Screw Compressor
Air Cooled Flooded Chillers

HXAC Series

R134a

60 Hz

70 to 200 Tons
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NOMENCLATURE

HX AC 75 - 6 S R
Horizontal Screw Compressor
Blank = R22
R = R134a
S = Standard
Q = Special
5 = 50Hz
6 = 60Hz
Air Cooled Flooded Chiller
Nominal Tons = 70, 80, 105, 115, 130, 150, 170, 180, 200
SPECIFICATIONS

General
The unit is completely factory assembled and wired in a single package complete with horizontal screw compressors, evaporator, condenser, starting control and safety and operating controls. It is given a complete factory operating and control sequence test under load conditions and is shipped with full operating charge of refrigerant and oil.

Construction
Unit shall be constructed of heavy gauge steel, cleaned, primed with a rust inhibitor and painted.

Evaporator
Flooded evaporator which has smaller approach temperature* than direct expansion evaporator gives higher capacity and EER for the unit with the same compressor. Evaporators are constructed according to ASME code, approved and certified by JKKP.

Condenser Coil/Fans
The condenser coil is constructed with seamless inner-grooved copper tubes expended into die-formed aluminum fins in staggered configuration. The condenser coil was tested for leakage up pressure of 450 psig. High efficiency low-noise multi-wings condenser fans shall be used. Unique design of “V” coil to increase condensing surface area, and the “V” coil has internal baffle for fan cycling and fan staging.

Compressor
The compressors are of semi-hermetic twin screw design. Rotors shall be the latest asymmetrical profiles to assure operation at the highest efficiencies. Each compressor shall be provided with an integral oil separator of multi-layered mesh element to effectively separate oil from the gas stream. An oil level sight glass is also provided. Each rotor shall be fitted with a set of anti –friction tapered roller bearings, which are capable of carrying both radial and thrust loads. All housings are manufactured of high grade, low porosity cast iron.

Capacity Control
An infinitely variable capacity control system that is capable of exactly matching the demand requirement of the system is supplied. A microcomputer-based controller modulates the compressor slide valve, in response to supply water temperature within 1/2 of set point. This system is to provide precise and stable control of supply water temperature over the complete range of operating conditions. It is capable of controlling a system capacity range from 100% to 12.5% at specified conditions.

* Approach temperature – temperature difference between the evaporating temperature of the boiling liquid refrigerant and the chilled water outlet temperature.
ADVANTAGES OF FLOODED CHILLER

In a flooded cooler the refrigerant surrounds the tubes in the shell and the water to be cooled flows through the tubes. The level of liquid refrigerant in the shell is maintained by the combined action of an electronic level controller and a mod-motor actuated ball valve, which modulates the subcooled liquid refrigerant into the cooler. This ensures that all the cooler tubes are completely immersed in the liquid refrigerant for better heat transfer efficiency.

For a Direct Expansion (DX) cooler the refrigerant is expanded into the tubes while the chilled water is circulated through the shell. Thermostatic expansion valve is used to throttle the refrigerant in maintaining constant superheat of suction gas to the compressor.

The following are the advantages of using flooded chiller:

1. Higher Capacity and Higher EER Achievable with the Same Compressor

The flooded cooler with all the copper tubes immersed in the “boiling” liquid refrigerant enables a small approach temperature between the “boiling” liquid refrigerant temperature in the shell and the outlet chilled water temperature in the cooler tubes to be achieved. This approach temperature or temperature difference between the evaporating temperature of the boiling liquid refrigerant and the chilled water outlet temperature, for a flooded cooler, is typically less than 3°F. On the contrary, for a DX or Direct Expansion Cooler, the typical approach temperature is between 8°F to 10°F. This simply means that the same compressor in a flooded cooler system will operate at a higher saturated evaporating temperature when compared to the same compressor in a DX-Cooler system, when outlet chilled water temperatures in both cases are set at the same temperature.

