TRANE® AIR CONDITIONING

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LITERATURE FILE NO.

CVHE-W-1

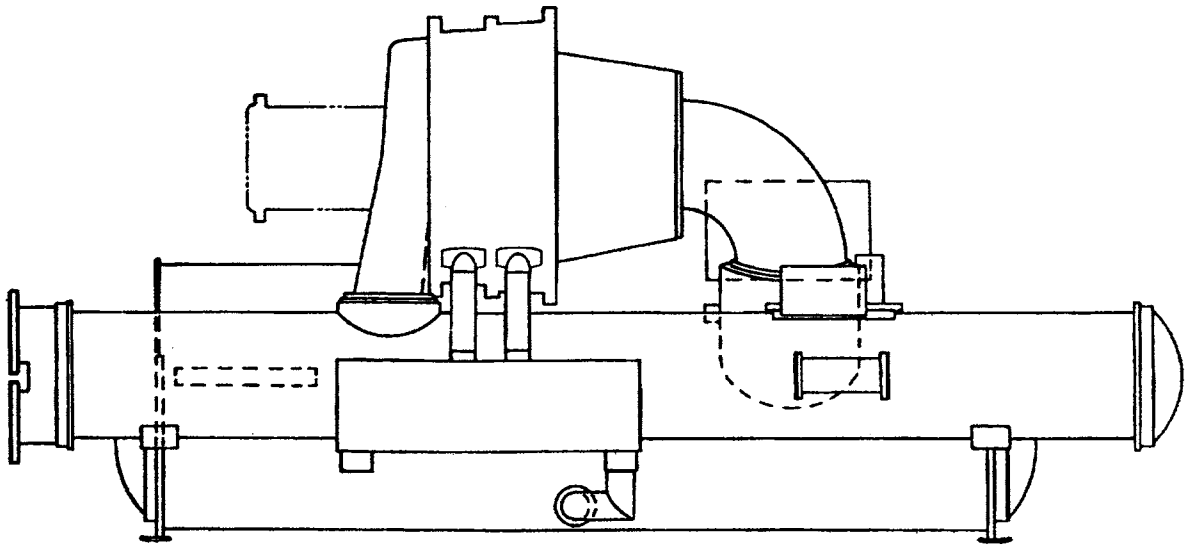
UNIT WIRING

Since the Trane Company has a policy of continuous product improvement, it reserves the right to change specifications and design without notice. The installation and servicing of the equipment referred to in this booklet should be done by qualified, experienced technicians.

FEBRUARY 1982
Supersedes CVHE-W-1
Dated May 1981

LIQUID CHILLERS - CENTRIFUGAL DIRECT DRIVE CENTRAVAC®

MODELS CVHE 013 THROUGH CVHE 125
COOLING ONLY AND HEAT RECOVERY UNITS



COMMERCIAL AIR CONDITIONING DIVISION
LA CROSSE, WISCONSIN 54601
PRINTED IN U.S.A.

MODEL NUMBER DESCRIPTION

Trane Model Numbers allow the complete description of a machine and its standard options without referring to the serial number. Although all model number information is not required to determine machine performance, all designators must be filled in to enter an order into the Trane order system. Most standard designators are shown below. Other designators for optional or special features or materials may be provided by the factory.

CV H E 050 F A _ 2 M _ 240 1 D A 1

CENTRAVAC

DIRECT DRIVE

DEVELOPMENT SEQUENCE

COMPRESSOR DESIGNATORS
are listed in Table 13-1, Page 13

NOMINAL VOLTAGE DESIGNATOR

DESIGNATOR	NOMINAL VOLTAGE
A	200 V – 60 HZ – 3 PH
B	208 V – 60 HZ – 3 PH
E	440 V – 60 HZ – 3 PH
F	460 V – 60 HZ – 3 PH
G	480 V – 60 HZ – 3 PH
H	575 V – 60 HZ – 3 PH
J	600 V – 60 HZ – 3 PH
K	2300 V – 60 HZ – 3 PH
L	2400 V – 60 HZ – 3 PH
M	4000 V – 60 HZ – 3 PH
N	4160 V – 60 HZ – 3 PH

UNIT TYPE

DESIGNATOR	UNIT TYPE
A	Cooling-Only
B	Heat Recovery
C	Auxiliary Condenser
D	Free Cooling

***DESIGN SEQUENCE**

ECONOMIZER DESIGNATOR

DESIGNATOR	ECONOMIZER
1	One Economizer
2	Two Economizers
3	One Economizer with Hot Gas Bypass
4	Two Economizers with Hot Gas Bypass

COMPRESSOR MOTOR DESIGNATOR

DESIGNATOR	A	B	C	D	E	F	G	H	J	K	L
Compressor Motor Kw	98	105	118	131	142	155	172	184	204	220	256

DESIGNATOR	M	N	P	R	T	U	V	W	X	Y	Z
Compressor Motor Kw	284	322	361	403	453	513	566	653	742	853	954

***COMPRESSOR MOTOR VENDOR DESIGNATOR**

IMPELLER DESIGNATOR

DESIGNATOR	235	240	245	250	255	260	265	270	275
Size (in)	23.5	24.0	24.5	25.0	25.5	26.0	26.5	27.0	27.5

EVAPORATOR BUNDLE SIZE DESIGNATOR

DESIGNATOR	BUNDLE SIZE
1	One
2	Two
3	Three
4	Four
5	Five

EVAPORATOR LENGTH DESIGNATOR

DESIGNATOR	EVAPORATOR LENGTH
C	Standard
D	Long

EVAPORATOR TUBE DESIGNATOR

Standard copper tubes are denoted by designator "A". Availability and designators of additional tube materials or wall thicknesses will be provided by the factory upon request.

EVAPORATOR CONNECTION ARRANGEMENT DESIGNATOR

DESIGNATOR	NUMBER OF PASSES	TYPE*	CONNECTION ARRANGEMENT* INLET: RIGHT OR LEFT HAND	INLET: END, FRONT OR REAR	OUTLET: RIGHT OR LEFT HAND	OUTLET: END, FRONT OR REAR
A	1	M	–	F	–	F
B	1	M	–	R	–	R
C	1	M	LH	F	RH	R
C	1	M	RH	R	LH	F
D	1	M	LH	R	RH	F
D	1	M	RH	F	LH	R
J	2	M	LH	F	LH	R
K	2	M	LH	R	LH	F
L	2	M	RH	F	RH	R
M	2	M	RH	R	RH	F
N	2	M	LH	F	RH	R
N	2	M	RH	R	LH	F
P	3	M	RH	F	LH	R
P	3	M	LH	R	RH	F
Y	1	NM	–	E	–	E
2	2	NM	RH	E	RH	E
1	2	NM	LH	E	LH	E
3	3	NM	–	E	–	E

*Type "M" = Marine Type NM = Non-Marine Type
*Connection arrangement determined when facing control panel side of unit

C 1 1 D A 1 C 0 0 0 0 0 0

EVAPORATOR WATERSIDE WORKING PRESSURE DESIGNATOR

DESIGNATOR	CONNECTION TYPE	WORKING PRESSURE
A	Flanged	150 PSIG
B	Flanged	300 PSIG
C	Victaulic	150 PSIG
D	Victaulic	300 PSIG

CONDENSER REFRIGERANT SIDE CONSTRUCTION DESIGNATOR

DESIGNATOR	DESCRIPTION
1	Without ASME Code
2	With ASME Code

CONDENSER BUNDLE SIZE DESIGNATOR

DESIGNATOR	BUNDLE SIZE
1	One
2	Two
3	Three
4	Four
5	Five

CONDENSER LENGTH DESIGNATOR

DESIGNATOR	Condenser Length
C	Standard
D	Long

CONDENSER TUBE DESIGNATOR

Standard copper tubes are denoted by designator "A". Availability and designators of additional tube materials or wall thicknesses will be provided by the factory upon request.

CONDENSER CONNECTION ARRANGEMENT DESIGNATOR

DESIGNATOR	NUMBER OF PASSES	TYPE*	CONNECTION ARRANGEMENT*			
			INLET		OUTLET	
			RIGHT OR LEFT HAND	END, FRONT OR REAR	RIGHT OR LEFT HAND	END, FRONT OR REAR
A	1	M	--	F	--	F
B	1	M	--	R	--	R
C	1	M	LH	F	RH	R
C	1	M	RH	R	LH	F
D	1	M	LH	R	RH	F
D	1	M	RH	F	LH	R
E	2	M	LH	F	LH	F
F	2	M	LH	R	LH	R
G	2	M	RH	F	RH	F
H	2	M	RH	R	RH	R
J	2	M	LH	F	LH	R
K	2	M	LH	R	LH	F
L	2	M	RH	F	RH	R
M	2	M	RH	R	RH	F
Y	1	NM	--	E	--	E
Z	2	NM	RH	E	RH	E
1	2	NM	LH	E	LH	E

*Type M = Marine Type NM = Non-Marine Type
*Connection arrangement determined when facing control panel side of unit

*factory assigned

CONDENSER WATERSIDE WORKING PRESSURE DESIGNATOR

DESIGNATOR	CONNECTION TYPE	WORKING PRESSURE
A	Flanged	150 PSIG
B	Flanged	300 PSIG
C	Victaulic	150 PSIG
D	Victaulic	300 PSIG

HEAT RECOVERY CONDENSER BUNDLE SIZE DESIGNATOR

DESIGNATOR	BUNDLE SIZE
1	One
2	Two
3	Three
4	Four
5	Five
0	No Heat Recovery Condenser

HEAT RECOVERY CONDENSER LENGTH DESIGNATOR

DESIGNATOR	HEAT RECOVERY CONDENSER LENGTH
C	Standard
D	Long
0	No Heat Recovery Condenser

HEAT RECOVERY CONDENSER TUBE DESIGNATOR

Standard copper tubes are denoted by designator "A". Availability and designators of additional tube materials or wall thicknesses will be provided by the factory upon request. If no heat recovery condenser is provided, this designator should be "0"

HEAT RECOVERY CONDENSER CONNECTION ARRANGEMENT DESIGNATOR

DESIGNATOR	NUMBER OF PASSES	TYPE*	CONNECTION ARRANGEMENT*			
			INLET		OUTLET	
			RIGHT OR LEFT HAND	END, FRONT OR REAR	RIGHT OR LEFT HAND	END, FRONT OR REAR
A	1	M	--	F	--	F
B	1	M	--	R	--	R
C	1	M	LH	F	RH	R
C	1	M	RH	R	LH	F
D	1	M	LH	R	RH	F
D	1	M	RH	F	LH	R
E	2	M	LH	F	LH	F
F	2	M	LH	R	LH	R
G	2	M	RH	F	RH	F
H	2	M	RH	R	RH	R
J	2	M	LH	F	LH	R
K	2	M	LH	R	LH	F
L	2	M	RH	F	RH	R
M	2	M	RH	R	RH	F
Y	1	NM	--	E	--	E
Z	2	NM	RH	E	RH	E
1	2	NM	LH	E	LH	E
0	No Heat Recovery Condenser					

*Type M = Marine Type NM = Non-Marine Type
*Connection arrangement determined when facing control panel side of unit

D 0 0 0 0 0 3 2 G 0 0

STARTER OPTIONS DESIGNATOR

DESIGNATOR	OPTION*					
	TERMINALS	AMMETER	VOLTMETER	CIRCUIT BREAKER	HIGH AMPS. RUPTURE CAPACITY CIRCUIT BREAKER	GROUND FAULT PROTECTION
A	X					
B	X	X				
C	X		X			
D	X	X	X			
E				X		
F		X		X		
G			X	X		
H		X	X	X		
J					X	
K		X			X	
L			X		X	
M		X	X		X	
N				X		X
P		X		X		X
R			X	X		X
T		X	X	X		X
U					X	X
V		X			X	X
W			X		X	X
Y		X	X		X	X
0	No Unit Mounted Starter					

* "X" indicates the option(s) provided

STARTER DESIGNATOR

DESIGNATOR	DESCRIPTION
0	Without Unit Mounted Starter
1	With Unit Mounted Starter

CONTROL PANEL OPTIONS DESIGNATOR

DESIGNATOR	OPTION*					
	ELECTRIC CONTROL	PNEUMATIC CONTROL	NUMBER OF STARTS COUNTER	ELAPSED TIME METER	U L APPROVAL	C S A APPROVAL
A	X				X	X
B	X					
C	X					
D		X			X	
E		X				X
F		X				
G	X		X	X	X	
H	X		X	X		X
J	X		X	X		
K		X	X	X	X	
L		X	X	X		X
M		X	X	X		

* "X" indicates the option(s) provided

INSULATION AND PACKAGING DESIGNATOR

DESIGNATOR	INSULATION*	PACKAGING*	
		STANDARD	EXPORT
1	X	X	
2		X	
3	X		X
4			X

* "X" indicates the option(s) provided

ORIFICE DESIGNATOR

The CenTraVac computer selection program output will include the proper orifice designator to be used.

