TRANE

See Table of Contents p6 for the page numbers of each section

Service Guide

Series R CenTraVac® Chiller Model RTHA

Commercial Systems Group

Important Notices

World environmental scientists have concluded, based on the best currently available evidence, that ozone in our upper atmosphere is being reduced, due to the release of CFC fully-halogenated compounds.

The Trane Company urges all HVAC servicers, working on Trane equipment and other manufacturer's products, to make every effort to eliminate, if possible, or vigorously reduce emissions of CFC, HCFC and HFC refrigerants to the atmosphere resulting from installation, operation, routine maintenance, or major service on this equipment. Always act in a responsible manner to conserve refrigerants for continued use, even when acceptable alternatives are available.

Conservation and emission reduction can be accomplished by following Trane operation, maintenance and service procedures, with specific attention to the following:

1. Refrigerants used in any type of air conditioning or refrigerating equipment should be recovered for reuse, recovered and/or recycled for reuse, reprocessed (reclaimed), or properly destroyed, whenever it is removed from equipment. Never release refrigerant to the atmosphere.

2. Always determine possible recycle or reclaim requirements of the recovered refrigerant before beginning recovery by any method. (Questions about recovered refrigerants and acceptable refrigerant quality standards are addressed in ARI Standard 700).

3. Use approved containment vessels and safety standards. Comply with all applicable transportation standards when shipping refrigerant containers.

4. In order to assist in reducing power generation emissions, always attempt to improve equipment performance with improved maintenance and operations, which will help conserve energy resources.

Series R CenTraVac®
Service Guide
RLC-SG-1

Forward

This Service Guide is designed to provide the Service Engineer with detailed instructions for servicing the Trane Series R CenTraVac®. The information, illustrations and procedures presented in this manual are intended to provide instructions that will give these units long and useful operating lives. By consulting specific sections, the Service Engineer will become acquainted with the components of the unit, as well as the proper procedures to follow during start-up, troubleshooting and repair.

This manual describes equipment being manufactured at the time of its publication. As equipment designs change or new units are introduced, new sections of this manual will be issued. Existing sections will be revised and updated to reflect the latest product developments.

Commercial air conditioning equipment requires substantial electric current draw. High speed moving parts also constitute a potential hazard. It is important that personal safety and the safety of others is given careful consideration.

In the interest of providing continuing, quality service information to the Trane technical force, new ideas and comments are solicited from qualified Service Engineers, for incorporation into this manual. With individual cooperation, this Service Guide will become an increasingly valuable tool for the Service Engineer.

Table of Contents
Series R CenTraVac®
Model RTHA

Important Notices

Anytime access to the refrigerant side of the equipment is required, the pumpdown procedures outlined in section 7.1 should be performed before entering the system. Make sure that pre-pumpdown checks are performed before pumping down the system.

Caution: Water must be flowing through the tube bundles during this process. Refrigerant pressures below 70 psig can cause freezing and rupturing of the heat exchangers.

Caution: Do not charge refrigerant into the unit unless there is water flow.

Caution: Do not charge liquid refrigerant into the unit unless the temperature/pressure relationship is above 70 psig.

If the unit does not have isolation valves to isolate the refrigerant charge, a reclaiming process for transfer of the refrigerant must be used.

Caution: It is essential to confirm that proper phase rotation is established - Phase A to L1, Phase B to L2, and Phase C to L3. Phase rotation must be checked with a phase sequence indicator before start-up, otherwise catastrophic damage to the compressor may result.

If this is the initial start-up or the main power system has been modified, do not rely on the phase sequence relay in the starter panel (unit-mounted or remote-mounted) or the motor terminal box to indicate phase rotation.

If rotation is incorrect, follow the instructions in RTHA-IOM to establish proper rotation.

IOM

Section 1.0 Installation, Operation and Maintenance Manual
• RTHA-IOM-1

Unit Wiring page10

Section 2.0 Unit-Mounted and Remote-Mounted Starter Wiring Diagrams
• RTHA-W-1B
• RTHA-W-2

Start-Up page30

Section 3.0 Start-up Guide For Unit-Mounted and Remote-Mounted Starter

Section 3.1 Preliminary Job Site Inspection

Section 3.2 Job Site Check-out Two Weeks Prior To Start-up

Section 3.3 Preparation

Section 3.4 Start-up

Controls page52

Section 5.0 Controls, Operation, Set-up and Troubleshooting

Section 5.1 Oil Flow Switch Operation

Section 5.2 Oil Tank Heater and Wattage

Section 5.3 Electrical Phasing and Phase Monitor For Unit-Mounted and Remote-Mounted Starters

Section 5.4 Ice Making Panel Operation for Design Sequence A thru H only. See RTHA-SB-8 for New Panel Operation.

Unit Disassembly page57

Section 6.0 RTHA Torque Specifications and Metric Socket Sizes

Section 6.1 RTHA Disassembly Dimensions for Limited Access Installations

Section 6.2 RTHA Oil Tank Housing Removal and Replacement

Section 6.3 RTHA Compressor and Unit-Mounted Starter Removal and Replacement

Service Maintenance Page68

Section 7.0 Refrigerant Filter Service and Replacement Procedures

Section 7.1 Refrigerant Pumpdown Evacuation and Recharging for Units with Isolation Valves

Section 7.2 Refrigerant Evacuation Procedures Without Use of the Compressor

Section 7.3 Refrigerant Transfer

Section 7.5 Refrigerant Charging Procedures for Units That Have Been Completely Evacuated

Unit Repair page77

Section 8.0 Condenser and Evaporator Tube Removal and Replacement

Compressor Repair page85

Section 9.0 Motor Terminal Replacement

Section 9.1 Load and Unload Solenoid Replacement

Service Bulletins page92

Section 10.0 General Information and Current Service Bulletins

The Trane Company
La Crosse, Wisconsin 54601-7599
Printed in U.S.A.

TRANE™

Installation, Operation and Maintenance Manual

Literature File No.	RLC-SG-1
Section	1.0
Date	June 1990

The manual which follows this page contains information and instructions necessary for the proper installation, operation, and maintenance of the Series R CenTraVac® Chiller Units.

RTHA-IOM-1A

WILL BE REPLACED BY

RTHB-IOM-1

IN THE NEAR FUTURE

TRANE

Unit-Mounted and Remote-Mounted Starter Wiring Diagrams

Literature File No.	RLC-SG-1
Section	2.0
Date	June 1990

The manual which follows this page contains the current, typical field connection diagrams, electrical schematics and connection diagrams for the Series R CenTraVac® units.

TRANE™

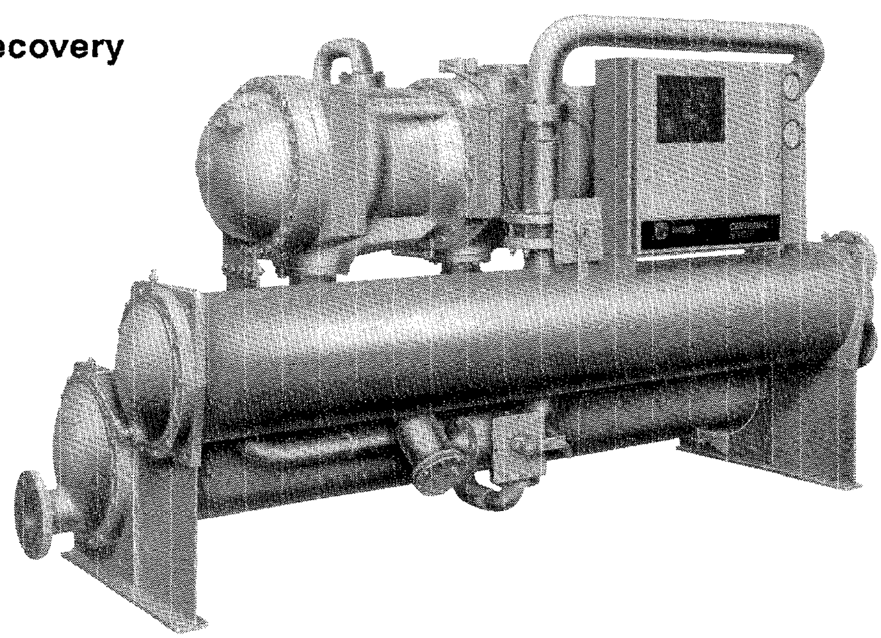
Wiring

RTHA-W-1B

Library	Service Literature
Product Section	Refrigeration
Product	Rotary Liquid Chillers - Water-Cooled
Model	RTHA
Literature Type	Unit Wiring
Sequence	1B
Date	February 1990
File No.	SV-RF-RLC-RTHA-W-1B-290
Supersedes	RTHA-W-1A Dated 488

Series R Water-Cooled Hermetic CenTraVac

Cooling-Only and Heat-Recovery Rotary Liquid Chillers



Models

RTHA 130 RTHA 215
RTHA 150 RTHA 255
RTHA 180 RTHA 300

"A" Thru "G" Design Sequences

Table of Contents

3 **General Information**
3 Literature Change History
3 Unit Electrical Data

5 **All RTHA Units**
6 Figure 1 - Field Wiring Layout and Sensor Location Schematic for RTHA Units

9 **RTHA Units W/Unit-Mounted Starter Panel**
10 Figure 2 - Field Wiring Diagram for RTHA Units with Unit-Mounted Starter
12 Figure 3 - System Schematic Diagram for RTHA Units with Unit Mounted Wye-Delta Starter (Page 1)
14 Figure 4 - System Schematic for RTHA Units with Unit Mounted Wye-Delta Starter (Page 2)
16 Figure 5 - Control Panel Component Location Diagram for RTHA Units with Unit-Mounted Starter
17 Figure 6 - Unit Component Location Diagram for RTHA Units with Unit-Mounted Starter (Wye-Delta)
18 Figure 7 - Component Interconnection Diagram for RTHA Units with Unit-Mounted Starter (Wye-Delta)

19 **RTHA Units W/Remote-Mounted Starter Panel**
20 Figure 8 - Field Wiring Diagram for RTHA Units with Remote-Mounted Starter
22 Figure 9 - System Schematic for RTHA Units with Remote-Mounted "Wye-Delta" Starter (Page 1)
24 Figure 10 - System Schematic for RTHA Units with Remote-Mounted "Wye-Delta" Starter (Page 2)
26 Figure 11 - Control Panel Component Location Diagram for RTHA Units
27 Figure 12 - Unit Component Location for RTHA Units with Remote-Mounted Starter
28 Figure 13 - Component Interconnection Diagram for RTHA Units with Remote-Mounted Starter

The Trane Company
La Crosse, Wisconsin 54601-7599
Printed in U.S.A.

General Information

Literature Change History

RTHA-W-1 (December 1987)

Original issue of manual; provides typical field connection diagrams, electrical schematics and connection diagrams for RTHA units of "A" design sequence.

RTHA-W-1A (April 1988)

First revision of manual, updating electrical schematics and connection diagrams for UL requirements and to correct low pressure cutout (4S6) contact illustration in Figure 4. Manual still applies to RTHA units of "A" design sequence only.

RTHA-W-1B (February 1990)

Manual revised to update electrical schematics and connection diagrams and add electrical diagrams for remote-mounted starter and ice-making applications. Applies to RTHA units. "A" thru "G" design sequence.

Note: The typical wiring diagrams in this booklet are representative of the above design sequence units, and are provided only for general reference; **these diagrams may not reflect the actual wiring of your unit.** For specific electrical connection and schematic information, always refer to the wiring diagrams that shipped with the unit.

Unit Electrical Data

To determine the specific electrical characteristics of a particular chiller, always refer to the unit nameplates mounted on the condenser below the unit control panel.

A summary of unit and compressor motor electrical data is published in the "IOM" manual that shipped with the unit.

WARNING: It is imperative that L1-L2-L3 in the starter be connected in the A-B-C sequence to prevent equipment damage due to reverse rotation.

All RTHA Units

The diagrams that appear in this section are representative of all RTHA units, with unit-mounted or remote-mounted starter panels.

Figure 1
Field Wiring Layout and Sensor Location Schematic for RTHA Units

(continued on next page)

NOTES:

1. DASHED LINES INDICATE FIELD WIRING BY OTHERS. PHANTOM LINES INDICATE ALTERNATE CIRCUITRY OR AVAILABLE SALES OPTION. CHECK SALES ORDER TO DETERMINE IF WIRING IS REQUIRED FOR SPECIFIC OPTIONS.
2. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE (NEC), STATE AND LOCAL REQUIREMENTS. OTHER COUNTRIES APPLICABLE NATIONAL AND/OR LOCAL REQUIREMENTS SHALL APPLY.

3 AUXILIARY CONTROLS FOR A CUSTOMER SPECIFIED OR INSTALLED LATCHING SAFETY TRIPOUTS.

4. THE FOLLOWING CAPABILITIES ARE OPTIONAL – THEY ARE IMPLIMENTED AND WIRED AS REQUIRED FOR A SPECIFIC SYSTEM APPLICATION.

   - A CHILLED WATER RESET – REQUIRES MATCHED PAIR OF THERMISTORS FOR 4RT1 AND 4RT2. IF AMBIENT TEMP BASED CHILLED WATER RESET IS REQUIRED, USE THE STANDARD SUPPLIED LEAVING EVAP WATER TEMP SENSOR (4RT1) FOR 4RT6 AS AN AMBIENT TEMP SENSOR.
   - C ENTERING EVAP TEMP SENSOR – REQUIRES MATCHED PAIR OF THERMISTORS FOR 4RT1 AND 4RT2.
   - D ENTERING AND LEAVING CONDENSER WATER TEMP SENSORS MATCHED PAIR OF THERMISTORS FOR 4RT3 AND 4RT4.
   - E TRACER MONITORING PACKAGE INCLUDES OPTIONS "C" AND "D". IF AMBIENT TEMP BASED CHILLED WATER RESET IS REQUIRED. USE THE STANDARD SUPPLIED LEAVING EVAP WATER TEMP SENSOR (4RT1) FOR 4RT6 AS AN AMBIENT TEMP SENSOR.
   - F ICE MAKING OPTION INCLUDES 6U5, 6U6, 6RT1 & 6RT2.

5. FOR SENSOR DESCRIPTION SEE 5706-0917.

WIRING REQUIREMENTS:

DO NOT RUN LOW VOLTAGE WIRE (30 VOLTS MAX) IN CONDUIT OR RACEWAY WITH HIGHER VOLTAGE WIRE.

REQUIRED WIRING:

- 21 8 WIRES #14 AWG 600V
- 22 8 WIRES #14–#16 AWG 600V, RUN IS SEPARATE CONDUIT. USE #16 AWG UP TO 250 FT ONEWAY OR #14 AWG UP TO 400 FT ONEWAY.
- 23 COPPER WIRE ONLY SIZED PER NEC 1984 BASED ON NAMEPLATE RLA SEE TABLE 1. (IF UNIT IS SUPPLIED WITH MOUNTED STARTER, WIRING BETWEEN UNIT AND STARTER IS NOT REQUIRED)
- 24 4 WIRES #14 AWG 600V, SEPARATE 115 VAC POWER IS REQUIRED TO STARTER.
- 25 2 WIRES #14 AWG 600V
- 26 2 WIRES #14–#18 AWG 600V, DO NOT RUN IN CONDUIT WITH HIGHER VOLTAGE WIRE. SEE TABLE 2.

OPTIONAL WIRING:

- 27 3 WIRES #14 AWG 600V, SEPARATE 115 VAC POWER SUPPLY IS REQUIRED.
- 28 2 WIRES #14 AWG 600V, SEPARATE 115 VAC POWER SUPPLY IS REQUIRED.
- 29 2 WIRES #14 AWG 600V.
- 30 2 WIRES #14–#18 AWG 600V, DO NOT RUN IN CONDUIT WITH HIGHER VOLTAGE WIRE. SEE TABLE 2.
- 31 SHIELDED TWISTED PAIR, 30V OR LESS #14–#18 AWG 600V. MAX LENGTH 5000 FT. DO NOT RUN IN CONDUIT WITH HIGHER VOLTAGE WIRE.
- 32 IF UNIT IS SUPPLIED WITH MOUNTED STARTER, FIELD WIRING BETWEEN UNIT AND STARTER IS NOT REQUIRED.

⚠ WARNING	⚠ CAUTION
DISCONNECT ELECTRIC POWER SUPPLY BEFORE SERVICING TO PREVENT INJURY OR DEATH DUE TO ELECTRICAL SHOCK.	USE COPPER CONDUCTORS ONLY TO PREVENT EQUIPMENT DAMAGE. UNIT TERMINALS ARE NOT DESIGNED TO ACCEPT ANY OTHER WIRING.
AVERTISSEMENT	ATTENTION
DEBRANCHER DU CIRCUIT D'ALIMENTATION ELECTRIQUE AVANT L'ENTRETIEN POUR EVITER BLESSURE OU MORT PAR ELECTROCUTION.	UTILISER SEULEMENT DES CONDUCTEURS EN CUIVRE POUR EVITER D'ENDOMMAGER L'EQUIPMENT. LES BORNES NE SONT PAS PREVUES POUR AUTRES TYPES DE FILS CONDUCTEURS.

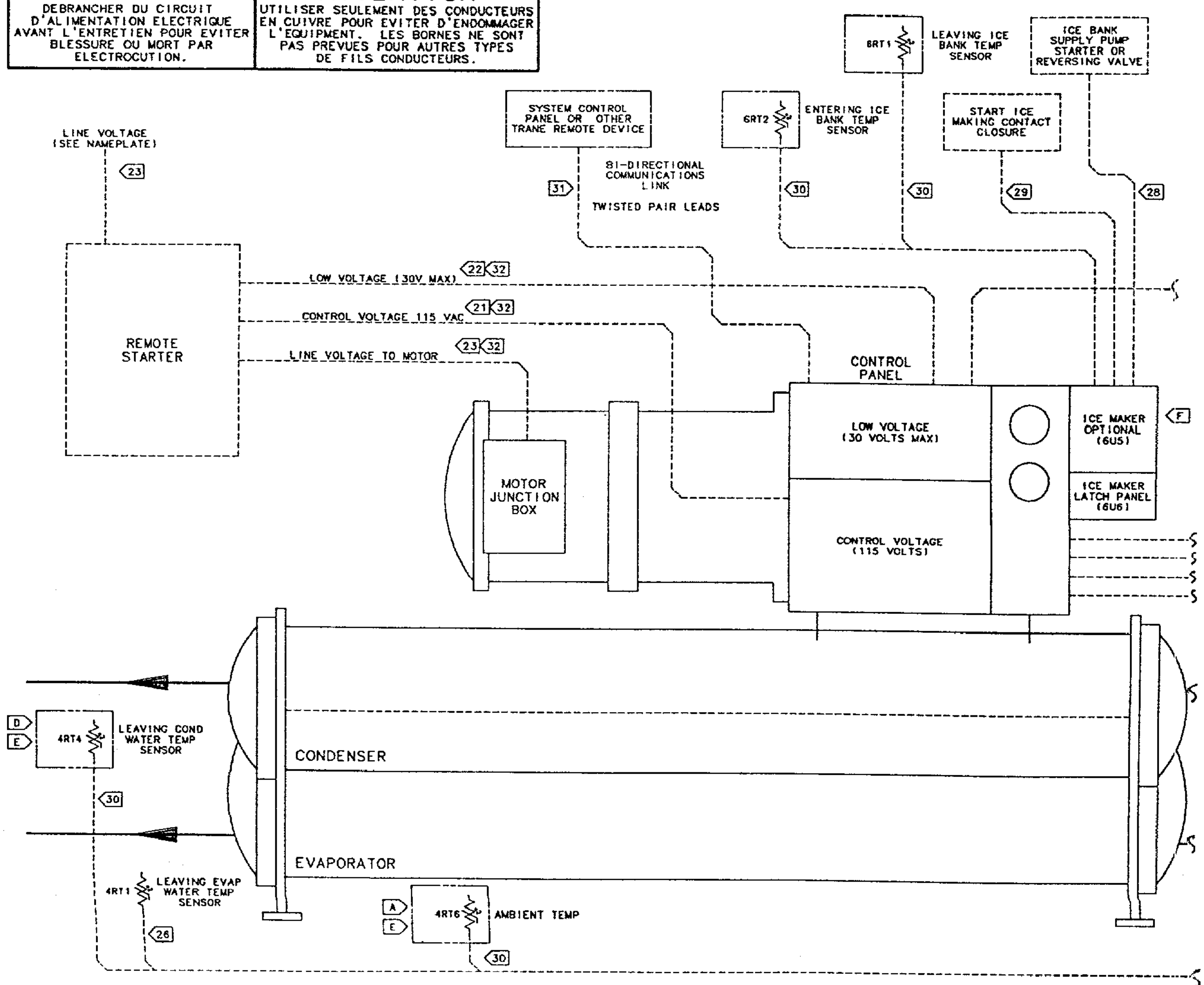


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TABLE 1

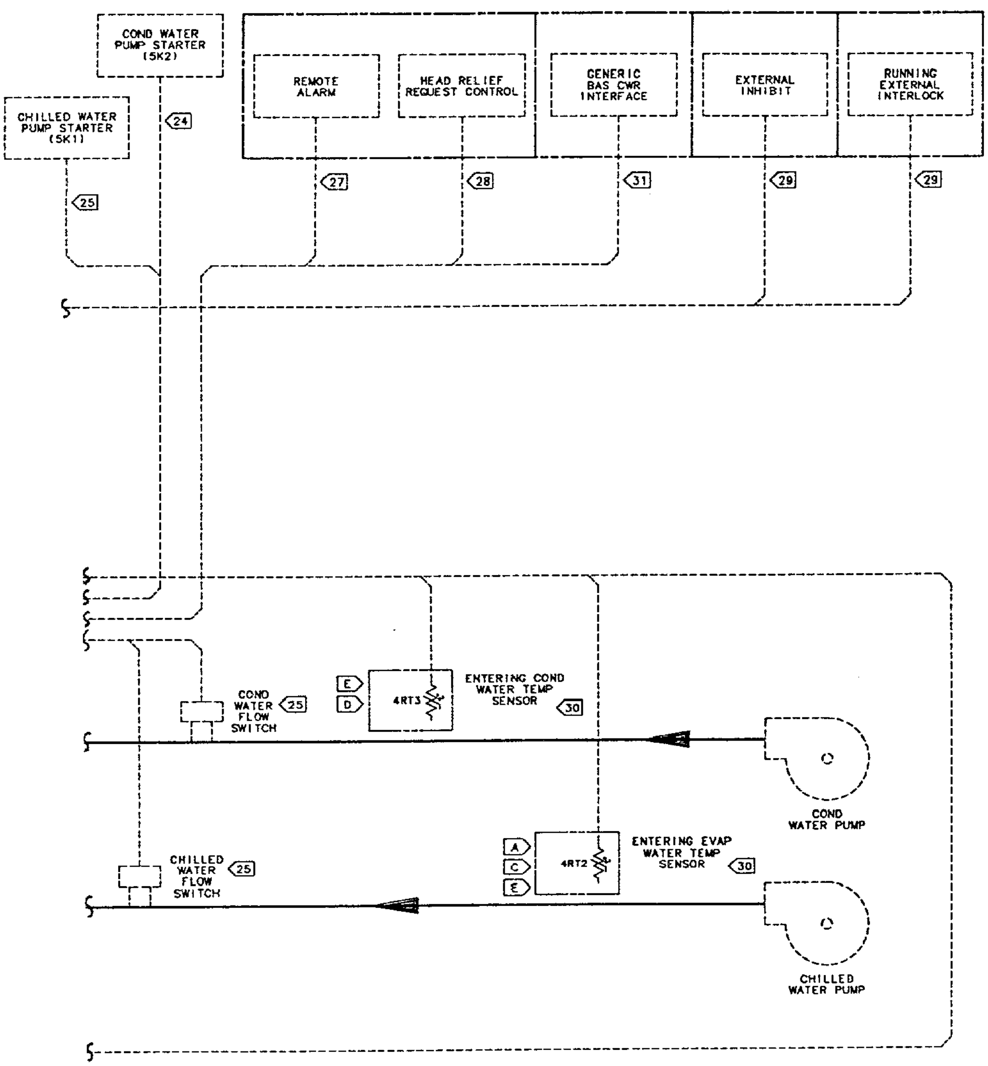
RECOMMENDED WIRE SELECTION TABLE (REF. NEC 1984)

RATED LOAD CURRENT (NAMEPLATE)

MIN WIRE SIZE COPPER 75°C	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	N/A	N/A	68.2	55.4
6	52	N/A	N/A	90.0	72.0
4	68	N/A	N/A	117.8	94.1
3	80	N/A	N/A	138.4	110.7
2	92	N/A	N/A	159.2	127.3
1	104	N/A	N/A	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	221.4
0000	184	368	294.4	318.3	254.7
250	204	408	328.4	352.9	282.3
300	228	456	384.8	394.4	315.6
350	248	498	396.8	429.0	343.2
400	268	538	428.8	483.6	370.9
500	304	608	486.4	525.9	420.7
600	336	672	537.8	581.3	465.0

TABLE 2

WIRE SIZE	MAXIMUM LENGTH FOR SENSOR LEADS
14 AWG	5000 FT
16 AWG	2000 FT
18 AWG	1000 FT



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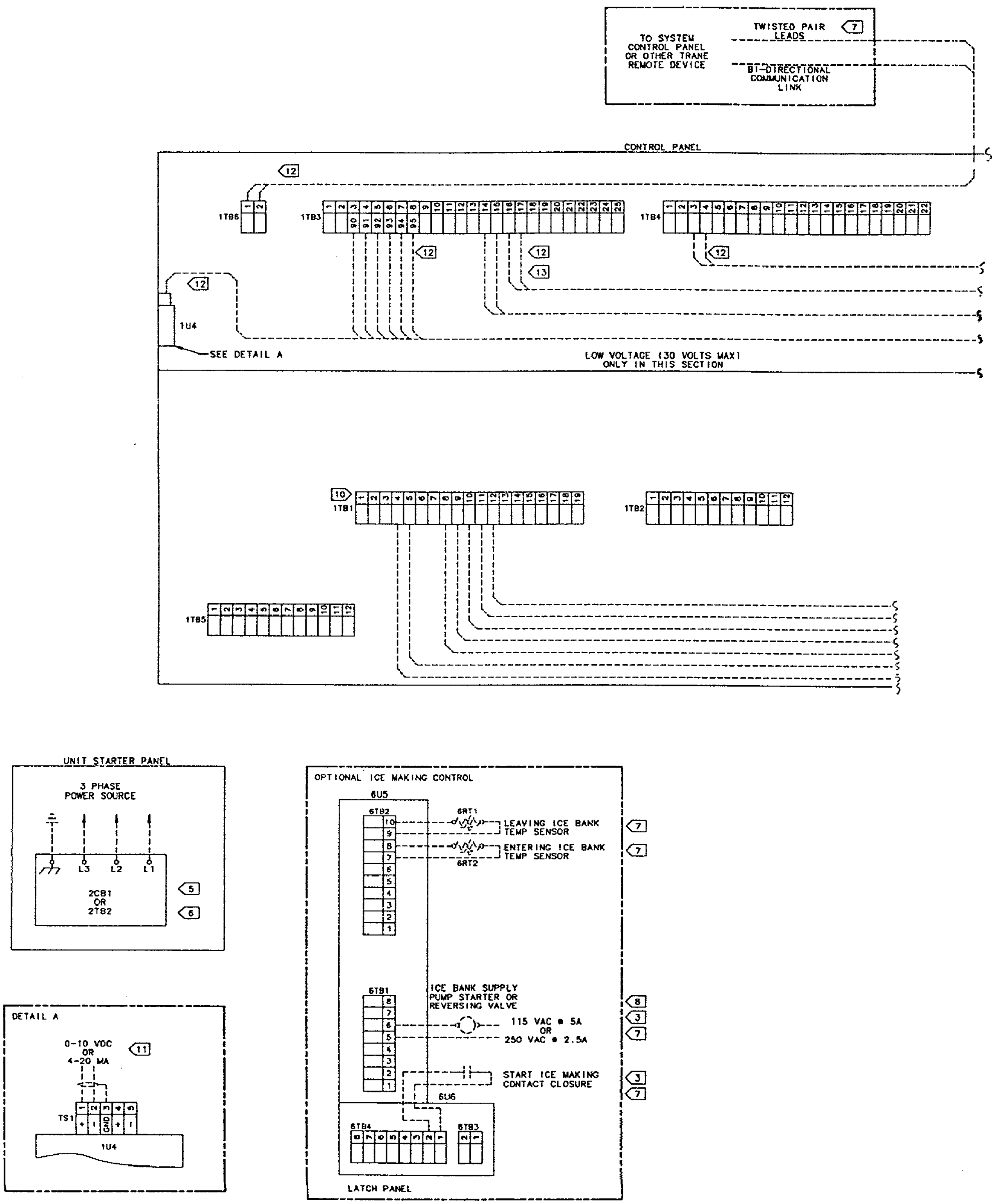
RTHA Units W/Unit-Mounted Starter Panel

The diagrams that appear in this section are representative of RTHA units equipped with a unit-mounted starter panel.