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Figure 1 shows the typical screw compressor capacity performance curve at a particular condensing temperature over saturated evaporating temperature of between 30°F to 50°F, and the typical power input curve over the same conditions. It can be noted that the same compressor when operating with a flooded cooler will generate approximately 8% more cooling capacity while compressor KW input increases negligibly by about 1.8%. Therefore, the same compressor when coupled to a flooded cooler will typically achieved higher cooling capacity performance with correspondingly higher Energy Efficiency Ratio (EER) i.e. (Btu/watt) or lower kw/Ton.

A DX cooler uses TXV throttling to maintain about 10 to 15°F suction superheat to prevent liquid flood back to the compressor. In a flooded cooler, the refrigerant boils off in the shell and gas can be sucked out from the top of cooler back to compressor. The suction superheat is usually about 2 to 3°F. Reduction in suction superheat will further increase the capacity performance of the compressor.
ADVANTAGES OF FLOODED CHILLER

DX coolers are typically designed with higher tube velocities to ensure proper oil return to the compressor both at full load and at reduced load. This will contribute to higher refrigerant pressure drop through the cooler. On the contrary, there is very little shell side pressure losses for a flooded cooler. Therefore, lower suction pressure drop in the flooded design will impose less capacity penalty on the compressor and this will further enable the compressor in a flooded cooler to generate more capacity than one with a DX Cooler.

2. Better Part Load Performance
The Dunham-Bush Air Cooled Flooded Chiller with its sophisticated microcomputer control and patented oil management system has all cooler tubes completely immersed in the “boiling” liquid refrigerant to achieve superior heat transfer efficiency while ensuring adequate oil return to the compressor(s). This ensures superior full-load efficiency and even better part-load efficiency as the full heat transfer surface areas of the cooler tubes are utilized even at part-load conditions. On the contrary, in the Direct Expansion Cooler, because of the need to maintain adequate refrigerant gas velocities in the cooler tubes for proper oil return, it is typical for certain bundle of cooler tubes to be “blocked” or “baffled off” at part-load conditions. Thus not utilizing the full heat transfer surface areas of the cooler tubes and therefore have a lower efficiency when compared with a flooded cooler chiller at part-load conditions.

3. Excellent Capacity Modulation in Response to Building Loads
Dunham-Bush utilizes its state-of-the-art DB-Director microcomputer controller in combination with the electronic level controller and mod-motor actuated ball valve to ensure instantaneous and precise feeding of liquid refrigerant to the flooded cooler in response to changes in building demand; and maintains precise (±1/2°F) preset outlet chilled water temperatures even at very low load conditions; whereas most of Dunham-Bush’s competitors, in screw chillers, still utilizes the conventional “centrifugal chiller” method of using orifice plates to modulate refrigerant feed to the cooler; and as such their machines do not function efficiently at low-load conditions and can encounter oil return problem!

4. Cleanable Cooler
For a single pass cooler, the end plates at both ends of the water boxes (2 pass only at return end) can be removed easily without dismantling the chilled water piping connections, for inspection and for mechanical tubes cleaning with brushes or auto-brush. This will enable low tube fouling factor in the cooler to be ensured, thus maintaining system efficiency.

5. Lower Water Side Pressure Drop
In a DX cooler, the water flows transversely over the outside of the tubes. The water flow is guided with vertical baffles. This will have a higher-pressure drop as compared with the water flow in the tubes of a flooded cooler. In other words, the equivalent flooded chiller will require smaller water pump to operate at lower power consumption.

6. Commonly Used In Large Tonnage Chillers Where Efficiency Is Critical
As a general rule, DX-cooler are typically used in small and medium tonnage chillers where efficiency is not important and the low initial cost is the main consideration! However, with increasing energy cost and the drive to reduce global warming, flooded cooler chillers will increasingly become more popular not only in the large tonnage but also in the small and medium tonnage chillers. Dunham-Bush, again, leads the industry in this respect!
Complimenting our high-energy efficient product is a Full Function Microcomputer Controller designed to keep your system running at its most Energy Efficient Level, based on current load.