AUXILIARY CONDENSER WATERSIDE WORKING PRESSURE DESIGNATOR

DESIGNATOR	CONNECTION TYPE	WORKING PRESSURE
A	Flanged	150 PSIG
B	Flanged	300 PSIG
C	Victaulic	150 PSIG
D	Victaulic	300 PSIG
0	No Auxiliary Condenser	

AUXILIARY CONDENSER CONNECTION ARRANGEMENT DESIGNATOR

DESIGNATOR	NUMBER OF PASSES	TYPE†	CONNECTION ARRANGEMENT*			
			INLET		OUTLET	
			RIGHT OR LEFT HAND	END, FRONT, OR REAR	RIGHT OR LEFT HAND	END, FRONT, OR REAR
A	1	M	—	F	—	F
B	1	M	—	R	—	R
C	1	M	LH	F	RH	R
D	1	M	RH	R	LH	F
E	1	M	LH	R	RH	F
F	1	M	RH	F	LH	R
G	2	M	LH	F	LH	F
H	2	M	LH	R	LH	R
J	2	M	RH	F	RH	F
K	2	M	RH	R	RH	R
L	2	M	LH	F	LH	R
M	2	M	LH	R	LH	F
N	2	M	RH	F	RH	R
P	2	M	RH	R	RH	F
R	1	NM	—	E	—	E
S	2	NM	RH	E	RH	E
T	2	NM	LH	E	LH	E
0	No Auxiliary Condenser					

†Type M = Marine Type NM = Non-Marine Type
*Connection arrangement determined when facing control panel side of unit

AUXILIARY CONDENSER BUNDLE SIZE DESIGNATOR

DESIGNATOR*	Bundle Size
A	Standard
B	Large
0	No Auxiliary Condenser

* Standard copper tubes are denoted by designators "A" and "B". Availability and dimensions of additional tube materials or wall thicknesses will be provided by the factory upon request

HEAT RECOVERY CONDENSER WATERSIDE WORKING PRESSURE DESIGNATOR

DESIGNATOR	CONNECTION TYPE	WORKING PRESSURE
A	Flanged	150 PSIG
B	Flanged	300 PSIG
C	Victaulic	150 PSIG
D	Victaulic	300 PSIG
0	No Heat Recovery Condenser	

TABLE 1 — Compressor Motor Electrical Data

UNIT COMPRESSOR DESIGNATION	MOTOR DESIGNATOR	AVAILABLE MOTOR RATING (Kw)	NOMINAL VOLTAGE	200	208	440	460	480	575	600	2300	2400	4000	4160
			VOLTAGE UTILIZATION RANGE	187/229	187/229	414/506	414/506	414/506	540/660	540/660	2160/2640	2160/2640	3744/4576	3744/4576
CVHE 013-020	A	96	Rated Load Amps	314	302	142	136	130	107	103				
			Locked Rotor Amps	2154	2240	995	1040	1085	763	796				
	B	105	Rated Load Amps	342	329	155	148	142	117	112				
			Locked Rotor Amps	2154	2240	995	1040	1085	763	796				
	C	118	Rated Load Amps	379	364	172	164	157	131	126				
			Locked Rotor Amps	2154	2240	995	1040	1085	763	796				
	D	131	Rated Load Amps	419	403	190	182	174	146	140				
			Locked Rotor Amps	2154	2240	995	1040	1085	763	796				
	E	142	Rated Load Amps	464	446	210	201	193	159	152				
			Locked Rotor Amps	2862	2976	1239	1295	1351	958	1000				
	F	155	Rated Load Amps	503	484	228	218	209	173	166				
			Locked Rotor Amps	2862	2976	1239	1295	1351	958	1000				
	G	172	Rated Load Amps	553	532	251	240	230	192	184				
			Locked Rotor Amps	2862	2976	1239	1295	1351	958	1000				
CVHE 022-032	E	142	Rated Load Amps	464	446	203	196	188	159	152				
			Locked Rotor Amps	3014	3135	1349	1410	1471	1045	1090				
	F	155	Rated Load Amps	501	482	224	214	205	173	166				
			Locked Rotor Amps	3014	3135	1349	1410	1471	1045	1090				
	G	172	Rated Load Amps	551	530	248	237	227	192	184				
			Locked Rotor Amps	3014	3135	1349	1410	1471	1045	1090				
	H	184	Rated Load Amps	604	581	272	260	249	206	197				
			Locked Rotor Amps	4003	4163	1679	1755	1831	1272	1327				
	J	204	Rated Load Amps	662	637	299	286	274	228	218				
			Locked Rotor Amps	4003	4163	1679	1755	1831	1272	1327				
	K	230	Rated Load Amps	744	715	337	322	309	257	246				
			Locked Rotor Amps	4003	4163	1679	1755	1831	1272	1327				
	L	256	Rated Load Amps	820	788	373	357	342	286	274				
			Locked Rotor Amps	3880	4035	1720	1798	1876	1261	1316				
CVHE 035-050	J	204	Rated Load Amps	654	629	295	282	270	225	216				
			Locked Rotor Amps	4610	4794	1971	2060	2150	1466	1530				
	K	230	Rated Load Amps	732	704	333	318	305	254	243	63.9	61.2	36.7	35.3
			Locked Rotor Amps	4610	4794	1971	2060	2150	1466	1530	347	362	201	209
	L	256	Rated Load Amps	815	784	370	354	340	283	271	71.1	68.1	40.9	39.3
			Locked Rotor Amps	4610	4794	1971	2060	2150	1466	1530	347	362	201	209
	M	284	Rated Load Amps	916	881	415	397	380	316	303	79.2	75.9	45.6	43.8
			Locked Rotor Amps	4495	4675	2023	2115	2207	1550	1617	376	392	217	226
	N	323	Rated Load Amps	1037	997	469	449	430	359	344	90.1	86.3	51.8	49.8
			Locked Rotor Amps	4495	4675	2023	2115	2207	1550	1617	408	426	237	246
	P	361	Rated Load Amps			525	502	481	402	385	99.4	95.3	57.2	55.0
			Locked Rotor Amps			2023	2115	2207	1550	1617	485	506	281	292
	R	403	Rated Load Amps			580	555	532	445	426	111.8	107.1	64.3	61.8
			Locked Rotor Amps			2541	2657	2773	1954	2039	542	565	314	326

In all cases, the motor to be furnished must have a KW rating equal to or greater than the full load KW determined from the Trane Computer Program. Motor selections must correspond to the available component combinations tabulated in Table 13-1, page 13.

TABLE 2 — Motor Designators

AVAILABLE MOTOR RATINGS (Kw)	CVHE MOTOR DESIGNATOR	AVAILABLE VOLTAGES[1]	AVAILABLE MOTOR RATINGS (Kw)	CVHE MOTOR DESIGNATOR	AVAILABLE VOLTAGES[1]
96	A	X	284	M	Y
105	B	X	323	N	Y
118	C	X	361	P	Z
131	D	X	403	R	Z
142	E	X	453	T	Z
155	F	X	513	U	Z
172	G	X	586	V	Z
184	H	X	653	W	Z
204	J	X	742	X	Z
230	K	Y	853	Y	Z
256	L	Y	954	Z	Z

[1]NOTE: X = 200, 208, 440, 460, 480, 575, 600 volts
Y = 200, 208, 440, 460, 480, 575, 600, 2300, 2400, 4000, 4160 volts
Z = 440, 460, 480, 575, 600, 2300, 2400, 4000, 4160 volts

CENTRAVAC CONTROL SYSTEM

The Model CVHE CenTraVac is capable of continuous capacity modulation from 100% to 10% of full load at design conditions. This is achieved through the electronic control panel which is illustrated in Figure 1.

CONTROL PANEL

All safety and operating controls are housed in the CenTraVac control panel. The panel functions are divided into four categories, as indicated by the external panel layout:

1. Pressure indicating gauges have no operating function. They are used only to provide condenser, evaporator, lubricating oil and purge drum pressures.
2. System sequence status lights perform an important diagnostic function. A series of seven lights shows the progress of the CenTraVac starting sequence. As each of the seven circuit interlocks is verified, its individual pilot light comes on. Therefore, the reason for an aborted start can be determined by observing the pilot lights and determining the point at which the sequence was breached.
3. Five fault trip indicators display the status of each safety cutout control. Circuit interrupters are used to open the circuit instead of relays because they will hold their position in the event of power interruption. Therefore, power failure does not require the manual resetting of all safeties. Additional alarm contacts on each of the fault trip indicators are brought to a terminal strip for external connection.
4. The electronic capacity control system consists of three elements:

   a. Demand limiter
   b. Chilled water temperature control
   c. Manual inlet vane control and status

   The demand limiter control can be set to control at any value between 40 and 100 percent of motor full load current. Motor current is sensed by three current transformers and is processed into a proportional DC voltage by the CenTraVac motor overload. This same DC voltage is monitored by the demand limiter. When the set percentage of full load current is reached, the demand limiter prohibits further opening of the inlet vanes. If the setting is exceeded, the inlet vanes are moved toward the closed position.

   The chilled water temperature control module uses a solid state temperature sensor to sense chilled water temperature. Should this temperature vary from setpoint, an electronic controller sends a pulsed signal to the inlet vane actuator. A combination of proportional and floating control is used to provide high accuracy and low sensitivity (hunting).

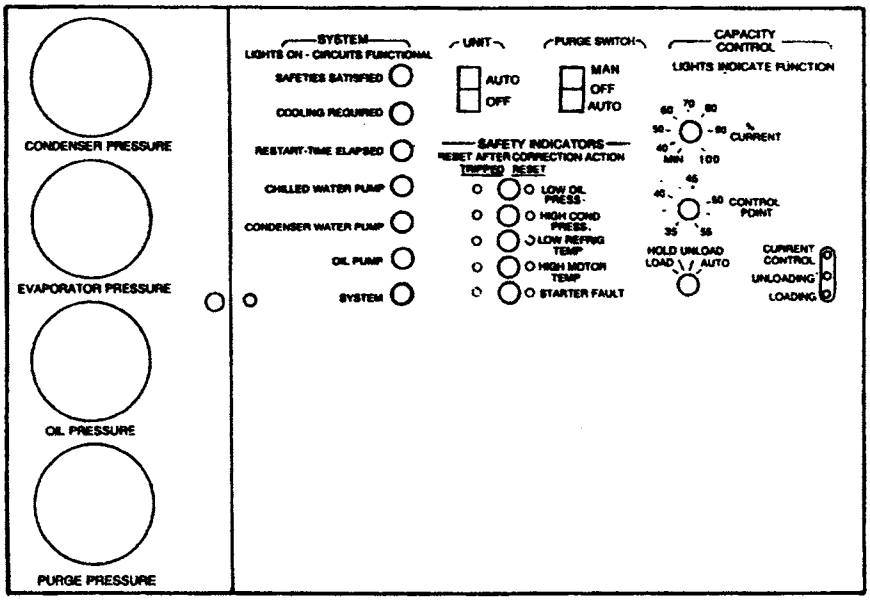


FIGURE 1 - Model CVHB CenTraVac Chiller Control Panel

Electronic Control System
(Refer to Figure 2)

A1 (line 9) is an electronic overload relay. Its purpose is to monitor the current draw of the compressor and to de-energize the compressor starter if the current draw exceeds the setting of A1. (A1 should be set at 105% of FLA.)

A3 (line 39) is the compressor inlet vane actuator electric motor. A3 end switch (line 26) is closed when the inlet vanes are full closed. A3 limit switch (line 38) is open when the inlet vanes are full open. A3 limit switch (line 40) is open when the inlet vanes are full closed.

S4 (line 35) is a multi-program timer. It limits the compressor to one start every 30 minutes and also provides the "start" signal to the compressor starter. S9 (line 43) is the oil pump timer. It keeps the oil pump motor energized for 7 minutes after the compressor starter is de-energized to provide lubrication during compressor coast-down.

U1 (line 37) is the capacity control module. It modules the inlet vane actuator (A3, line 39) in response to leaving water temperature as sensed by sensor U3 (line 38). U1 also serves as a load limiting device thru an input signal from the electronic overload relay. Power must be applied to terminal 84 (line 40) before U1 can open the inlet vanes.

U2 (line 35) is the compressor motor high temperature cut-out. Its M1-M2 contacts will close shortly after 115V is applied to terminals T1 and T2.

Sequence of Operation for Typical Start-Up
(Refer to Figure 2)

Energize the chilled water pump starter K12 (line 13).

Close the circuit breaker CB10 (line 1). Since the contacts of U2 (line 35) do not close instantly, relay K11 (line 36) will not be energized in time to prevent fault trip indicator CB4 (line 16) from tripping. After approximately one second delay, U2 contacts will close energizing K11. Reset CB4. Set switch S6 (line 26) in the "auto" position.

Control power flows thru the safety controls and fault trip indicator contacts (line 16). If all safeties are satisfied, light DS1 (line 20) will light. Power flows on to the chilled water demand switch S3 (line 26) whose temperature sensing element is located in the return water entering the chiller. Upon a rise in return water temperature, S3 closes energizing light DS2 (line 20) and feeding power to timer contact S4. If 30 minutes or more has elapsed since the previous compressor start, timer contact S4 (line 26) feeds power to light DS3 (line 20). Power also flows through compressor inlet vane end switch A3 (if vanes are closed), through relay K7 contacts (if compressor is off) to terminal 8. If chilled water flow is proven, power feeds thorugh flow switch S5 to light DS4 (line 20). Power also feeds through switch S6 energizing relay K4 (line 19). K4 contacts (line 16) close to energize the condenser water pump starter, K13; if condenser water flow is proven, power feeds through flow switch S7 (line 26) to light DS5 (line 20) and also energizes relay K5 (line 21). One set of K5 contacts (line 43) close energizing the oil pump timer S9. A second set of K5 contacts (line 28) close keeping the control circuit complete by jumpering out the start inhibit functions. In 40 seconds timer S9 contacts (line 44) close energizing the oil pump motor B2 (line 45). When oil pressure is established, oil pressure switch S8 (line 26) closes lighting DS6 (line 22) and energizing relay K6 (line 23). One set of K6 SPDT contacts (lines 14 and 15) switch energizing relay K3 (line 14). K3 contacts (line 16) close keeping relay K3 energized and arming the low oil pressure circuit breaker circuit.