Figure 2
Field Wiring Diagram for RTHA Units with Unit-Mounted Starter

(continued on next page)



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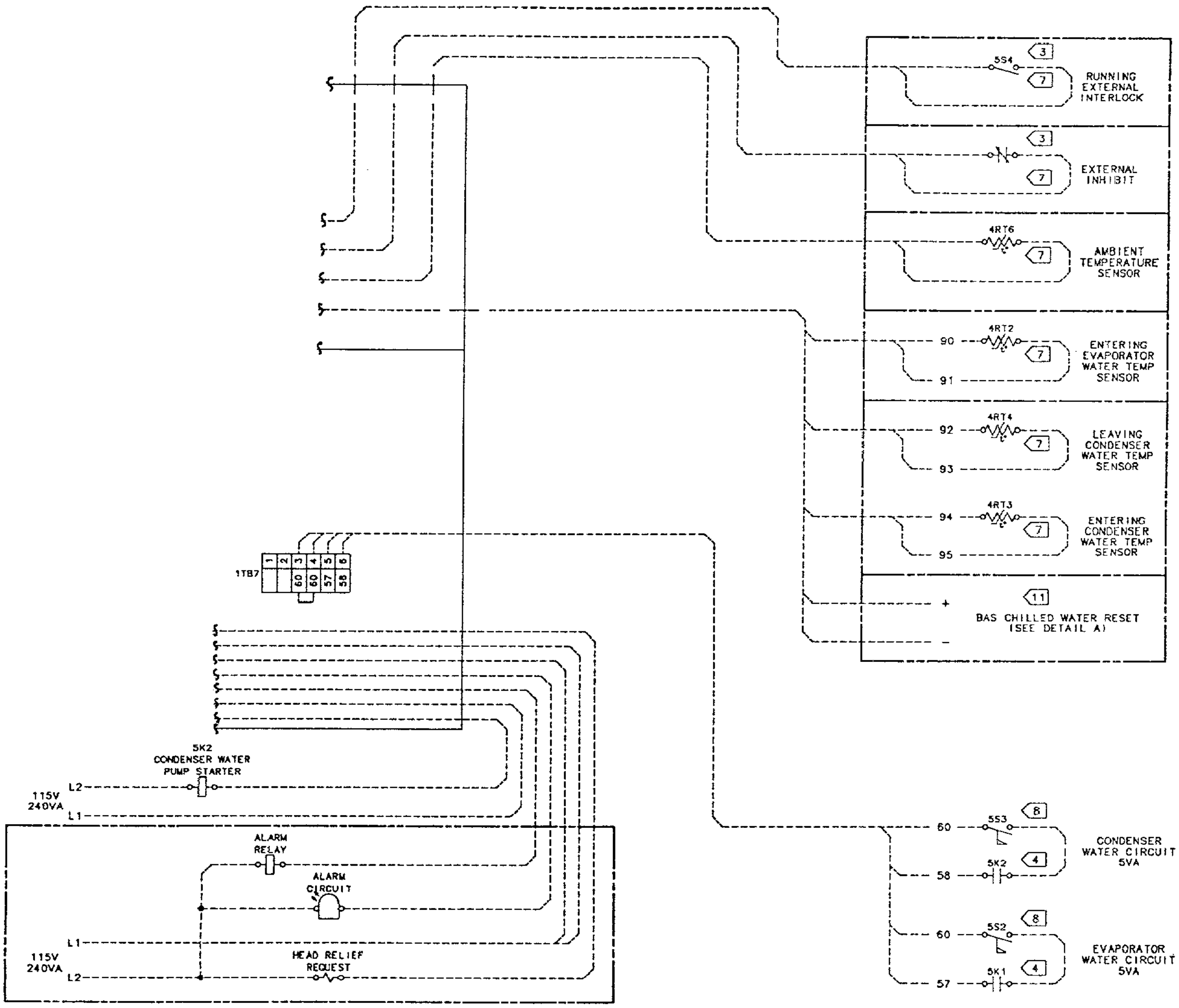
⚠ WARNING	⚠ CAUTION
DISCONNECT ELECTRIC POWER SUPPLY BEFORE SERVICING TO PREVENT INJURY OR DEATH DUE TO ELECTRICAL SHOCK.	USE COPPER CONDUCTORS ONLY TO PREVENT EQUIPMENT DAMAGE. UNIT TERMINALS ARE NOT DESIGNED TO ACCEPT ANY OTHER WIRING.
AVERTISSEMENT	**ATTENTION**
DEBRANCHER DU CIRCUIT D'ALIMENTATION ELECTRIQUE AVANT L'ENTRETIEN POUR EVITER BLESSURE OU MORT PAR ELECTROCUTION.	UTILISER SEULEMENT DES CONDUCTEURS EN CUIVRE POUR EVITER D'ENDOMMAGER L'EQUIPMENT. LES BORNES NE SONT PAS PREVUES POUR AUTRES TYPES DE FILS CONDUCTEURS.



CUSTOMER NOTE:

1. DASHED LINES INDICATE RECOMMENDED FIELD WIRING BY OTHERS PHANTOM LINES INDICATE ALTERNATE CIRCUITRY OR AVAILABLE SALES OPTION. CHECK SALES ORDER TO DETERMINE IF WIRING IS REQUIRED FOR SPECIFIC OPTIONS.
2. 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.

3 — CUSTOMER SUPPLIED CONTACTS MUST BE COMPATIBLE WITH DRY CIRCUIT 12 VDC, 45MA. GOLD PLATED CONTACTS RECOMMENDED.

4 — RECOMMENDED CIRCUIT: COMPONENTS SUPPLIED BY OTHERS, 5K1 AND 5K2 ARE AUX CONTACTS ON PUMP STARTERS: 5S2 AND 5S3 ARE FLOW SWITCHES IN APPROPRIATE WATER CIRCUITS.

5 — RETIGHTEN TERMINALS A MINIMUM OF 24 HOURS AFTER INITIAL INSTALLATION. DO NOT OVER TIGHTEN.

6 — COPPER WIRE, SIZED PER NEC, BASED ON UNIT NAMEPLATE RLA PLUS TRANSFORMER LOAD IN L1 AND L2. PHASING OF 3 PHASE INPUT: L1 TO A, L2 TO B, L3 TO C WHERE ABC REPRESENTS STANDARD PHASE ROTATION.

7 — 30V OR LESS #14-18 AWG 600V WIRE. DO NOT RUN IN CONDUIT WITH HIGHER VOLTAGE WIRE.

8 — 115V AC. #14 AWG 600V WIRE.

10 — FIELD WIRED ELECTRICAL LOADING IS NOT TO EXCEED THE FOLLOWING CONTACT RATINGS:

TERMINALS	DEVICE	RATED VOLTAGE (VAC)	RATED V/A
1TB1-4,5	1U1K6	120	240
1TB1-8,10	1U1K4-2	120	240
1TB1-9,10	1U1K4-1	120	240
1TB1-11,12	1U1K3	120	240

11 — NEGATIVE SIGNAL INPUTS ARE GROUNDED TO UCP ENCLOSURE. FOR CORRECT OPERATION, EXTERNAL EQUIPMENT SIGNALS SHALL BE ISOLATED OR FLOATING WITH RESPECT TO UCP ELECTRICAL SERVICE GROUND AND ISOLATED FROM EACH OTHER. SPECIAL CONSIDERATION MUST BE GIVEN TO 4-20 MA SIGNALS. IF THE CURRENT SOURCE REGULATES CURRENT FLOW ON THE NEGATIVE LEAD, USE A SEPARATE POWER SUPPLY FOR EACH CHANNEL. IN SOME APPLICATIONS IT MAY BE NECESSARY TO INSTALL A LOOP ISOLATOR IN EACH CHANNEL TO PREVENT LOOP INTERFERENCE.

12 — USE TWISTED, SHIELDED PAIR 18 AWG WIRE (BELDEN 8760 OR EQUIVALENT) OR CLASS 1 WIRING ONLY.

13 — WHEN EXTERNAL INHIBIT IS USED AND ICE MAKING CONTROL IS SUPPLIED ON UNIT, EXTERNAL INHIBIT CONTACT MUST BE WIRED IN SERIES WITH 6U6 - 6TB4-7.

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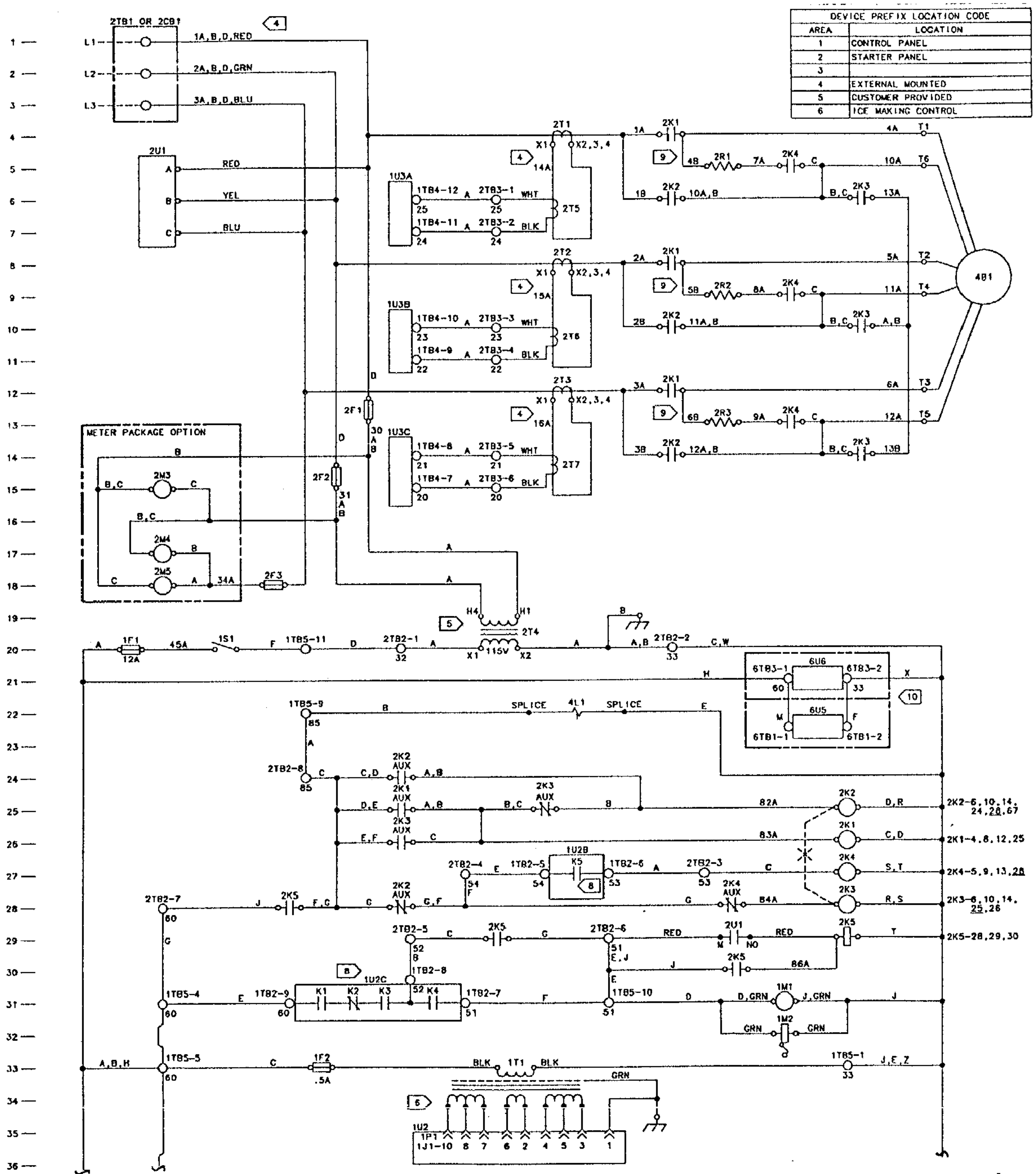
Figure 3
System Schematic Diagram for RTHA Units with Unit-Mounted "Wye-Delta" Starter (Page 1)

DEVICE PREFIX LOCATION CODE	
AREA	LOCATION
1	CONTROL PANEL
2	STARTER PANEL
3	
4	EXTERNAL MOUNTED
5	CUSTOMER PROVIDED
6	ICE MAKING CONTROL



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LEGEND		
DEVICE DESIGNATION	DESCRIPTION	LINE NUMBER
1F1	FUSE, CONTROL CIRCUIT	20
1F2	FUSE, 1T1 PRIMARY	33
1J1-1J4	JACK	
1P1-1P4	PLUG	
1K16	RELAY 5S2 INTERFACE	45
1K17	RELAY 5S3 INTERFACE	46
1M1	HOUR METER	32
1M2	START METER	31
1R1	COND. PRESS. TRANSDUCER	75
1S1	SERVICE SWITCH	20
1S3	HIGH PRESSURE CUTOUT	96
1T1	POWER SUPPLY TRANSFORMER	33
1TB1	TERM BLOCK REL OUTPUT	
1TB2	TERM BLOCK POWER SPLY	
1TB3	TERM BLOCK MICRO-MOD INPUT	
1TB4	TERM BLOCK MICRO-MOD INPUT	
1TB5	TERM BLOCK CONTROL PNL	
1TB6	TERM BLOCK MICRO-MOD INPUT	
1TB7	TERM BLOCK CUSTOMER CONNECT	
1U1A-C	RELAY, OUTPUT MOD	SHEET 2
1U1 K1	RELAY, HOT GAS BYPASS ENABLE	38
1U1 K3	RELAY, HEAD RELIEF REQUEST	88
1U1 K4	RELAY, ALARM	85
1U1 K6	RELAY, COND. WATER PUMP	82
1U1 Q7	SLIDE VALVE-LOAD	38
1U1 Q8	SLIDE VALVE-UNLOAD	39
1U2A-E	POWER SUPPLY OUTPUT MODULE	SHEET 2
1U2 K1	RESET RELAY	31
1U2 K2	STOP RELAY	31
1U2 K3	OVERLOAD RELAY	31
1U2 K4	COMPR. START RELAY	31
1U2 K5	COMP. TRANSITION RELAY	27
1U2 K6	OIL HEATER RELAY	48
1U3A-D	MICRO MODULE	SHEET 2
1U4	BAS CHILLED WTR RESET	80
2CB1	STARTER CIRCUIT BREAKER	1
2F1,2F2,2F3	FUSE, 2T4 PRIMARY	17-18
2K1	START CONTACTOR	26
2K2	RUN CONTACTOR	25
2K3	SHORTING CONTACTOR	28
2K4	TRANSITION CONTACTOR	27
2K5	PILOT RELAY	29
2M3,4,5	VOLT METER	15,17,18
2M6,7,8	AMP METER	51,54,57
2R1-9	TRANSITION RESISTOR	5,9,13
2T1-3	CURRENT TRANSFORMER, LARGE	4,8,12
2T4	CONTROL POWER TRANSFORMER	19
2T5-7	CURRENT TRANSFORMER, SMALL	6,10,14
2TB1	LINE TERMINAL BLOCK	1
2TB2	CONTROL TERMINAL BLOCK	
2TB3	LOW VOLTAGE TERMINAL BLOCK	
2U1	PHASE REVERSAL MONITOR	4
4B1	COMPRESSOR MOTOR	8
4B1R2,3,4	MOTOR WINDING TEMP SENSOR	72,73,75
4HR1	OIL TANK HEATER	47
4HR2	OIL TANK HEATER	48
4L1	MASTER SOLENOID VALVE	22
4L2	LOAD SOLENOID VALVE	38
4L3	UNLOAD SOLENOID VALVE	39
4L9	HOT GAS BYPASS VALVE	40
4S5	OIL FLOW SWITCH	65
4S6	LOW PRESSURE CUTOUT	67
4RT1	LEAVING EVAP SENSOR	102
4RT2	ENTERING EVAP SENSOR	69
4RT3	ENTERING COND SENSOR	71
4RT4	LEAVING COND SENSOR	73
4RT5	EVAP REF TEMP SENSOR	78
4RT6	AMBIENT TEMP SENSOR	80
4RT8	DISCHARGE TEMP SENSOR	76
5K1	EVAP WATER PUMP CONT AUX	45
5K2	COND WATER PUMP CONT AUX	82
5S2	WATER FLOW SWITCH	45
5S3	WATER FLOW SWITCH	46
5S4	RUN SPARE FAULT SWITCH	68
6RT1	LEAVING ICE BANK TEMP SENSOR	97
6RT2	ENTERING ICE BANK TEMP SENSOR	99
6U5	ICE MAKING CONTROL	22,40 67,97
6U6	ICE MAKING LATCH PANEL	21,82 104
6TB1	TERM BLOCK HIGH VOLTAGE	22,40 99,104
6TB2	TERM BLOCK CONTROL SIGNAL	67,68 97,99
6TB3	TERM BLOCK POWER INPUT	21
6TB4	TERM BLOCK INPUT/OUTPUT	82,83 103

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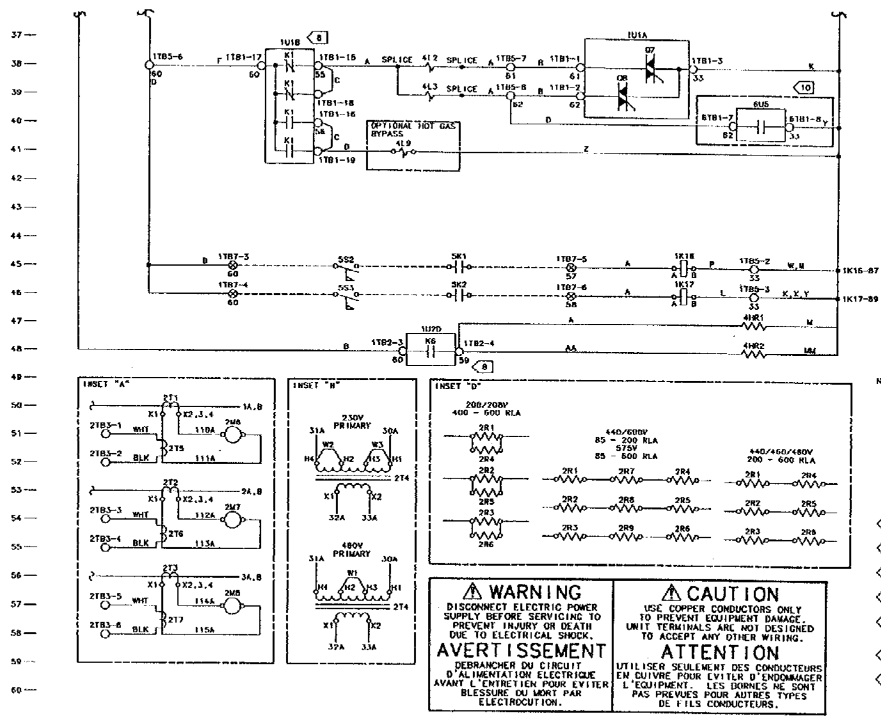


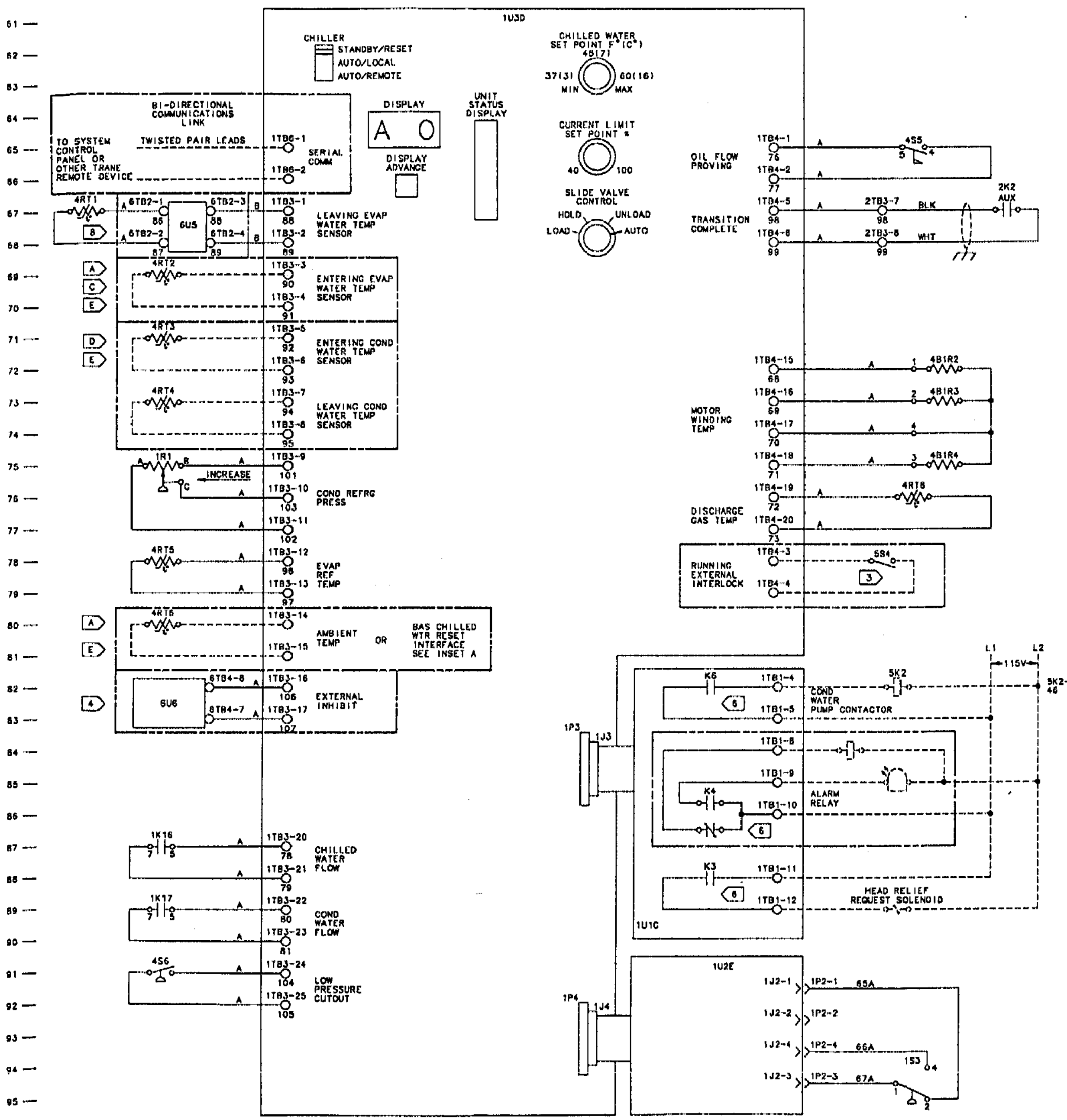
NOTES:

1. UNLESS OTHERWISE NOTED, ALL SWITCHES ARE SHOWN AT 25°C (77°F), AT ATMOSPHERIC PRESSURE, AT 50% RELATIVE HUMIDITY, WITH ALL UTILITIES TURNED OFF AND AFTER A NORMAL SHUTDOWN HAS OCCURED.
2. SOLID LINES INDICATE TRANE WIRING. DASHED LINES INDICATE FIELD WIRING. PHANTOM LINES INDICATE OPTIONAL FEATURES.
3. NUMBERS ALONG THE RIGHT SIDE OF THE SCHEMATIC DESIGNATE THE LOCATION OF THE CONTACTS BY LINE NUMBER. AN UNDERLINED NUMBER INDICATES A NORMALLY CLOSED CONTACT. AN OPEN ARROWHEAD BELOW THE LINE NUMBER POINTING UPWARD INDICATES A TIMED CONTACT WHICH BEGINS TIMING WHEN ENERGIZED.

