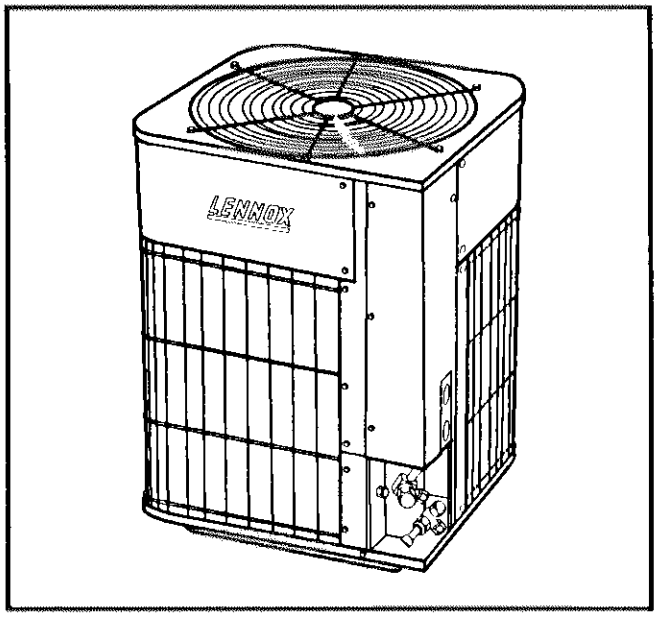
HS20 SERIES UNITS

The HS20 is a mid-efficiency residential split-system condensing unit which features a scroll compressor. It operates much like a reciprocating compressor condensing unit, but the HS20's scroll compressor is unique in the way that it compresses refrigerant. Several models are available in sizes ranging from 1-1/2 through 3-1/2 tons. The series is designed for use with an expansion valve or RFCII flow control device in the indoor unit.



This manual is divided into sections which discuss the major components, refrigerant system, charging procedure, maintenance and operation sequence.

All specifications in this manual are subject to change.

SPECIFICATIONS

Model No.		HS20-211V	HS20-261V	HS20-311V	HS20-411V	HS20-461V
Outdoor Coil	Face area (sq.ft.) inside / outside	---/8.4	---/8.4	---/9.2	3.4/9.2	6.0/9.2
	Tube diameter (in.)	3/8	3/8	3/8	3/8	3/8
	No. of Rows	1.0	1.0	1.0	1.4	1.7
	Fins per inch	16	16	20	18	20
Condenser Fan	Diameter (in.)	18	18	18	18	18
	No. of Blades	4	4	4	4	4
	Motor hp	1/6	1/6	1/6	1/6	1/6
	Cfm	2600	2600	2500	2500	2400
	RPM	1060	1060	1050	1050	1050
	Watts	250	250	260	260	265
Refrigerant-22 (charge furnished)		3lbs. 5oz.	3lbs. 9oz.	4lbs. 0oz.	4lbs. 14oz.	5lbs. 13oz.
Liquid line connection		5/16	5/16	3/8	3/8	3/8
Suction line connection		5/8	5/8	3/4	3/4	7/8

ELECTRICAL DATA

Model No.		HS20-211	HS20-261	HS20-311	HS20-411	HS20-461
Line voltage data - 60hz./1 phase		208/230V	208/230V	208/230V	208/230V	208/230V
Compressor	Rated load amps	9.7	11.6	13.5	18.0	20
	Power factor	.96	.97	.96	.96	.97
	Locked rotor amps	50.0	62.5	76.0	90.5	107
Condenser Fan Motor	Full load amps	1.2	1.2	1.2	1.2	1.2
	Locked rotor amps	2.2	2.2	2.2	2.2	2.2
Max fuse or c.b. size (amps)		20	25	30	40	45
*Minimum circuit ampacity		13.4	15.7	18.1	23.7	27.0

*Refer to National Electrical Code Manual to determine wire, fuse and disconnect size requirements.

NOTE - Extremes of operating range are plus 10% and minus 5% of line voltage

I-APPLICATION

All major components (indoor blower/coil) must be matched according to Lennox recommendations for the compressor to be covered under warranty. Refer to the Engineering Handbook for approved system matchups. A misapplied system will cause erratic operation and can result in early compressor failure.

II-SCROLL COMPRESSOR

The scroll compressor design is simple, efficient and requires few moving parts. A cutaway diagram of the scroll compressor is shown in figure 2. The scrolls are located in the top of the compressor can (cutaway in figure 2) and the motor is located just below. The oil level is immediately below the motor.

The scroll is a simple compression concept centered around the unique spiral shape of the scroll and its inherent properties. Figure 1 shows the basic scroll form. Two identical scrolls are mated together forming concentric spiral shapes as shown in figure 3. One scroll remains stationary, while the other is allowed to "orbit" as shown in figure 4. Note that the orbiting scroll does not rotate or turn but merely "orbits" the stationary scroll.