A second K6 contact (line 35) closes energizing timer S4 (line 35). In 20 seconds S4 contacts (line 33) close keeping timer S4 energized through its entire timing cycle. 5 seconds later S4 contacts (line 28) close feeding power to light DS7 (line 28 and energizing comrpessor starter K1 (line 29). K1 contacts (line 30) close keeping power on K1. A second set of contact of K1 (line 31) close energizing relay K10 (line 33). K10 contacts (line 31) close keeping K10 energized for the remaining timing cycle of S4. A second K10 contact (line 29) opens removing the "start" signal from the K1 relay circuit. Thus the "start" signal lasts only long enough to energize and close K1 start contactor.

A third K1 start contact (line 45) closes keeping the oil pump motor energized as long as the K1 start contactor remains closed.

When K1 connects the compressor in the run configuration, K1 "run" contacts (line 40) close feeding power to terminal 84 of the capacity control module U1 (line 40) (if refrigerant temperature switch S2 is closed) thus allowing U1 to open the compressor inlet vanes as necessary.

When K1 is initially energized, relay K9 (line 26) is also energized. K9 contacts (line 25) open keeping relay K8 de-energized. This arms the starter fault safety circuit 15 seconds after the initial start pulse is sent to K1. S4 contacts (line 26) switch from 13-81 to 13-79 energizing relay K7 (line 24). K7 contacts (line 26) close keeping K7 energized and completing the arming of the starter fault circuit. If K1 opens for any reason, contacts K1 (line 29) open de-energizing relay K9. K9 contacts (line 26) close energizing relay K8. K8 contacts (line 15) close tripping fault trip indicator CB5 and locking the unit off. When there is no longer a call for cooling or if a safety opens, compressor starter K1 and relay K5 will be de-energized. A contact of timer S9 (line 44) will keep timer S9 and oil pump motor B2 energized for 7 minutes to provide lubrication during compressor coast-down.

If there is a loss of oil pressure while the compressor is running, oil pressure switch S8 (line 26) opens stopping the compressor and de-energizing relay K6 (line 23). Power then feeds from terminal 12 (line 26) through contacts of K3 (line 16) and NC contacts of K6 (line 14) to trip fault trip indicator CB1 locking the compressor off.

Alarm contacts (line 56) are factory wired using NC contacts of the control circuit breakers. NO alarm contacts may be used by moving one wire on each circuit breaker.

FREE COOLING

Free Cooling is an accessory to the Trane Model CVHB CenTraVac Chiller. Free cooling adapts the basic chiller to function as a simple heat exchanger using refrigerant as the working fluid. When condenser water is available at temperatures lower than the desired chilled liquid temperature, Free Cooling can provide up to 45 percent of nominal chiller capacity without operation of the compressor. This feature can result in substantial energy cost savings on many installations.

Operation

Free Cooling operates on the principle that refrigerant flows to the area of lowest temperature in the system. When condenser water is available at a temperature lower than the required leaving chilled water temperature, the operator stops the compressor and starts the Free Cooling cycle by a simple pushbutton control. Changeover back to mechanical cooling is also by simple pushbutton control.

The Free Cooling accessory consists of the following factory-installed or supplied components:

1. A refrigerant gas line, including an electrically actuated shutoff valve, installed between the evaporator and condenser.
2. A valved liquid return line including an electrically actuated shutoff valve, between the condenser sump and evaporator.
3. A liquid refrigerant storage vessel.
4. Added refrigerant charge.
5. Free Cooling changeover controls.

Upon changeover to Free Cooling, the shutoff valve in the liquid and gas lines open and a lockout circuit prevents compressor energization. Liquid refrigerant drains by gravity from the storage tank into the evaporator, flooding the tube bundle. Since the refrigerant temperature and pressure will be higher in the evaporator than in the condenser due to the water temperature difference, the refrigerant vaporized in the evaporator flows to the condenser. The gas then is condensed by the effects of the cooling tower water and flows by gravity back to the evaporator. This automatic refrigeration cycle is sustained as long as a temperature difference exists between the condenser and evaporator liquids.

The difference in temperature between the condenser water and evaporator water determines the rate of refrigerant flow between the two shells and hence the Free Cooling capacity.

If the system load becomes greater than the Free Cooling available capacity, the operator stops Free Cooling operation. The gas and liquid valves close and compressor operation begins. Refrigerant gas is drawn out of the evaporator by the compressor and is compressed and discharged to the condenser. Most of the condensed liquid first takes the path of least resistance by flowing into the storage tank which is vented to the economizer sump through a small bleed line. When the storage tank is full, liquid refrigerant must flow through the bleed line restriction. The pressure drop through the bleed line is greater than that through the orifice flow control device, hence liquid refrigerant flows normally from the condenser through the orifice system and into the economizer.

During changeover to mechanical cooling, the refrigerant transfer process requires less than three minutes. The loading ramp prevents carryover by slowly loading the machine.

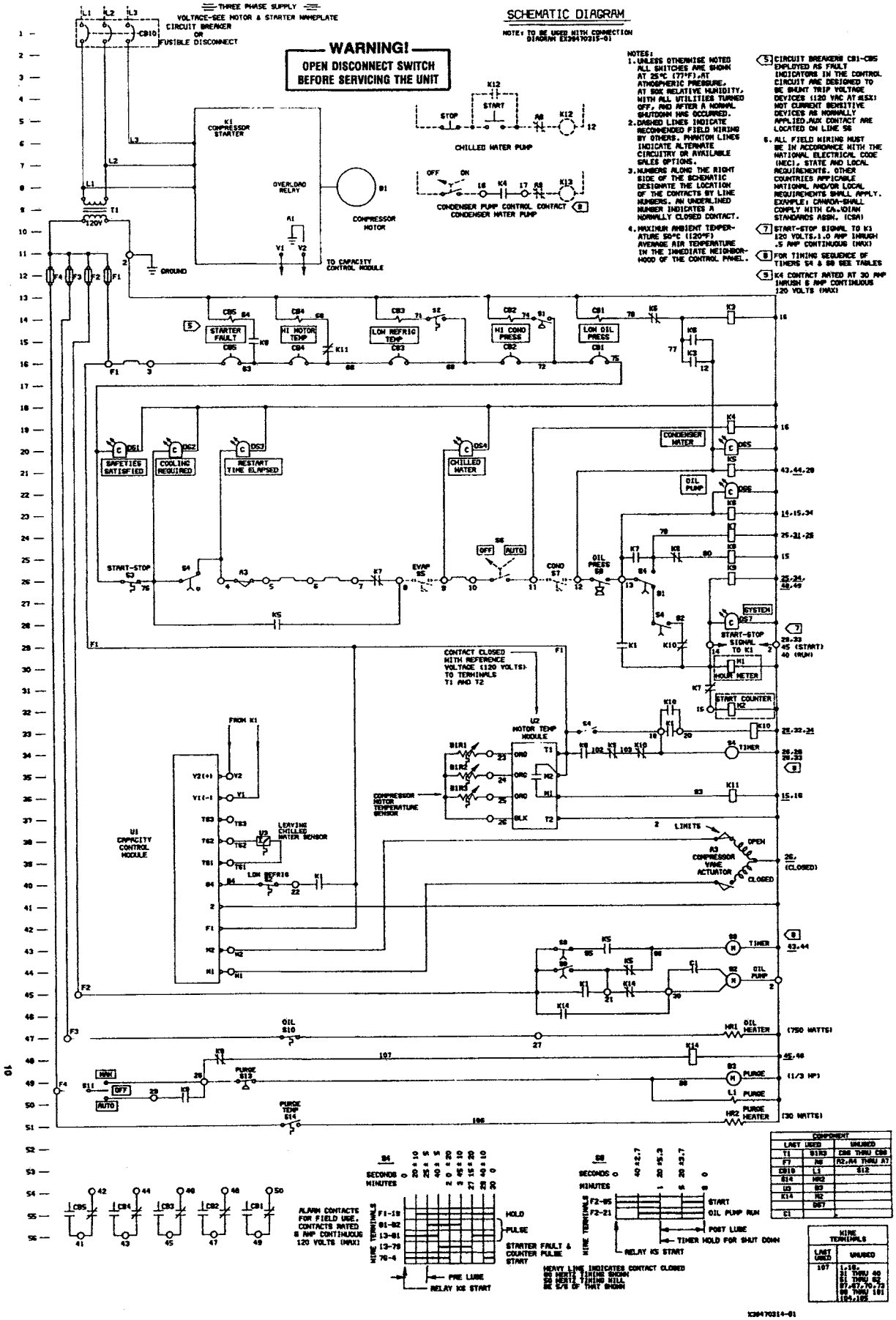
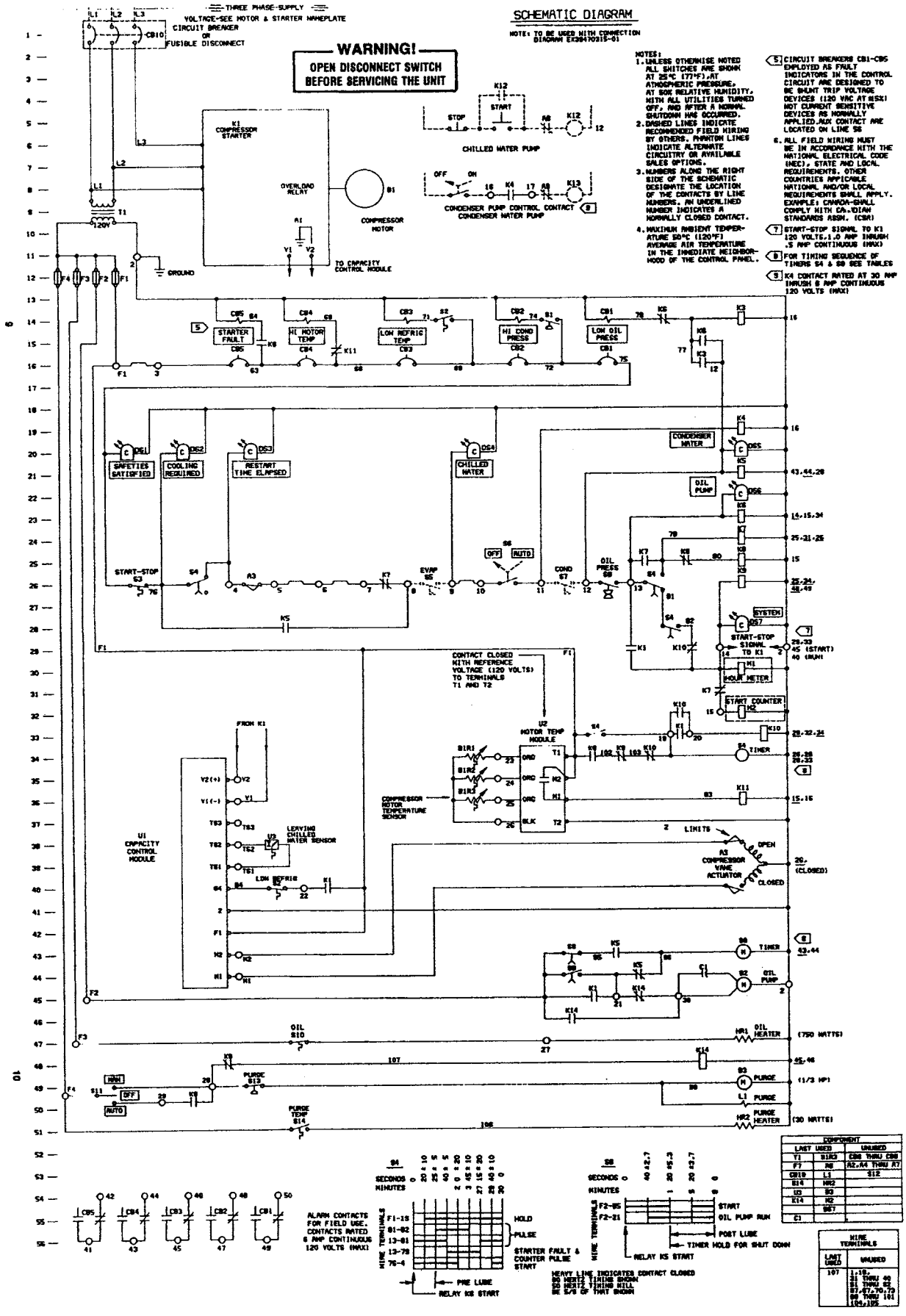


FIGURE 2 - Typical Schematic Diagram, Electric Capacity Control



NOTES:
1. UNLESS OTHERWISE NOTED ALL SWITCHES ARE SHOWN AT 25°C (77°F) AT ATMOSPHERIC PRESSURE, AT 60% RELATIVE HUMIDITY, WITH ALL UTILITIES TURNED OFF, AND AFTER A NORMAL SHUTDOWN HAS OCCURRED.
2. DASHED LINES INDICATE RECOMMENDED FIELD WIRING BY OTHERS. PHANTOM LINES INDICATE ALTERNATE CIRCUITRY OR AVAILABLE SALES OPTIONS.
3. NUMBERS ALONG THE RIGHT SIDE OF THE SCHEMATIC DESIGNATE THE LOCATION OF THE CONTACTS BY LINE NUMBERS. AN UNDERLINED NUMBER INDICATES A NORMALLY CLOSED CONTACT.
4. MAXIMUM AMBIENT TEMPERATURE 50°C (120°F) AVERAGE AIR TEMPERATURE IN THE IMMEDIATE NEIGHBORHOOD OF THE CONTROL PANEL.