This system is designed as a Control ‘State’ (control status) microcomputer providing the user with the current Control State for exact knowledge of what the microcomputer is doing. Some of the main features of the controller are as follows:

- A large character LCD display that can be seen in bright or dim lighting.
- A 16 function keypad that is so user friendly it rarely requires a manual.
- A four-layer printed circuit board provides extremely high quality and unit control stability.
- A battery backed up Real Time Clock that should never need attention.
- An automatic power monitoring system that is designed to protect your system.
- Multiple authorization levels to provide complete security of the control system.
- Automatic history storage that provides data to a flexible static and dynamic graphing system.
- Extended temperature range to allow operation in either hot or cold climates, from -40°F (-40°C) to 140°F (60°C).
- A PC control programming download/pullback in only 45 seconds.
- Alarm information is provided in simple English for the previous 32 alarms, with data shown down to the second.
- The system provides ‘last time’ enabled & disabled, number cycles, and total run hours.
- A slope algorithm control function with all analogs read 10 times per second provides unparalleled stability.

- A ‘fuzzy logic control zone’ based on leaving fluid temperature that reduces compressor cycling, and improves unit part load efficiency.
- A proactive compressor protection logic for protecting against low or high discharge pressure to minimize compressor cycling and nuisance trips.
- A Window® based display providing all pertinent information on your ‘PC’.
- A high speed RS232 port operating at 19,200 baud for connection to a local PC up to 100 feet away or a modem at 14,400 baud rate communications for remote communication.
- A high speed RS485 port for connection to a building management system, or PC at 38,400 baud rate communications up to 6000 feet away from the chiller (s).

**Display Information**

All information is displayed using common terms that are easy to understand. It is a simple procedure to determine the actual status of the system and the individual circuits, as they are displayed in common terms that are meaningful. The 2 line by extra large character alphanumeric liquid crystal display (LCD) utilizes easy to understand menu-driven software. The LCD displays eight character alphanumeric sensor names and twelve character alphanumeric set point names enabling the use of meaningful status names. This enables an inexperienced operator to quickly work through these menus to obtain the information they require or to modify control parameters. The well designed keypad is separated into a DISPLAY STATUS section and an ENTRY section each consisting of eight keys that are clearly labeled to identify the information that will be displayed. When data is being modified, the second display line contains help information to ensure that the desired modification is properly made. Easily accessible measurements include:

- Current capacity status
- Current circuit / compressor status
- Entering and leaving chilled water temperature
- Evaporator pressure of each refrigerant circuit
- Condenser pressure of each refrigerant circuit
- Compressor elapsed run time, each compressor
- Number of compressor starts
- Compressor contactor status with actual Amp draw
- Fan on/off status
UNIT FEATURES

- Remote chilled water reset input (optional)
- Water flow switch status
- External start/stop command status
- Optional low ambient temperature sensor for easier cold ambient starting
- Optional low ambient lockout

Two proactive control features included in the microcomputer are low suction and high discharge pressure unload. Compressor #1 will be unloaded if circuit #1 discharge pressure exceeds the high pressure unload setpoint or if suction pressure from either refrigerant circuit approaches the low-pressure trip setpoint. If there is more than one compressor on a refrigerant circuit, one of the compressors will be shut down under one of these “near-fault” conditions.

Capacity Control

Control is based upon leaving chilled water temperature. How fast the temperature is changing and the rate of change are calculated and capacity decisions are based upon the rate, the current temperature, and the control temperature zone. Capacity is never added if the system is moving toward the temperature target at an acceptable rate. The unit will monitor all control functions and load the compressors to the required operating capacity. Remote adjustment of the leaving chilled water setpoint is accomplished through either direct connection or a remote keypad to the microcomputer through the RS485 long distance differential communications port, via PC or a modem connected to the RS232 communication port, or from an external Building Automation System supplying a simple 0 to 5 VDC signal.

System Control

The unit may be started or stopped manually, or through the use of an external signal from a Building Automation System. In addition, the microcomputer may be programmed with a seven-day optional cycle or other DB control packages may start and stop the system through interconnecting wiring.