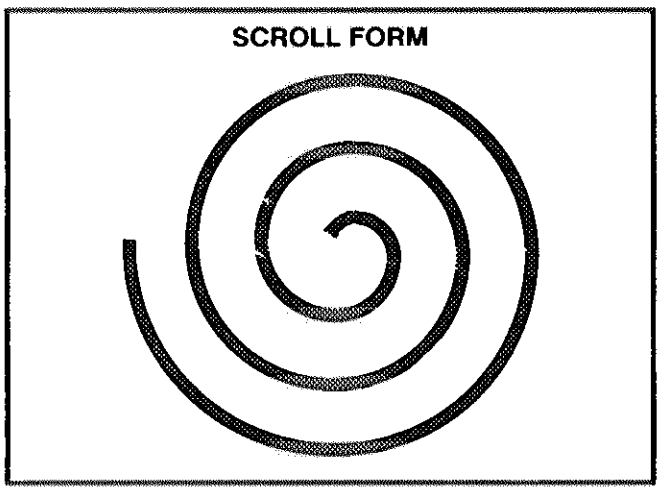


FIGURE 1

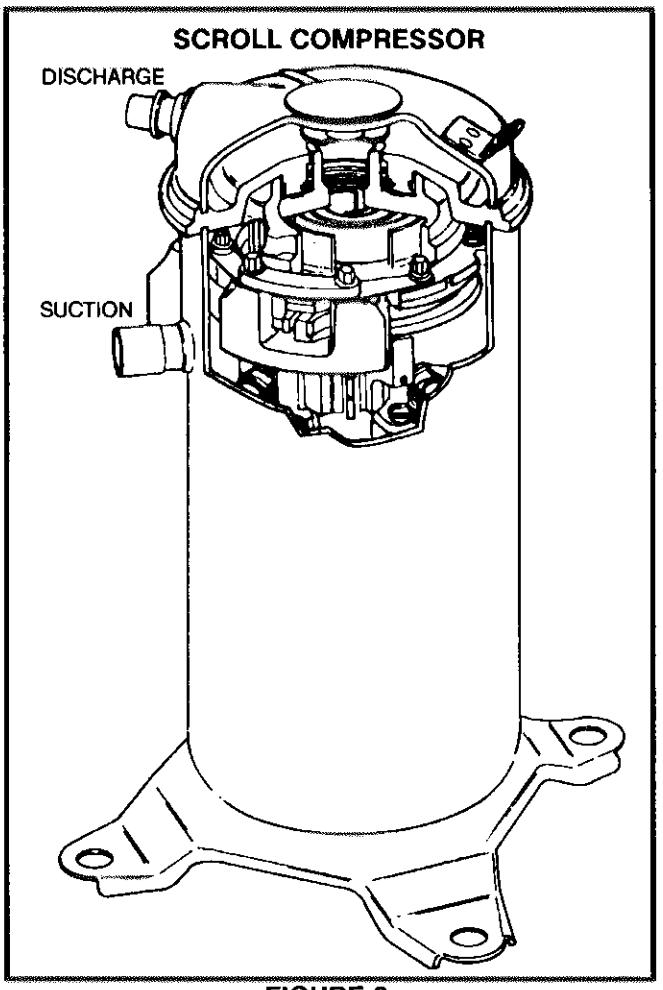


FIGURE 2

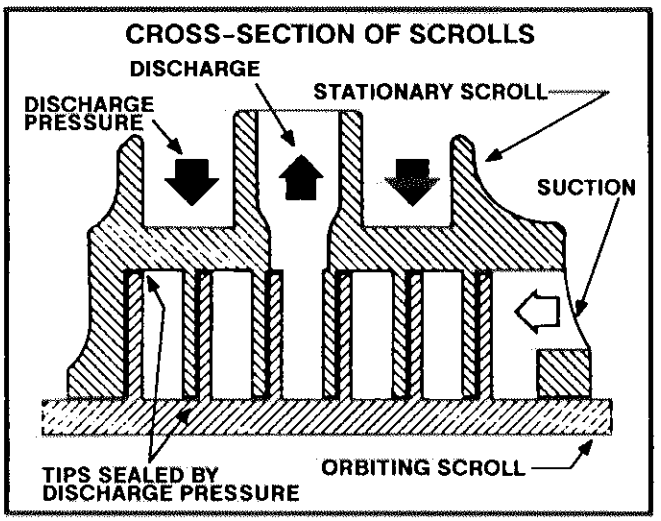


FIGURE 3

The counterclockwise orbiting scroll draws gas into the outer crescent shaped gas pocket created by the two scrolls (figure 4 - 1). The centrifugal action of the orbiting scroll seals off the flanks of the scrolls (figure 4 - 2). As the orbiting motion continues, the gas is forced toward the center of the scroll and the gas pocket becomes compressed (figure 4 - 3). When the compressed gas reaches the center, it is discharged vertically into a chamber and discharge port above the scroll (figure 2). The discharge pressure forces down on the top scroll to help seal off the upper and lower edges (tips) of the scrolls (figure 3). During a single orbit, several pockets of gas are compressed simultaneously providing smooth continuous compression.

The scroll compressor is tolerant to the effects of liquid return. If liquid enters the scrolls, the orbiting scroll is allowed to separate from the stationary scroll. The liquid is worked toward the center of the scroll and is discharged. If the compressor is replaced, conventional Lennox cleanup practices must be used.