4. IF METER PACKAGE OPTION IS REQUIRED SEE INSET "A".
5. 200/575 VOLT PRIMARY SHOWN. SEE INSET "B" FOR OTHER VOLTAGES.
6. SEE SERVICE MANUAL FOR INDIVIDUAL SECONDARY VOLTAGES.
7. THREE PHASE POWER SUPPLY VOLTAGE SEE UNIT NAMEPLATE.
8. RELAY COILS NOT SHOWN. CONTACTS ARE CONTROLLED BY THE LOGIC OF THE MICRO-MODULE (1U3). SEE SEQUENCE OF OPERATION LINES 102-115 PAGE 2.
9. RESISTOR SHOWN FOR 200/208V AND 200-400 RLA. FOR OTHER VOLTAGES AND RLA SEE INSET "D".
10. OPTIONAL ICE MAKING CONTROL(6U5, 6U6).

X39530028C

Figure 4
System Schematic Diagram for RTHA Units with Unit-Mounted "Wye-Delta" Starter (Page 2)



NOTES:

1. DASHED LINED INDICATE FIELD WIRING BY OTHERS. PHANTOM LINES INDICATE ALTERNATE CIRCUITRY OR AVAILABLE SALES OPTION. CHECK SALES ORDER TO DETERMINE IF WIRING IS REQUIRED FOR SPECIFIC OPTIONS.

2. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE (NEC), STATE AND LOCAL REQUIREMENTS. OTHER COUNTRIES APPLICABLE NATIONAL AND/OR LOCAL REQUIREMENTS SHALL APPLY. ALL WIRING TO 1TB3, 1TB4 & 1TB6 IS LOW VOLTAGE (30 VOLTS MAX) ONLY.

3. MANUAL RESET IS ACCOMPLISHED BY MOVING THE CHILLER SWITCH, LINE 62, FROM "STANDBY/RESET" TO "AUTO". MANUAL RESET IS ALSO REQUIRED FOR A TRIP-OUT DUE TO THE RUNNING EXTERNAL INTERLOCK, LINE 78.

4. AUXILIARY TERMINAL CONNECTIONS FOR A CUSTOMER SPECIFIED OR INSTALLED NON-LATCHING UNIT START/STOP SIGNAL. TERMINALS 1TB3-16 AND 1TB3-17 MUST BE JUMPERED IF EXTERNAL INTERLOCK OR ICE MAKING CONTROL IS NOT USED.

5. THE FOLLOWING CAPABILITIES ARE OPTIONAL - THEY ARE IMPLEMENTED AND WIRED AS REQUIRED FOR SPECIFIC SYSTEM APPLICATION.

   A. CHILLED WATER RESET- REQUIRES MATCHED PAIR OF THERMISTORS FOR 4RT1 & 4RT2, LINES 67 & 69. IF AMBIENT TEMP BASED CHILLED WATER RESET IS REQUIRED, USE STD SUPPLIED LEAVING EVAP WATER TEMP SENSOR (4RT1 LINE 67) FOR 4RT6 LINE 80 AS AN AMBIENT TEMP SENSOR.

   C. ENTERING EVAP TEMP SENSOR - REQUIRES MATCHED PAIR OF THERMISTORS 4RT1 & 4RT2, LINES 67 & 69.

   D. ENTERING AND LEAVING CONDENSER WATER TEMP SENSORS MATCHED PAIR OF THERMISTORS FOR 4RT3 & 4RT4 LINES 71 & 73.

   E. TRACER MONITORING PACKAGE INCLUDES OPTIONS C AND D.

   F. REMOTE GENERIC BAS CHILLED WTR RESET INTERFACE. MUST BE USED WITH CHILLED WATER RESET INTERFACE PANEL OPTION.

6. RELAY COILS NOT SHOWN. CONTACTS ARE CONTROLLED BY THE LOGIC OF THE MICROMODULE (1U3). SEE SEQUENCE OF OPERATION LINES 102 - 115.

7. NEGATIVE SIGNAL INPUTS ARE GROUNDED TO UCP ENCLOSURE. FOR CORRECT OPERATION, EXTERNAL EQUIPMENT SIGNALS SHALL BE ISOLATED OR FLOATING WITH RESPECT TO UCP ELECTRICAL SERVICE GROUND AND ISOLATED FROM EACH OTHER. SPECIAL CONSIDERATION MUST BE GIVEN TO 4-20 mA SIGNALS. IF THE CURRENT SOURCE REGULATES CURRENT FLOW ON THE NEGATIVE LEAD USE A SEPARATE POWER SUPPLY FOR EACH CHANNEL. IN SOME APPLICATIONS IT MAY BE NECESSARY TO INSTALL A LOOP ISOLATOR IN EACH CHANNEL TO PREVENT LOOP INTERFERENCE.

8. OPTIONAL ICE MAKING CONTROL SHOWN SEE INSET B FOR WIRING WHEN OPTION IS NOT USED.

⚠ WARNING

DISCONNECT ELECTRIC POWER SUPPLY BEFORE SERVICING TO PREVENT INJURY OR DEATH DUE TO ELECTRICAL SHOCK.

AVERTISSEMENT

DEBRANCHER DU CIRCUIT D'ALIMENTATION ELECTRIQUE AVANT L'ENTRETIEN POUR EVITER BLESSURE OU MORT PAR ELECTROCUTION.

⚠ CAUTION

USE COPPER CONDUCTORS ONLY TO PREVENT EQUIPMENT DAMAGE. UNIT TERMINALS ARE NOT DESIGNED TO ACCEPT ANY OTHER WIRING.

ATTENTION

UTILISER SEULEMENT DES CONDUCTEURS EN CUIVRE POUR EVITER D'ENDOMMAGER L'EQUIPMENT. LES BORNES NE SONT PAS PREVUES POUR AUTRES TYPES DE FILS CONDUCTEURS.

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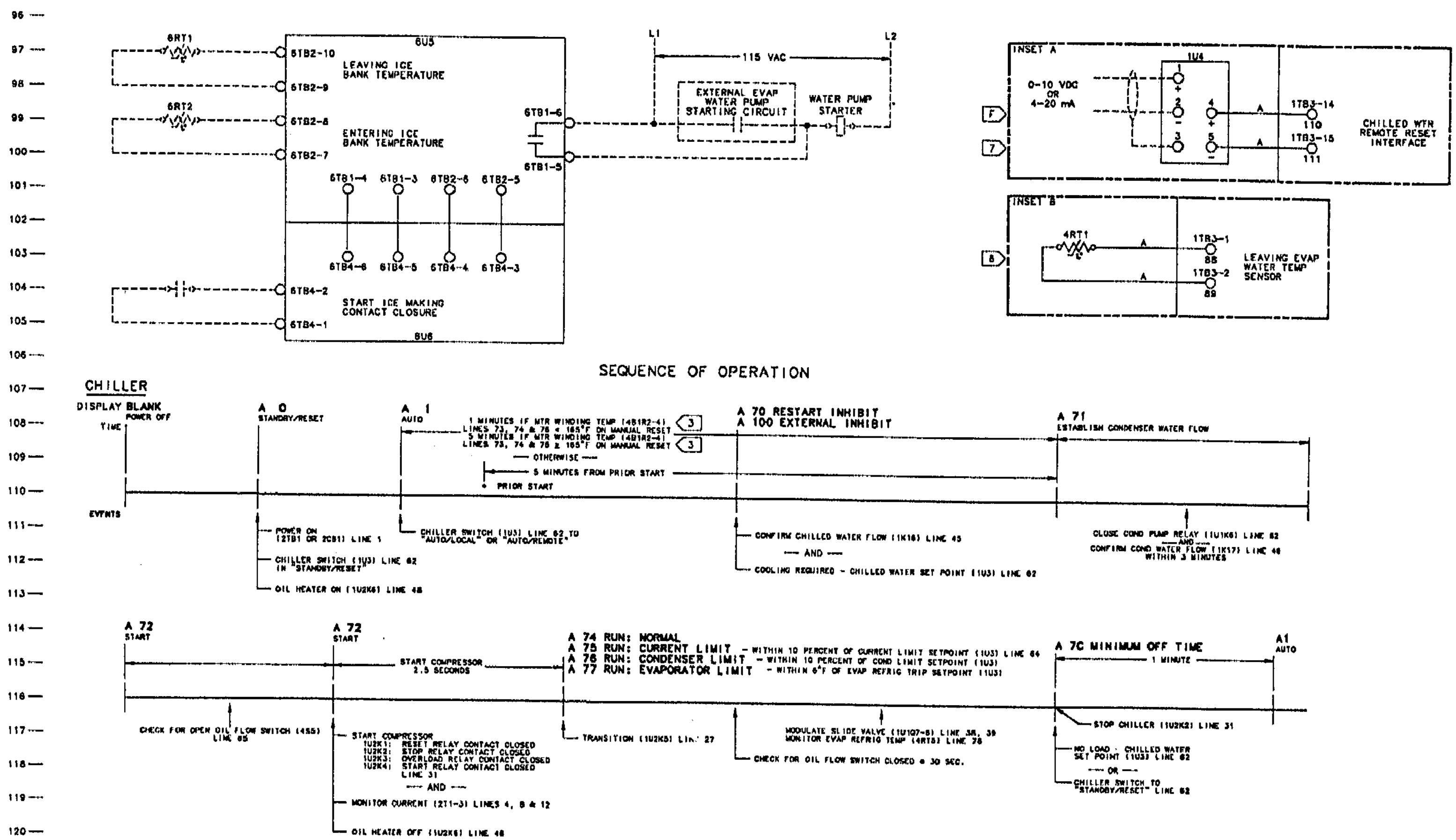

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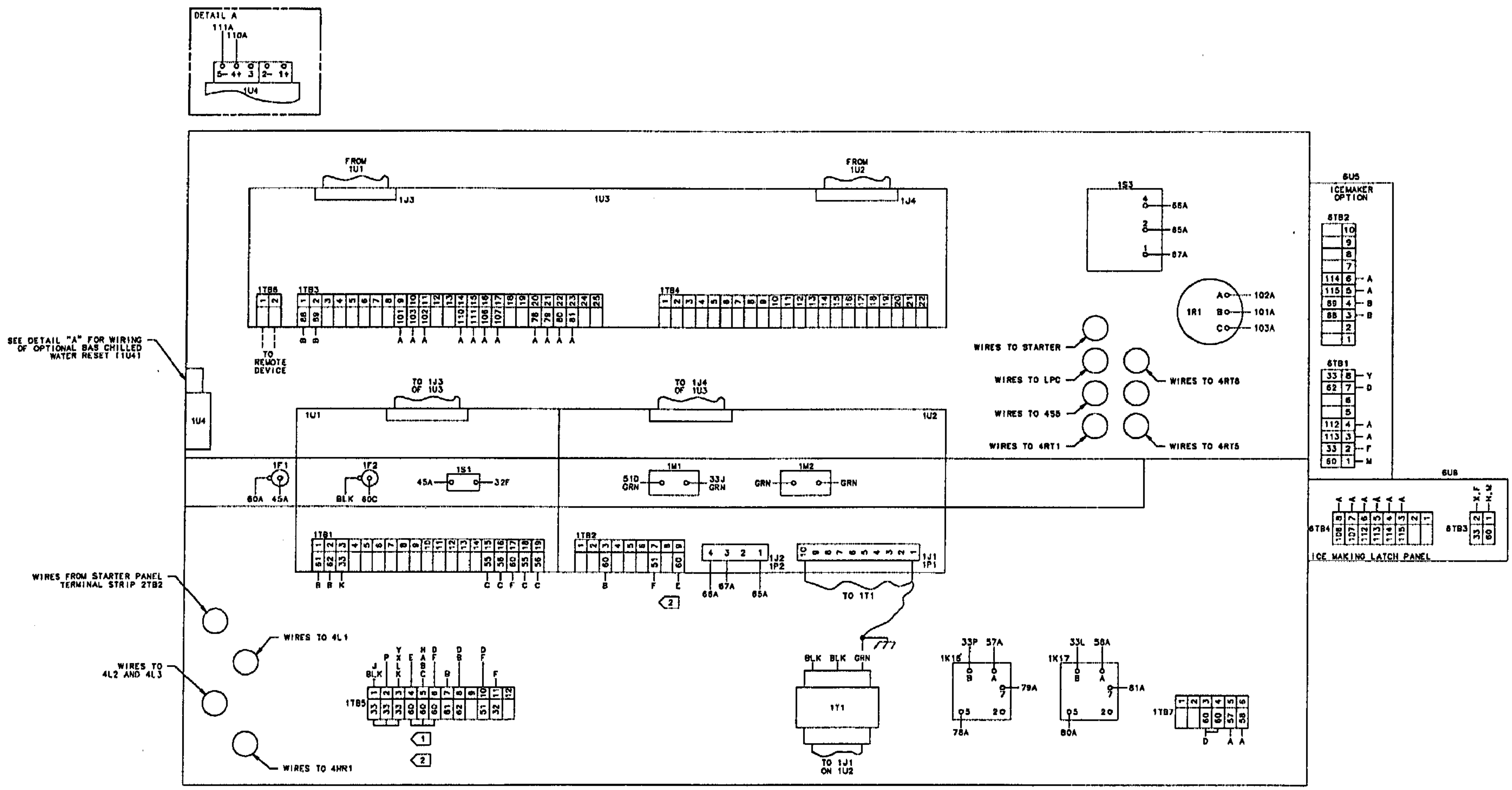
Figure 5
Control Panel Component Location Diagram for RTHA Units with Unit-Mounted Starter



NOTES:

1. FOR REMOTE MOUNTED STARTER UNITS - REMOVE JUMPER CLIP BETWEEN 1TB5-4 AND 1TB5-5.
2. FOR REMOTE MOUNTED STARTER UNITS - WIRE #60E BETWEEN 1TB5-4 AND 1TB2-9 TO BE RELABELED 63A.

2306-9104C

Figure 6
Unit Component Location Diagram for RTHA Units with Unit-Mounted Starter (Wye-Delta)

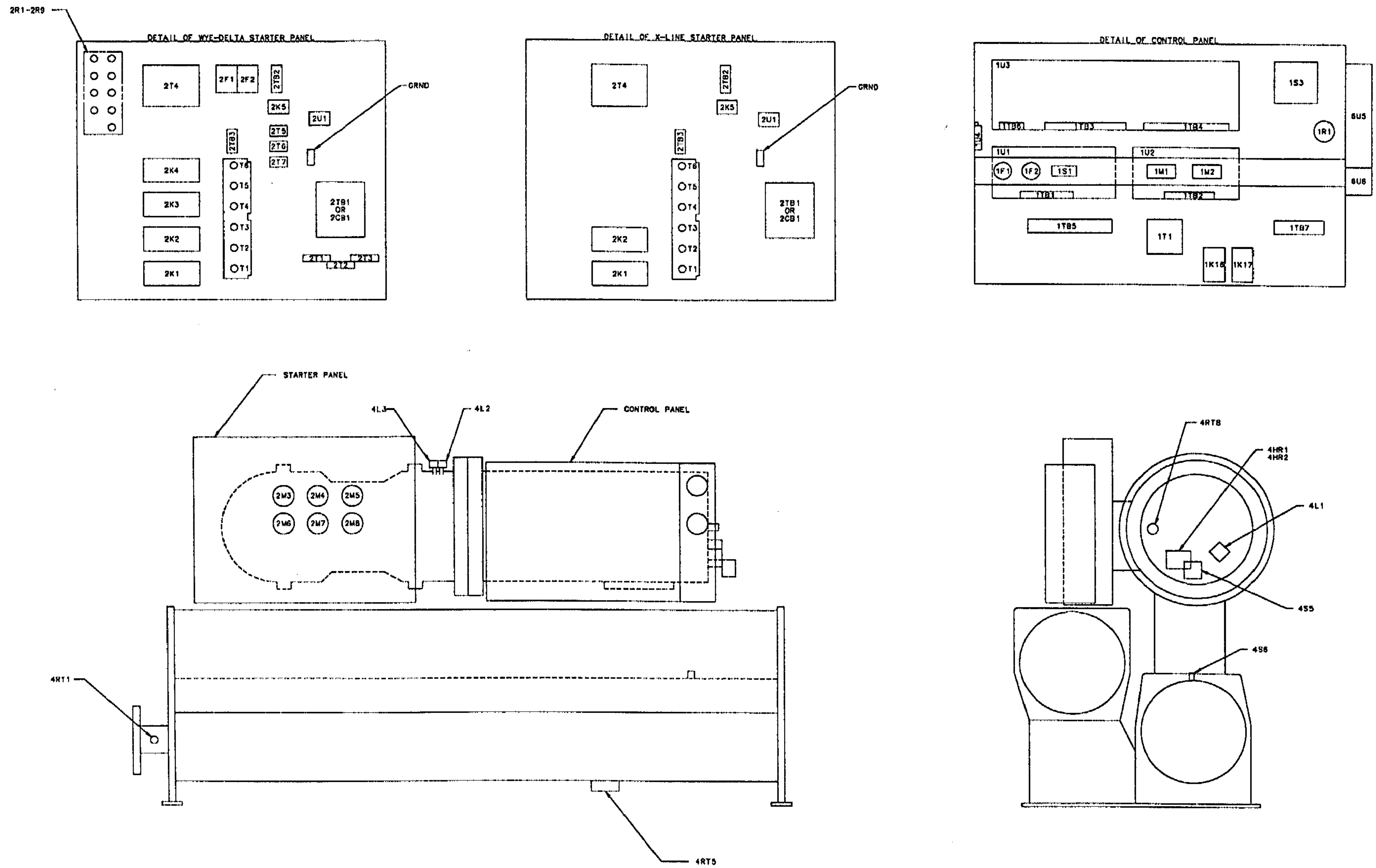


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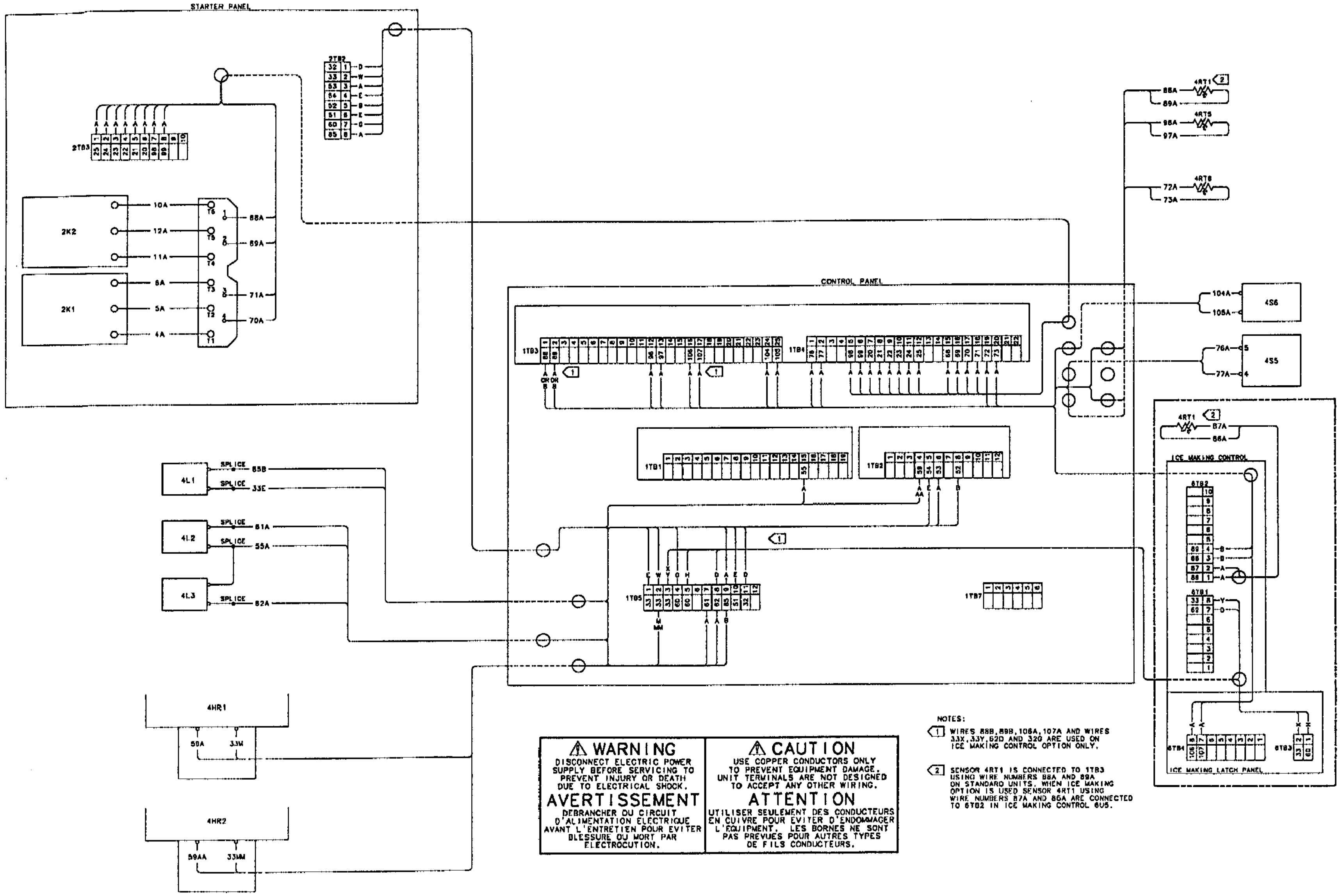
Figure 7
Component Interconnection Diagram for RTHA Units with Unit-Mounted Starter (Wye-Delta)



⚠ WARNING	⚠ CAUTION
DISCONNECT ELECTRIC POWER SUPPLY BEFORE SERVICING TO PREVENT INJURY OR DEATH DUE TO ELECTRICAL SHOCK.	USE COPPER CONDUCTORS ONLY TO PREVENT EQUIPMENT DAMAGE. UNIT TERMINALS ARE NOT DESIGNED TO ACCEPT ANY OTHER WIRING.
AVERTISSEMENT	ATTENTION
DEBRANCHER OU CIRCUIT D'ALIMENTATION ELECTRIQUE AVANT L'ENTRETIEN POUR EVITER BLESSURE OU MORT PAR ELECTROCUTION.	UTILISER SEULEMENT DES CONDUCTEURS EN CUIVRE POUR EVITER D'ENDOMMAGER L'EQUIPMENT. LES BORNES NE SONT PAS PREVUES POUR AUTRES TYPES DE FILS CONDUCTEURS.

NOTES:

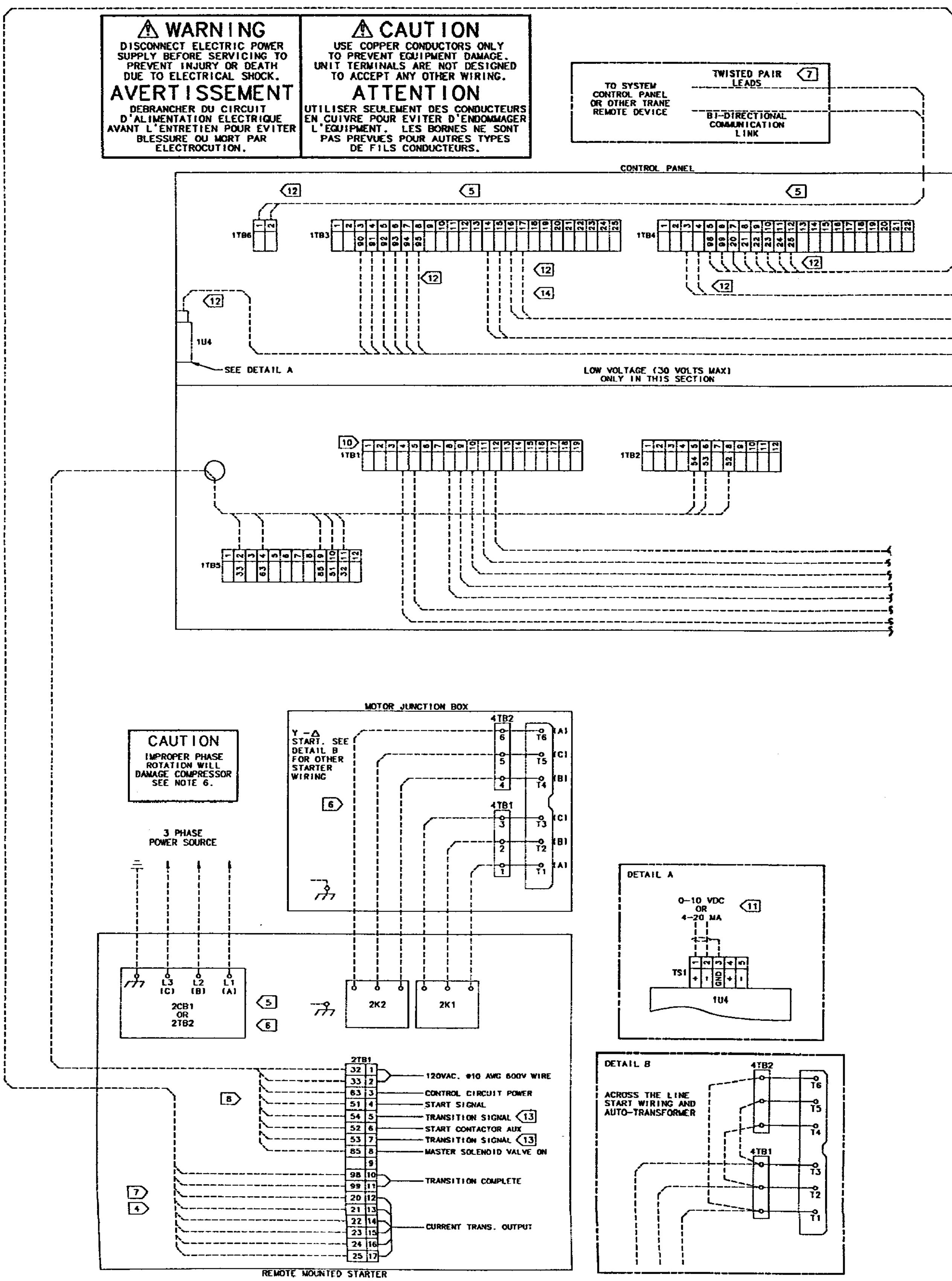
1. WIRES 88B, 89B, 106A, 107A AND WIRES 33X, 33Y, 62D AND 32D ARE USED ON ICE MAKING CONTROL OPTION ONLY.
2. SENSOR 4RT1 IS CONNECTED TO 1TB3 USING WIRE NUMBERS 88A AND 89A ON STANDARD UNITS. WHEN ICE MAKING OPTION IS USED SENSOR 4RT1 USING WIRE NUMBERS 87A AND 86A ARE CONNECTED TO 6TB2 IN ICE MAKING CONTROL 6U5.