System Protection

The following system protection controls will automatically act to insure system reliability:
- Low suction pressure
- High discharge pressure
- High motor temperature/over current
- Freeze protection
- Compressor run error
- Low oil pressure
- Power loss
- Chilled water flow loss
- Sensor error
- Anti-recycle
- Time delay

Remote Monitoring

The Microcomputer is equipped with a high speed RS232 communications port and two high speed RS485 communications ports, to allow for a variety of different remote monitoring operations. The RS232 communications port allows for remote communications at distances of up to 100 feet over a 4-wire shielded cable. The RS485 communication system allows for remote communications at up to 6000 feet with a 2-wire shielded cable connection.

1) RMCT-Remote Mounted Control Terminal

This Remote Mounted Control Terminal (RMCT) is a stand alone Control Terminal to communicate and control the unit from a remote location up to 6000 feet away, via the 485 communications port, when wired with a 2-wire shielded cable. This enhanced version of the Remote Mounted Control Terminal with 8 relay outputs and 8 sensor inputs provides remote alarm capabilities and additional sensor inputs as may be required.

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![Diagram of Remote Mounted Control Terminal](image)
UNIT FEATURES

2) PCON – PC Connection:
The PC Connection function provides communications for complete operation of the packaged chiller including graphing information. This option is available through two communications techniques as follows:

a) PCCB (Basic)
The standard communications for PCCB is via the RS232 connection which may be as 100 feet away from the packaged chiller.

As can be seen, the microcomputer system allows for a variety of remote connection capabilities for almost infinite flexibility. Utilizing the PC connection portion of the system, the unit will support up to twenty packaged chillers connected via the RS485/RS232 ports into the system. The user may then select whichever packaged chiller to review.

Refrigerating Cycle

The refrigerant management system, is very similar to centrifugal water chillers and is shown in the refrigerant cycle diagram below. Liquid refrigerant enters the flooded evaporator uniformly where it absorbs heat from water flowing through the evaporator tubes. The vaporized refrigerant is then drawn into the suction port of the compressor where the compression begins. This partially compressed gas is then joined by additional gas from the flash economizer as the rotors rotate past the vapor injection port at an intermediate pressure. Compressed gaseous refrigerant is then discharged into the integral oil separator where oil, which is contained in the refrigerant vapor, is removed and returned to the oil sump. Fully compressed and superheated refrigerant is then discharged into the condenser, where air is being drawn through the condenser tube by the propeller fan cools and condenses the refrigerant. Liquid refrigerant then passes through the first expansion device and into the flash economizer where flash gas and liquid refrigerant are separated. The gaseous refrigerant is then drawn out of the flash economizer and into the vapor
injection port of the compressor. The remaining liquid refrigerant then passes through a second expansion device, which reduces refrigerant pressure to evaporator levels where it is then distributed evenly into the evaporator.

By removing the flash gas from the flash economizer at an intermediate pressure, the enthalpy of the refrigerant flowing into the evaporator is reduced. This increases the refrigeration effect and improves the efficiency of the refrigeration cycle.

Refrigerant flow into and out of the flash economizer is controlled by modulating valves which eliminate the energy wasting hot gas bypass effect inherent with fixed orifices.

Part-Load Performance

Through the use of flash economizer modulating flow control and multiple compressors, Dunham-Bush air-cooled chillers have best part-load performance characteristics in the industry when measured in accordance with ARI Standard 550/590-98.

In most cases, actual building system loads are significantly less than full load design conditions, therefore chillers operate at part load most of the time.

Dunham-Bush air-cooled chillers combine the efficient operation of multiple compressors with an economizer cycle and microprocessor control to yield the best total energy efficiency and significant operating saving under any load.

When specifying air conditioning equipment, it is important to consider the system load characteristics for the building application. In a typical city, the air conditioning load will vary according to changes in the ambient temperature. Weather data compiled over many years will predict the number of hours that equipment will operate at various load percentages.
OPERATING BENEFITS

Efficiency and Reliability

ENERGY EFFICIENCY

- Designed to provide the greatest amount of cooling for the least kilowatt input over the entire operating range of your building.
- Delivers outstanding efficiency and total energy savings through the utilization of economizer cycle and microcomputer-controlled staging producing greater capacity with fewer compressors.
- Maximized performance through computer-matched components and multiple compressors on a single refrigerant circuit.
- High efficiency oil recovery system guarantees removal of oil carried over in the refrigerant and maintains the heat exchangers at their maximum efficiency at both full and part load.