5. CIRCUIT BREAKERS CB1-CB5 EMPLOYED AS FAULT INDICATORS IN THE CONTROL CIRCUIT ARE DESIGNED TO BE SHUNT TRIP VOLTAGE DEVICES (120 VAC AT 6.5X) NOT CURRENT SENSITIVE DEVICES AS NORMALLY APPLIED. AUX CONTACT ARE LOCATED ON LINE 56
6. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE (NEC), STATE AND LOCAL REQUIREMENTS. OTHER COUNTRIES APPLICABLE NATIONAL AND/OR LOCAL REQUIREMENTS SHALL APPLY. EXAMPLE: CANADA-SHALL COMPLY WITH CAN/CSA STANDARDS ASSN. (CSA)
7. START-STOP SIGNAL TO K1 120 VOLTS, 1.0 AMP INRUSH .5 AMP CONTINUOUS (MAX)
8. FOR TIMING SEQUENCE OF TIMERS S4 & S8 SEE TABLES
9. K4 CONTACT RATED AT 30 AMP INRUSH 6 AMP CONTINUOUS 120 VOLTS (MAX)

COMPONENT		
LAST USED		UNUSED
T1	B1R3	CB6 THRU CB8
F7	K8	A2,A4 THRU A7
CB10	L1	S12
B14	HR2	
U2	S3	
K14	H2	
	S87	
C1		

WIRE TERMINALS	
LAST USED	UNUSED
107	1-10, 31 THRU 40 51 THRU 62 67,67,70,73 88 THRU 101 104,105

FIGURE 2 - Typical Schematic Diagram, Electric Capacity Control

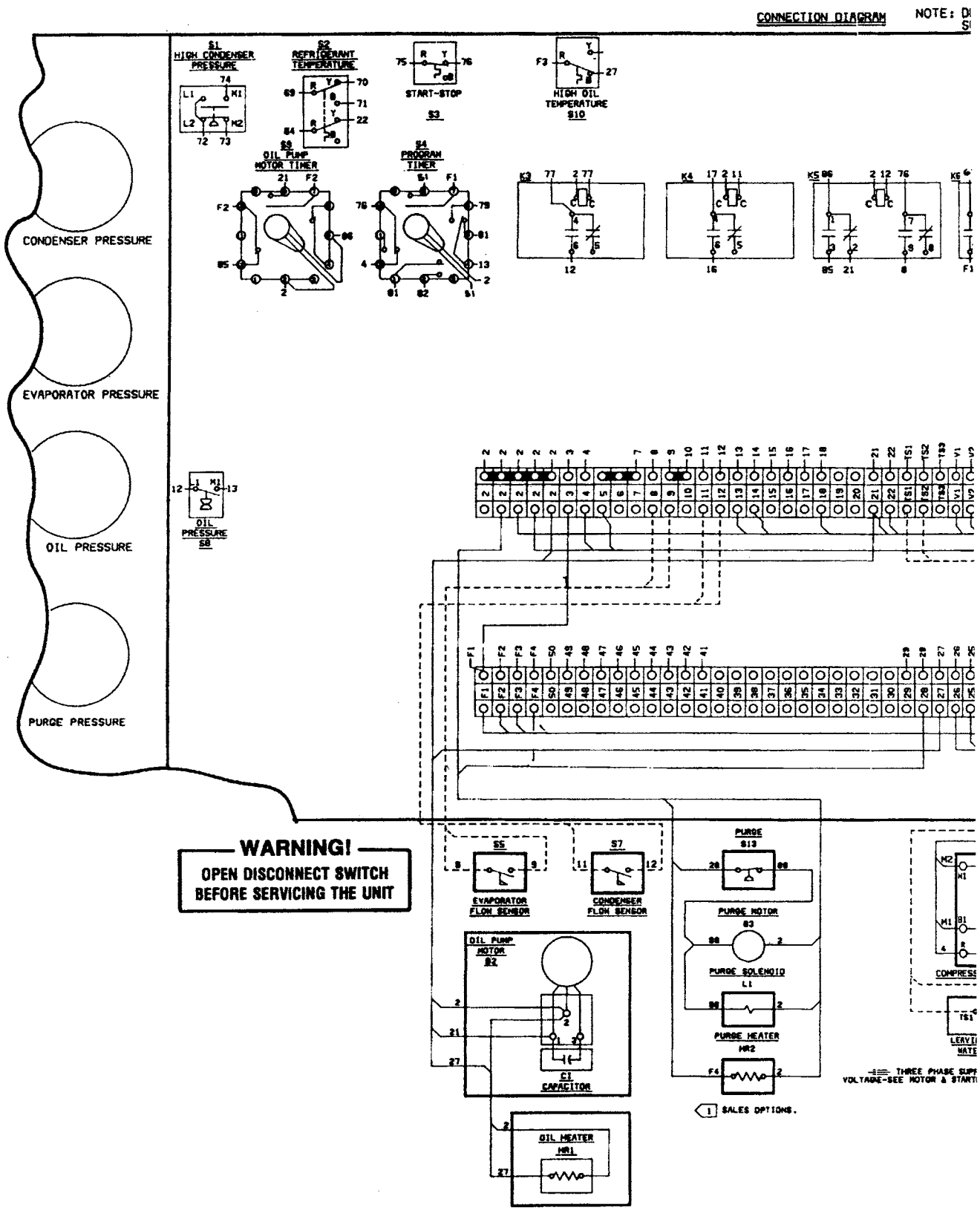
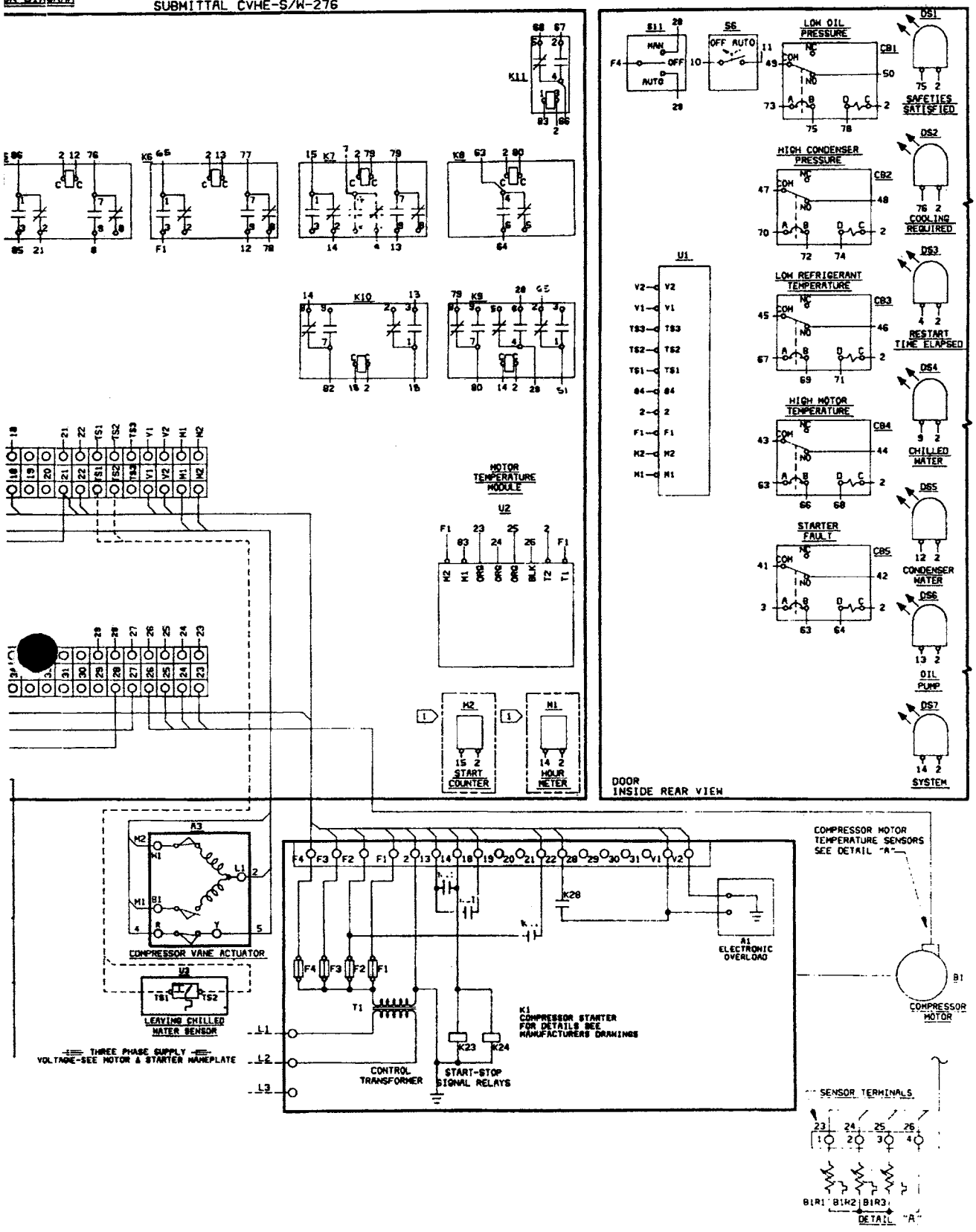