2306-9106B

RTHA Units W/Remote-Mounted Starter Panel

The diagrams that appear in this section are representative of RTHA units that utilize a remote-mounted starter panel.

Figure 8
Field Wiring Diagram for RTHA units with Remote-Mounted Starters



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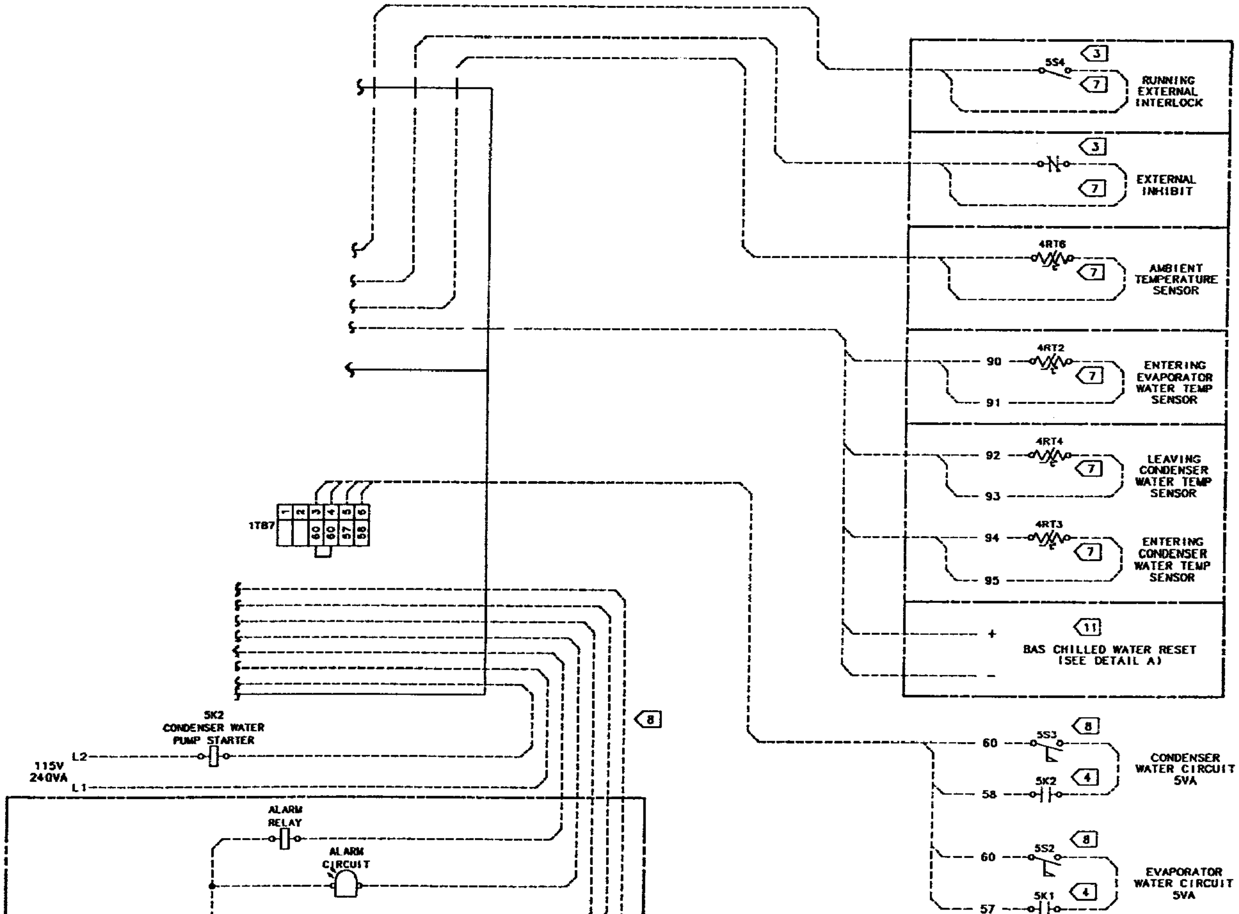

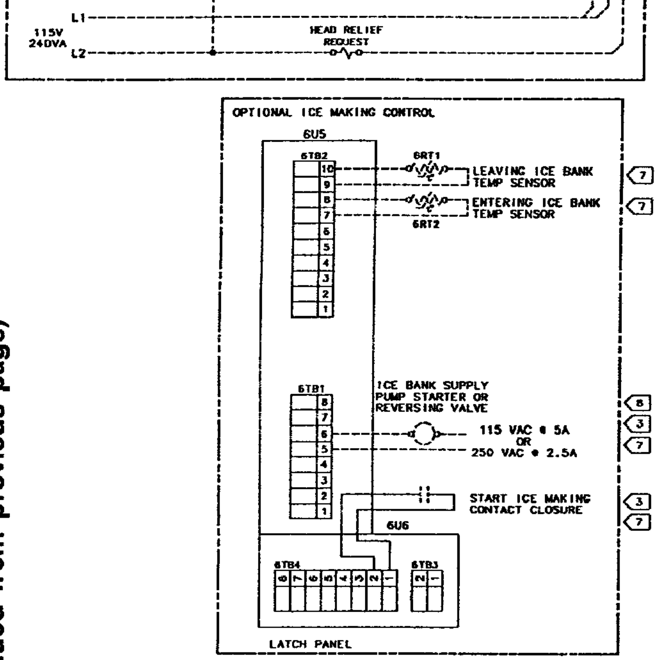

CUSTOMER NOTE:

1. SOLID LINES INDICATE TRANE WIRING. DASHED LINES INDICATE RECOMMENDED FIELD WIRING BY OTHERS. PHANTOM LINES INDICATE ALTERNATE CIRCUITRY OR AVAILABLE SALES OPTION. CHECK SALES ORDER TO DETERMINE IF WIRING IS REQUIRED FOR SPECIFIC OPTIONS.

2. 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.

3 CUSTOMER SUPPLIED CONTACTS MUST BE COMPATIBLE WITH DRY CIRCUIT 12 VDC, 45MA. GOLD PLATED CONTACTS RECOMMENDED.

4 RECOMMENDED CIRCUIT: COMPONENTS SUPPLIED BY OTHERS, 5K1 AND 5K2 ARE AUX CONTACTS ON PUMP STARTERS: 5S2 AND 5S3 ARE FLOW SWITCHES IN APPROPRIATE WATER CIRCUITS.

5 RETIGHTEN TERMINALS A MINIMUM OF 24 HOURS AFTER INITIAL INSTALLATION. DO NOT OVER TIGHTEN.

6 COPPER WIRE, SIZED PER NEC, BASED ON UNIT NAMEPLATE RLA PLUS TRANSFORMER LOAD IN L1 AND L2. PHASING OF 3 PHASE INPUT: L1 TO A, L2 TO B, L3 TO C WHERE ABC REPRESENTS STANDARD PHASE ROTATION.

7 30V OR LESS #14-18 AWG 600V WIRE. DO NOT RUN IN CONDUIT WITH HIGHER VOLTAGE WIRE.

8 115V AC. #14 AWG 600V WIRE.

10 FIELD WIRED ELECTRICAL LOADING IS NOT TO EXCEED THE FOLLOWING CONTACT RATINGS:

TERMINALS	DEVICE	RATED VOLTAGE (VAC)	RATED V/A
1TB1-4,5	1U1K6	120	240
1TB1-8,10	1U1K4-2	120	240
1TB1-9,10	1U1K4-1	120	240
1TB1-11,12	1U1K3	120	240

11 NEGATIVE SIGNAL INPUTS ARE GROUNDED TO UCP ENCLOSURE. FOR CORRECT OPERATION, EXTERNAL EQUIPMENT SIGNALS SHALL BE ISOLATED OR FLOATING WITH RESPECT TO UCP ELECTRICAL SERVICE GROUND AND ISOLATED FROM EACH OTHER. SPECIAL CONSIDERATION MUST BE GIVEN TO 4-20 MA SIGNALS. IF THE CURRENT SOURCE REGULATES CURRENT FLOW ON THE NEGATIVE LEAD, USE A SEPARATE POWER SUPPLY FOR EACH CHANNEL. IN SOME APPLICATIONS IT MAY BE NECESSARY TO INSTALL A LOOP ISOLATOR IN EACH CHANNEL TO PREVENT LOOP INTERFERENCE.

12 USE TWISTED, SHIELDED PAIR 18 AWG WIRE (BELDEN 8760 OR EQUIVALENT) OR CLASS 1 WIRING ONLY.

13 NOT REQUIRED ON ACROSS THE LINE AND AUTO TRANSFORMER STARTERS.

14 WHEN EXTERNAL INHIBIT IS USED AND ICE MAKING CONTROL IS SUPPLIED ON UNIT, EXTERNAL INHIBIT CONTACT MUST BE WIRED IN SERIES WITH 6U6 – 6TB4-7.

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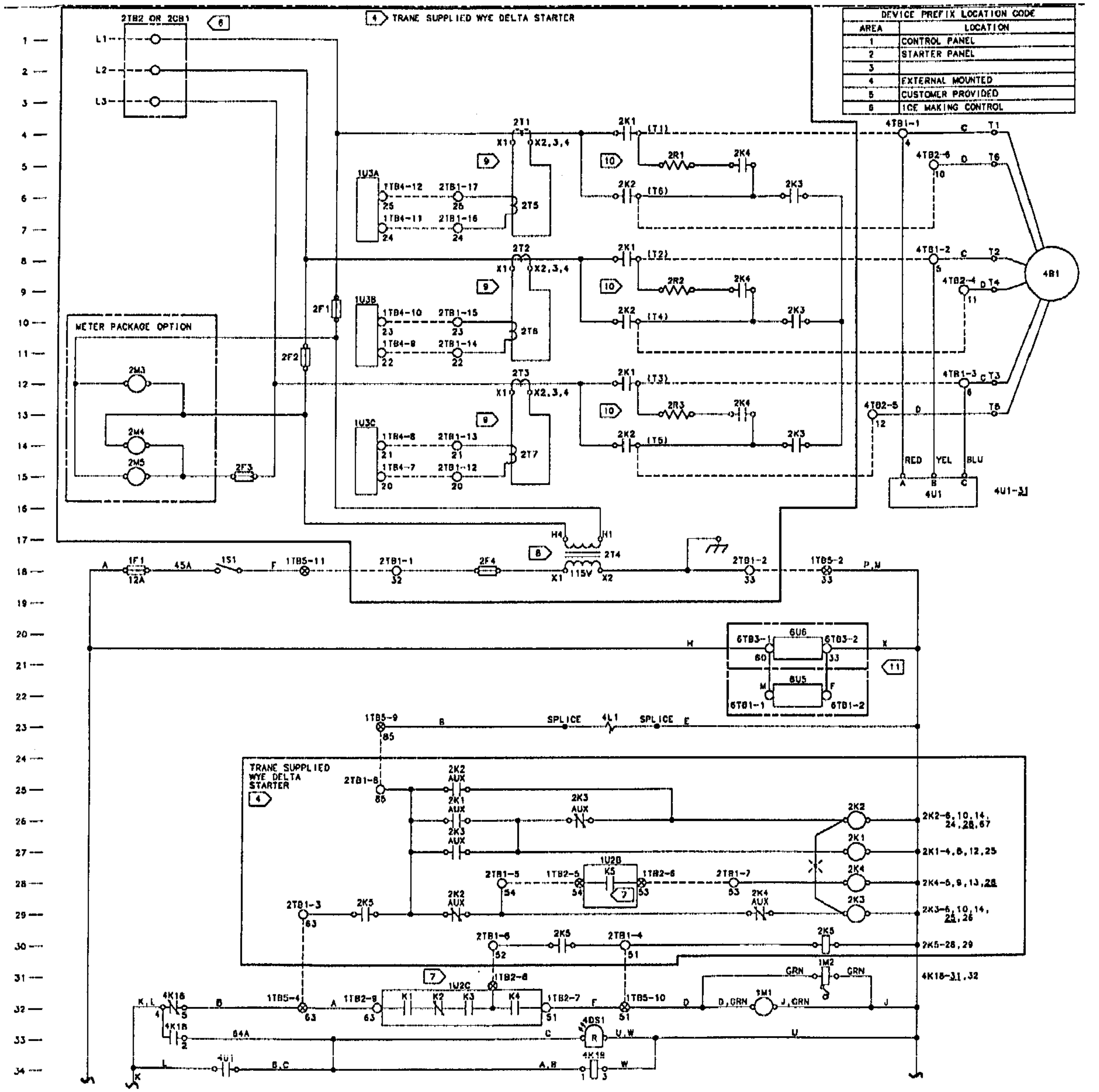
Figure 9
System Schematic for RTHA units with Remote-Mounted "Wye-Delta" Starter (Page 1)



DEVICE PREFIX LOCATION CODE	
AREA	LOCATION
1	CONTROL PANEL
2	STARTER PANEL
3	
4	EXTERNAL MOUNTED
5	CUSTOMER PROVIDED
6	ICE MAKING CONTROL

(continued on next page)

LEGEND

DEVICE DESIGNATION	DESCRIPTION	LINE NUMBER
1F1	FUSE, CONTROL CIRCUIT	18
1F2	FUSE, 1T1 PRIMARY	34
1J1-1J4	JACK	
1P1-1P4	PLUG	
1K16	RELAY 5S2 INTERFACE	45
1K17	RELAY 5S3 INTERFACE	46
1M1	HOUR METER	31
1M2	START METER	30
1R1	COND. PRESS. TRANSDUCER	75
1S1	SERVICE SWITCH	18
1S3	HIGH PRESSURE CUTOUT	96
1T1	POWER SUPPLY TRANSFORMER	34
1TB1	TERM BLOCK REL OUTPUT	
1TB2	TERM BLOCK POWER SPLY	
1TB3	TERM BLOCK MICRO-MOD INPUT	
1TB4	TERM BLOCK MICRO-MOD INPUT	
1TB5	TERM BLOCK CONTROL PNL	
1TB6	TERM BLOCK MICRO-MOD INPUT	
1TB7	TERM BLOCK CUSTOMER CONNECT	
1U1A-C	RELAY, OUTPUT MOD	SHEET 2
1U1 K1	RELAY, HOT GAS BYPASS ENABLE	39
1U1 K3	RELAY, HEAD RELIEF REQUEST	88
1U1 K4	RELAY, ALARM	85
1U1 K6	RELAY, COND. WATER PUMP	82
1U1 Q7	SLIDE VALVE-LOAD	39
1U1 Q8	SLIDE VALVE-UNLOAD	40
1U2A-E	POWER SUPPLY OUTPUT MODULE	SHEET 2
1U2 K1	RESET RELAY	31
1U2 K2	STOP RELAY	31
1U2 K3	OVERLOAD RELAY	31
1U2 K4	COMPR. START RELAY	31
1U2 K5	COMP. TRANSITION RELAY	27
1U2 K6	OIL HEATER RELAY	48
1U3A-D	MICRO MODULE	SHEET 2
1U4	BAS CHILLED WTR RESET	80
2CB1	STARTER CIRCUIT BREAKER	1
2F1,2F2,2F3	FUSE, 2T4 PRIMARY	10,11,15
2F4	FUSE, 2T4 SECONDARY	18
2K1	START CONTACTOR	28
2K2	RUN CONTACTOR	25
2K3	SHORTING CONTACTOR	26
2K4	TRANSITION CONTACTOR	27
2K5	PILOT RELAY	29
2M3,4,5	VOLT METER	12,14,15
2M6,7,8	AMP METER	51,54,57
2R1-9	TRANSITION RESISTOR	5,9,13
2T1-3	CURRENT TRANSFORMER, LARGE	4,8,12
2T4	CONTROL POWER TRANSFORMER	17
2T5-7	CURRENT TRANSFORMER, SMALL	6,10,14
2TB1	LINE TERMINAL BLOCK	1
2TB2	CONTROL TERMINAL BLOCK	
2TB3	LOW VOLTAGE TERMINAL BLOCK	
4B1	COMPRESSOR MOTOR	8
4B1R2,3,4	MOTOR WINDING TEMP SENSOR	72,73,75
4DS1	PHASE REVERSAL INDICATOR	32
4HR1	OIL TANK HEATER	47
4HR2	OIL TANK HEATER	48
4K18	PHASE REVERSAL LOCKOUT RELAY	30
4L1	MASTER SOLENOID VALVE	22
4L2	LOAD SOLENOID VALVE	39
4L3	UNLOAD SOLENOID VALVE	40
4L9	HOT GAS BYPASS VALVE	41
4RT1	LEAVING EVAP SENSOR	67
4RT2	ENTERING EVAP SENSOR	69
4RT3	ENTERING COND SENSOR	71
4RT4	LEAVING COND SENSOR	73
4RT5	EVAP REF TEMP SENSOR	78
4RT6	AMBIENT TEMP SENSOR	80
4RT8	DISCHARGE TEMP SENSOR	76
4S5	OIL FLOW SWITCH	65
4S8	LOW PRESSURE CUTOUT	67
4TB1,2	COMPRESSOR TERM. BLOCK	
4U1	PHASE SEQUENCE MONITOR	15
5K1	EVAP WATER PUMP CONT AUX	
5K2	COND WATER PUMP CONT AUX	82
5S2	WATER FLOW SWITCH	45
5S3	WATER FLOW SWITCH	46
5S4	RUN SPARE FAULT SWITCH	68
6RT1	LEAVING ICE BANK TEMP SENSOR	97
6RT2	ENTERING ICE BANK TEMP SENSOR	99
6U5	ICE MAKING CONTROL	22,42 67,97
6U6	ICE MAKING LATCH PANEL	21,82 104
6TB1	TERM BLOCK HIGH VOLTAGE	22,42 98,104
6TB2	TERM BLOCK CONTROL SIGNAL	67,68 97,99
6TB3	TERM BLOCK POWER INPUT	21
6TB4	TERM BLOCK INPUT/OUTPUT	82,83 103

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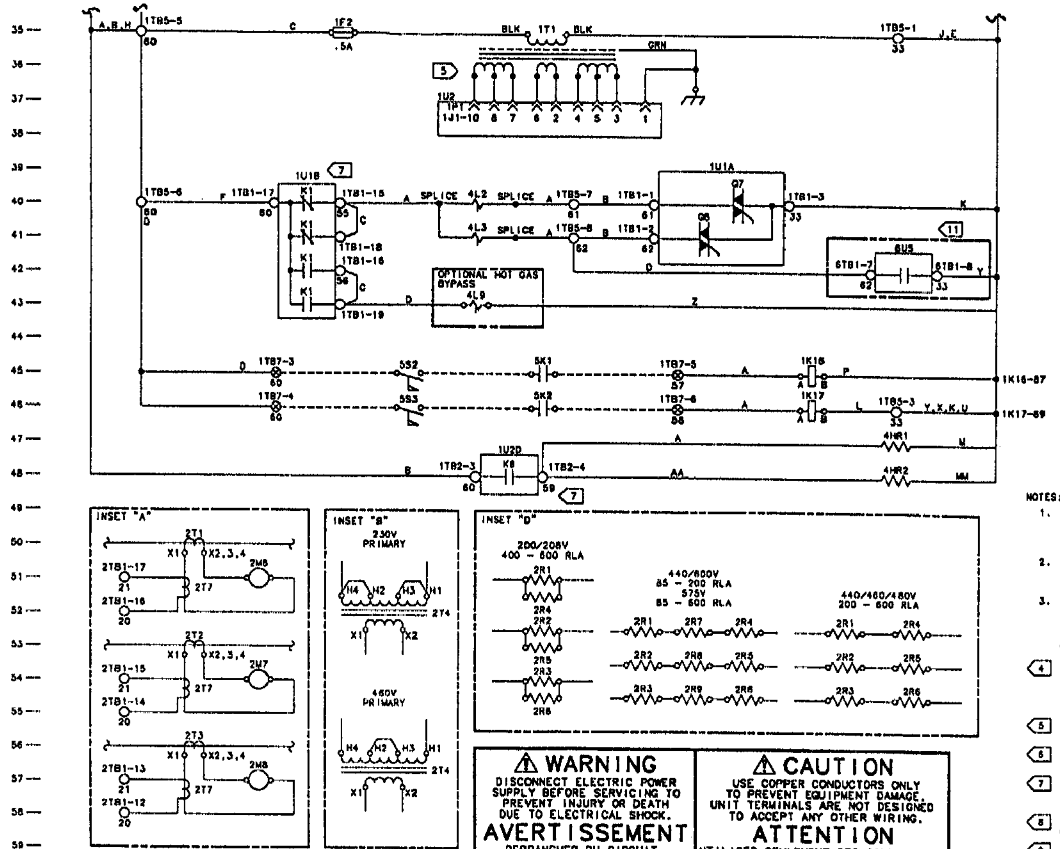

⚠ WARNING

DISCONNECT ELECTRIC POWER SUPPLY BEFORE SERVICING TO PREVENT INJURY OR DEATH DUE TO ELECTRICAL SHOCK.

AVERTISSEMENT

DEBRANCHER DU CIRCUIT D'ALIMENTATION ELECTRIQUE AVANT L'ENTRETIEN POUR EVITER BLESSURE OU MORT PAR ELECTROCUTION.

⚠ CAUTION

USE COPPER CONDUCTORS ONLY TO PREVENT EQUIPMENT DAMAGE. UNIT TERMINALS ARE NOT DESIGNED TO ACCEPT ANY OTHER WIRING.

ATTENTION

UTILISER SEULEMENT DES CONDUCTEURS EN CUIVRE POUR EVITER D'ENDOMMAGER L'EQUIPMENT. LES BORNES NE SONT PAS PREVUES POUR AUTRES TYPES DE FILS CONDUCTEURS.

NOTES:

1. UNLESS OTHERWISE NOTED, ALL SWITCHES ARE SHOWN AT 25°C (77°F), AT ATMOSPHERIC PRESSURE, AT 50% RELATIVE HUMIDITY, WITH ALL UTILITIES TURNED OFF AND AFTER A NORMAL SHUTDOWN HAS OCCURED.
2. SOLID LINES INDICATE TRANE WIRING. DASHED LINES INDICATE FIELD WIRING. PHANTOM LINES INDICATE OPTIONAL FEATURES.
3. NUMBERS ALONG THE RIGHT SIDE OF THE SCHEMATIC DESIGNATE THE LOCATION OF THE CONTACTS BY LINE NUMBER. AN UNDERLINED NUMBER INDICATES A NORMALLY CLOSED CONTACT. AN OPEN ARROWHEAD BELOW THE LINE NUMBER POINTING UPWARD INDICATES A TIMED CONTACT WHICH BEGINS TIMING WHEN ENERGIZED.
4. REMOTE Y-Δ STARTER SHOWN AND WIRING BETWEEN CONTROL PANEL AND STARTER REMAIN SIMILAR FOR VARIOUS TYPES OF STARTERS. SEE STARTER MANUFACTURES WIRING DIAGRAM FOR SPECIFIC STARTER WIRING.
5. SEE SERVICE MANUAL FOR INDIVIDUAL SECONDARY VOLTAGES.
6. THREE PHASE POWER SUPPLY VOLTAGE SEE UNIT NAMEPLATE.
7. RELAY COILS NOT SHOWN. CONTACTS ARE CONTROLLED BY THE LOGIC OF THE MICRO-MODULE (1U3). SEE SEQUENCE OF OPERATION LINES 102-116 PAGE 2.
8. 200/575 VOLT PRIMARY SHOWN. SEE INSET "B" FOR OTHER VOLTAGES.
9. IF METER PACKAGE OPTION IS REQUIRED SEE INSET "A".
10. RESISTOR SHOWN FOR 200/208V AND 200-400 RLLA. FOR OTHER VOLTAGES AND RLA SEE INSET "D"
11. OPTIONAL ICE MAKING CONTROL (6U5, 6U6).