INSTALLATION EASE

- Dramatic payback in reduced maintenance and overhaul costs both in down time and in labor expenditures.
- Ease of troubleshooting through microprocessor retention of monitored functions.
- Factory run tested.

SAFETY CODE

- ASME Boiler and Pressure Vessel Code, Section VIII Division 1 "Unfired Pressure Vessels".
- JKKP Code.
- ASME Standard B31.5 Refrigeration Piping.
- IEEE.

REFRIGERANT COMPATIBILITY

- Designed to operate with environmentally safe and economically smart HFC-134a with proven efficiency and reliability.
- Consult Factory for use of other HFC refrigerants.

CONTROL FLEXIBILITY

- Microcomputer-based with DDC (direct digital control) features precise push button control over every aspect of operation with built-in standard features that allow extra energy savings on start-up and throughout the life of your equipment.
- Insured uniform compressor loading and optimal energy efficiency through microcomputer controls, which utilize pressure transducers to measure evaporator and condenser pressure.
- Lower energy costs resulting from automatic load monitoring and increased accuracy and efficiency in compressor staging.
- Monitor your chiller's key functions from a remote location with a simple, low cost, phone modem option.
- Proactive control by microcomputer that anticipates problems and takes corrective action before they occur. Controls will unload compressor(s) if head or suction pressure approach limits. This will enable unit to stay on the line while warning operator of potential problems.
**TYPICAL SEQUENCE OF OPERATION**

The Dunham-Bush air-cooled water chiller depends mainly on its on-board microcomputer for control. Operation described is for two-compressor units and is very similar for single, four-compressor units.

For initial start-up, the following conditions must be met:

- Power supply to unit energized.
- Unit circuit breakers in the "on" position.
- Control power switch on for at least 15 minutes. Compressor switches on.
- Reset pressed on microcomputer keypad.
- Chilled water pump running and chilled water flow switch made.
- Leaving chilled water temperature at least 2°F above setpoint.
- All safety conditions satisfied.

After all above conditions are met, the microcomputer will call for the lead compressor to start. The compressor 15-minute anti-recycle timer is initiated at compressor start.

The microcomputer monitors compressor amps, volts, leaving water temperature and suction and discharge pressures. The compressor and cooling capacity is controlled by pulsed signals to load and unload solenoid valves on the compressor. When the compressor starts, it is fully unloaded, yielding about 25% of its full load capacity. As the computer gives it load signals, capacity gradually increases. The rate of compressor loading is governed by ramp control, which is adjustable in the computer.

The computer responds to leaving chilled water temperature and its rate of change, which is proportional and derivative control. If leaving chilled water temperature is within the deadband (+/-0.8°F from setpoint), no load or unload commands are given. If chilled water temperature is above deadband, the computer will continue loading the compressor until a satisfactory rate of decline is observed. If leaving chilled water temperature is below the deadband, the compressor is commanded to unload. Thus the compressor capacity is continuously modulated to match applied load and hold leaving chilled water temperature at setpoint.

If the applied load is greater than one compressor can handle, it will load fully and then the microcomputer will call for a second compressor. After one minute, the second compressor will start in the same manner as the first. Then both compressors will be commanded to adjust load to 50%. They are gradually loaded up together until the applied load is satisfied. In this way the two compressors share the load equally.

If the applied load decreases to the point that both compressors are running at about 40% capacity, the computer shuts down the lag compressor and loads the remaining compressor to about 80%. If applied load decreases further, the remaining compressor unloads proportionately. If applied load decreases to less than the minimum capacity of one compressor, the leaving chilled water temperature will decline to 2°F below setpoint, at which time the lead compressor will shut down. It will restart automatically if leaving chilled water temperature rises to 2°F above setpoint and both 15 minute anti-recycle and one minute start delay timers are satisfied.