FIGURE 3 - Typical Field Connection Diagram, Electric Capacity Control

ON DIAGRAM NOTE: DESIGNED TO BE USED WITH SCHEMATIC SUBMITTAL CVHE-S/W-276



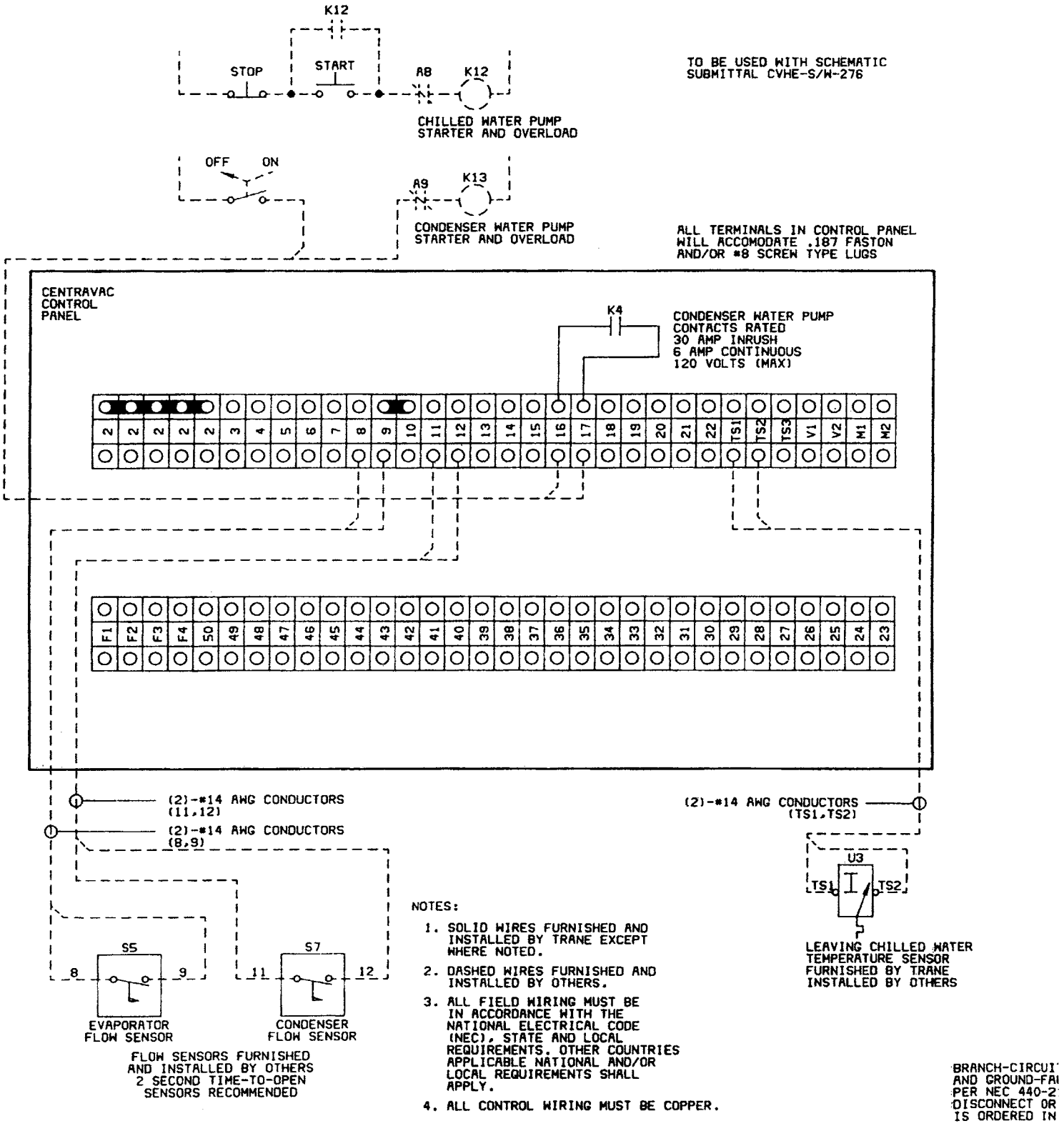


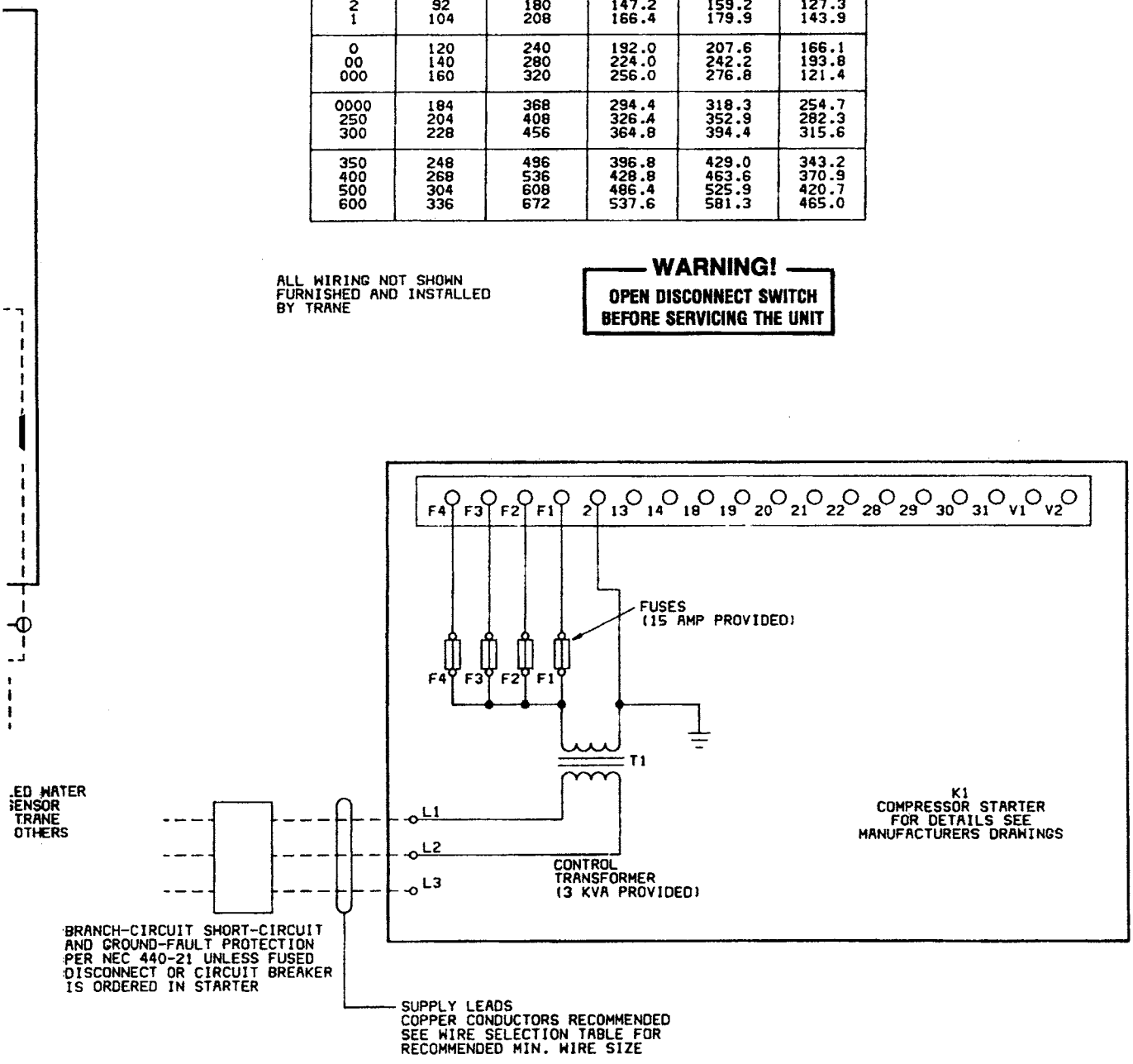
FIGURE 4 - Typical Field Connection Diagram, Electric Capacity Control, Unit Mounted Starter

MIN. WIRE SIZE COPPER 75°C	WIRE SELECTION TABLE (REF. NEC 1981) RATED LOAD CURRENT (NAMEPLATE)				
	SUPPLY LEADS OR MOTOR LEADS FOR ACROSS-THE-LINE OR AUTO-TRANS STARTER			MOTOR LEADS FOR STAR DELTA STARTER	
	1 CONDUIT 3 WIRES	2 CONDUITS 3 WIRES EA	1 CONDUIT 6 WIRES	2 CONDUITS 3 WIRES EA	1 CONDUIT 6 WIRES
8	40	80	64.0	69.2	55.4
6	52	104	83.2	90.0	72.0
4	68	136	108.8	117.6	94.1
3	80	160	128.0	138.4	110.7
2	92	180	147.2	159.2	127.3
1	104	208	166.4	179.9	143.9
0	120	240	192.0	207.6	166.1
00	140	280	224.0	242.2	193.8
000	160	320	256.0	276.8	121.4
0000	184	368	294.4	318.3	254.7
250	204	408	326.4	352.9	282.3
300	228	456	364.8	394.4	315.6
350	248	496	396.8	429.0	343.2
400	268	536	428.8	463.6	370.9
500	304	608	486.4	525.9	420.7
600	336	672	537.6	581.3	465.0

ALL WIRING NOT SHOWN FURNISHED AND INSTALLED BY TRANE

WARNING!

OPEN DISCONNECT SWITCH BEFORE SERVICING THE UNIT



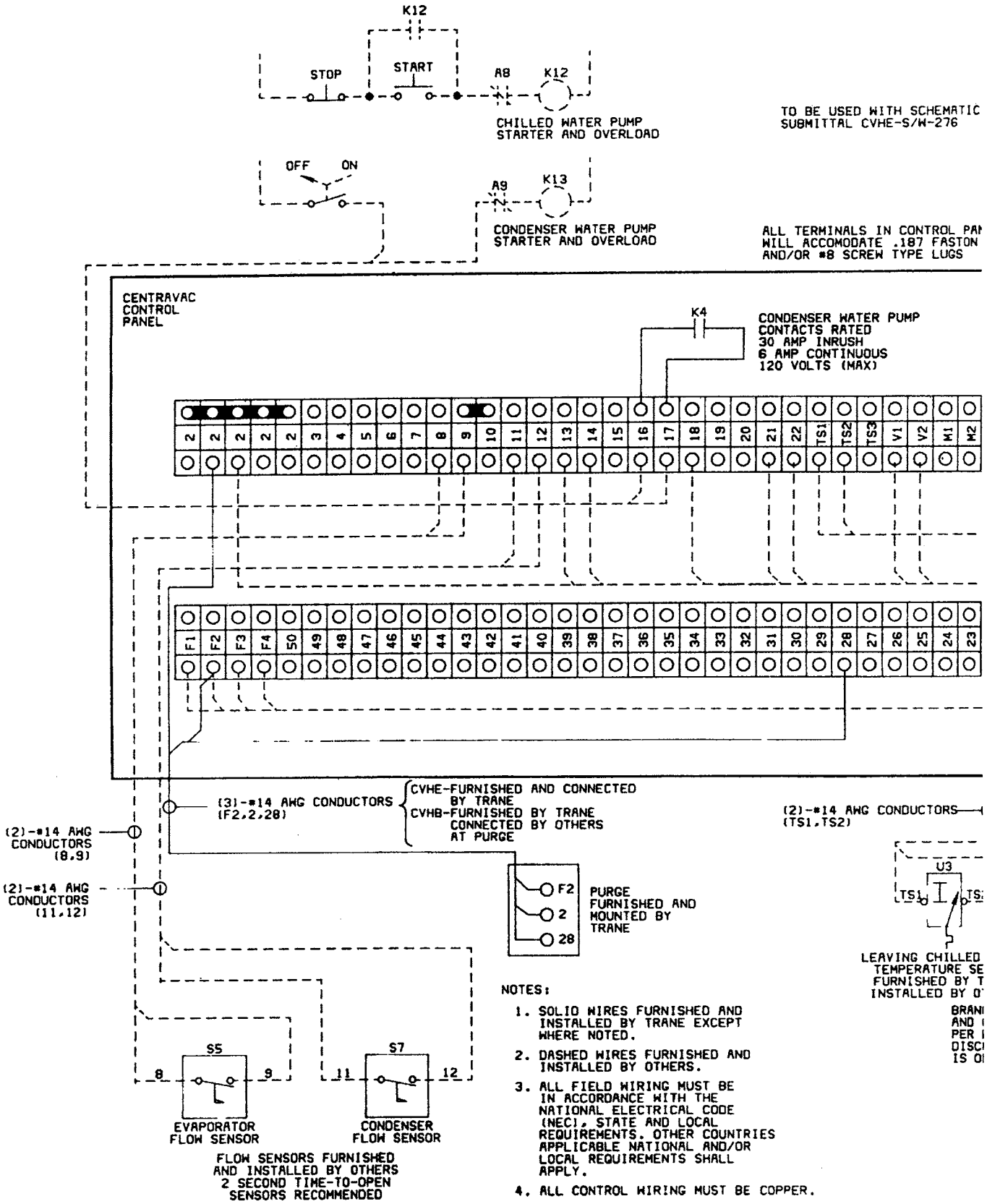


FIGURE 5 - Typical Field Connection Diagram, Electric Capacity Control, Remote Starter

USED WITH SCHEMATIC
TAL CVHE-S/W-276

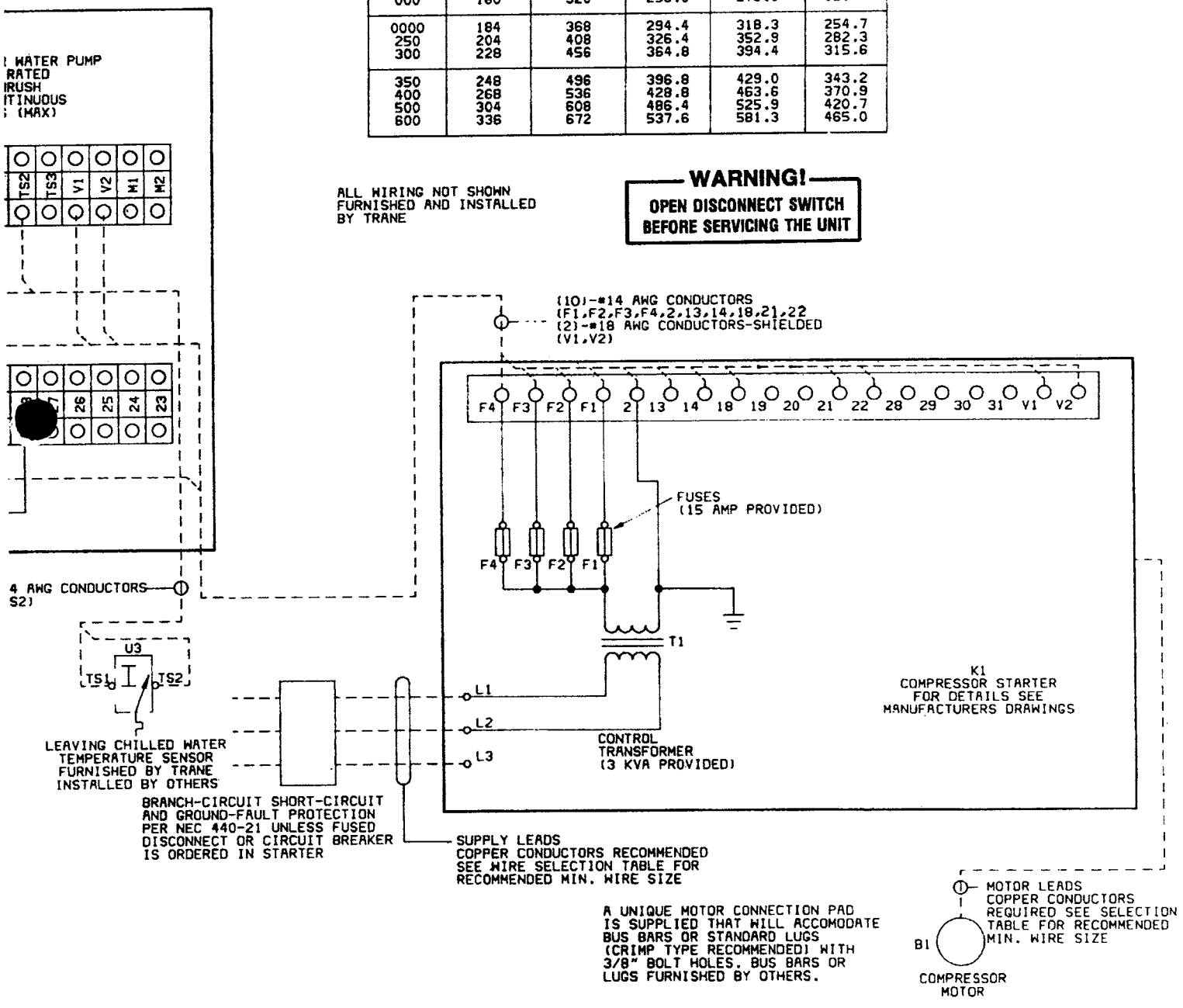
MIN. WIRE SIZE COPPER 75°C	WIRE SELECTION TABLE (REF. NEC 1981) RATED LOAD CURRENT (NAMEPLATE) SUPPLY LEADS OR MOTOR LEADS FOR ACROSS-THE-LINE, AUTO-TRANS STARTER OR PRIMARY REACTOR STARTER			MOTOR LEADS FOR STAR DELTA STARTER	
	1 CONDUIT 3 WIRES	2 CONDUITS 3 WIRES EA	1 CONDUIT 6 WIRES	2 CONDUITS 3 WIRES EA	1 CONDUIT 6 WIRES
8	40	80	64.0	69.2	55.4
6	52	104	83.2	90.0	72.0
4	68	136	108.8	117.6	94.1
3	80	160	128.0	138.4	110.7
2	92	180	147.2	159.2	127.3
1	104	208	166.4	179.9	143.9
0	120	240	192.0	207.6	166.1
00	140	280	224.0	242.2	193.8
000	160	320	256.0	276.8	121.4
0000	184	368	294.4	318.3	254.7
250	204	408	326.4	352.9	282.3
300	228	456	364.8	394.4	315.6
350	248	496	396.8	429.0	343.2
400	268	536	428.8	463.6	370.9
500	304	608	486.4	525.9	420.7
600	336	672	537.6	581.3	465.0