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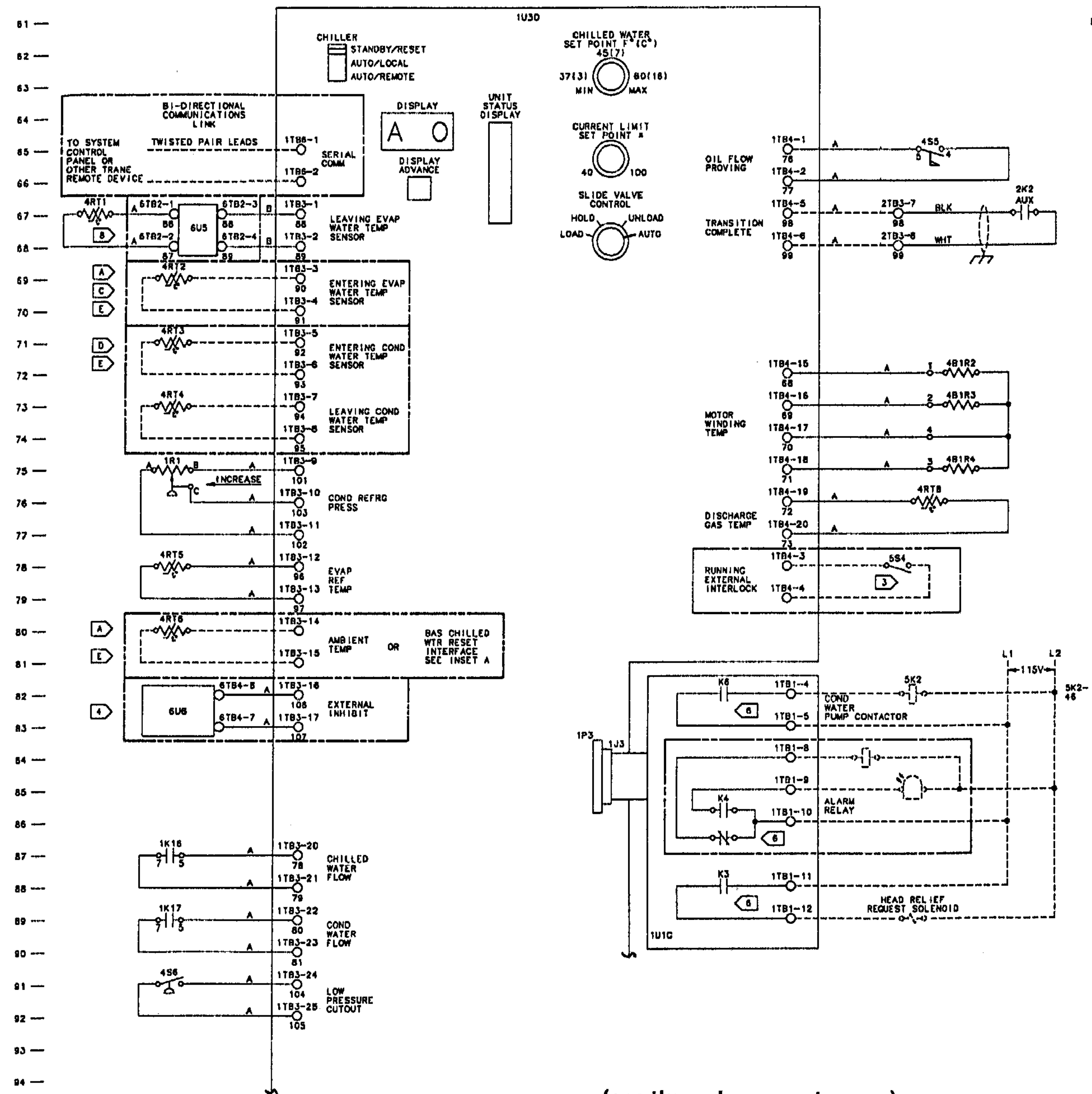
Figure 10
System Schematic for RTHA Units with Remote-Mounted "Wye-Delta" Starter (Page 2)



NOTES:

1. DASHED LINED INDICATE FIELD WIRING BY OTHERS. PHANTOM LINES INDICATE ALTERNATE CIRCUITRY OR AVAILABLE SALES OPTION. CHECK SALES ORDER TO DETERMINE IF WIRING IS REQUIRED FOR SPECIFIC OPTIONS.

2. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE (NEC), STATE AND LOCAL REQUIREMENTS. OTHER COUNTRIES APPLICABLE NATIONAL AND/OR LOCAL REQUIREMENTS SHALL APPLY. ALL WIRING TO 1TB3, 1TB4 & 1TB6 IS LOW VOLTAGE (30 VOLTS MAX) ONLY.

3. MANUAL RESET IS ACCOMPLISHED BY MOVING THE CHILLER SWITCH, LINE 62, FROM "STANDBY/RESET" TO "AUTO". MANUAL RESET IS ALSO REQUIRED FOR A TRIP-OUT DUE TO THE RUNNING EXTERNAL INTERLOCK, LINE 78.

4. AUXILIARY TERMINAL CONNECTIONS FOR A CUSTOMER SPECIFIED OR INSTALLED NON-LATCHING UNIT START/STOP SIGNAL. TERMINALS 1TB3-16 AND 1TB3-17 MUST BE JUMPERED IF EXTERNAL INTERLOCK OR ICE MAKING CONTROL IS NOT USED.

5. THE FOLLOWING CAPABILITIES ARE OPTIONAL - THEY ARE IMPLEMENTED AND WIRED AS REQUIRED FOR SPECIFIC SYSTEM APPLICATION.

   A. CHILLED WATER RESET- REQUIRES MATCHED PAIR OF THERMISTORS FOR 4RT1 & 4RT2, LINES 67 & 69. IF AMBIENT TEMP BASED CHILLED WATER RESET IS REQUIRED, USE STD SUPPLIED LEAVING EVAP WATER TEMP SENSOR (4RT1 LINE 67) FOR 4RT6 LINE 80 AS AN AMBIENT TEMP SENSOR.

   C. ENTERING EVAP TEMP SENSOR - REQUIRES MATCHED PAIR OF THERMISTORS 4RT1 & 4RT2, LINES 67 & 69.

   D. ENTERING AND LEAVING CONDENSER WATER TEMP SENSORS MATCHED PAIR OF THERMISTORS FOR 4RT3 & 4RT4 LINES 71 & 73.

   E. TRACER MONITORING PACKAGE INCLUDES OPTIONS C AND D.

   F. REMOTE GENERIC BAS CHILLED WTR RESET INTERFACE. MUST BE USED WITH CHILLED WATER RESET INTERFACE PANEL OPTION.

6. RELAY COILS NOT SHOWN. CONTACTS ARE CONTROLLED BY THE LOGIC OF THE MICRO-MODULE (1U3). SEE SEQUENCE OF OPERATION LINES 102 - 115.

7. NEGATIVE SIGNAL INPUTS ARE GROUNDED TO UCP ENCLOSURE. FOR CORRECT OPERATION, EXTERNAL EQUIPMENT SIGNALS SHALL BE ISOLATED OR FLOATING WITH RESPECT TO UCP ELECTRICAL SERVICE GROUND AND ISOLATED FROM EACH OTHER. SPECIAL CONSIDERATION MUST BE GIVEN TO 4-20 mA SIGNALS. IF THE CURRENT SOURCE REGULATES CURRENT FLOW ON THE NEGATIVE LEAD USE A SEPARATE POWER SUPPLY FOR EACH CHANNEL. IN SOME APPLICATIONS IT MAY BE NECESSARY TO INSTALL A LOOP ISOLATOR IN EACH CHANNEL TO PREVENT LOOP INTERFERENCE.

8. OPTIONAL ICE MAKING CONTROL SHOWN SEE INSET B FOR WIRING WHEN OPTION IS NOT USED.

⚠ WARNING
DISCONNECT ELECTRIC POWER SUPPLY BEFORE SERVICING TO PREVENT INJURY OR DEATH DUE TO ELECTRICAL SHOCK.

AVERTISSEMENT
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USE COPPER CONDUCTORS ONLY TO PREVENT EQUIPMENT DAMAGE. UNIT TERMINALS ARE NOT DESIGNED TO ACCEPT ANY OTHER WIRING.

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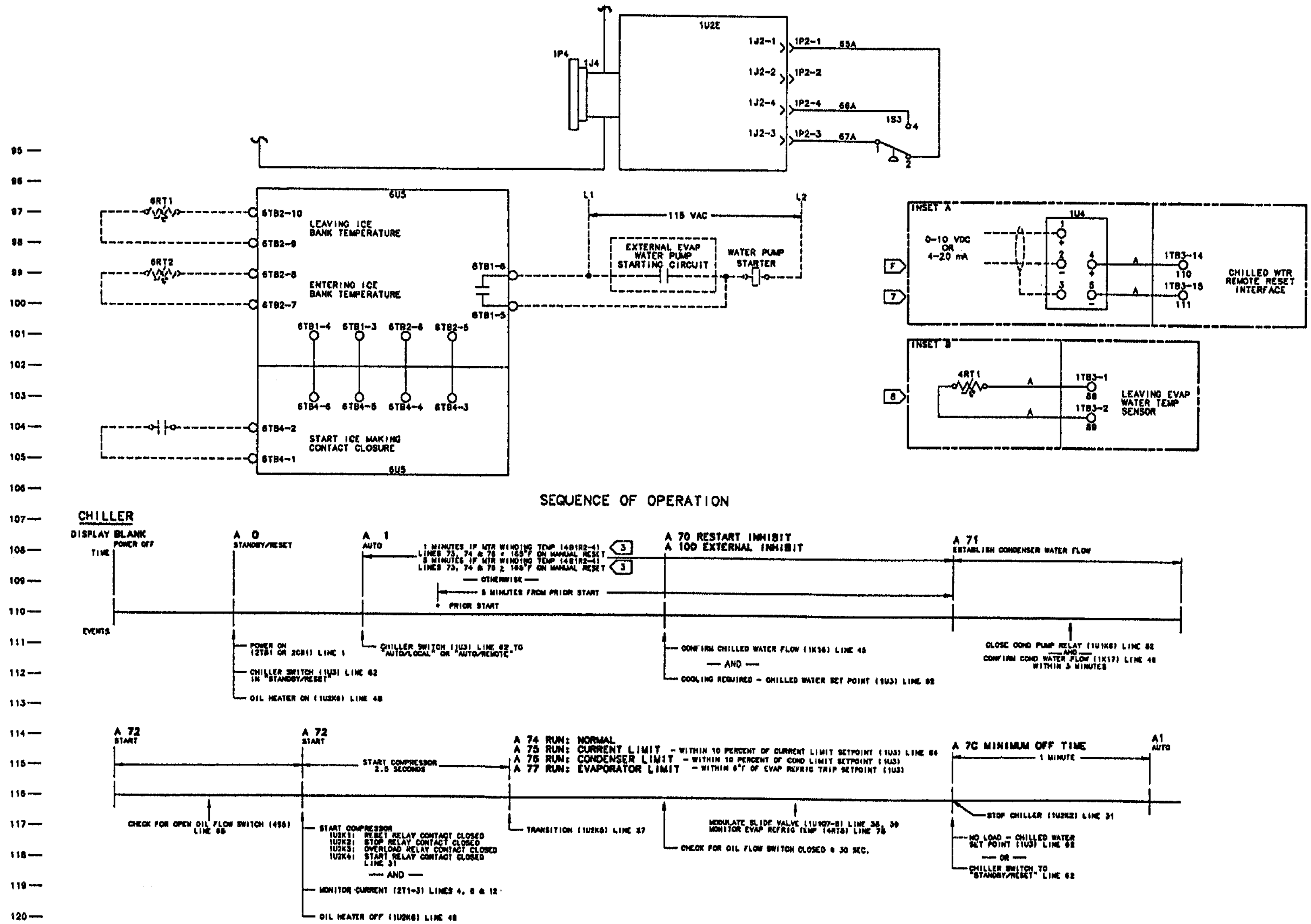

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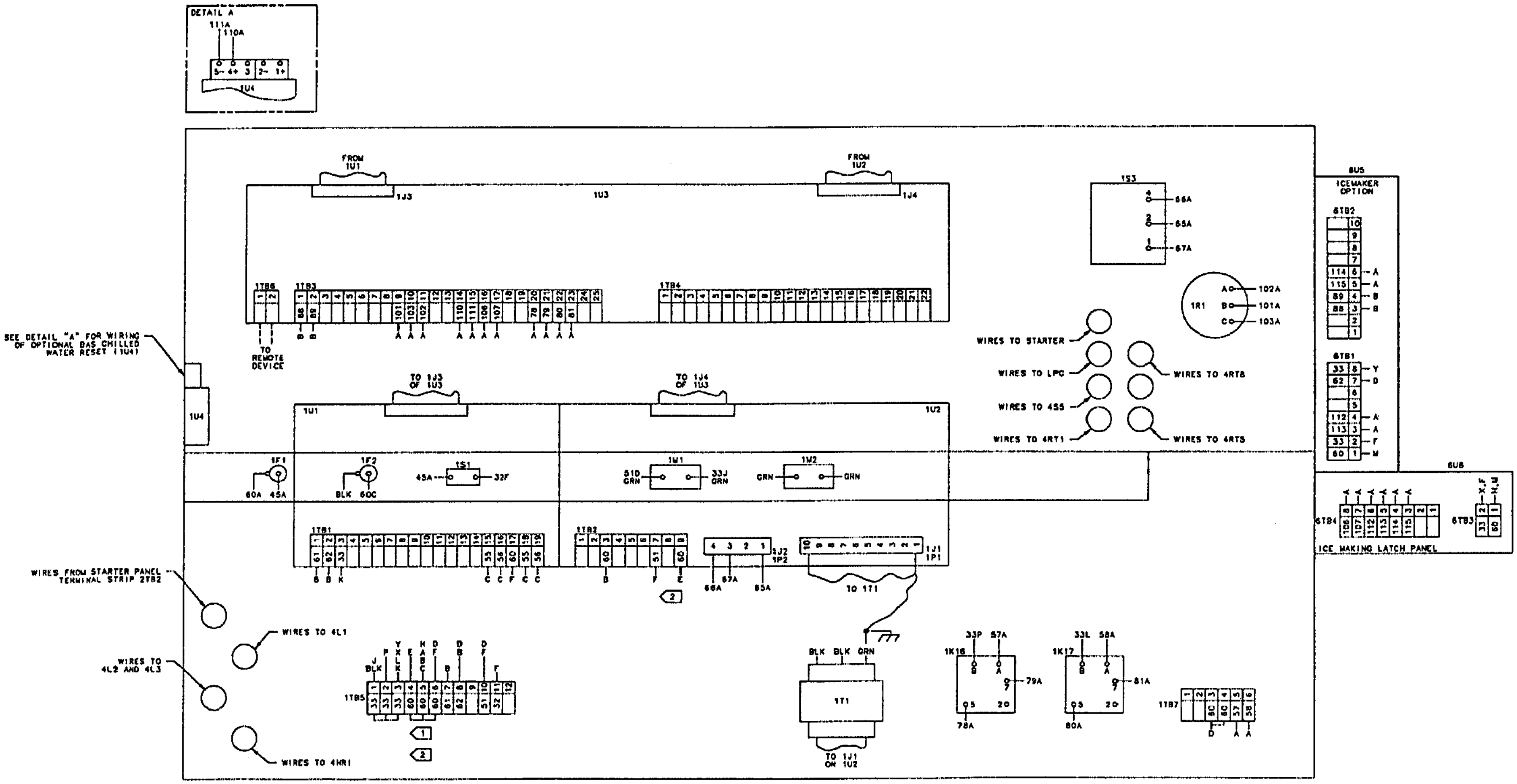
Figure 11
Control Panel Component Location Diagram for RTHA Units

WARNING
DISCONNECT ELECTRICAL POWER SOURCE TO PREVENT INJURY OR DEATH FROM ELECTRICAL SHOCK

CAUTION
Use copper conductors only to prevent equipment damage

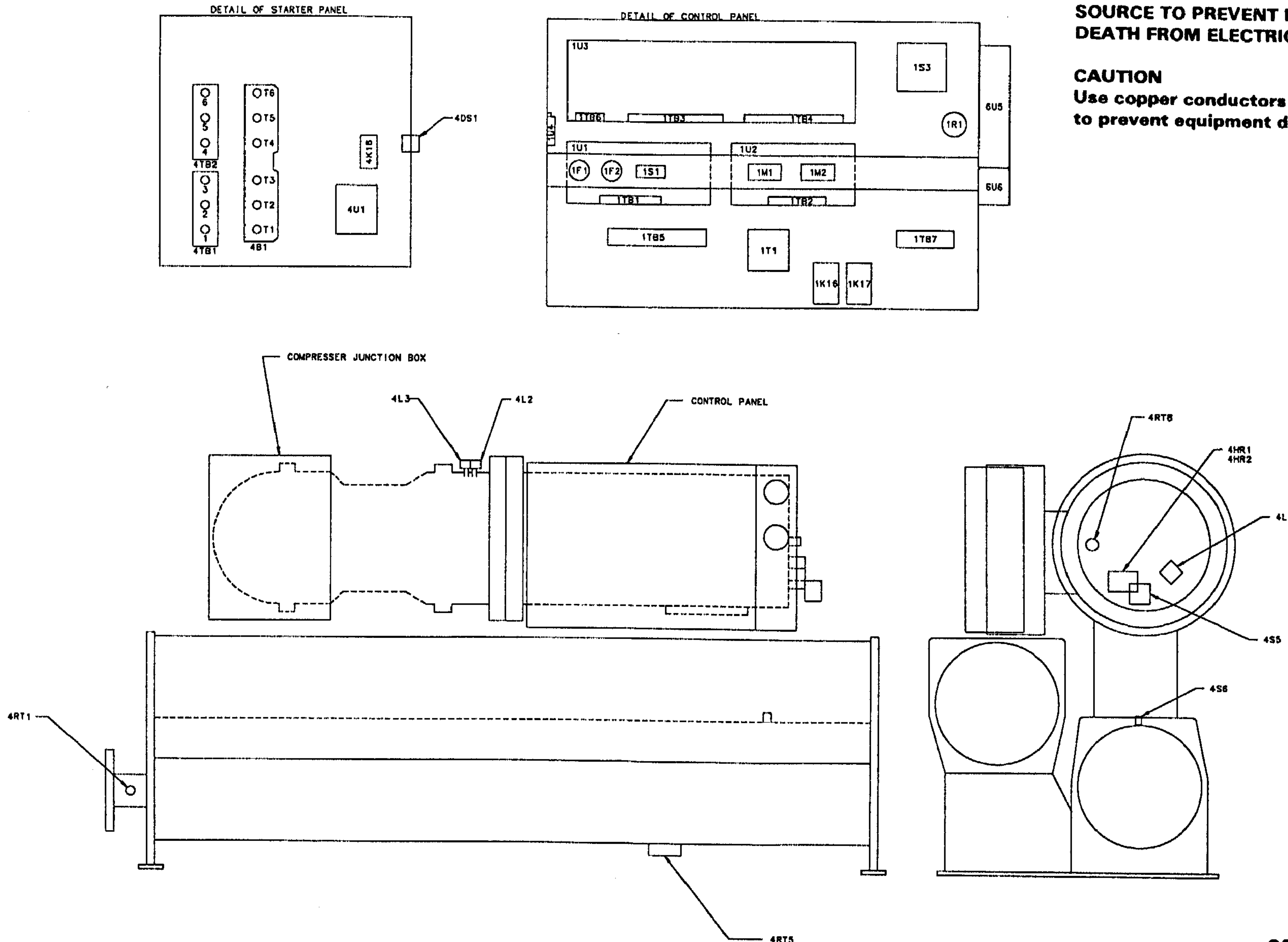


NOTES:

1. FOR REMOTE MOUNTED STARTER UNITS – REMOVE JUMPER CLIP BETWEEN 1TB5-4 AND 1TB5-5.
2. FOR REMOTE MOUNTED STARTER UNITS – WIRE #60E BETWEEN 1TB5-4 AND 1TB2-9 TO BE RELABELED 63A.

2306-9104C

Figure 12
Unit Component Location Diagram for RTHA Units with Remote-Mounted Starter



WARNING
DISCONNECT ELECTRICAL POWER SOURCE TO PREVENT INJURY OR DEATH FROM ELECTRICAL SHOCK

CAUTION
Use copper conductors only to prevent equipment damage

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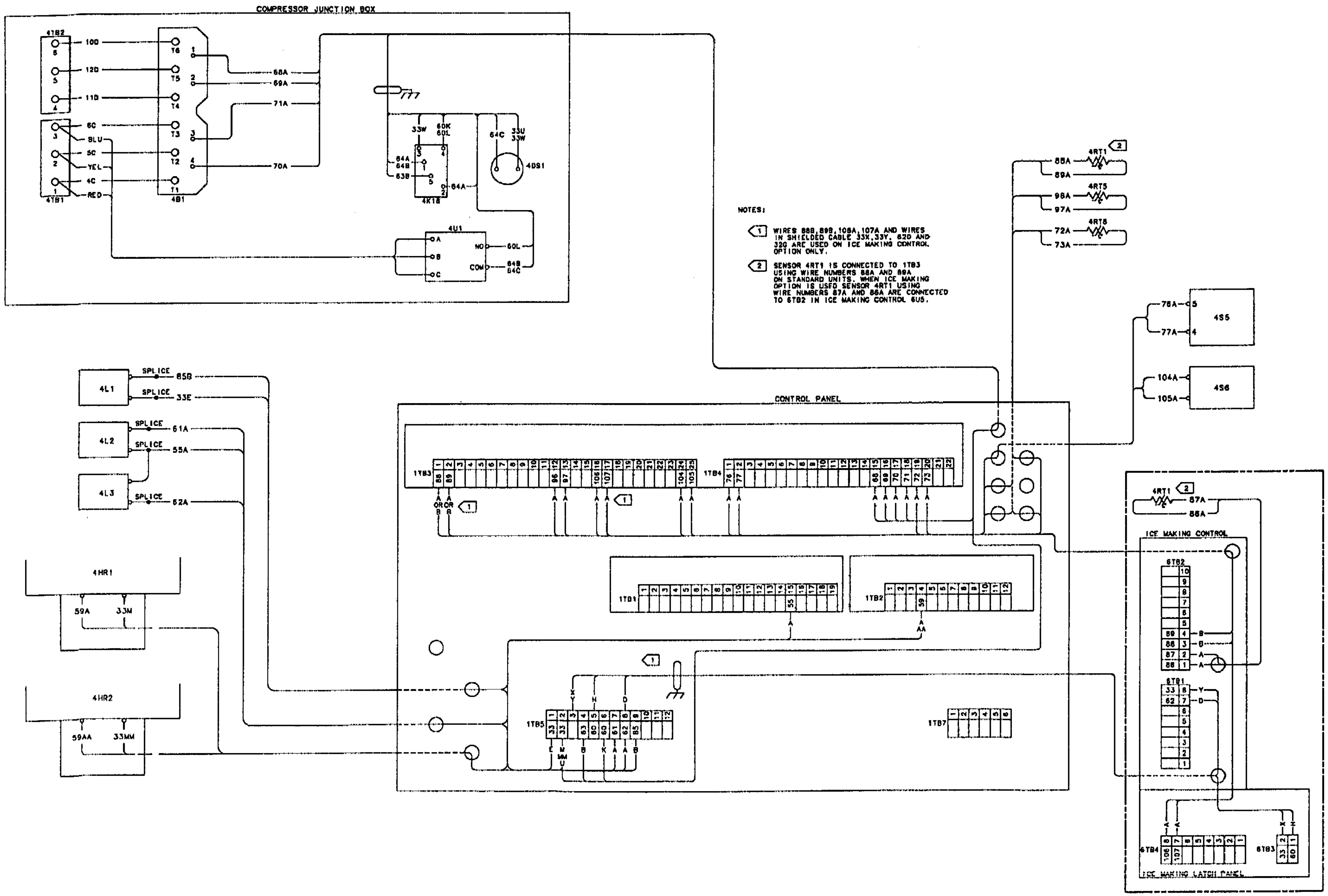
Figure 13
Component Interconnection Diagram for RTHA Units with Remote-Mounted Starter



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RH/JH

TRANE

Start-Up Guide for Unit-Mounted and Remote-Mounted Starters

Literature File No.	RLC-SG-1
Section	3.0
Date	June 1990

The start-up procedures discussed in the following sections are applicable only to RTHA units.

All the inspections, job site reviews and procedures are presented in the chronological order in which they are to be performed and the personnel responsible for the performance of these tasks is also indicated.

The beginning of each section lists the tasks associated with this phase of the start-up process. This is followed by a more detailed explanation of each task, when necessary.

TRANE

Preliminary Job Site Inspection Suggested Sales Engineer's Responsibility

Literature File No.	RLC-SG-1
Section	3.1
Date	June 1990

The tasks associated with the Preliminary Job Site Inspection are listed below:

1. Inspect the unit for shipping damage and material shortages as soon as it is delivered to the job site.

2. Review the system design and layout.

Caution: To prevent equipment damage, do not use untreated or improperly treated water.

3. Verify that pressure relief vent piping conforms to local codes.

4. Ensure that all electrical power wiring, interconnecting wiring and control interlock circuits are complete.

5. Ensure that the loose parts box, which was shipped with the unit, is intact and in proximity of the unit.

Note: Some Trane Field Offices have developed their own checklist, which serves as a "prompt sheet" for this Preliminary Job Site Inspection. An typical example is shown at the end of this section.

Detailed Task Explanations

Because there are a number of specific inspections associated with tasks 1, 2, and 4 above, these are described in more detail, as follows:

1. Inspect the unit for shipping damage and material shortages as soon as it is delivered to the job site.

Fully inspect the unit and all unit components as soon as the equipment arrives at the job site, so that any necessary shipping claims can be made. Careless handling during the rigging and final placement processes can also result in unit damage. Look for signs of collision, such as scars, nicks, bent piping and other evidence of unit damage.

Note: All units are inspected at the factory prior to shipping. Any damage which is found must be immediately reported to the carrier.

In addition to inspection of the unit, carefully check all items ordered from Trane, or through Trane on a "direct ship" (DS) order, for completeness and for any shipping damage. Store items in a cool, dry location (preferably indoors) until ready for their use.

Ensure that the correct wiring, control and piping diagrams are at the job site. Also verify that the unit is level and that the isolators are properly installed. See RTHA-IOM-1 in Section 1.

2. Review the system design and layout.

Thoroughly review the design and layout of the system's water piping to ensure that both conform to the Trane company's requirements for chiller connection, control and service accessibility.