Due to its efficiency, the scroll compressor is capable of drawing a much deeper vacuum than reciprocating compressors. Deep vacuum operation can cause internal fusite arcing resulting in damaged internal parts and will result in compressor failure. Never use a scroll compressor for evacuating or "pumping-down" the system. This type of damage can be detected and will result in denial of warranty claims.

NOTE - During operation, the head of a scroll compressor may be hot since it is in constant contact with discharge gas.

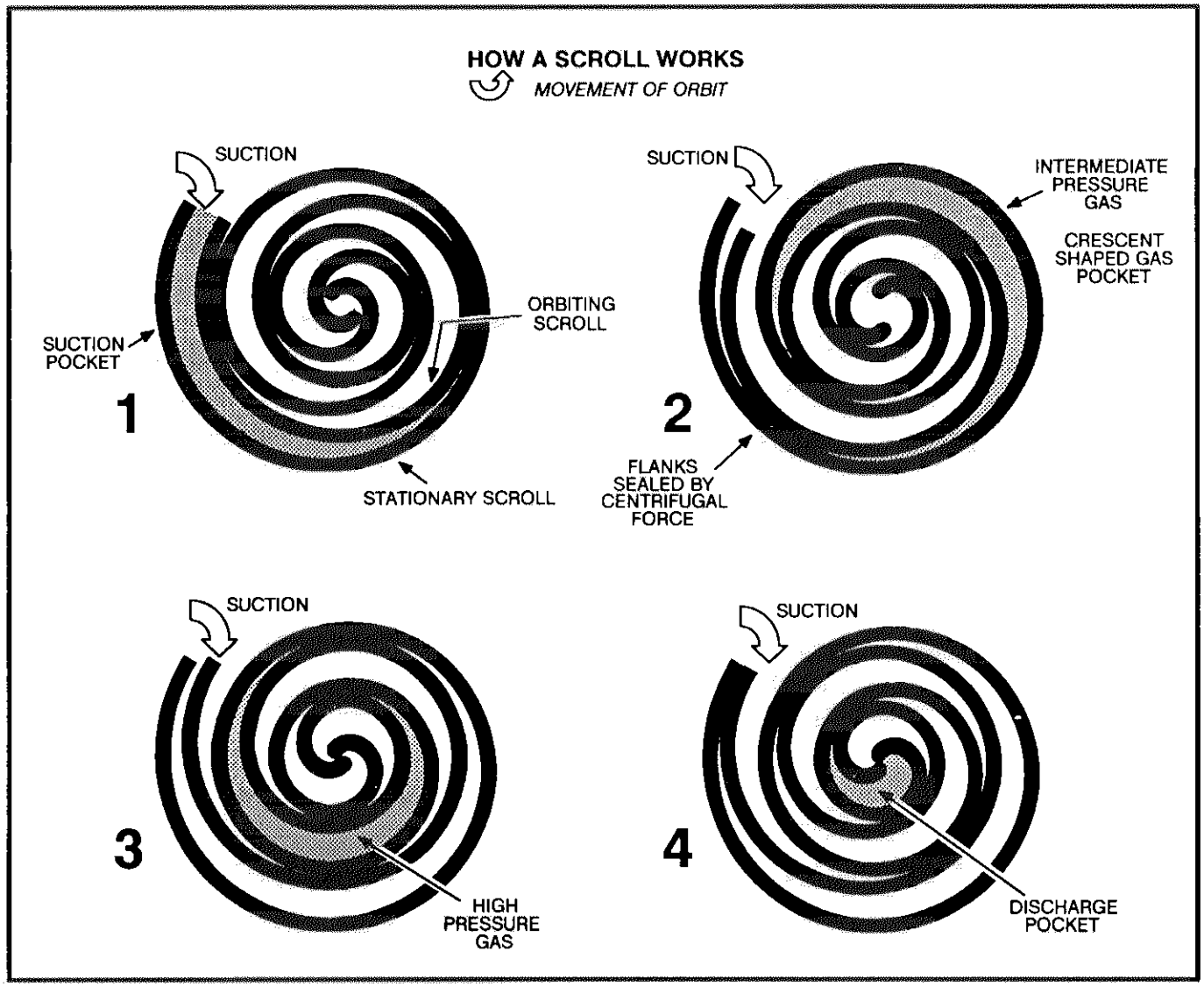


FIGURE 4

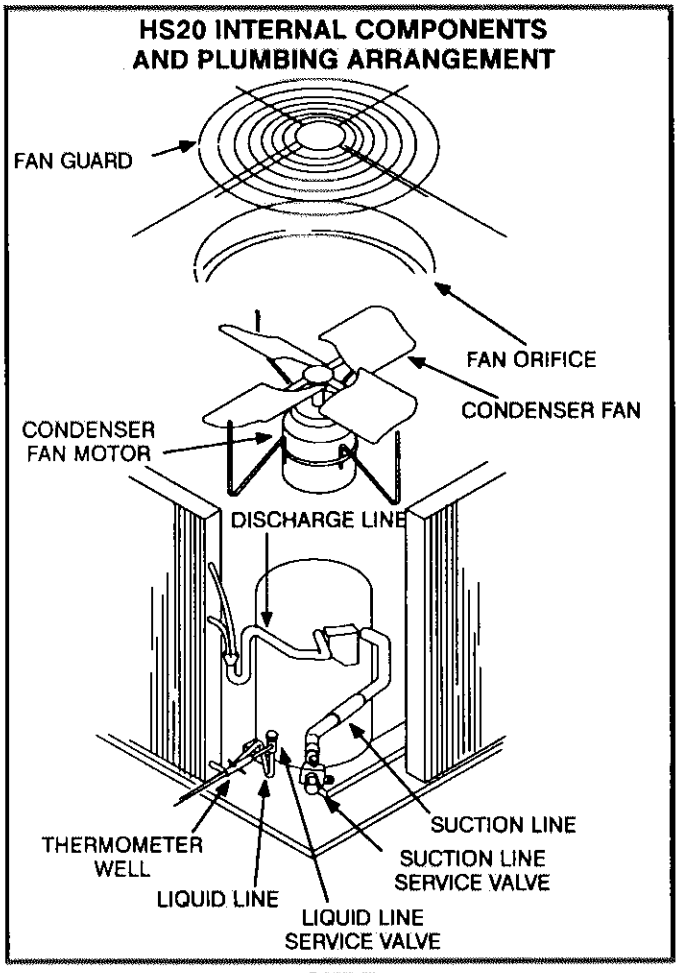


FIGURE 5

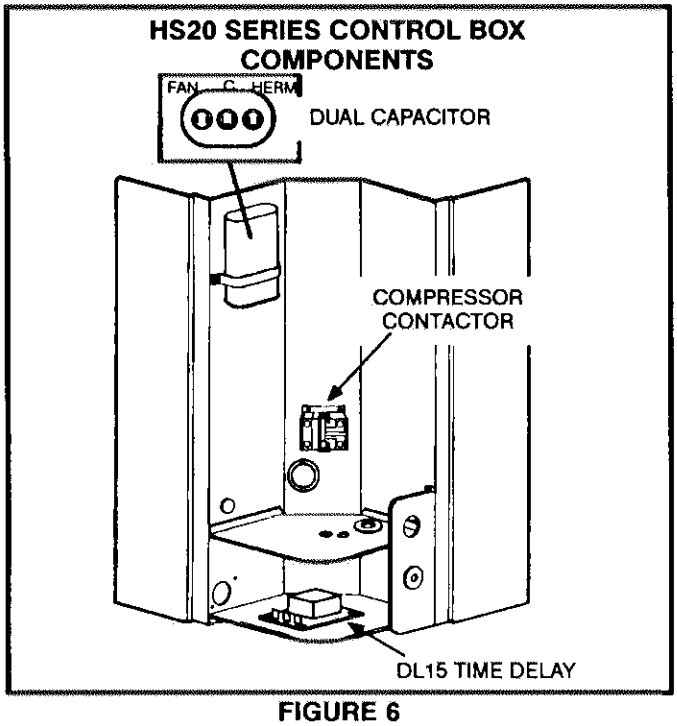


FIGURE 6

III-UNIT COMPONENTS

A-Transformer

The HS20 is not equipped with a 24V transformer. The contactor coil, time delay and temperature sensor are all energized by 24VAC supplied by the indoor unit. All other controls in the outdoor unit are powered by line voltage. Refer to unit wiring diagram.

B-Contactor

The compressor is energized by a contactor located in the control box. All units use SPST contactors. The contactor is energized by indoor thermostat terminal Y when thermostat demand is present.

WARNING - ALL HS20 UNITS USE SINGLE-POLE CONTACTORS. ONE LEG OF COMPRESSOR, CAPACITOR AND CONDENSER FAN ARE CONNECTED TO LINE VOLTAGE AT ALL TIMES. POTENTIAL EXISTS FOR ELECTRICAL SHOCK RESULTING IN INJURY OR DEATH. REMOVE ALL POWER AT DISCONNECT BEFORE SERVICING.

