proper clearances for service access have been maintained around equipment.	
2		Equipment is level and mounting fasteners are tight.	
3		If required, piping completed to refrigerant or coolant loop.	
4		All field installed piping leak tested.	
5		If required, refrigerant charge added.	
6		Condensate drain line connected with P-trap and is filled with water.	
7		If required, water supply line connected to humidifier (if required).	
8		If manual cut-off valve is installed, open valve.	
9		Humidifier On/Off/Drain switch is in the on position.	
10		Filter(s) installed.	
11		Duct plenums sealed.	
12		Incoming line voltage matches equipment nominal nameplated rating ± tolerances.	
13		Main power wiring connections to the equipment, including earth ground, have been properly installed.	
14		Customer supplied main power circuit breaker (HACR type) or fuses have proper ratings for equipment installed.	
15		All wiring connections are tight.	
16		If required, control wiring connections completed to field mounted sensors.	
17		Foreign materials have been removed from inside and around all equipment installed (shipping materials, construction materials, tools, etc.).	
18		Inspect all piping connections for leaks during initial operation.	

Maintenance Checklist

Prepared by		**Model Number**	
Title		**Item Number**	
Date		**Serial Number**	

Monthly

Filters	Y/N	Fans	Y/N	Condensate Drain	Y/N
Cleanliness		Fan(s) rotate		Drain is open	
No obstructions				Condensate pan safety switch operates freely	
Additional					
Check chilled water/hot water circuits for air (bleed as required)					
Coils clean and clear of obstructions					
Humidifier cylinder and controls operate properly					

Semi-

Monthly

	Y/N		Y/N
Tighten electrical connections		Clean coils	
Check contacts on contactors for pitting		Clean condensate pump	
Heat/reheat operational		Inspect and clean CW screen	
Clean unit			

Annually

	Y/N
Inspect chilled water unit for leaks and corrosion	
Conduct a complete check of all services listed above	
Clean unit interior	

Glossary

Term	Definition	Term	Definition
BMS	Building Management System,	MAX CKT BKR	Maximum Circuit Breaker
BTU/Hr	British Thermal Units Per Hour	MAX FUSE	Maximum Fuse
CFM	Cubic Feet Per Minute	MCA	Minimum Circuit Ampacity
CNDCT	Conductor	NEC	National Electric Code
CW	Chilled Water	NFPA	National Fire Protection Agency
ESD	Electrostatic Discharge	PH	Phase
ºF	Degrees Fahrenheit	PSI	Pounds Per Square Inch
FLA	Full Load Amps	PSIG	Pounds Per Square Inch Gauge
FOB	Freight on Board	RLA	Run Load Amps
HACR	Heating, Air Conditioning, Refrigeration	R-Value	Thermal Resistance
HP	Horse Power	SDS	Safety Data Sheet
Hz	Hertz	SPDT	Single Pole, Double Throw
IAQ	Indoor Air Quality	STULZ	STULZ Air Technology Systems, Inc.
in. w.g.	Inches of Water Gauge	V	Volt
kVA	Kilo Volt Amps	VAC	Volt, Alternating Current
kW	Kilowatt	VFD	Variable Frequency Drive

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