The evaporator piping must allow water to enter the upper connection. The condenser must be piped to allow water to enter the lower connection. Verify that none of the installed water pumps is rated at 3600 RPM since this rotational speed will subject the installation to "sympathetic-beat-frequency" vibrations, i.e. vibrations caused by the close rotational speeds of the compressor/ motor assembly and the water pumps.

Conduct the inspections of the chilled water and condenser water systems listed below:

a. Check for proper installation of isolation valves, flow or pressure switches, pressure taps, strainers, pipe isolators, drain valves and vent cocks.

Note: Verify that the flow switches are in the water lines that serve their respective chillers. On applications where more than one chiller is installed, the flow switches that serve one chiller must not be in a water line that can serve more than that specific chiller.

b. Verify that the working pressure specifications for each of the piping components meet, or exceed, the system requirements.

c. Ensure that proper water treatment is planned and available before initial chiller start-up. Check to be sure that glycol has been added to the water system, if necessary, and that the resulting solution is of the correct specific gravity.

Note: The Trane Company warranty specifically excludes liability for corrosion, erosion, or deterioration of Trane equipment. Also, the Trane Company assumes no responsibility for damage caused by the use of untreated, improperly treated, saline, or brackish water.

Caution: To prevent damage to the equipment, do not use untreated or improperly treated water.

4. Ensure that all electrical power wiring, interconnecting wiring and control interlock circuits are complete.

WARNING: To prevent injury or death due to electrical shock, place the safety-lock main disconnect switch in the "OPEN" position.

---

a. Check the incoming power leads (L1, L2, and L3) to the starter, to verify that the proper number of leads have been pulled. Wire sizing is the responsibility of the installing contractor.

b. If the remote-mounted starter option is used, check the wiring between the starter panel and the compressor motor. Ring out all wires to verify that each lead is located on its proper terminal.

1) Determine what starter type is installed, i.e. Wye-Delta, auto-transformer, or across-the-line. Also verify the inrush current to determine breaker size.

2) Verify that one conduit is connected to the low-voltage (<30 VAC, upper half) portion of the control panel and that the other conduit is connected to the high-voltage (>30 VAC, lower half) portion of the control panel.

Caution: To prevent possible serious damage to the equipment, do not install the high-voltage wiring (>30 VAC) in close proximity to the low-voltage wiring (<30 VAC).

Caution: All low-voltage wiring (<30 VAC) installed between a remote-mounted starter and the control panel must be shielded in separate conduit.

3) Check the proximity of the wiring between the terminal strip and the conduit entrance in the starter panel. The low-voltage and high-voltage wiring bundles must be separated by a minimum of 6inches. Also, each of these bundles should have its own raceway.

Caution: To prevent electrical noise interference, install low-voltage (<30 VAC) wiring a minimum of 6 inches away from high-voltage wiring.

c. Verify that the control interlock circuits are installed and that all electrical connections are tight.

Check Sheet and Request For Serviceman

This completes the Preliminary Job Site Inspection, performed by the Sales Engineer. If all of the inspections are completed with satisfactory results, instruct the contractor to prepare the "Check Sheet and Request For Serviceman" form so that the unit can be scheduled for start-up. A copy of this form can be found at the end of this section.

(Example of RTHA Preliminary Job Site Inspection sheet and "Check Sheet and Request For Serviceman" form)

RTHA Preliminary Job Site Inspection Sheet

[ ] Look for shipping damage, scars, nicks, bent piping

[ ] Be sure correct diagrams for wiring, control, and piping are at the site

[ ] Contractor has leveled the unit

[ ] Isolators are installed (spring or pad)

Water Piping:	Condenser	Evaporator
a. Isolation valves	[ ]	[ ]
b. Flow or differential pressure switches	[ ]	[ ]
c. 5 pipe diameters for flow switch or time delay	[ ]	[ ]
d. Pipe isolators	[ ]	[ ]
e. Pressure taps	[ ]	[ ]
f. Strainers	[ ]	[ ]
g. Drain valves	[ ]	[ ]
h. Vent cocks	[ ]	[ ]

___ Water treatment (yes or no)

[ ] Pressure relief piping conforming to local codes

[ ] Non-interruptive 120 VAC power source

[ ] Air handling units running

[ ] Wiring completed from starter to RTHA

[ ] Interlock control circuits

[ ] Water system flushed

TRANE

Job Site Check-Out Prior To Start-Up
Suggested Sales Engineer's Responsibility

Literature File No.	RLC-SG-1
Section	3.2
Date	June 1990

At least two weeks before scheduled start-up, if the installation is not complete or if problems are discovered during the preliminary-job site inspection, the following tasks are to be performed:

1. Review –

a. Design data on the order write-up.

b. All wiring diagrams associated with the application.

c. Design control schedule for cooling tower water temperature. Suggest minor control setting deviations if the design conditions cannot be met during start-up.

d. Special chiller modifications, such as unit options or the addition of glycol.

e. The "Check Sheet and Request For Serviceman" form completed by the installing contractor.

f. The "Preliminary Job Site Inspection" and "Problem" report submitted by the Sales Engineer. Verify that all problems have been corrected.

2. Assemble the service technician's documentation packet, including service literature, wiring diagrams, design data, submittals and suggested log forms.

3. Set up specific attendance times during unit start-up for the electrician, control representative and installing contractor. Provide each with the appropriate start-up information.

4. If necessary, arrange for the control representative to thoroughly double-check the system wiring and piping before the scheduled start-up date.

5. If necessary, make advance security clearance arrangements for the service technician during the days designated for unit start-up.

6. Assemble the tools required by the service technician for unit start-up.

Detailed Task Explanations

As the tasks above indicate, this phase of the initial start-up process is primarily concerned with actual equipment operational checks, as opposed to the site installation checks completed by the sales engineer in Section 3.1. It is intended to ensure that all contractor functions are complete and that all equipment associated with the system is operational.

The final check-out phase is especially important since it allows the detection – and correction – of minor equipment or system problems that might otherwise abort unit start-up, inconvenience the owner and incur additional expense for the delay and rescheduling of start-up.

Some of the items in the final check-out phase may already have been completed and reviewed to the satisfaction of the service coordinator or service technician. The service coordinator must be convinced that these areas have not been overlooked and should recheck each item.

Review the sales engineer's report of the Preliminary Job Site Inspection, including any noted problems or incompletions, and the "Check Sheet and Request For Serviceman" form submitted by the installing contractor.

The "Preliminary Job Site Inspection" sheet and "Problem" report, submitted by the Sales Engineer after his/her inspection, allows the service coordinator to specifically review those aspects of the installation that were unsatisfactory and verify that they have been completed or corrected.

By submitting the "Check Sheet and Request For Serviceman" form, the installing contractor is certifying that the unit and all related systems are properly installed and that he is satisfied that the unit is ready for start-up.

When used correctly, this form places some degree of responsibility for a smooth start-up on the installing contractor. If delays are encountered during start-up, because items were certified complete but, in fact are not operational, charge-backs against the contractor may be in order.

Assemble the following special tools that may be required by the service technician for start-up:

- Phase sequence indicator (Triplett Model 920)
- Digital volt-ohm meter
- Electronic thermometer (including surface probe)
- Metric wrenches
- Refrigerant pressure/temperature chart for R-22

TRANE

Preparation
Service Technician's Responsibility

Literature File No.	RLC-SG-1
Section	3.3
Date	June 1990

On the day before the scheduled start-up, meet with the service coordinator and:

1. Obtain the documentation packet.

2. Pick up the necessary start-up tools.

Be aware that the start-up procedure for an RTHA is planned for 6 hours, plus travel, and an additional 4.5 hours for each additional chiller unit.

Become familiar with the start-up plan, the description of the tasks required (as shown in the following section), and the efficient use of time required.

Unless otherwise indicated, each of the tasks is the responsibility of the service technician who has been assigned to perform the initial start-up.

TRANE

Start-Up
Service Technician's Responsibility

Literature File No.	RLC-SG-1
Section	3.4
Date	June 1990

WARNING: To prevent injury or death due to electrical shock, place the safety-lock main disconnect switch in the "OPEN" position.

1. Check the refrigerant pressure and MEG compressor motor.

2. Check the integrity of the power supply wiring, the control interlock circuits, and the interconnecting wiring from the starter to both the control panel and the motor. Verify that the dip switch settings are correctly set to the factory specifications (for unit-mounted and remote-mounted starters). See Section 10. Service Bulletin RTHA-SB-5.

3. "Power up" the control panel with auxiliary power. Check the service and operator interface control set points on the micro module (1U3).

4. Dry run the starter panel.

5. Balance the water flows and check the water flow interlocks.

6. Start the chiller and fine tune the controls.

7. Instruct the operators in the operation of the chiller unit.

8. "Pull down" start-up. Complete the log and do necessary housekeeping to complete the operation.

Detailed Task Explanations

WARNING: To prevent injury or death due to electrical shock, place the safety-lock main disconnect switch in the "OPEN" position.

1. Check the refrigerant pressure and MEG compressor motor.

Check refrigerant pressure in the evaporator and the condenser by verifying that the service valves for the gauges are open. After run-test at the factory, units with isolation valves are pumped down. Therefore most of the refrigerant is isolated in the condenser. (Units without isolation valves are not pumped down.)

The pressure/temperature relationship of the condenser pressure should equal the temperature of the water in the condenser water circuit. The pressure/temperature relationship of the evaporator pressure may be equal or slightly less than the temperature of the water in the chilled water circuit.

Note: Do not open the condenser isolation valves at this time.

Meg test the compressor motor.

Caution: To prevent serious motor damage, never MEG test the compressor motor in a vacuum.

Using a megohmmeter at the motor terminals, test the compressor for any possible leakage in the motor lead insulation which may cause interference.

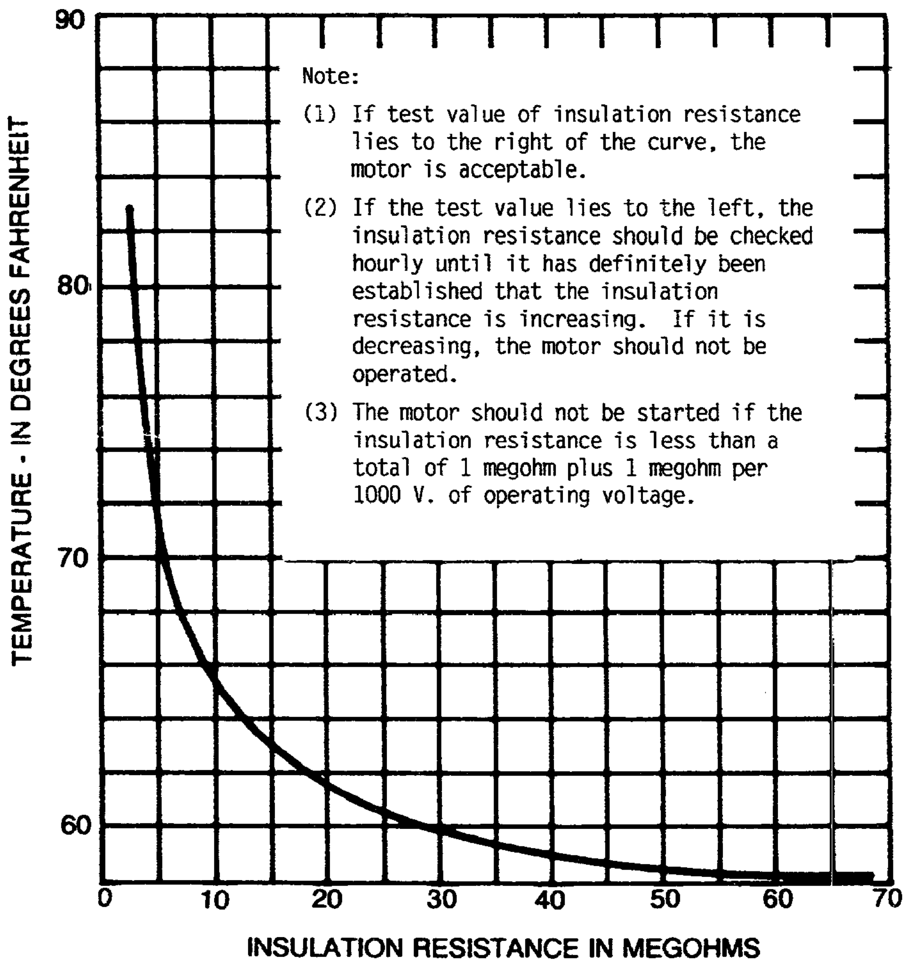
Before MEG testing the compressor motor, be sure that –

a. the power leads are disconnected

b. the chiller is charged with refrigerant

MEG test each phase against each of the other phases and the ground, as specified in the start-up log. Any major difference in megohm reading between a phase and ground is cause for concern. Insulation resistance, in megohms, is shown in Chart 1.

Chart 1
Temperature Vs.
Insulation Resistance



If the recorded megohm readings are not within the limits shown in Chart 1, clean the motor terminal board with denatured alcohol. Any oil, grease or dirt on the terminal board may contain sufficient moisture to cause low megohm readings.

2. Check the integrity of the power supply wiring, the control interlock circuits, and the interconnecting wiring from the starter to both the control panel and the motor. Verify that the dip switch settings are correctly set to the factory specifications (for unit-mounted and remote-mounted starters).

Inspect all electrical wire and terminal connections in the control panel, the starter panel and the motor terminal box for loose connections and controls. Also look for any dirt or debris that may have fallen into the starter. Open all the contactors in the starter panel, to check for debris and ensure the integrity of the contacts. Manually close the contactors to verify the operation of the auxiliary contacts and the mechanical interlocks.

To check the interconnecting wiring between the starter and the control panel (for unit-mounted and remote-mounted starters:

a. Make sure that each conduit contains the proper size and number of wires for the respective voltages and that the wires are properly labeled.

b. All interconnecting wires from the starter must be connected to the proper terminals at each end.

c. Use an ohmmeter to check the integrity of each of the interconnecting electrical circuits between the starter and the control panel.

Check the main supply wiring to the starter panel and verify that:

a. each of the incoming power leads (L1, L2, L3) is connected to the correct starter terminal lug.

b. all incoming power leads are in conduits and have a balanced phase representation. Each conduit must have an equal representation of each phase.

Note: An unequal phase representation can produce a phase imbalance that results in loss of motor efficiency.

c. proper phase rotation is established, i.e. Phase A to L1, Phase B to L2, and Phase C to L3.

Caution: It is essential to confirm that proper phase rotation is established – Phase A to L1, Phase B to L2, and Phase C to L3. Phase rotation must be checked with a phase sequence indicator before start-up, otherwise catastrophic damage to the compressor may result.

If the direction of rotation is wrong, correct the situation per the instructions in Section 5.3.

Check the wiring between the starter panel and the compressor motor to be sure that:

a. the "T" legs (in conduits) have a balanced phase representation. Each conduit must have an equal representation of each phase. WYE-DELTA starters with 2 conduits must have leads 1, 2, and 3 in one conduit and leads 4, 5, and 6 in the other conduit.

Note: An unequal phase representation, such are leads 1, 2, and 6 in one conduit and 4, 5, and 3 in the other, can produce a phase imbalance that results in a loss of motor efficiency.

b. the "T" legs between the starter contactors and the motor terminals are connected properly. See the "as-built" wiring diagrams that shipped with the unit.

Verify that the dip switch settings are correctly set to the factory specifications (for unit-mounted and remote-mounted starters). The dip switches can be seen by removing the cover strip along the top of the micro module 1U3. The factory settings are shown in Section 10. Service Bulletin RTHA-SB-5.

Note: Enter the dip switch setting on the Log Sheet.

3. "Power up" the control panel with auxiliary power. Check the service and operator interface control set points on the micro module (1U3).

To energize the control panel:

a. Verify that the starter safety-lock main disconnect switch is still in the "OPEN" position and that fuses 2F1, 2F2, and 2F3 are not installed in the starter panel. Be sure to remove these fuses.

b. Set the three-position chiller switch to the "STANDBY/RESET" position.

c. Using an auxiliary 115 VAC power source, connect the "hot" side of this power source to terminal 1TB5-11 and the "neutral" side to terminal 1TB5-2 in the control panel (unit/remote mounted).

WARNING: The control panel and starter panel are now energized. Extreme care must be taken when completing this procedure to prevent injury or death due to electrical shock.

Caution Reversing the connections of the auxiliary 115 VAC power source will cause an electrical short in the equipment.

To check the service interface, open the control panel door and turn on the service switch (1S1). Adjust the 4 service potentiometers – control response, start differential, condenser limit, and evaporator refrigerant "trip point" – to the set points indicated in RTHA-IOM-1.

If the unit is equipped with the optional chilled water reset, adjust the reset action and reset reference knobs to the proper settings, as indicated in RTHA-IOM-1. Ensure that the reset type switch remains in the "OFF" position while logging the unit.

To check the operator interface, adjust the current limit set-point to 100% and set the chilled water set-point to the design value indicated on the order write-up.

4. Dry run the starter panel.

The following method for a dry run test of the starter panel does not require removal of the compressor leads. While it is specifically intended for WYE-DELTA starters, it can be modified for use with auto-transformer and across-the-line starters.

a. Verify that the starter safety-lock main disconnect switch is still in the "OPEN" position and that fuses 2F1, 2F2, and 2F3 are not installed in the starter panel. Be sure to remove these fuses.

b. Verify that the auxiliary 115 VAC power source is disconnected from terminals 1TB5-11 and 1TB5-2.

c. To simulate a "start signal", connect a switched jumper between terminals 1TB2-9 and 1TB2-7 in the control panel. Make sure that the jumper's switch is "open".

d. To simulate a "transition signal", connect a switched jumper between terminals 1TB2-5 and 1TB2-6 in the control panel. Make sure that the jumper's switch is "open".

e. If the starter is unit-mounted, jumper out the contact on the phase sequence relay (2U1) by placing a jumper between terminals 86A and 51J on the 2K5 contactor.

f. On remote-mounted starters, verify that the 4U1 phase monitor is working properly. This is done by first removing all wires to the motor terminals. Then swap two wires on 4U1. Normally open 4U1 should close, normally closed 4K18 should open and normally open 4K18 should close. This should stop all power from feeding 1U2.

g. Using an auxiliary 115 VAC power source, connect the "hot" side of this power source to terminal 1TB5-11 and the "neutral" side to terminal 1TB5-2 in the control panel (unit/remote mounted).

WARNING: The control panel and starter panel are now energized. Extreme care must be taken when completing this procedure to prevent injury or death due to electrical shock.

Caution: Reversing the connections of the auxiliary 115 VAC power source will cause an electrical short in the equipment.

The following steps may require the assistance of a second person. If the starter is remote-mounted, station one person at the control panel and the other at the starter panel. Both should be within hearing distance or the use of walkie-talkie type equipment may be required.

h. Close service switch 1S1. Simulate a "start signal" by closing the switch on the jumper between terminals 1TB2-9 and 1TB2-7. On the starter panel, the pilot relay (2K5), the shorting contactor (2K3), and the start contactor (2K1) should now be energized.

i. With Step h. above completed, simulate a "transition signal" by momentarily closing the switch on the jumper between terminals 1TB2-5 and 1TB2-6. On the starter panel, the following should occur:

   1) transition contactor (2K4) momentarily energizes

   2) shorting contactor (2K3) de-energized

   3) run contactor (2K2) energizes

j. When Step i. above is completed, open the switch on the jumper between terminals 1TB2-9 and 1TB2-7 to de-energize the starter.

5. Balance the water flows and check the water flow interlocks.

a. Determine the chilled water and condenser water flow rates by subtracting the leaving water pressure from the entering water pressure in each case. Then multiply the resultant pressure by 2.3 to convert from PSIG to pressure in feet of water.

If the system water circuit has gauge locations at different heights, be sure to take this into consideration when calculating pressures. One (1) PSIG equals 2.3 feet of water.

Note: To avoid any discrepancies that may exist between different gauges, use one gauge and move it from one point to the next for measurement of entering and leaving pressures.

b. Use the pressure drop curves in RTHA-IOM-1 to determine water flow rates. Do not exceed the recommended flow rates, as erosion of the tubes may occur. Also, if flow rates are insufficient, there will not be enough turbulence of chilled water to get adequate heat transfer.

The order specification sheet shows the design-required net pressure drops (in feet of water; multiply by 0.433 to get PSIG) as well as the design-required water flow rates (in gallons per minute, GPM).

c. Make the necessary adjustments to achieve the design-required flow rates and enter the final flow rates on the Log Sheet.

d. Adjust the flow (or differential pressure) switches to trip at the final flow rate. A conservative adjustment is to allow the switches to open at the minimum pressure drop – or at 50% of design – whichever is greater. If the flow switch is not adjustable, be sure that it operates correctly within the desired flow range.

Use the appropriate pressure drop curves to convert the minimum pump flow rate to pressure differential for both the evaporator and the condenser. Adjust the flow rate to this calculated pressure differential and then adjust the flow switch to open at this time.

After recalibration, retrim the flow rates to design specifications.

e. Check the flow switches and the pump starter interlock circuits for the evaporator and the condenser.

   1) To check the chilled water flow interlock circuit, connect a voltmeter across terminals 1TB7-5 and 1TB5-2. When there is proper flow, the meter will read 115 VAC. Reduce the flow to the minimum and the opening of the flow switch will cause a voltage drop.

   To check the chilled water pump starter interlock, connect a jumper across the flow switch contacts. Turn the chilled water pump "OFF". This will again cause a voltage drop.

   2) To check the condenser water flow interlock circuit, connect a voltmeter across terminals 1TB7-6 and 1TB5-3. When there is proper flow, the meter will read 115 VAC. Reduce the flow to the minimum and the opening of the flow switch will cause a voltage drop.

   To check the condenser pump starter interlock, connect a jumper across the flow switch contacts. Turn the condenser water pump "OFF". This will again cause a voltage drop.

Note: Remove all the jumpers which were connected during the above tests before proceeding.

f. Disconnect auxiliary power from 1TB5-11 and 1TB5-2.

g. Remove the three jumpers that were used for the dry run test of the starter panel (2K5 contacts, 1TB2-9 and 1TB2-7, and 1TB2-5 and 1TB2-6).

h. Connect the compressor motor leads to the appropriate terminals, unless already completed.

i. Re-install the starter fuses (2F1, 2F2, and 2F3) in the starter panel.

j. Verify that the chiller switch is in the "STANDBY/RESET" position.

k. Unlock the starter disconnect switch and close it to energize the starter and the control panel. Close the service switch (1S1). Feel the oil sump exterior to verify that the oil tank heater is energized.

WARNING: Do not feel the oil tank heater, directly.

Note: If the condenser isolation valves were never opened prior to now, it will not be necessary to wait 24 hours after energizing the oil tank heater before starting the unit. Most of the unit's refrigerant is stored in the condenser and the time during which the auxiliary power was applied (approximately 3 hours) was adequate to drive any remaining refrigerant from the oil before start-up.

Caution: If the condenser isolation valves were open prior to now or the unit is not equipped with isolation valves, it will be necessary to energize the oil tank heater for 24 hours prior to start-up.

l. Open the condenser's inlet isolation valves. Before opening the outlet isolation valves, verify that the evaporator's refrigerant pressure/ temperature relationship is above freezing.

Caution: If liquid refrigerant is introduced into a tube bundle that is below 65 PSIG (at sea level), there is the possibility of freezing the water in a tube, causing it to rupture.

m. Verify that the master solenoid inlet valve, the oil filter outlet valve (if installed on the unit), and the two valves serving the refrigerant gauges are all open. Verify that all oil line valves are open prior to start-up.

Note: On later design sequences, only one angle valve (inlet to the oil filter) is installed on the unit.

Caution: Refer to Section 5.3, Electrical Phasing, before proceeding with the following steps.

n. Start the chiller and observe that the condenser pressure rises and the evaporator pressure drops.

Caution: This is an indication that the compressor rotation is correct, but do not forego the phase sequence indicator check (Section 5.3) and use this as the check for proper rotation.

o. Follow the steps below to determine if the refrigerant charge is proper for fully-loaded operation:

1) With the unit operating under fully-loaded conditions, set the temperature of the water entering the condenser at 85 F and the temperature of the chilled water leaving the evaporator at 44 F.

2) Measure the refrigerant pressure in the condenser and convert this to temperature T(Cond).

3) Remove 4RT8 and at that point measure the temperature T(4RT8).

4) Subtract T(Cond) from T(4RT8) to determine the discharge superheat temperature T(Dis).

5) The T(Dis) temperature should be 18 F to 22 F. A higher reading indicates that the unit charge is low.

6) If fully-loaded conditions cannot be maintained, the superheat temperature may be higher, approaching 30 F to 35 F in the fully-unloaded state. Interpolate data to determine the charge level, eg. if the unit is running at half-load, the T(Dis) temperature might be 26 F.

p. Check the high pressure control cutout (1S3), as follows:

   1) While the unit is running, jumper out the condenser water interlock circuit.

   2) Stop the condenser water pump.

   3) The unit should shut down when the condenser pressure rises to 270 +5 PSIG and should indicate a latching diagnostic.

q. On units with isolation valves, check the low pressure control cutout (4S6), as follows:

   1) While the unit is running, set the "slide valve control" switch to the "UNLOAD" position.

   2) Close the condenser outlet isolation valve.

   3) This will cause the unit to go into pumpdown mode and transfer the refrigerant charge to the condenser.

   4) The unit should shut down when the evaporator pressure drops to 45 +10 PSIG and should indicate a latching diagnostic.

Note: On later design sequences, the low pressure control cutout occurs at 25 +10 PSIG.

Note: Whenever the compressor is de-energized, the closing of the check valve in the compressor is audible and is a normal condition.

7. Instruct the operators in the proper operation of the chiller unit.

Operator training is extremely important. Operating personnel should be instructed in the following:

   1) Interpretation of the control panel's operating and diagnostic codes.

   2) Reading and recording operating data.

   3) Developing an awareness of operating conditions that can affect the life of performance of the unit.

   4) Recognition of data trends that may indicate the development of operating problems.

Note: If there is more than one chiller operator, it may be beneficial for the local Trane representative and owner to arrange for a group seminar, designed to instruct proper operation of the unit to all operating personnel, as well as the maintenance supervisor.