C-DL15 Time Delay

Each HS20 is equipped with a time delay (DL15) located in the control box (figure 6). The time delay is electrically connected between thermostat terminal Y and the compressor contactor. On initial thermostat demand, the compressor contactor is delayed for 8.5 seconds. At the end of the delay, the compressor is allowed to energize. When thermostat demand is satisfied, the time delay opens the circuit to the compressor contactor coil and the compressor is de-energized.

Without the delay it would be possible to short cycle the compressor. A scroll compressor, when short cycled, can run backward if started while head pressure is still high. It does not harm a scroll compressor to run backward, but it could cause a nuisance tripout of safety limits (internal overload). For this reason, if a DL15 delay should fail, it must be replaced. Do not bypass the control.

DANGER - DO NOT ATTEMPT TO REPAIR THIS CONTROL. UNSAFE OPERATION WILL RESULT. IF THE CONTROL IS FOUND TO BE INOPERATIVE, SIMPLY REPLACE THE ENTIRE CONTROL.

D-Compressor

Table 1 shows the specifications of compressors used in HS20 series units.

TABLE 1

Unit	Phase	LRA	RLA	Oil fl.oz.
HS20-211	1	50.0	9.7	24*
HS20-261	1	62.5	11.6	28*
HS20-311	1	76.0	13.5	28*
HS20-411	1	90.5	18.0	34*
HS20-461	1	107	20.0	38*

*Shipped with conventional white oil (Sontex 200LT). 3GS oil may be used if additional oil is required.