INALS IN CONTROL PANEL
)MODATE .187 FASTON
3 SCREW TYPE LUGS

I WATER PUMP
RATED
IRUSH
ITINUOUS
; (MAX)

ALL WIRING NOT SHOWN
FURNISHED AND INSTALLED
BY TRANE

WARNING!
OPEN DISCONNECT SWITCH BEFORE SERVICING THE UNIT



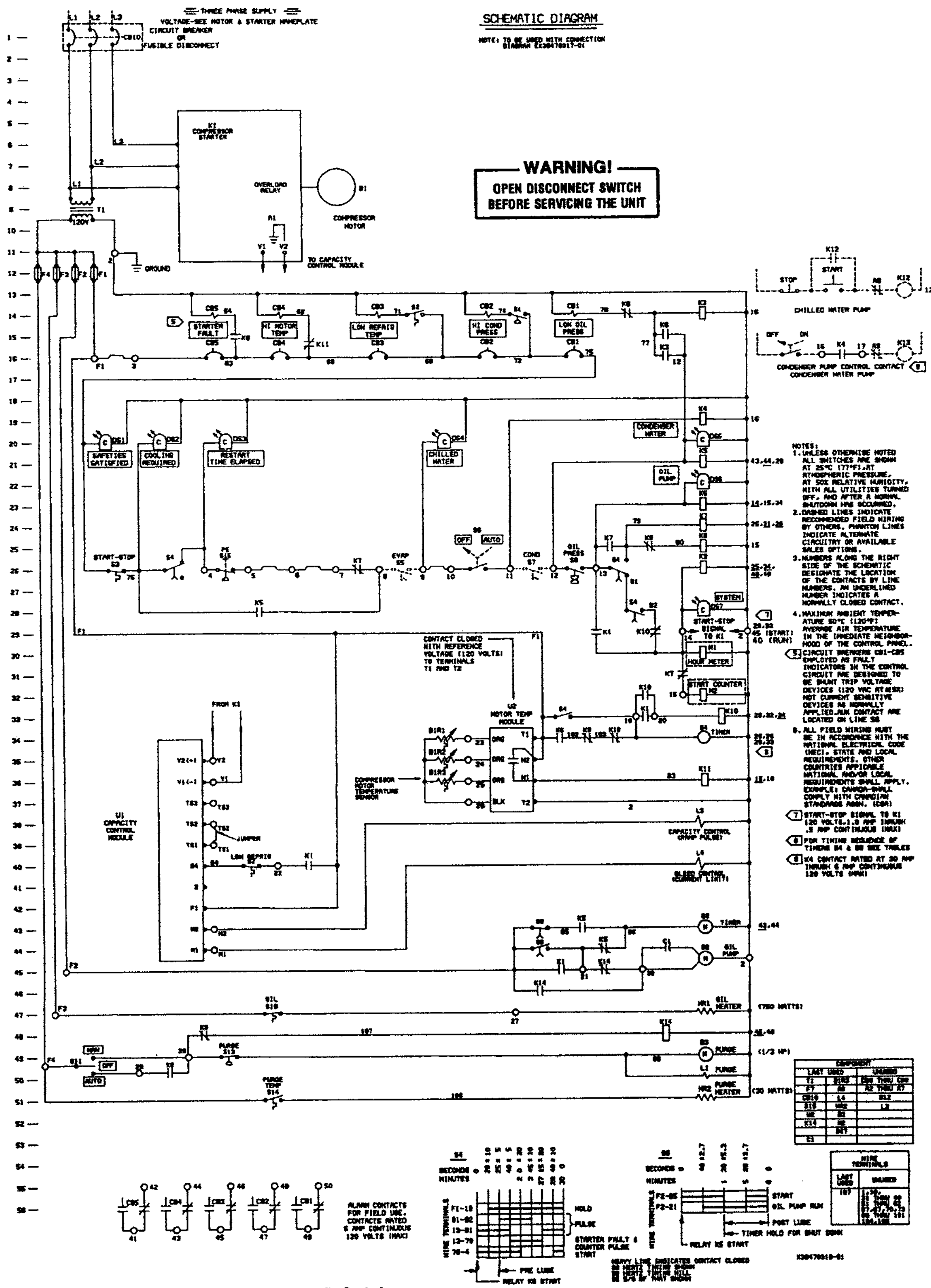


FIGURE 6 - Typical Schematic Diagram, Pneumatic Capacity Control

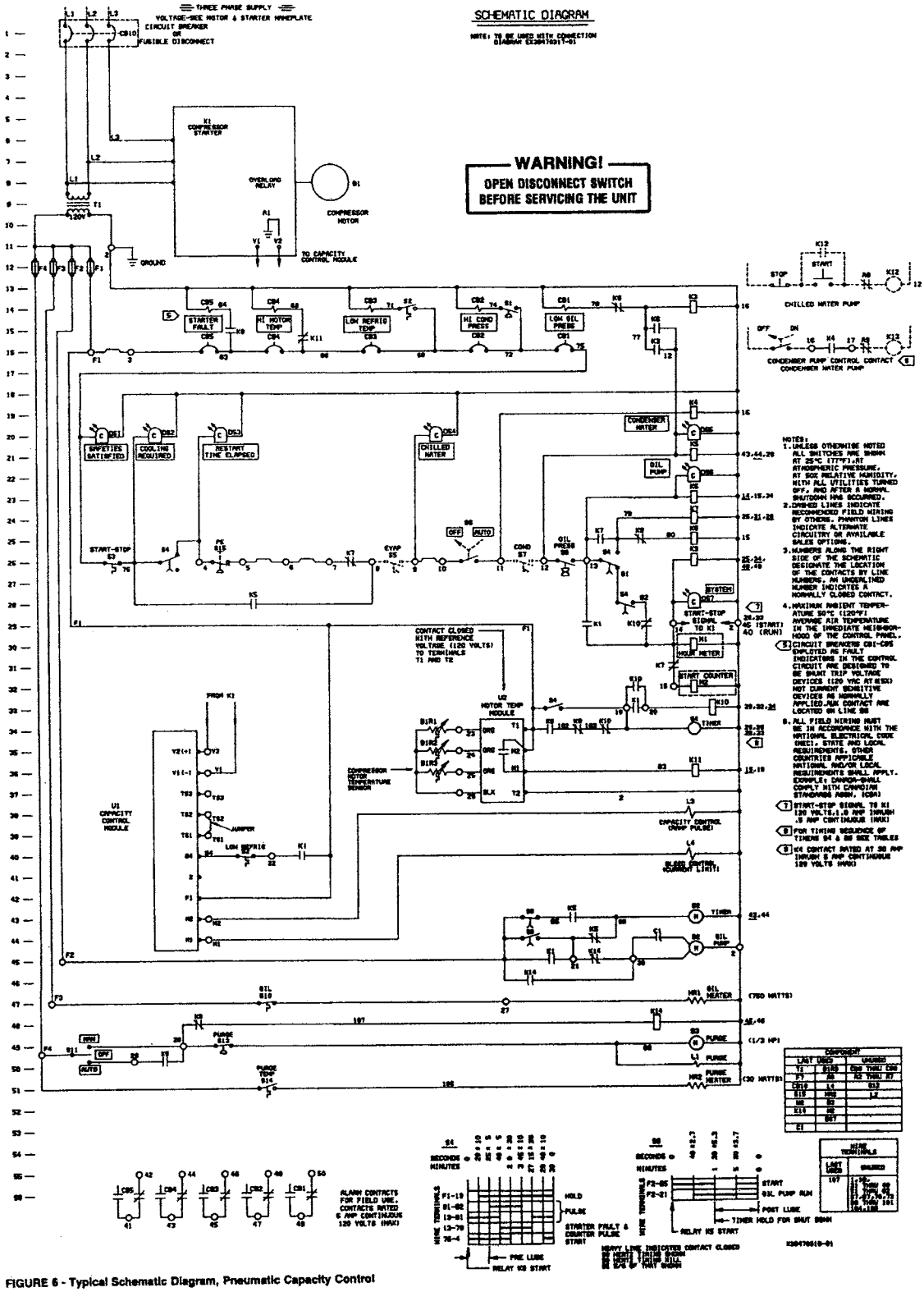


FIGURE 6 - Typical Schematic Diagram, Pneumatic Capacity Control

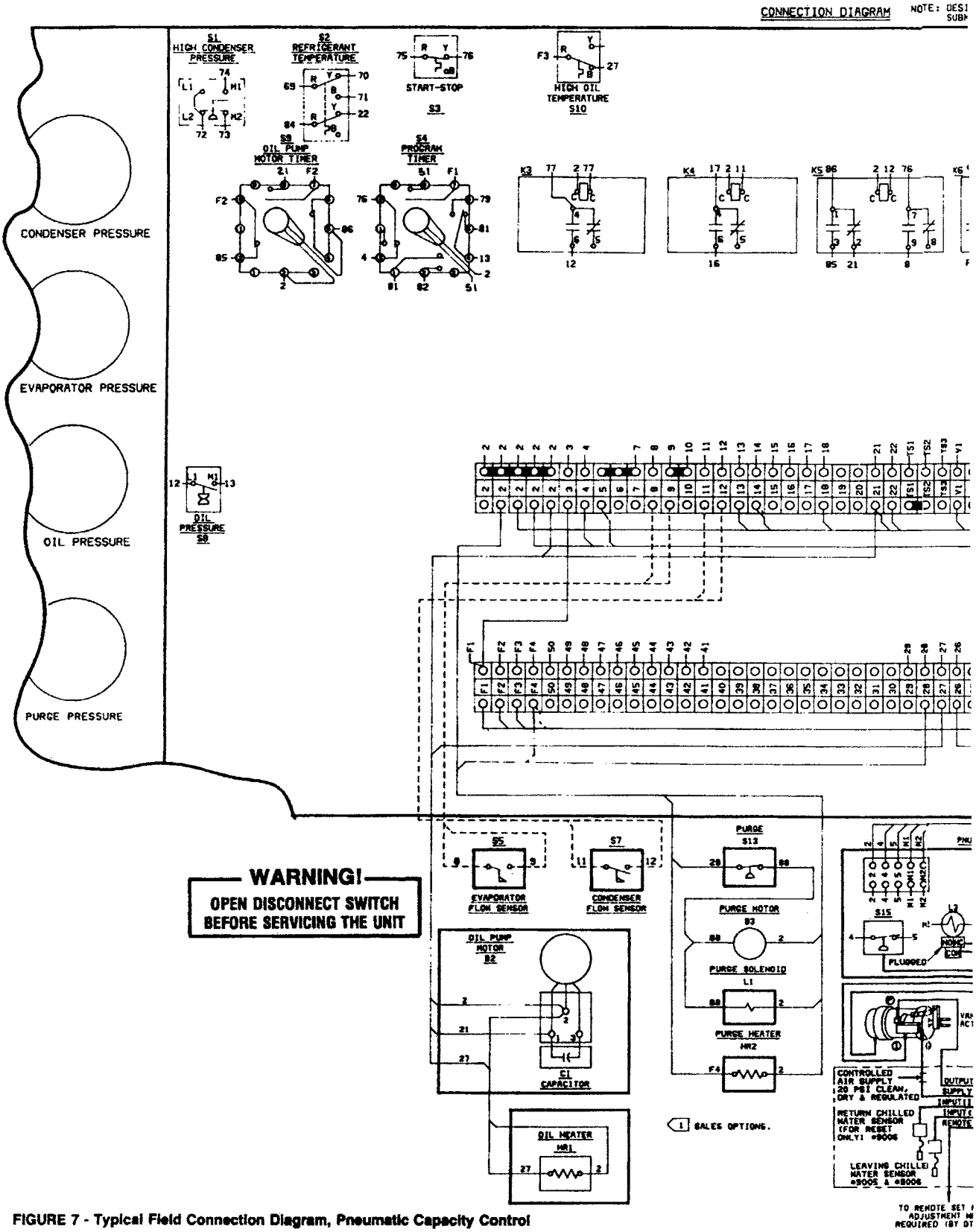
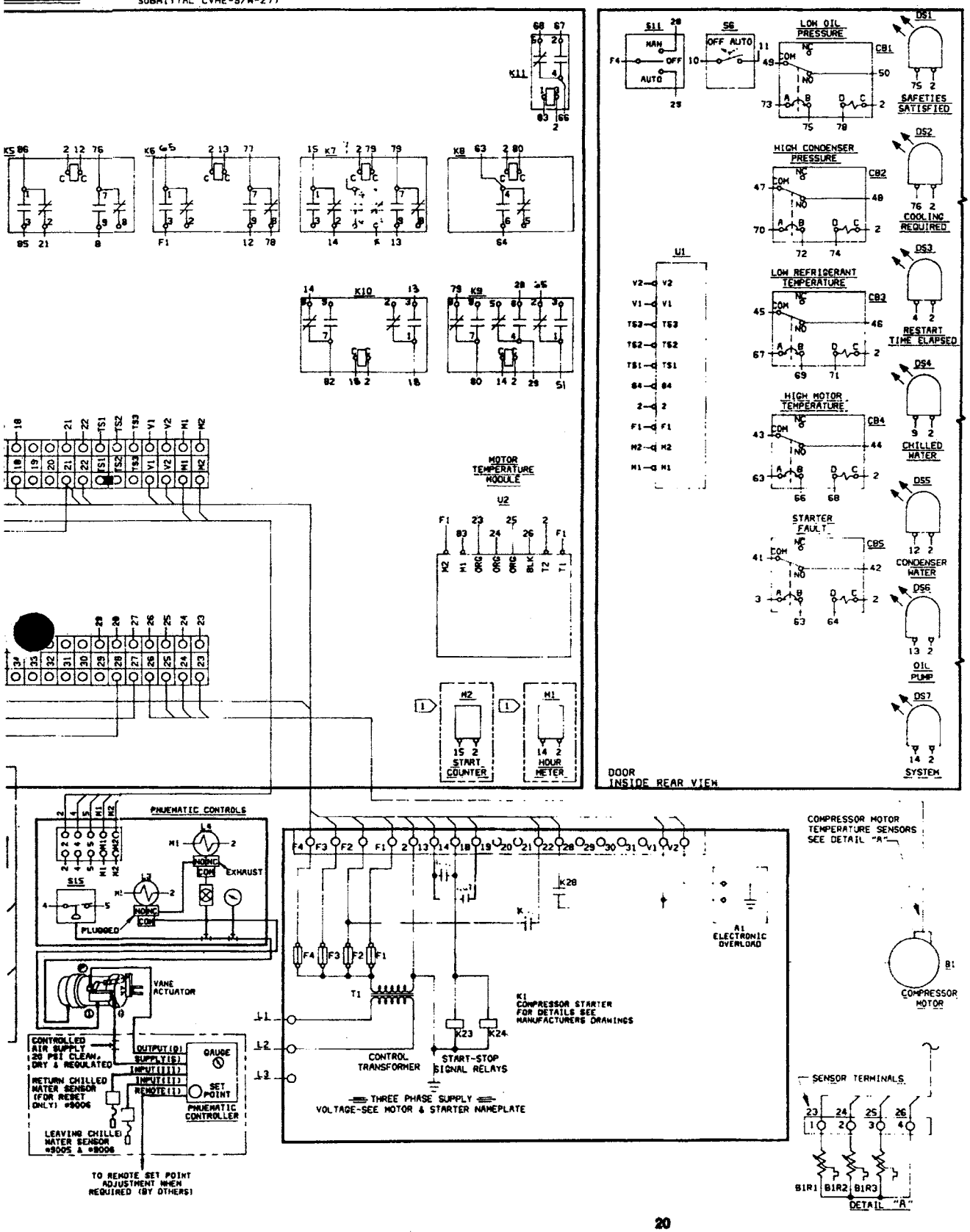


FIGURE 7 - Typical Field Connection Diagram, Pneumatic Capacity Control

ION DIAGRAM NOTE: DESIGNED TO BE USED WITH SCHEMATIC SUBMITTAL CVHE-S/W-277



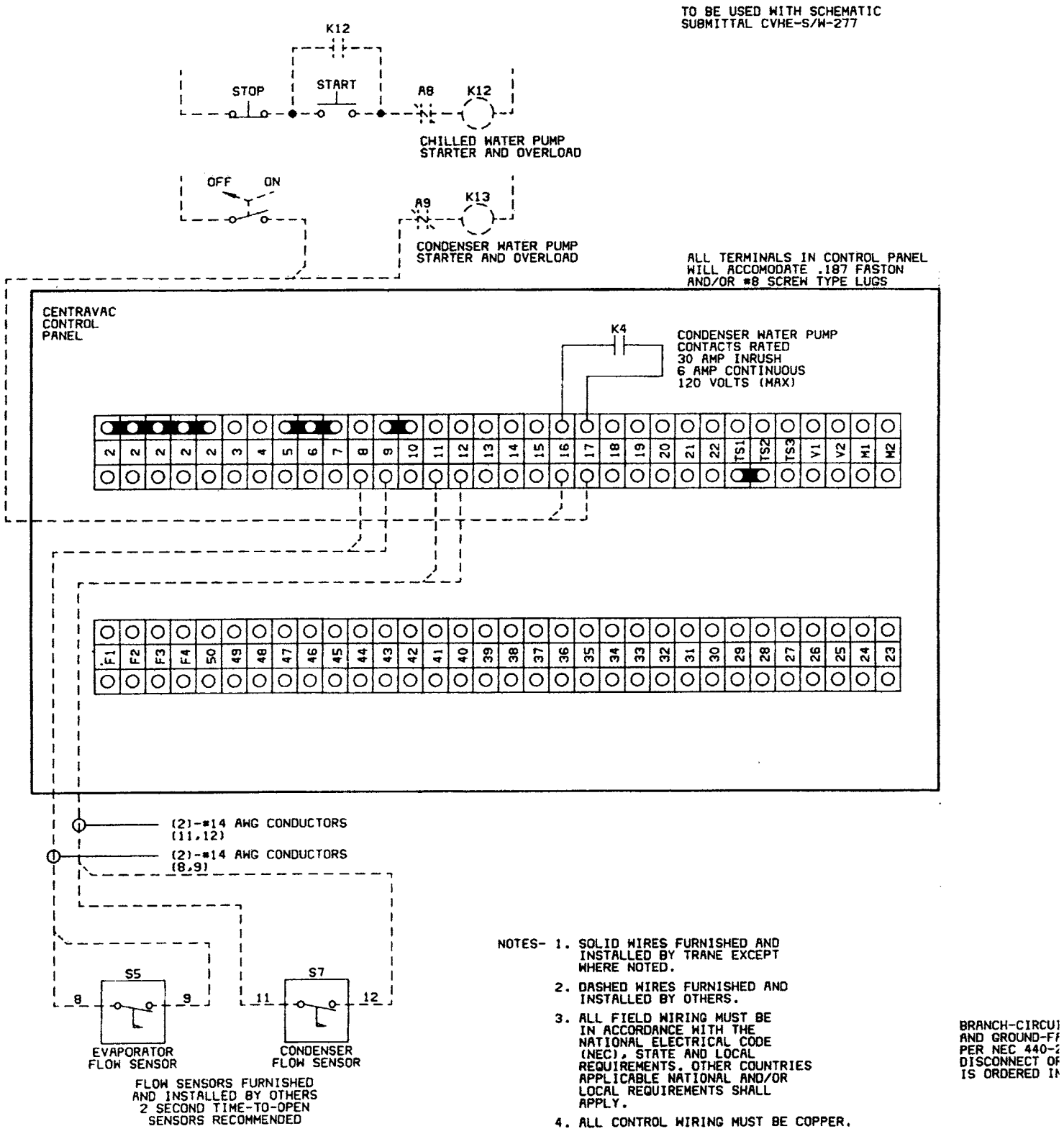
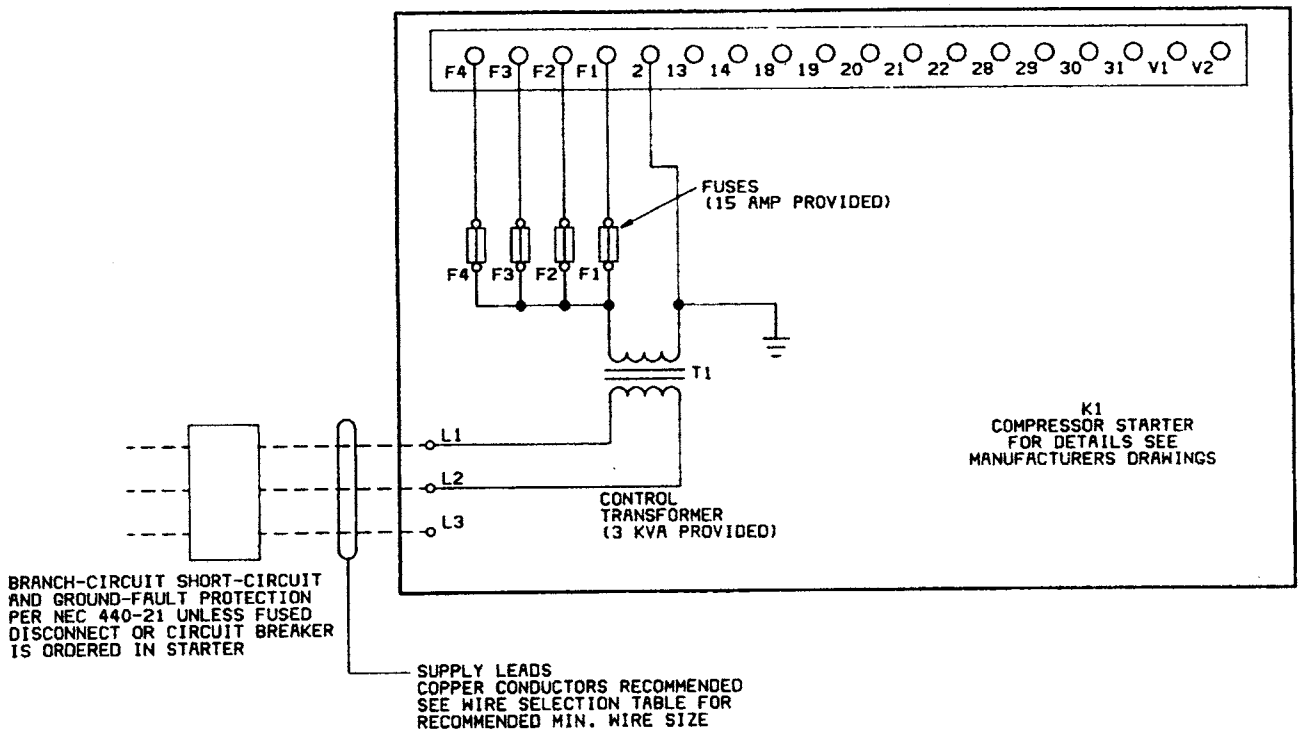


FIGURE 8 - Typical Field Connection Diagram, Pneumatic Capacity Control, Unit Mounted Starter