8. "Pull down" the start-up. Complete the log and do necessary housekeeping to complete the operation.

a. Start the chiller. Once it stabilizes at the design water flows and the desired entering and leaving condenser temperatures, accurately record all temperatures, pressures and other related data specified on the Start-up Log. Use Form 1.27.90 entitled "Water-Cooled CenTraVacs with Microcomputer-Based Control Panels".

   Explain to the operator that the start-up log is designed to provide an accurate record of actual performance. It will be compared to later operating logs to diagnose any problems that may develop from continued operation. This kind of information is essential for service personnel and factory representatives in the event a problem is experienced.

   Notice that the operating start-up log provides for 3 separate readings, taken at 15 minute intervals, while the unit is operating under design conditions. Multiple readings are primarily helpful in determining any small performance drop that might be caused by hard-to-detect obstructions (i.e. foreign objects in water lines of heat exchangers). They are also useful for detecting changes in operation as the chiller stabilizes at a typical load from a "pull down" condition.

b. Wipe all construction dust off the unit and use touch-up paint to cover up scratches and marks that may have been made during installation. This will show the owner the pride you take in your work and in this Trane equipment. (Feedback from customers confirms that they notice and appreciate this.)

c. Before leaving the job site, recheck all the settings in the control panel to ensure that they are set at the normal positions.

TRANE

Control Operation, Setup and Troubleshooting

Literature File No.	RLC-SG-1
Section	5.0
Date	June 1990

Current information regarding control operations, setup, and troubleshooting will be found in Section 10. Service Bulletins.

Oil Flow Switch Operation

Literature File No.	RLC-SG-1
Section	5.1
Date	June 1990

The unit control module (UCM) automatically checks the oil flow switch, prior to unit start-up, when the chiller switch is set in the "AUTO/LOCAL" or "AUTO/REMOTE" position.

If, prior to starting the unit, the UCM detects a closure of the oil flow switch contacts (piston is open), the operator display will alternately flash diagnostic messages b E8 and A 72, indicating that the oil flow switch is malfunctioning.

If the UCM detects open contacts (piston is closed), the UCM will proceed in the start mode. Once the unit starts, and sufficient oil flow through the bearing oil supply system is obtained within 30 seconds, the oil flow switch contacts will close (piston is open).

If the contacts on the oil flow switch do not close, check the oil filter "pop out" indicator to verify that the filter is not dirty, thereby restricting flow to the switch.

Oil Tank Heater and Wattage

Literature File No.	RLC-SG-1
Section	5.2
Date	June 1990

Oil tank heaters for Design Sequence E and later (4HR1 and 4HR2) are energized via the normally-open oil tank heater relay contacts (K6) of the power supply module (1U2). The status of this contact is monitored by the UCM.

The UCP control logic is designed to energize the oil tank heater when the compressor is not running. At compressor start-up, 1U2 – K6 contacts open, de-energizing the heater.

The oil heater wattages are as follows:

A Design –	Cast Heater	500 Watts
B Design –	Strip Heater	200 Watts
E Design and later –	Plug Heater 2 each	100 Watts 2 each

Note: Refer to RTHA-SB-2 in Section 10 for information about the oil heater change-out kit.

TRANE

Electrical Phasing & Phase Monitor for Unit-Mounted & Remote-Mounted Starters

Literature File No.	RLC-SG-1
Section	5.3
Date	June 1990

Electrical Phasing

(Use procedures given in RTHA-IOM)

Caution: It is essential to confirm that proper phase rotation is established – Phase A to L1, Phase B to L2, and Phase C to L3. Phase rotation must be checked with a phase sequence indicator before start-up, otherwise catastrophic damage to the compressor may result.

If this is the initial start-up or the main power system has been modified, do not rely on the phase sequence relay in the starter panel (unit-mounted or remote-mounted) or the motor terminal box to indicate phase rotation.

If rotation is incorrect, follow the instructions in RTHA-IOM to establish proper rotation.

Phase Monitor Operation

The unit-mounted starter phase reversal monitor (2U1) will look at incoming power to confirm an "ABC" rotation. If phasing is correct, pilot relay (2K5) will pull in and begin the start procedure. If rotation is "CBA", the phase reversal monitor will not close, thus preventing energizing of the pilot relay (2K5). The start-up procedure will not proceed.

Note: In the event that the C.T.'s do not sense current draw but a start is initiated and the phase monitor locks out (2K5), a phase-loss diagnostic (b E4) may occur.

The remote-mounted starter phase reversal monitor checks for "ABC" rotation at the motor terminals (T1, T2, and T3). If phasing is "CBA" when the starter contactors pull in, they will immediately drop out.

When 4U1 detects a "CBA" phase rotation, the 4U1 contacts will close (energizing 4K18), one contact of the phase reversal lockout relay (4K18) will open, and the other set of contacts will close, causing 4K18 to lock in and the phase reversal indicator to light. When the normally closed contact of 4K18 opens, power is no longer allowed to 1U2 and the start procedure will not proceed.

TRANE

Ice Making Panel Operation

Literature File No.	RLC-SG-1
Section	5.4
Date	June 1990

When ice making is called for by a contact closure between 6TB4-1 and 6TB4-2, the ice making control will place a resistor in parallel with the leaving chilled water temperature sensor located on the outlet of the evaporator. This will bias the existing temperature upward and cause the chiller to run fully loaded.

At this time, a contact closure is made between 6TB1-5 and 6TB1-6, which can be used to engage a pump starter in the ice bank loop. This can also shut down peripheral equipment when ice making is complete, to prevent heat input to the ice bank.

The field-installed leaving ice bank temperature sensor (6RT1) will monitor the solution being returned to the chiller from the ice bank. During ice making, it will read a temperature that has been pulled down to 32 F, or lower. The leaving ice bank temperature sensor is field adjustable.

Once the ice bank has become fully charged and the leaving temperature has been reached, ice making will be terminated. The compressor will unload for 60 seconds, after which contacts 6TB1-5 and 6TB1-6 will open, shutting down the circulation pump and chiller.

The chiller will not re-enter the ice making mode until the command signal at 6TB4-1 and 6TB4-2 is opened and then closed.

Note: The low temperature cutout can be set lower than the ice bank termination set point. This setting can remain during the normal cooling mode, provided the glycol solution can accommodate this temperature setting.

TRANE

RTHA Torque Specificatons

Literature File No.	RLC-SG-1
Section	6.0
Date	March 1991

It is important for proper performance of the unit to insure that all fittings (nuts and bolts) are tightened to design torque specifications during reassembly. Listed in Table 6.0-1, below, are general torque specifications and metric socket sizes.

Table 6.0-1
Bolt Torque Specifications and Metric Socket Sizes

Item	Quantity Bolts Each	Unit Size Ton	Bolt Size mm	Socket Size mm	Torque Ft-Lbs
Economizer Plate	9	130 thru 215	M6 x 12	10	8
Economizer Filter	4	130 thru 215	M6 x 12	10	8
Labrith Seal	4	130 thru 215	M8 x 25	13	20
Labrith Seal	4	255 thru 215	M8 x 20	13	20
Economizer Plate	5	255 thru 215	M8 x 20	13	20
Stator Ring	6	150 and 215	M10 x 80	17	40
Stator Ring	6	130 and 180	M10 x 60	17	40
Stator Ring	8	255	M12 x 70	19	66
Stator Ring	8	300	M12 x 100	19	66
Economizer Cover	28	130-150-180-215	M16 x 80	24	170
Rotor Housing to Motor Housing	20	130-150-180-215	M16 x 75	24	170
Oil Tank Housing to Rotor Housing	36	130-150-180-215	M16 x 90	24	170
Economizer Cover	80	255 and 300	M20 x 90	30	317
Rotor Housing to Motor Housing	80	255 and 300	M20 x 90	30	317
Oil Tank Housing to Rotor Housing	80	255 and 300	M20 x 90	30	317
Load/Unload Solenoid Valves	8	All Sizes	M6 x 35 (Allen Head)	–	–
RTD Terminal Spade Connector	4	All Sizes	–	–	10
Suction Line to Motor Flange	4	130 thru 150	M12 x 50	19	66
	8	180 thru 215	M12 x 40	19	66
	8	255 thru 300	M12 x 45	19	66
Motor Cooling Line Flange to Motor Housing	4 ea.	130 thru 150	M12 x 45	19	66
	4 ea.	180 thru 215	M12 x 40	19	66
Discharge to Oil Tank Flange	4	130 thru 150	M12 x 50	19	66
	8	180 thru 300	M12 x 45	19	66
Liquid Line to Orifice Flange	4 ea.	130 thru 150	M12 x 105	19	66
	4 ea.	180 thru 215	M12 x 95	19	66
Discharge Line to Condenser Valve Body Flange	8	130 thru 300	M12 x 70	19	66

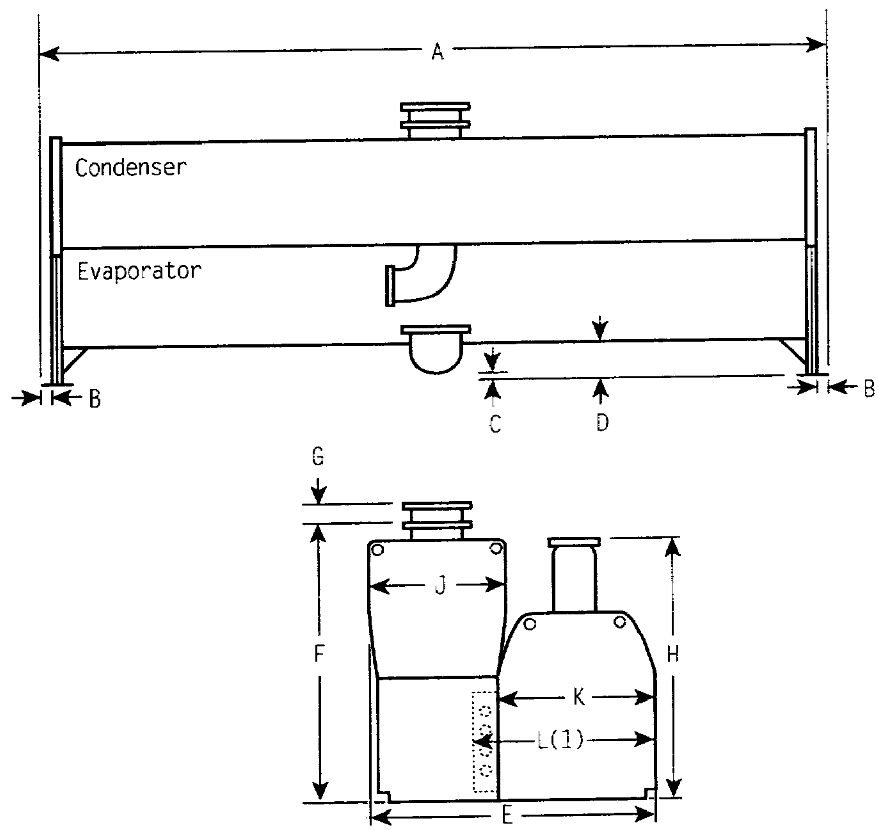
NOTE
Replace all gaskets and O-rings when reassembling any items on unit (see parts manual for part numbers).

RTHA Disassembly Dimensions For Limited Access Installations

Literature File No.	RLC-SG-1
Section	6.1
Date	March 1991

This section contains illustrations and applicable dimensions required for disassembly of the unit and components in limited access installations.

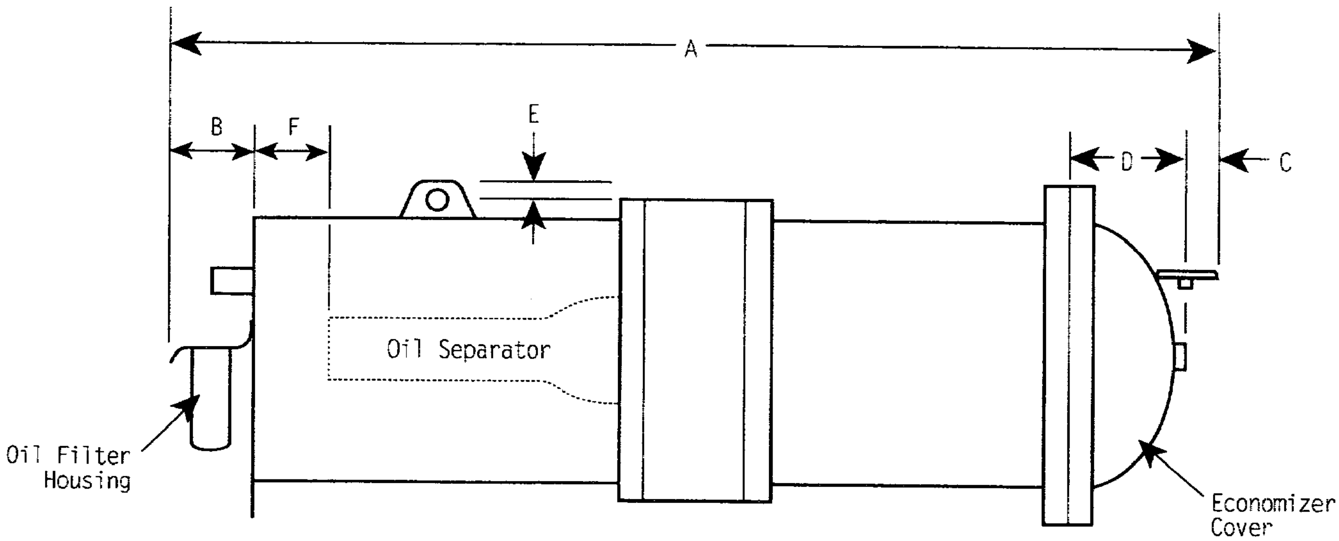
Figure 6.1-1
Unit Dimensions.

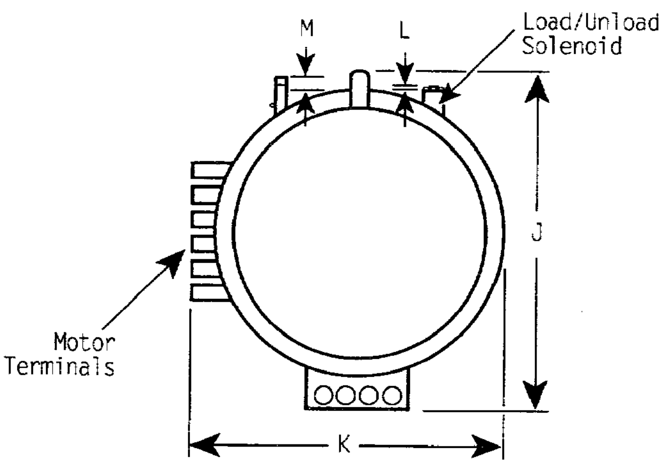


RTHA	Shells	A	B	C	D	E	F	G	H	J	K	L(1)
130/150	Std	94.3	1.25	.76	4.38	34.00	34.50	3.5	31.62	16.30	18.30	21.30
130/150	Long	124.3	1.25	.76	4.38	34.00	34.50	3.5	31.62	16.30	18.30	21.30
180/215	Std	94.3	1.25	.87	5.32	42.63	41.90	4.5	37.77	19.30	21.80	24.80
180/215	Long	124.3	1.25	.87	5.32	42.63	41.90	4.5	37.77	19.30	21.80	24.80
255/300	Std	94.3	1.25	1.45	6.12	47.25	48.97	4.5	41.50	21.80	24.00	27.00
255/300	Long	124.3	1.25	1.45	6.12	47.25	48.97	4.5	41.50	21.80	24.00	27.00

NOTE:
All dimensions are in inches.
(1) For units with separable shell option.

Figure 6.1-2
Compressor Dimensions

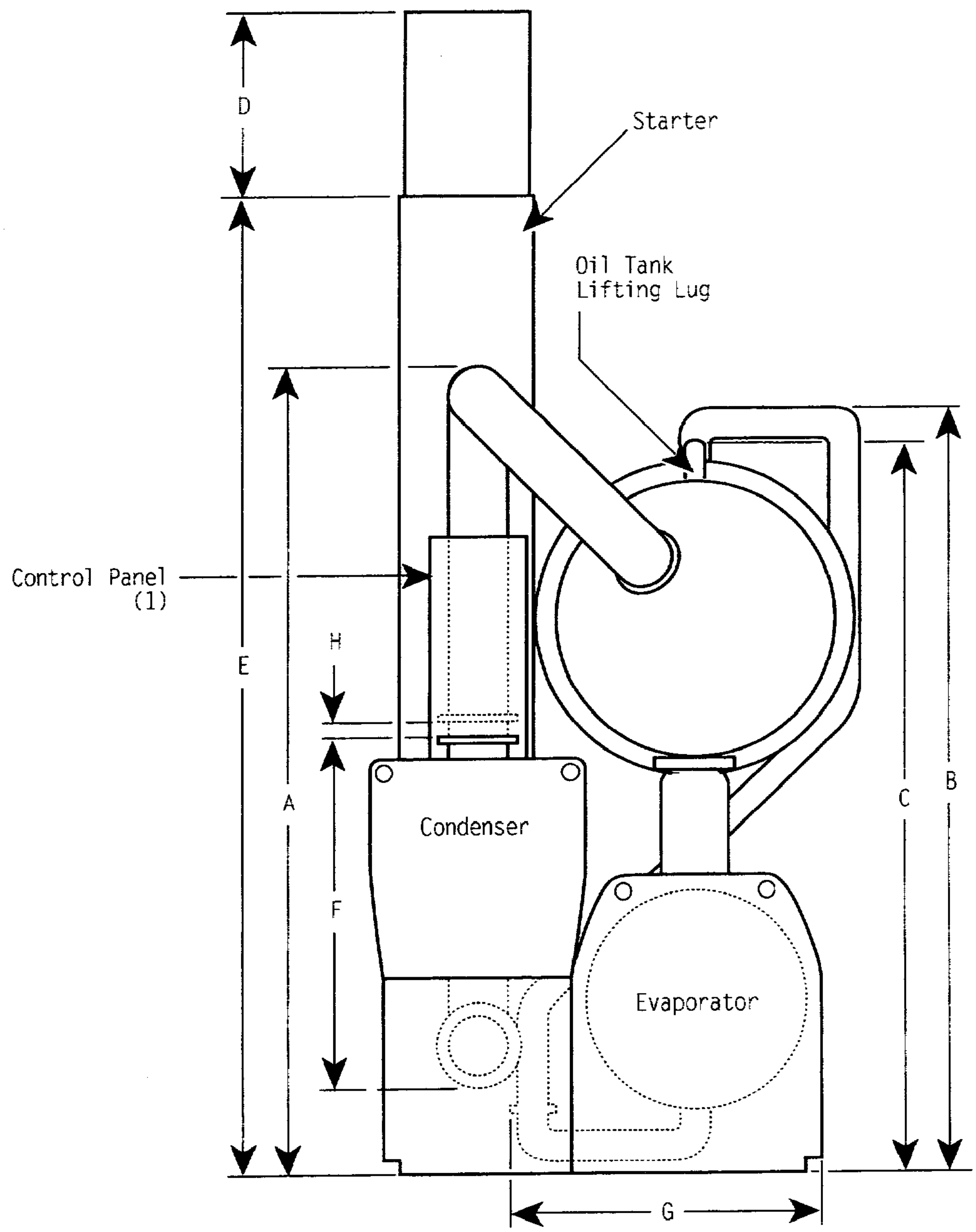




RTHA	A	B	C	D	E	F	J	K	L	M
130/150	83.00	6.5	2.75	9.5	1.5	6.00	27	24.5	1.0	2.5
180/215	89.50	6.5	2.75	9.5	1.5	5.25	30	25.5	1.5	2.5
255/300	89.75	6.5	2.75	9.5	1.5	4.00	34	30.5	1.5	2.5

NOTE:
All dimensions are in inches.

Figure 6.1-3
Starter Panel and
Pipe Dimensions



RTHA	A	B	C	D	E	F	G	H
130/150	61.5	58.25	56.12	N/A	460/575V 69.5 200/230V 74.5	31	27	3.5
180/215	71.5	66.75	64.75	14	74.25	33	28	4.5
255/300	79.0	77.25	75.25	14	79.87	38	28	4.5

NOTE:
All dimensions are in inches.
(1) Control Panel Height from Base is less than Compressor Height from Base.

TRANE

RTHA Oil Tank Housing Removal And Replacement

Literature File No.	RLC-SG-1
Section	6.2
Date	March 1991

Removal and replacement of the oil tank housing is accomplished by following the procedures outlined below. Before starting this work, be sure to have the following tools and equipment available:

An A-frame with a lifting capacity greater than the weight of the entire compressor, including all required safety factors. Refer to Table 6.2-1 for weight specifications.

A set of metric socket wrenches.

A 3-foot extension for the socket wrench.

Three, 3-inch guide pins.

Standard wrenches for removal of miscellaneous components.

1. If the unit is equipped with condenser isolation valves, perform the "Refrigerant Pumpdown Evacuation" procedure described in Section 7.1.

Caution: These instructions must be performed exactly. Failure to do so can result in catastrophic damage to the compressor.

Note: If the unit is not equipped with condenser isolation valves, a reclamation pro-cess will be required to reclaim all refrigerant.

Caution: Water must be flowing through the tube bundles during the above process. Refrigerant pressures below 70 psig can cause freezing and rupturing of the heat exchangers.

Table 6.2-1
RTHA Weight Breakdown

RTHA Unit	Shell Length	Compressor Weight	Evap W/O Heads	Evap Heads Both	Cond W/O Heads	Cond Heads Both
130/150	Std	2475	832	160	940	129
130/150	Long	2475	1040	160	1170	129
180/215	Std	2950	1135	240	1240	184
180/215	Long	2950	1439	240	1340	184
255/300	Std	4150	1690	300	1730	250
255/300	Long	4150	2071	300	2050	250

RTHA Unit	Ref Charge	Unit Mtd Starter	Control Panel & Elec. Access.	Compressor Discharge Pipe	Interconnecting Pipes(2) & Access.
130/150	250	450	100	80	175
130/150	305	450	100	80	175
180/215	345	450	100	150	225
180/215	425	450	100	150	225
255/300	435	450	100	200	250
255/300	570	450	100	200	250

NOTE:

- All weights are in pounds (lbs).
- Weights given are for cast water boxes, add 70% for fabricated water boxes.
- Refrigerant charges for the above are for Design Sequence A thru LO.

2. Position the A-frame over the entire unit, lengthwise to the machine.

Note: The A-frame lifting mechanism must be able to move along the long axis of the unit for a distance of 3 feet past the end of the oil tank housing. This will allow the oil tank to clear the oil separator.

Caution: The A-frame must be capable of supporting the entire weight of the compressor. Include safety factors. The A-frame must also be equipped with a safety harness capable of supporting the entire weight of the compressor. This harness must be secured to the overhead support of the A-frame and to the oil tank housing, in the event the lifting mechanism of the A-frame fails.

3. Remove all remaining oil from the oil tank, via the oil charging valve.

4. Disconnect and remove the following:

a. High discharge temperature sensor
b. Oil heaters
c. Oil distribution lines
d. Discharge line

Note: All piping and wiring must be clear of the oil tank prior to removal.

5. Secure the oil tank to the lifting mechanism of the A-frame. Secure the safety harness between the oil tank and the overhead beam of the A-frame. Remove all slack between the oil tank and the A-frame.

6. Remove all bolts from the support brackets below the oil tank housing which are attached to the oil tank.

Caution: Be sure that the weight of the oil tank is being supported by the A-frame.

7. Loosen (approximately 1 turn) each of the bolts which attach the oil tank housing to the rotor housing. Then remove only the bolts that are in the 3 o'clock, 9 o'clock and 12 o'clock positions.

Note: The 3-foot long extension is required to reach the bolts that are behind the control panel.

Caution: Do not remove any of the other bolts at this time.

8. Into each of the three bolt holes (3 o'clock, 9 o'clock and 12 o'clock), insert one of the 3-inch guide pins.

For RTHA models 130, 150, 180 and 215 only:
As shown in Figure 6.2-1, there is a "dimple pipe" installed between the oil separator and the discharge opening in the oil tank. The pipe fits into the separator and into the oil tank housing. Each end is sealed by an O-ring.

The dimple pipe must be pulled away from the oil separator housing before proceeding with Step 9. Reach through the discharge line opening in the oil tank housing, to the far end of the dimple pipe. Pull the dimple pipe until it is clear of the separator. The dimple pipe cannot be removed through the discharge line opening until O-ring "A" is removed. This may be accomplished in Step 11.

Caution: The dimple pipe must be clear of the oil separator housing before removal of the oil tank housing or damage to the equipment may occur.

9. Once the dimple pipe is clear of the separator, the oil tank housing can be removed. Take out the remaining bolts which attach the oil tank housing to the rotor housing.

Caution : Be sure that the guide pins are in place and the weight of the oil tank is being supported by the A-frame.

10. The oil tank may now be moved away from the rotor housing, along the long axis of the unit, until it clears the oil separator. Once clear, the oil tank can be lowered onto a pallet and secured.

11. The oil separator, dimple pipe and O-rings can now be inspected, prior to reassembly.

12. After completion of inspection and any necessary repairs, reassembly can begin. Insert the dimple pipe with its O-rings into the oil separator. Then perform Steps 1 thru 11 in reverse order. Be sure that the dimple pipe is in the proper position, with its O-ring sealing at the oil separator and the oil tank housing.

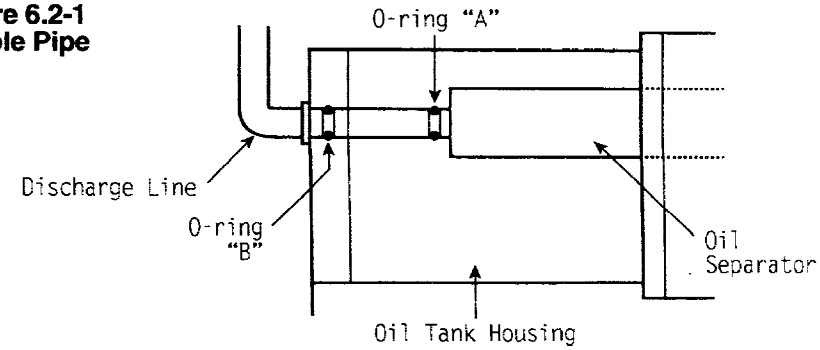
Caution: To prevent loss of discharge pressure and possible damage to the compressor, the dimple pipe O-rings must be reinstalled in their proper positions.