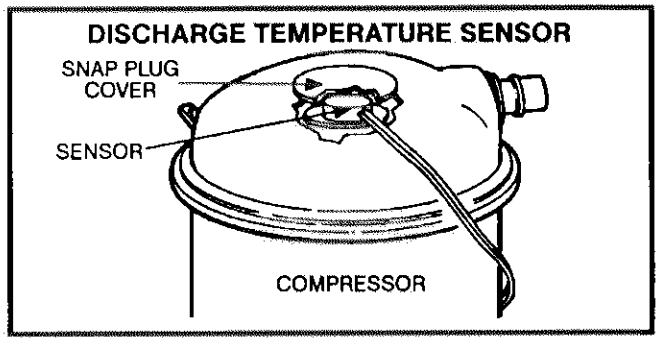


FIGURE 7

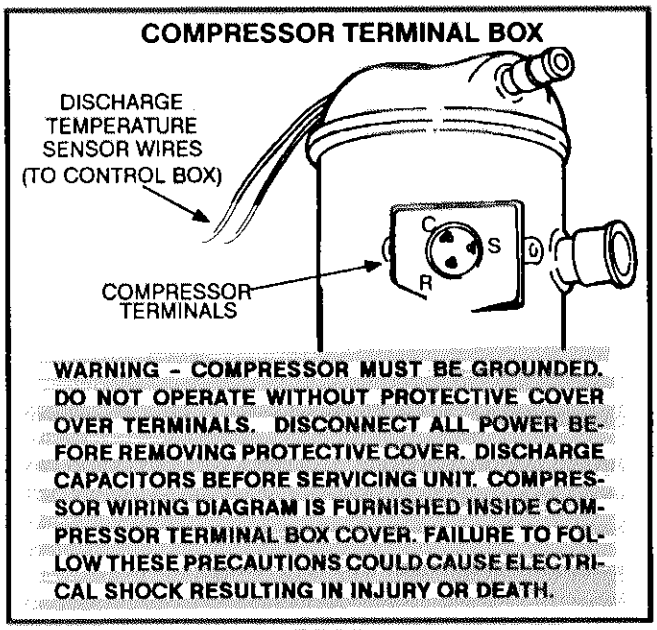


FIGURE 8

E-Temperature Sensor

Each scroll compressor is equipped with a temperature sensor located on the outside top of the compressor. The sensor is a SPST thermostat which opens when the discharge temperature exceeds 280°F ± 8°F on a temperature rise. When the switch opens, the circuit to the compressor contactor and the time delay is de-energized and the unit shuts off. The switch automatically resets when the compressor temperature drops below 130°F ± 14°F.

The sensor can be accessed by prying off the snap plug on top of the compressor (see figure 7). Make sure to securely seal the sensor after replacement. The sensor pigtails are located inside the unit control box. Figure 8 shows the arrangement of compressor line voltage terminals and discharge sensor pigtails.

F-Condenser Fan Motor

All units use single-phase PSC fan motors which require a run capacitor. The "FAN" side of the dual capacitor is used for this purpose. The specifications table on page 1 of this manual shows the specifications of outdoor fans used in HS20s. In all units, the outdoor fan is controlled by compressor contactor K1.

G-Dual Capacitor

The compressor and fan in HS20 series units use permanent split capacitor motors. A single "dual" capacitor is used for both the fan motor and the compressor (see unit wiring diagram). A dual capacitor is internally split into two capactiors. The fan side of the capacitor and the compressor side of the capacitor have different mfd ratings. The capacitor is located inside the unit control box (see figure 5). Table 2 shows the ratings of the dual capacitor.

TABLE 2

HS20 DUAL CAPACITOR RATING			
Units	Terminal	MFD	VAC
HS20-211	FAN	5	370
	HERM	25	
HS20-261	FAN	5	
	HERM	30	
HS20-311	FAN	5	
	HERM	35	
HS20-411	FAN	5	440
	HERM	35	
HS20-461	FAN	5	
	HERM	35	

IV-REFRIGERANT SYSTEM

A-Plumbing

Field refrigerant piping consists of liquid and vapor lines from the outdoor unit (sweat connections). Use Lennox L10 series line sets as shown in table 3 or field fabricated refrigerant lines. Refer to the piping section of the Lennox Service Unit Information Manual (SUI-803-L9) for proper size, type and application of field-fabricated lines.

TABLE 3

Model No.	LIQUID LINE	SUCTION LINE	L10 LINE SETS
HS20-211 HS20-261	5/16 in.	5/8 in.	L10-21 20 ft. - 50 ft.
HS20-311 HS20-411	3/8 in.	3/4 in.	L10-41 20 ft. - 50 ft.
HS20-461	3/8 in.	7/8 in.	L10-65 30 ft. - 50 ft.

Separate liquid and suction service ports are provided at the service valves for connection of gauge manifold during charging procedure.

B-Service Valves

The liquid line and suction line service valves and gauge ports are accessible outside the unit. The "one shot" suction line service valve (figure 9) cannot be closed once it has been opened. These gauge ports are used for leak testing, evacuating, charging and checking charge.