During start-up operation, the computer monitors the difference between discharge and suction pressures to ensure that minimum of 30 psi differential is available for compressor lubrication. If the difference falls below a minimum of 30psi, the computer closes refrigerant flow control valves, starving the evaporator, causing evaporator pressure to drop, increasing differential pressure. This is especially helpful at startup, when warm chilled water and low ambient temperature would cause a low head situation. This feature is called EPCAS: Evaporator Pressure Control at Startup. It is one of several proactive control features of the microcomputer, which overcome potential problems while continuing operation.

Two additional proactive features are low suction and high discharge pressure override. If operating pressures approach trip level, compressors are unloaded as necessary to continue operation.
### Physical Data

#### Compressor

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<tr>
<th>Model (QTY)</th>
<th>70-6SR</th>
<th>80-6SR</th>
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#### Evaporator

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#### Condenser

| No. of Fan | 6 | 6 | 8 | 8 | 10 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Fan Dia. (mm) | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 |
| Motor HP/Qty | 2.0/3 | 2.0/3 | 2.0/4 | 2.0/4 | 2.0/4 | 2.0/4 | 2.0/4 | 2.0/6 | 2.0/6 | 2.0/6 | 2.0/6 | 2.0/6 | 2.0/6 | 2.0/6 | 2.0/6 | 2.0/6 |
| FLA, AMP (QTY) | 3.4(3) | 3.4(3) | 3.4(4) | 3.4(4) | 3.4(4) | 3.4(4) | 3.4(4) | 3.4(4) | 3.4(4) | 3.4(4) | 3.4(4) | 3.4(4) | 3.4(4) | 3.4(4) | 3.4(4) | 3.4(4) |
| Total CFM | 74340 | 73020 | 97360 | 95880 | 92640 | 119340 | 153240 | 151620 | 147360 |

#### Electrical

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#### Notes:
1. Nominal capacity is based on standard condition, actual capacity depends on the specified operating conditions.
2. All evaporator models are 2 passes and based on standard condition. Evaporator model might change for non-standard conditions or applications.
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Notes:
1. Ratings based on 10 °F water range in evaporator and 0.0001 fouling factor.
2. Interpolation between ratings is permissible but extrapolation is NOT.
3. KWI is for compressor input.
4. Unit is running on part load on the shaded area due to the current limiter.

AMBIENT TEMPERATURE, °F

- 13 -

PERFORMANCE DATA
SOUND DATA

Sound Pressure Level for HXAC at 10 Meter

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<th>Model</th>
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PRESSURE DROP

Evaporator Cooler Water Pressure

CHILLED WATER FLOW RATE - USGPM

- 14 -
**DIEMNSIONAL CLEARANCE**

**RECOMMENDED SPACE REQUIREMENT FOR HXAC**

Single Pit (See Note 2)

- **72" [1829mm] MIN.**
- **96" [2438mm] MIN.**

Double Pit (See Note 2)

- **72" [1829mm] MIN.**
- **96" [2438mm] MIN.**
- **96" [2438mm] MIN.**
- **144" [3658mm] MIN.**
- **180" [4572mm] RECOMMENDED**

Multi Pit

- **72" [1829mm] MIN.**
- **96" [2438mm] MIN.**
- **144" [3658mm] MIN.**
- **180" [4572mm] RECOMMENDED**

Corner Wall

- **96" [2438mm] MIN.**
- **96" [2438mm] MIN.**
- **96" [2438mm] MIN.**

**Notes:**

1. All dimensions are minimal, unless otherwise noted.
2. Pit installations are not recommended. Re-circulation of hot condenser air in combination with surface air turbulence cannot be predicted. Hot air re-circulation will severely affect unit efficiency (EER) and can cause high pressure or fan motor temperature trips. Dunham-Bush will not be responsible for ducting fans to a higher level to alleviate the above mentioned conditions.
3. HXAC 115-6SR is shown in this drawing.
DIMENSIONAL CLEARANCE

h > H by minimum 24" [610mm]

If H > h, recommended to add a fan discharge hood as below:
X + h > H by minimum 24" [610mm].
DIMENSIONAL DATA

HXAC 70-6SR, 80-6SR

NOTE: ALL DIMENSIONS ARE IN INCHES [MM].