WIRE SELECTION TABLE (REF. NEC 1981)					
	RATED LOAD CURRENT (NAMEPLATE)				
MIN. WIRE SIZE COPPER 75°C	SUPPLY LEADS OR MOTOR LEADS FOR ACROSS-THE-LINE OR AUTO-TRANS STARTER			MOTOR LEADS FOR STAR DELTA STARTER	
	1 CONDUIT 3 WIRES	2 CONDUITS 3 WIRES EA	1 CONDUIT 6 WIRES	2 CONDUITS 3 WIRES EA	1 CONDUIT 6 WIRES
8	40	80	64.0	69.2	55.4
6	52	104	83.2	90.0	72.0
4	68	136	108.8	117.6	94.1
3	80	160	128.0	138.4	110.7
2	92	180	147.2	159.2	127.3
1	104	208	166.4	179.9	143.9
0	120	240	192.0	207.6	166.1
00	140	280	224.0	242.2	193.8
000	160	320	256.0	276.8	121.4
0000	184	368	294.4	318.3	254.7
250	204	408	326.4	352.9	282.3
300	228	456	364.8	394.4	315.6
350	248	496	396.8	429.0	343.2
400	268	536	428.8	463.6	370.9
500	304	608	486.4	525.9	420.7
600	336	672	537.6	581.3	465.0