WARNING-DO NOT OPEN LIQUID LINE VALVE TOO FAR. VALVE IS NOT A BACKSEATING TYPE. A VALVE WHICH HAS BEEN OPENED TOO FAR MAY LEAK OR CAUSE RAPID LOSS OF PRESSURE RESULTING IN PERSONAL INJURY.

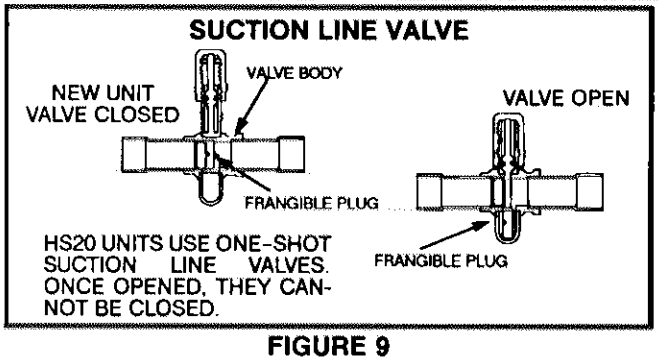


FIGURE 9

V-CHARGING

A-Factory and Set-up Charge

The unit is factory-charged with the amount of R-22 refrigerant indicated on the unit rating plate. The charge, as shown in table 4, is based on a matching indoor coil and outdoor coil with 20 feet (7820mm) of line set.

TABLE 4

Model	Refrigerant Charge R-22
HS20-211	3 lbs. 5 oz.
HS20-261	3 lbs. 9 oz.
HS20-311	4 lbs. 0 oz.
HS20-411	4 lbs. 14 oz.
HS20-461	5 lbs. 13 oz.

For varying lengths of line set, refer to table 5 for refrigerant charge adjustment. A blank space is provided on the unit rating plate to list actual field charge.

TABLE 5

LINE SET DIAMETER		Ozs per ft. (ml per mm) adjust from 20 ft. line set*
Liquid	Suction	
5/16 in. (8mm)	5/8 in. (16mm)	1/2 ounce (15ml)
3/8 in. (10mm)	3/4 in. (19mm)	3/4 ounce (21ml)
3/8 in. (10mm)	7/8 in. (22mm)	3/4 ounce (21ml)

** If line length is greater than 20 feet (6.10 m), add this amount. If line length is less than 20 feet (6.10 m), subtract this amount.*

B-Leak Testing

1- Attach gauge manifold and connect a drum of dry nitrogen to center port of gauge manifold.

CAUTION-WHEN USING DRY NITROGEN, A PRESSURE REDUCING REGULATOR MUST BE USED TO PREVENT EXCESSIVE PRESSURE IN GAUGE MANIFOLD, CONNECTING HOSES, AND WITHIN THE SYSTEM. REGULATOR SETTING MUST NOT EXCEED 150 PSIG (1034 KPA). FAILURE TO USE A REGULATOR CAN CAUSE EQUIPMENT FAILURE RESULTING IN INJURY.

2- Open high pressure valve on gauge manifold and pressurize line set and indoor coil to 150 psig (1034 kPa).

3- Check lines and connections for leaks.

NOTE-If electronic leak detector is used, add a trace of refrigerant to the nitrogen for detection by the leak detector.

4- Release nitrogen pressure from the system, correct any leaks and recheck.

C-Evacuating and Dehydrating the System

1- Attach gauge manifold. Connect vacuum pump (with vacuum gauge) to center port of gauge manifold. With both manifold service valves open, start pump and evacuate evaporator coil and refrigerant lines.

WARNING-DEEP VACUUM OPERATION MUST BE AVOIDED. EXTREMELY LOW VACUUMS CAN CAUSE INTERNAL FUSITE ARCING RESULTING IN COMPRESSOR FAILURE. DAMAGE CAUSED BY DEEP VACUUMING CAN BE DETECTED AND WILL VOID WARRANTY. COMPRESSORS MUST NEVER BE USED TO EVACUATE (PUMP-DOWN) AN AIR CONDITIONING SYSTEM.

NOTE-A temperature vacuum gauge, mercury vacuum (U-tube), or thermocouple gauge should be used. The usual Bourdon tube gauges are not accurate enough in the vacuum range.

2- Evacuate the system to 29 inches (737mm) vacuum. During the early stages of evacuation, stop the vacuum pump at least once to determine if there is a loss of vacuum. A rapid loss of vacuum indicates a leak in the system. Repeat steps outlined in the leak testing section.

3- After system has been evacuated to 29 inches (737mm), close gauge manifold valve to center port. Stop vacuum pump and disconnect from gauge manifold. Attach an upright nitrogen drum to center port of gauge manifold and open drum valve slightly to purge line. Break vacuum in system with nitrogen pressure by opening manifold high pressure valve. Close manifold high pressure valve to center port.

4- Close nitrogen drum valve and disconnect from gauge manifold center port. Release nitrogen pressure from system.

5- Connect vacuum pump to gauge manifold center port. Evacuate system through manifold service valves until vacuum in system does not rise above 29.7 inches (754mm) mercury (5mm absolute pressure) within a 20-minute period after stopping vacuum pump.

6- After evacuation is complete, close manifold center port, and connect refrigerant drum. Pressurize system slightly with refrigerant to break vacuum.