HXSR 105-6SR, 115-6SR, 130-6SR

NOTE: ALL DIMENSIONS ARE IN INCHES [MM].
NOTE: ALL DIMENSIONS ARE IN INCHES [MM].
TYPICAL WIRING SCHEMATIC

**NOTES:**

1. DISCONNECT MEANS A BRANCH CIRCUIT PROTECTION SHALL BE PROVIDED BY OTHERS.
2. USE COPPER CONDUCTOR ONLY. ALL FIELD WIRING TO COMPLY WITH LOCAL, STATE & NATIONAL CODES. FIELD INSTALLED CONTROL WIRING SHALL BE CLASS 4.
3. IF POWER SUPPLY HAS BEEN INTERRUPTED FOR A PROLONGED PERIOD OF TIME TO WHERE THE COMPRRESSOR RAMP FEEDS COLD TO THE TOWER, THE TOWER HEATERS MUST BE ENUMERATED FOR 24 HOURS BEFORE STARTING THE COMPRESSORS.
4. CUSTOMER CONTROL CONTACTS MUST BE WIRED BETWEEN TERMINAL 79 & 80. (SHIELD CABLE RECOMMENDED). SELECT POSITION 'A' FOR REMOTE START, POSITION 'B' FOR UNIT SHUT DOWN AND POSITION 'C' FOR LOCAL START.
5. THE SHIELDED CABLES ARE RECOMMENDED FOR FIELD INSTALLED CONTROL AND SIGNAL WIRING. CONNECT ONE END OF THE SHIELD TO SHIELD GROUND.
7. RECOMMENDED START/STOP TIMER SETTING OF 5-1 SEC.
8. CDT & 2 MUST BE SET AT MINIMUM 3 MINUTES.
9. IF A-1 OR 2 MUST BE SET AT MINIMUM 3 MINUTES.

**LEGEND:**

- AL - ANALOG INPUT
- AUX - AUXILIARY
- CB - CIRCUIT BREAKER
- COMP - COMPRESSOR
- COND - CONDENSER
- DPI - CONTROL POINT
- COR - CAPACITOR
- CR - CONTROL RELAY
- CT - CURRENT TRANSFORMER
- CHF - CHILLED WATER FLOW SWITCH
- CHW - CHILLED WATER PUMP
- DC - DELTA CONTACTOR
- DI - DIGITAL INPUT
- F - FUSE
- FLA - FULL LOAD AMPERE
- FLS - FLOW SWITCH
- FM - FAN MOTOR
- HST - HIGH EXHAUST TEMPERATURE
- HLP - HIGH AIR PRESSURE
- HMT - HIGH MOTOR TEMPERATURE
- HST - HIGH OIL TEMP
- HS - HIGH PRESSURE SWITCH
- HTR - HEATER
- JU - JUNCTION
- UO - UNION/OUTPUT
- LT - LIGHT
- LS - LEVEL SENSOR
- M - CONTACTOR
- MCA - MINIMUM CIRCUIT AMPERE
- MFS - MAXIMUM FUSE SIZE
- MWA - MOTOR WINDING AMPERE
- MP - MOTOR PROTECTOR
- MTR - MOTOR
- O - OVERLOAD
- OH - PUSH BUTTON
- PR - PRESSURE TRANSFORM
- PUL - REMOTE/OFF-LOCAL SELECTOR SWITCH
- RES - RESISTOR
- RL - RAISED LOAD AMPERE
- S - SWITCH
- SC - START CONTACTOR
- SN - SNAPPER
- SOL - SOLID-STATE TRANSMITTER
- ST - TEMPERATURE
- T - TRANSFORMER
- UVR - UNDER VOLTAGE RELAY
- VS - VACUUM FUSION SOLenoid
- VSF - VENTILATION FAN
- M - MANUAL RESET
- R - ROLLER
- W - FACTORY TERMINALS
- WF - FACTORY WIRE
- WIRE