ALL WIRING NOT SHOWN FURNISHED AND INSTALLED BY TRANE

WARNING!
OPEN DISCONNECT SWITCH BEFORE SERVICING THE UNIT



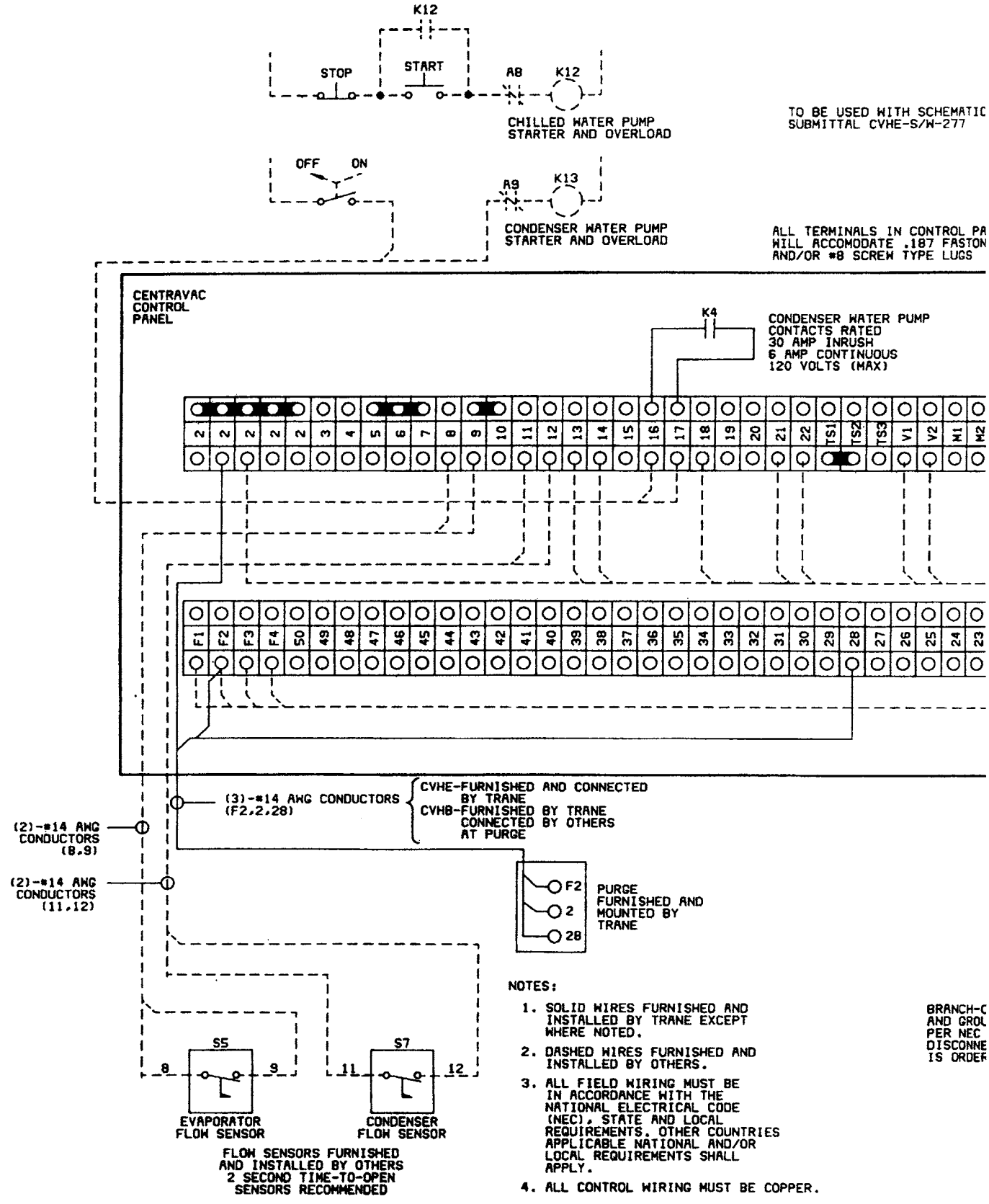


FIGURE 9 - Typical Field Connection Diagram, Pneumatic Capacity Control, Remote Starter

USED WITH SCHEMATIC
TAL CVHE-S/W-277

MIN. WIRE SIZE COPPER 75°C	WIRE SELECTION TABLE (REF. NEC 1981) RATED LOAD CURRENT (NAMEPLATE)				
	SUPPLY LEADS OR MOTOR LEADS FOR ACROSS-THE-LINE, AUTO-TRANS STARTER OR PRIMARY REACTOR STARTER			MOTOR LEADS FOR STAR DELTA STARTER	
	1 CONDUIT 3 WIRES	2 CONDUITS 3 WIRES EA	1 CONDUIT 6 WIRES	2 CONDUITS 3 WIRES EA	1 CONDUIT 6 WIRES
8	40	80	64.0	69.2	55.4
6	52	104	83.2	90.0	72.0
4	68	136	108.8	117.6	94.1
3	80	160	128.0	138.4	110.7
2	92	180	147.2	159.2	127.3
1	104	208	166.4	179.9	143.9
0	120	240	192.0	207.6	166.1
00	140	280	224.0	242.2	193.8
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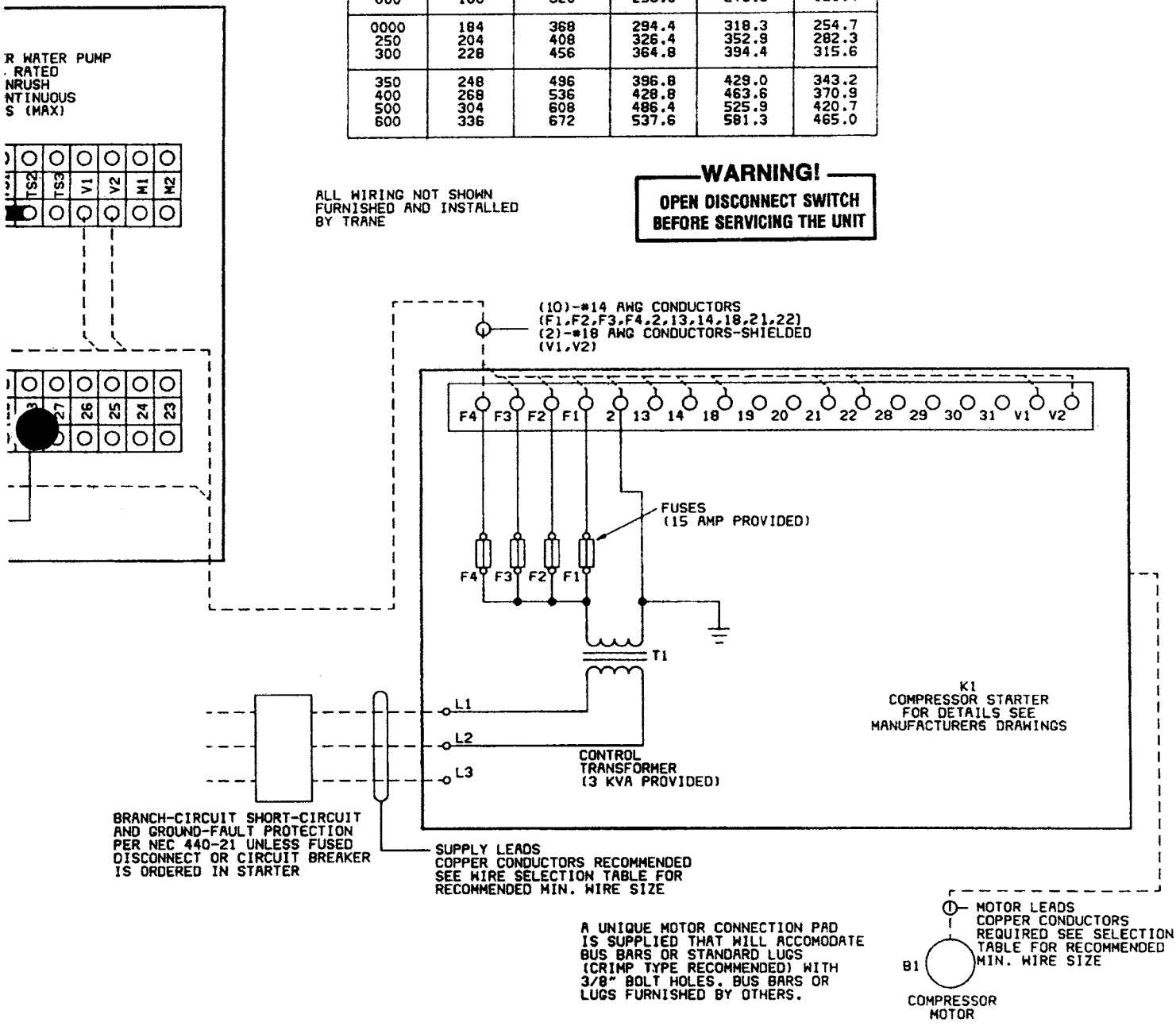
400	268	536	428.8	463.6	370.9
500	304	608	486.4	525.9	420.7
600	336	672	537.6	581.3	465.0

INALS IN CONTROL PANEL
COMODATE .187 FASTON
#8 SCREW TYPE LUGS

R WATER PUMP
RATED
NRUSH
NTINUOUS
S (MAX)

ALL WIRING NOT SHOWN
FURNISHED AND INSTALLED
BY TRANE

WARNING!
OPEN DISCONNECT SWITCH BEFORE SERVICING THE UNIT



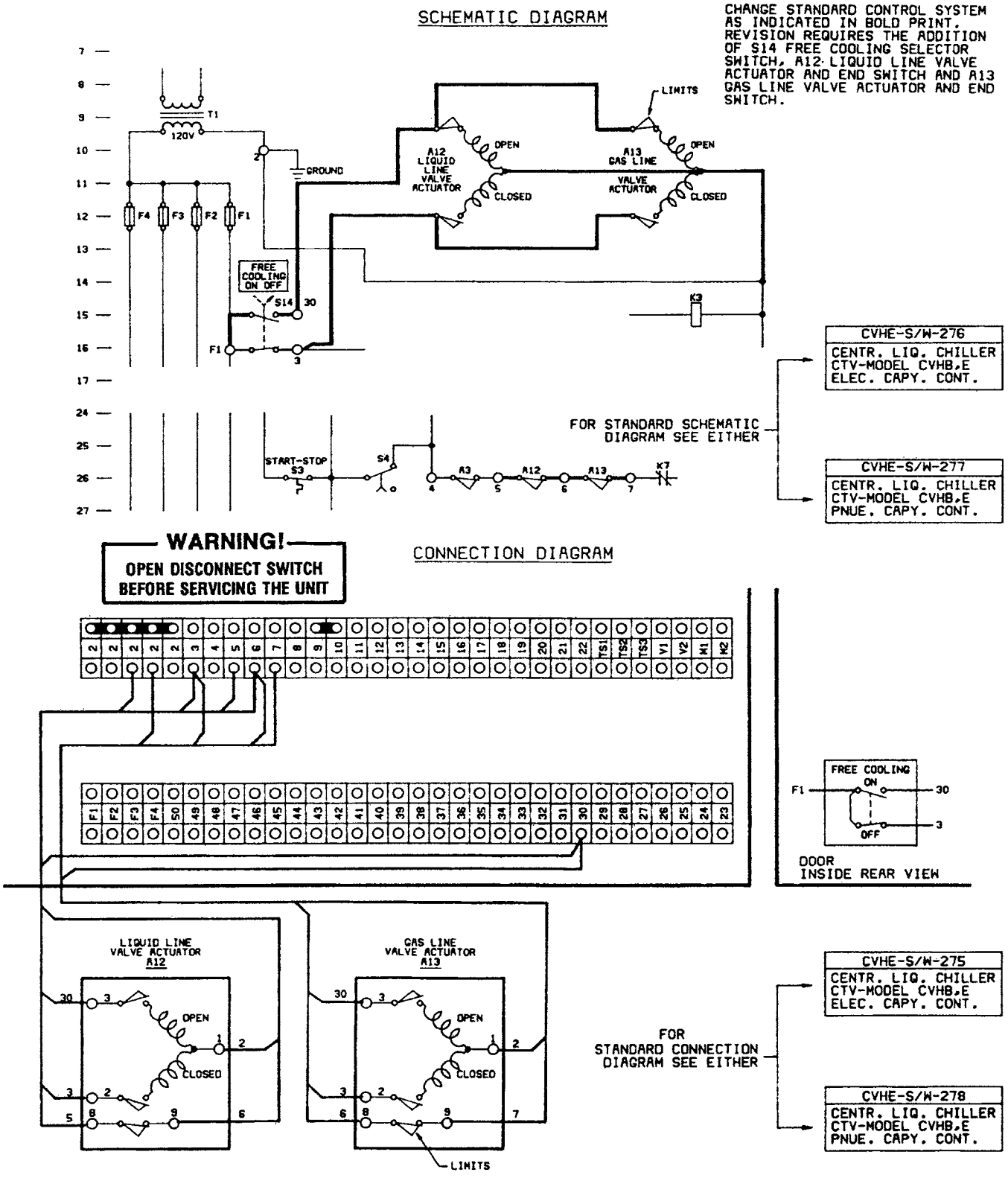


FIGURE 10 - Typical Schematic and Field Connection Diagram For Free Cooling Option

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