D-Charge Check and Adjustment

If the system is completely void of refrigerant, the recommended and most accurate method of charging is to weigh the refrigerant into the unit according to the total amount shown on the unit nameplate and in table 4.

If the charge needs only to be adjusted, use the following procedures as a general guide. For best results, indoor temperature should be between 70°F and 80°F. Outdoor temperature should be 60°F or above. Slight variations in charging temperature and pressure should be expected. Large variations may indicate a need for further servicing. Be sure to monitor system pressures while charging.

WARNING-SCROLL COMPRESSORS ARE CAPABLE OF OPERATING AT EXTREMELY HIGH PRESSURES. CHECK PRESSURE LIMITS OF GAUGES AND CHARGING EQUIPMENT. MONITOR SYSTEM CLOSELY WHILE CHARGING. DO NOT ALLOW UNIT TO OPERATE ABOVE UPPER LIMITS OF CHARGING EQUIPMENT. SERIOUS INJURY MAY RESULT.

1-Expansion Valve Systems

NOTE - The following procedure requires accurate readings of ambient (outdoor) temperature, liquid temperature and liquid pressure for proper charging. Use a thermometer with accuracy of ±2°F and a pressure gauge with accuracy of ±5PSIG.

1- Connect gauge manifold. Connect an upright R-22 drum to center port of gauge manifold.

2- Check and record ambient (outdoor) temperature.

3- Operate unit to allow system to stabilize both before and after each charge adjustment.

4- Make sure thermometer well is installed and is filled with mineral oil before checking liquid line temperature.

5- Place thermometer in well and read liquid line temperature. Difference between ambient and liquid line temperatures should match values given in table 6 (approach temperature = liquid line temperature minus ambient temperature). Refrigerant must be added to lower approach temperature. Remove refrigerant from system to increase approach temperature.

TABLE 6

APPROACH METHOD - EXPANSION VALVE SYSTEMS	
Model	**Liquid Temp Minus Ambient Temp. (°F)**
HS20-211	6±1
HS20-261	9±1
HS20-311	12±1
HS20-411	11±1
HS20-461	12±1

6- When unit is properly charged liquid line pressures should approximate those given in table 8 - Normal Operating Pressures.

2-RFCII SYSTEMS

1- Connect gauge manifold. Connect an upright R-22 drum to center port of gauge manifold.

2- Operate unit to allow system to stabilize both before and after each charge adjustment.

3- Make sure thermometer well is installed and is filled with mineral oil before checking liquid line temperature.

4- Place thermometer in well and record liquid line temperature.

5- Read liquid line pressure from gauge and convert to condensing temperature using standard R-22 temperature/pressure conversion chart (or use conversion scale on gauge.) Record condensing temperature.

6- The difference between the liquid line temperature (from step 4) and the condensing temperature (from step 5) is subcooling.

Subcooling = Condensing Temp. minus Liq. Temp.

Subcooling temperature should approximate the values given in table 7. Add refrigerant to increase subcooling and remove refrigerant to reduce subcooling.

7- When unit is properly charged liquid line pressures should approximate those given in table 8 - Normal Operating Pressures.

TABLE 7

OUTDOOR TEMP. (°F)	LIQUID SUBCOOLING (± 1°F)				
	HS20-211	HS20-261	HS20-311	HS20-411	HS20-461
60	17	14	19	16	20
65	16	13	18	15	20
70	15	12	17	14	19
75	14	11	16	13	18
80	13	10	15	12	17
85	13	9	15	11	16
90	12	8	14	10	16
95	11	7	13	9	15
100	10	6	12	8	14
105	9	5	11	7	13
110	8	4	11	6	12
115	7	3	10	5	12

NOTE – Use table 8 as a general guide for performing maintenance checks. Table 8 is not a procedure for charging the system. Variations in these pressures can be expected due to differences in installations and unit matchups. Significant deviations could mean that the system is not properly charged or that a problem exists with some component in the system. Used prudently, table 8 could serve as a useful service guide.

E-Oil Charge

Table 1 shows the factory oil charge in HS20 units.

TABLE 8

NORMAL OPERATING PRESSURES										
OUTDOOR COIL ENTERING AIR TEMPERATURE		HS20-211		HS20-261		HS20-311		HS20-411		HS20-461	
		LIQ. ± 10 PSIG	SUC. ± 10 PSIG	LIQ. ± 10 PSIG	SUC. ± 10 PSIG	LIQ. ± 10 PSIG	SUC. ± 10 PSIG	LIQ. ± 10 PSIG	SUC. ± 10 PSIG	LIQ. ± 10 PSIG	SUC. ± 10 PSIG
EXPANSION VALVE	82 °F	191	74	198	75	208	73	207	74	216	75
	95 °F	231	76	242	77	249	75	249	75	262	77
RFCII	82 °F	192	72	198	73	209	70	206	72	220	73
	95 °F	233	77	240	77	252	75	249	76	263	77

VI–Maintenance

At the beginning of each cooling season, the system should be checked and cleaned as follows:

A–Outdoor Unit

1- Clean and inspect condenser coil. (Coil may be flushed with a water hose).

2- Rotate fan to check for frozen bearings or binding. Condenser fan motor is prelubricated and ports are sealed with plugs. No further lubrication is required.

3- Visually inspect all connecting lines, joints and coils for evidence of oil leaks.

4- Check all factory and field-installed wiring for loose connections.

5- Check voltage supply at disconnect (unit not operating.) Voltage must be within range listed on unit rating plate. If not, do not start equipment until the power company has been consulted and the voltage condition corrected. Check for correct voltage at unit (unit operating).

6- Check condenser fan motor amp-draw.
Unit nameplate_____Actual_____.

7- Check compressor amp-draw.
Unit nameplate_____Actual_____.

NOTE - If insufficient heating or cooling occurs, the unit should be gauged and refrigerant charge checked.

B–Evaporator Coil

1- Clean coil if necessary.

2- Check connecting lines, joints and coil for evidence of oil leaks.

3- Check condensate line and clean if necessary.

C–Indoor Unit

1- Clean or change filters.

2- Lubricate blower motor and blower bearings according to instructions on indoor unit.

3- Adjust blower speed for cooling. The static pressure drop over the coil should be checked to determine the correct blower CFM.

4- *Belt Drive Blowers* - Check belt for wear and proper tension.

5- Check factory and field installed wiring for loose connections.

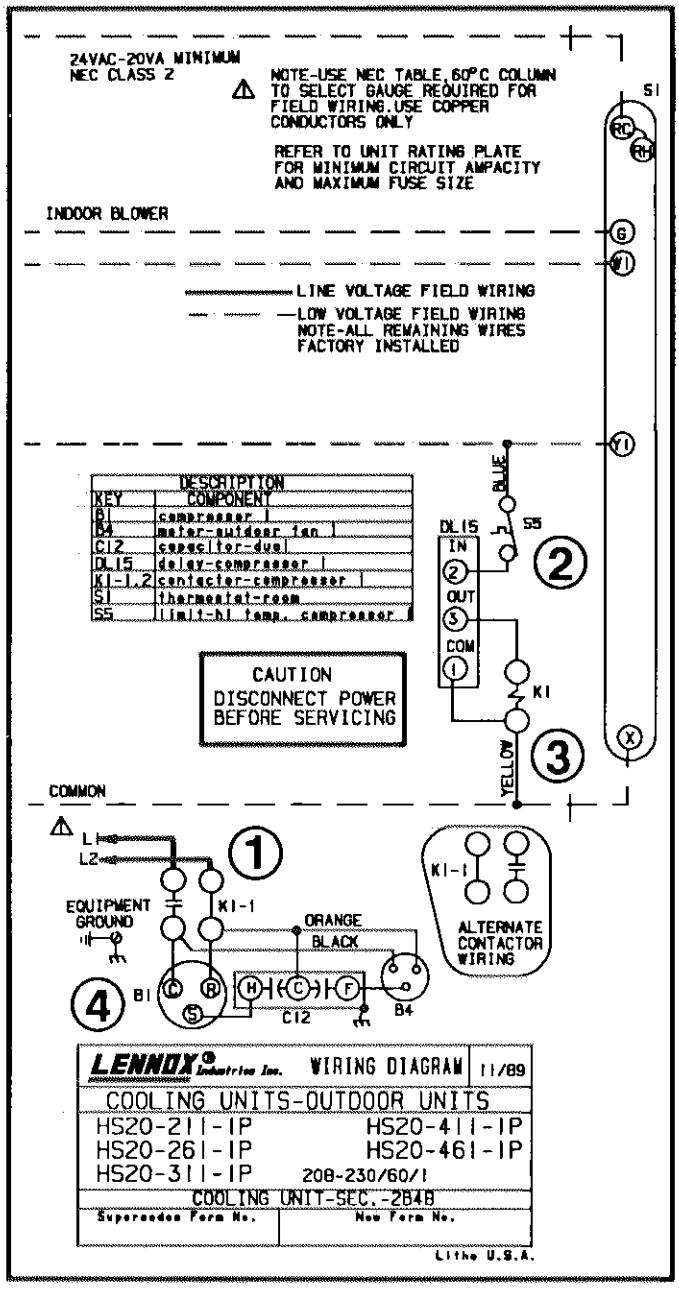
6- Check for correct voltage at unit.

7- Check amp-draw on blower motor.
Unit nameplate_____Actual_____.

VII–WIRING DIAGRAMS AND OPERATION SEQUENCE

A–Unit Diagram

UNIT DIAGRAM



B–Operation Sequence

1– **WARNING–All HS20 units use single-pole contactors. Capacitor terminal "COM," orange condenser fan wire and red "R" compressor wire are all connected to L2 at all times. Remove all power at disconnect before servicing.**

2– Cooling demand energizes thermostat terminal Y1. Voltage from terminal Y1 passes through discharge temperature sensor (compressor thermostat) to energize time delay terminal 2.

3– Time delay action is at the beginning of a thermostat demand. When energized, time delay DL15 delays 8.5 seconds before energizing DL15 terminal 3. When DL15 terminal 3 is energized, the contactor coil is energized.

4– When compressor contactor is energized, N.O. contactor contacts close to energize compressor terminal "C" (black wire) and black condenser fan motor wire. Condenser fan and compressor immediately begin operating.