13. Tighten all bolts to the torque values shown in Table 6.0-2.

14. As described in Section 7.1, perform Steps 1 thru 3 of the evacuation procedures. Then, to recharge the system, perform Steps 1 thru 4 of the recharging procedure.

Note: For units with no condenser isolation valves, refer to Section 7.5 for recharging.

Figure 6.2-1
Dimple Pipe



TRANE

RTHA Compressor and Unit-Mounted Starter Removal and Replacement

Literature File No.	RLC-SG-1
Section	6.3
Date	March 1991

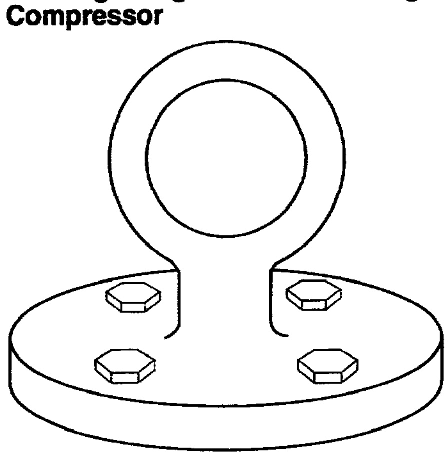
Removal and replacement of the compressor and unit-mounted starter is accomplished by following the procedures outlined below. Before starting this work, be sure to have the following tools and equipment available:

- A hoist with a lifting capability equal to or greater than the weight of the entire compressor. Be sure to include all required safety factors. Refer to Table 6.2-1 for unit weight specifications.
- A set of metric socket wrenches
- Two, 10 mm all-thread guide pins, approximately 5 inches in length (for Starter Panel guides)
- Standard wrenches for removal of miscellaneous components

The following equipment is required if the compressor is to be removed:

- A lifting flange, as described in Figure 6.3-1. Use a local vendor for fabrication of the flange. The flange must be capable of supporting the entire weight of the compressor. Refer to Table 6.2-1 for unit weight specifications.

Figure 6.3-1
Specifications for Manufacturing a Lifting Flange When Removing Compressor



	RTHA 130-150	RTHA 180-215	RTHA 255-300
Bolt Circle	4.375"	4.750"	5.375"
Bolt Holes	.551"	.551"	.551"

NOTES:
Weld eye hook for lifting purposes.
All bolt holes are (14mm) 4 x equally spaced.

- Two 24-inch long angle iron supports, as shown in Figure 6.3-2

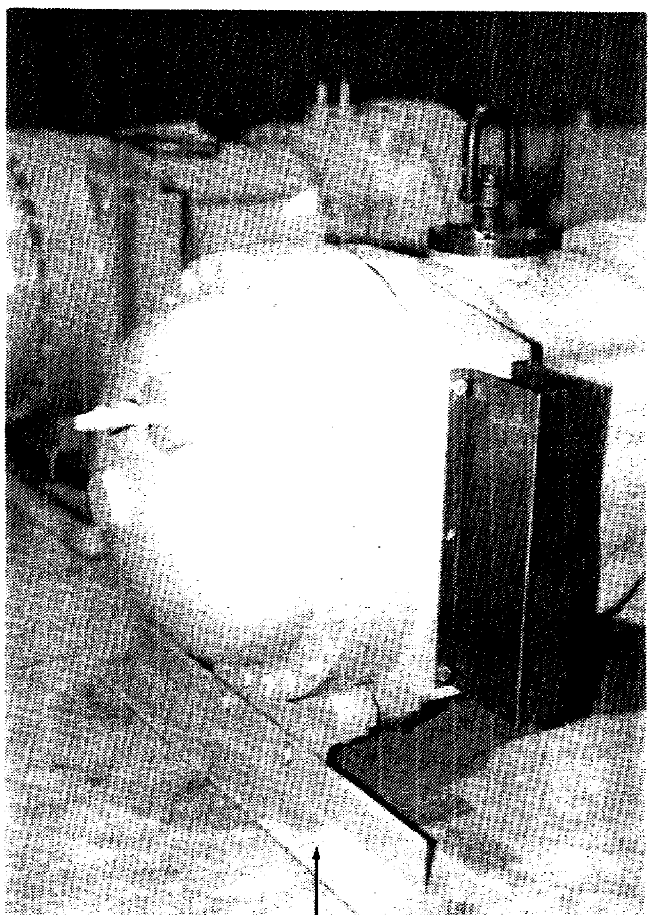
- Two, 12 mm all-thread guide pins, 2¾ inches long, for alignment of the compressor on the suction connection during reassembly.

- Required compressor gasket/O-ring change-out kit. See Table 6.3-1.

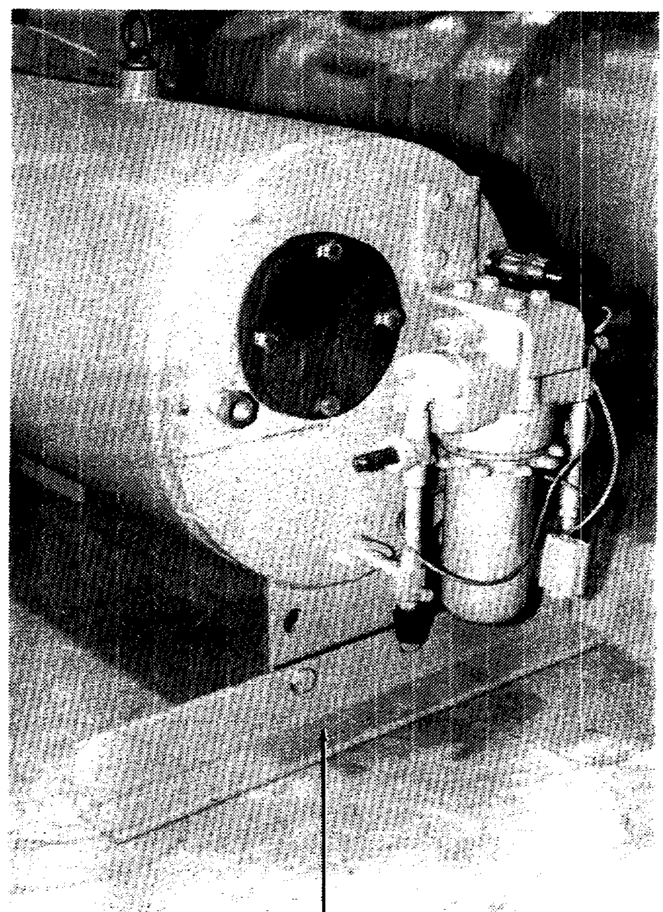
Table 6.3-1
Compressor Gasket/O-ring Change-out Kit.

Model	Kit No.
RTHA 130/150 Std/Long	1348
RTHA 180/215 Std/Long	1349
RTHA 255/300 Std/Long	1371

Figure 6.3-2
Angle Iron Support for Compressor



Angle Iron Support



Angle Iron Support

1. If the unit is equipped with condenser isolation valves, perform the "Refrigerant Pumpdown Evacuation" procedure described in Section 7.1.

Caution: These instructions must be performed exactly. Failure to do so can result in catastrophic damage to the compressor.

Note: If the unit is not equipped with condenser isolation valves, a reclamation process will be required to reclaim all refrigerant.

Caution: Water must be flowing through the tube bundles during this process. Refrigerant pressures below 70 psig can cause freezing and rupturing of the heat exchangers.

2. The following procedures are for the removal of the unit-mounted starter or terminal box.

a. Record, tag or otherwise mark all wiring and conduit, so that it can be reconnected exactly. Disconnect from the starter panel all wiring and conduit that is required to remove the panel.

WARNING: To prevent injury or death, disconnect all electrical power sources before with removal.

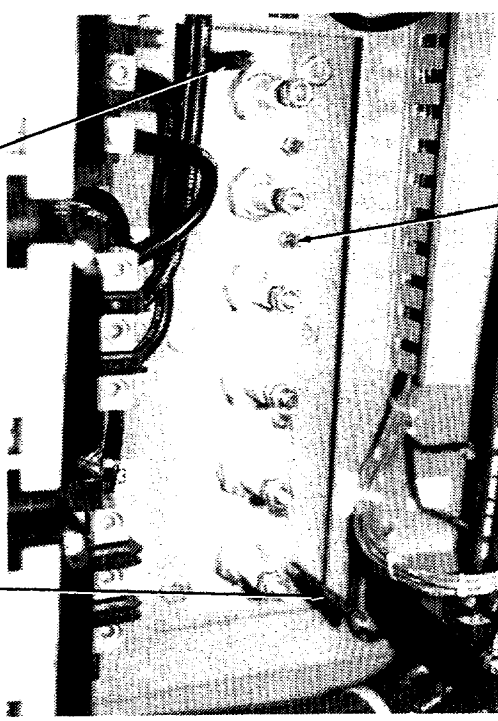
b. Remove the "T" leads from the contactors and motor terminals.

c. Install two eyebolts in the top of the starter panel. Secure these eyebolt to an overhead support, to prevent the starter from dropping, possibly breaking the motor terminals.

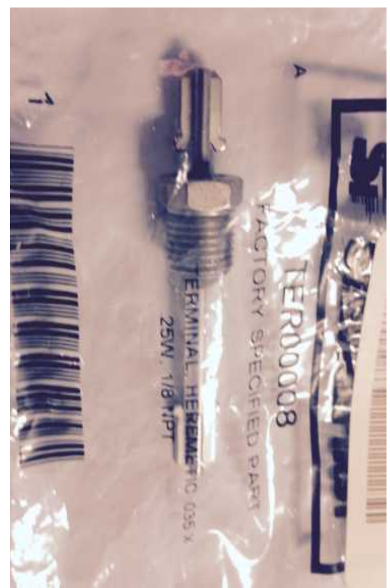
Caution: Be sure that the weight of the starter is being supported by the A-frame.

d. Remove two of the bolts that secure the starter panel to the motor housing and insert the two 10 mm all-thread guide pins. See Figure 6.3-3.

Figure 6.3-3
Guide Pins for Starter Removal



p/n TER0008
See KC wave29644: also need Economizer Cover Gasket GKT03230



e. Remove the remaining bolts.

f. Pull on the starter panel, horizon-tally, along the guide pins, until the panel clears the motor terminal plugs. Secure the starter panel.

g. The control panel is removed in the same manner, but the guide pins are not necessary.

3. If the compressor is to be removed, perform the following steps:

a. Remove the discharge line from the compressor (both ends).

b. Remove the motor cooling line from the top of the motor housing (flange) and from the liquid line to the filter assembly.

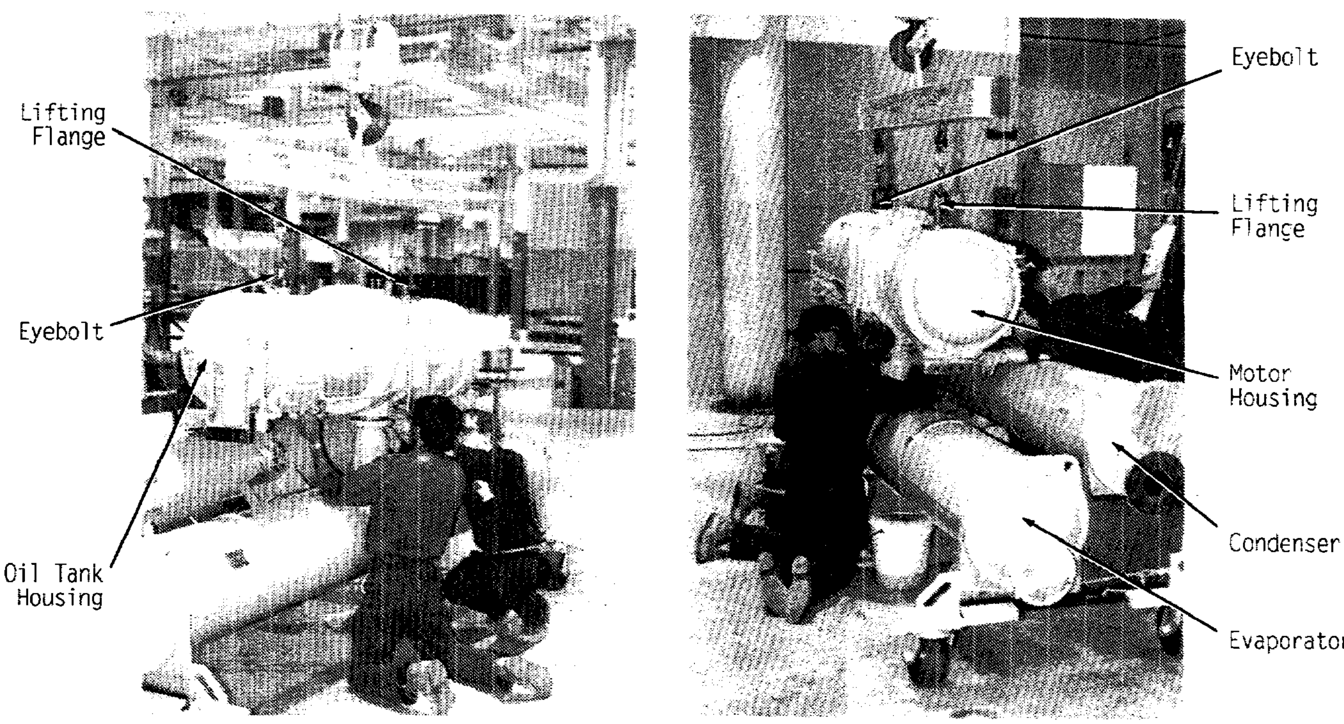
Note: Cover all openings to prevent contamination.

c. Remove the bolts from the compressor suction connection at the bottom of the motor housing.

4. Compressor removal procedure:

a. Install an eyebolt (16 mm threads) into the collar located on the top of the oil tank housing (if required). This will provide one of the two required lifting points. See Figure 6.3-4.

Figure 6.3-4
Removing Compressor from Unit



b. Install the lifting flange on the top of the motor housing, in the holes that are used to attach the motor cooling line. No O-ring is required.

c. Secure the eyebolts to the lifting mechanism. See Figure 6.3-4. Install a safety sling under each end of the compressor for additional safety.

Caution: Be sure that the weight of the compressor is being supported by the A-frame.

d. Remove the bolts from the support brackets under the compressor.

e. Raise the compressor directly upward approximately 10" and remove the suction strainer. Refer to Figure 6.3-5.

f. Lower the compressor to within 2 inches from the floor. Install the two angle iron supports, one on each end of the compressor, to the mounting support brackets. See Figure 6.3-2. Lower the compressor onto the floor or pallet.

5. To reassemble the unit, perform the above procedures in reverse order, with the following exceptions:

a. Coat all O-rings and gaskets with Oil-15 prior to installation.

b. Before setting the compressor on the suction connection, insert the two 12 mm all-thread guide pins into two opposing holes in the suction flange.

Note: The suction strainer must be centered on the evaporator suction connection flange, to ensure alignment with the recess on the compressor suction connection. See Figure 6.3-5.

c. Install, but do not tighten, the suction connection and the compressor mounting bracket bolts until all interconnecting piping has been installed.

Note: It may be necessary to rotate the compressor, slightly, to get alignment of bolt holes on the interconnecting piping.

d. After reassembly, check for refrigerant leaks, using a suitable leak detector. Pressurize the unit to nameplate test pressure with nitrogen and some refrigerant.

e. Evacuate the unit according to procedures in Section 7.4.

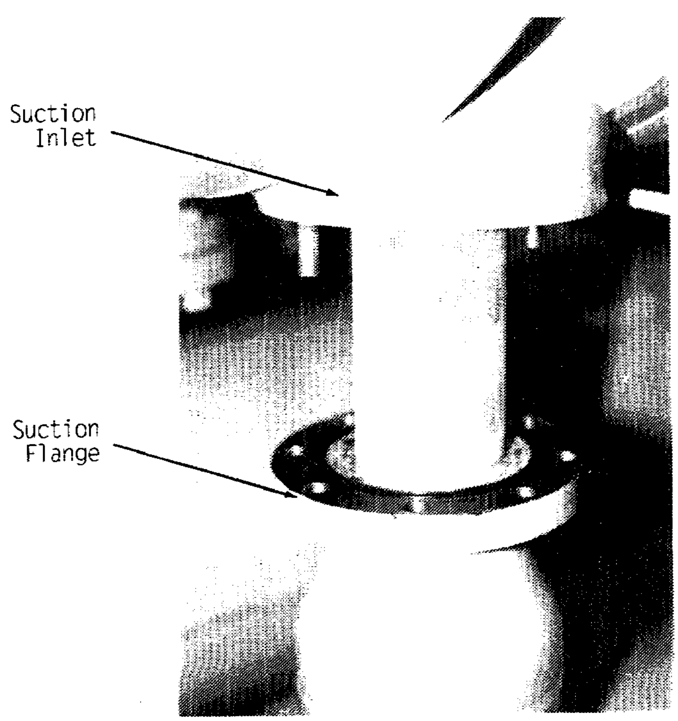
f. Replace the proper amount of oil into the compressor charging valve.

g. If the unit has condenser isolation valves, recharge as described in Section 7.1 by performing Steps 1 thru 4 of the recharging procedure.

Note: For units with no condenser isolation valves, refer to Section 7.5 for recharging.

Caution: Water must be flowing through the tube bundles during this process. Refrigerant pressures below 70 psig can cause freezing and rupturing of the heat exchangers.

Figure 6.3-5
Suction Strainer



TRANE

Refrigerant Filter Service and Replacement Procedures

Literature File No.	RLC-SG-1
Section	7.0
Date	June 1990

The refrigerant filter is located on the liquid line, downstream from the condenser outlet. Visually inspect the refrigerant filter to see if there is a formation of frost. This is an indication of a restriction in the filter.

If there is no frost on the filter, feel the outside of the condenser with your hand, at various intervals from top to bottom. Under normal conditions, the condenser will be warm from the top down to approximately the last 15% of the side (near the bottom), where the temperature will be cooler. If the side feels cool farther up the side, it is a sign that the refrigerant is stacking in the condenser. This can be caused by a clogged filter or by cold condenser water.

Another method of checking the filter is to mount two temperature sensors to measure temperatures upstream and downstream of the filter. Under fully-loaded conditions, the temperature difference should be no more than 3 F. A temperature difference greater than 3 F indicates a restriction in the filter.

Note: To change the refrigerant filter, follow the pumpdown procedures outlined in Section 7.1.

TRANE

Refrigerant Pumpdown Evacuation and Recharging for Units With Isolation Valves

Literature File No.	RLC-SG-1
Section	7.1
Date	March 1991

Pre-pumpdown Checks

Caution: These checks must be made before pumping down the system.

1. For Design Sequence "E" units and late, the hydraulic lines can be isolated from the rest of the system by closing the oil shutoff valves, located on the compressor. See the IOM for additional information. There is no need to pumpdown the unit to service the master solenoid, oil filter or oil flow switch.

2. Check to confirm that the oil level in the oil tank is 2½ to 3 inches high. Add oil, as required, before pumping down the unit.

3. Water must be flowing through the evaporator and condenser tube bundles during the pumpdown procedure.

Caution: Water must be flowing through the tube bundles during this entire process. Refrigerant pressures below 70 psig can cause freezing and rupturing of the heat exchangers.

Caution: To prevent damage to the heat exchangers due to freezing, start the condenser and evaporator water pumps before pumping down the unit.

Pumpdown Procedure

Caution: Do not deviate from the following pumpdown procedures.

1. Review all Pre-Pumpdown Checks, above. Be sure that the oil level is 2½ to 3 inches high.

2. Turn the Slide Valve Switch on the UCM to UNLOAD position.

3. Disconnect one of the electrical leads to the low pressure control (4S6).

4. Close the condenser refrigerant outlet isolation valve.

5. Allow the unit to pumpdown, until the evaporator pressure gauge indicates "15 psig".

Caution: Do not allow the pressure to fall below 15 psig.

Caution: To prevent compressor damage, do not allow the unit to pump down again. Otherwise catastrophic damage may result.

6. Immediately shutdown the chiller by turning the Chiller Switch on the UCM to the STANDBY/RESET position.

7. Close the condenser refrigerant inlet isolation valve.

8. Reclaim any refrigerant remaining in the low side of the system.

9. Reconnect the low pressure control (4S6) lead which was disconnected in Step 3.

Caution: Do not pumpdown the unit more than one time in succession. To do so can result in catastrophic compressor damage.

10. The unit is now ready for repair.

Evacuation Procedures

Caution: Water must be flowing through the tube bundles during this entire process. Refrigerant pressures below 70 psig can cause freezing and rupturing of the heat exchangers.

1. Remove the power wire to the load/unload solenoids and the master solenoid. Connect 115 VAC power to the master solenoid and the load/unload solenoids.

2. Evacuate the system using the access valve on the motor/economizer and the high pressure control (HPC) access above the condenser inlet isolation valve. The HPC access is used to remove any non-condensibles that may be between the internal compressor check valve and the condenser inlet isolation valve.

3. Evacuate the unit to 500 microns and isolate the vacuum pump.

Recharging Procedures

1. Using refrigerant gas, raise the evaporator pressure to what it was on the evaporator before it was relieved. This will give a fairly accurate refrigerant charge to the unit.

Caution: Do not charge refrigerant into the unit unless there is water flow.

Caution: Do not charge liquid refrigerant into the unit unless the temperature/pressure relationship is above 70 psig.

Caution: Water must be flowing through the tube bundles during this entire process. Refrigerant pressures below 70 psig can cause freezing and rupturing of the heat exchangers.

2. Open the condenser inlet isolation valves slowly and wait for the evaporator pressure to rise to 70 psig.

3. After evaporator pressure has reached a minimum of 70 psig, slowly open the condenser outlet butterfly valve.

4. For recharging purposes, use the angle valve below the evaporator. Once the pressure/temperature relationship in the evaporator is above 70 psig, start the chiller and charge a liquid directly into the evaporator while the unit is running.

TRANE

Refrigerant Evacuation Procedures Without Use of the Compressor

Literature File No.	RLC-SG-1
Section	7.2
Date	March 1991

When it is necessary to open the chiller unit for repairs, evacuate the chiller, as follows:

1. Use a vacuum pump with a minimum free-air capacity of 2 to 3 CFM but preferably up to 10 CFM. Larger capacity is better than smaller. If a large capacity pump is not available, use two or more pumps, each connected to its own opening in the chiller. For location of openings, see Note 1, below).

2. The suction line between the chiller and the pump should be as short as possible and the diameter should be at least one size larger than the suction connection at the pump (if not larger).

3. The dehydration time of a wet chiller can be reduced by using a water freeze-out chamber between the chiller and the pump. This can be fabricated by using a clean refrigerant drum (see Figure 7.2-1). It is important that the inlet be placed within 6 to 8 inches of the bottom of the drum.

Install shutoff valves, as shown, so that the freeze-out drum can be removed and drained. Replace the dry ice, as necessary, to keep the water in the drum frozen.

4. For accurate, high vacuum readings, it is recommended that a U-tube Meriam mercury manometer or electric vacuum gauge be used. Connect the gauge to an opening in the chiller, rather than the a suction line of the vacuum pumps.

5. During the evacuation process, run warm water, not to exceed 95 F, through the evaporator and condenser.

6. Evacuate the chiller to 500 microns or lower. Evacuation ports are shown in Figure 7.4-1.

7. After evacuation, return the chiller to atmospheric pressure using dry nitrogen. The unit can now be opened for repair.

Figure 7.2-1
Dry Ice Water
Freeze-Out Chamber

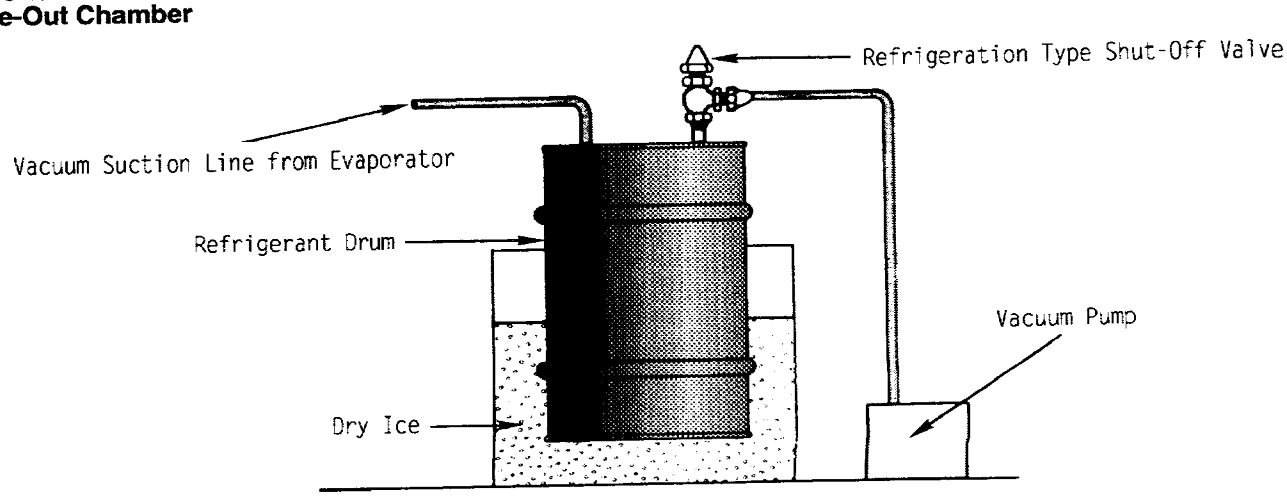
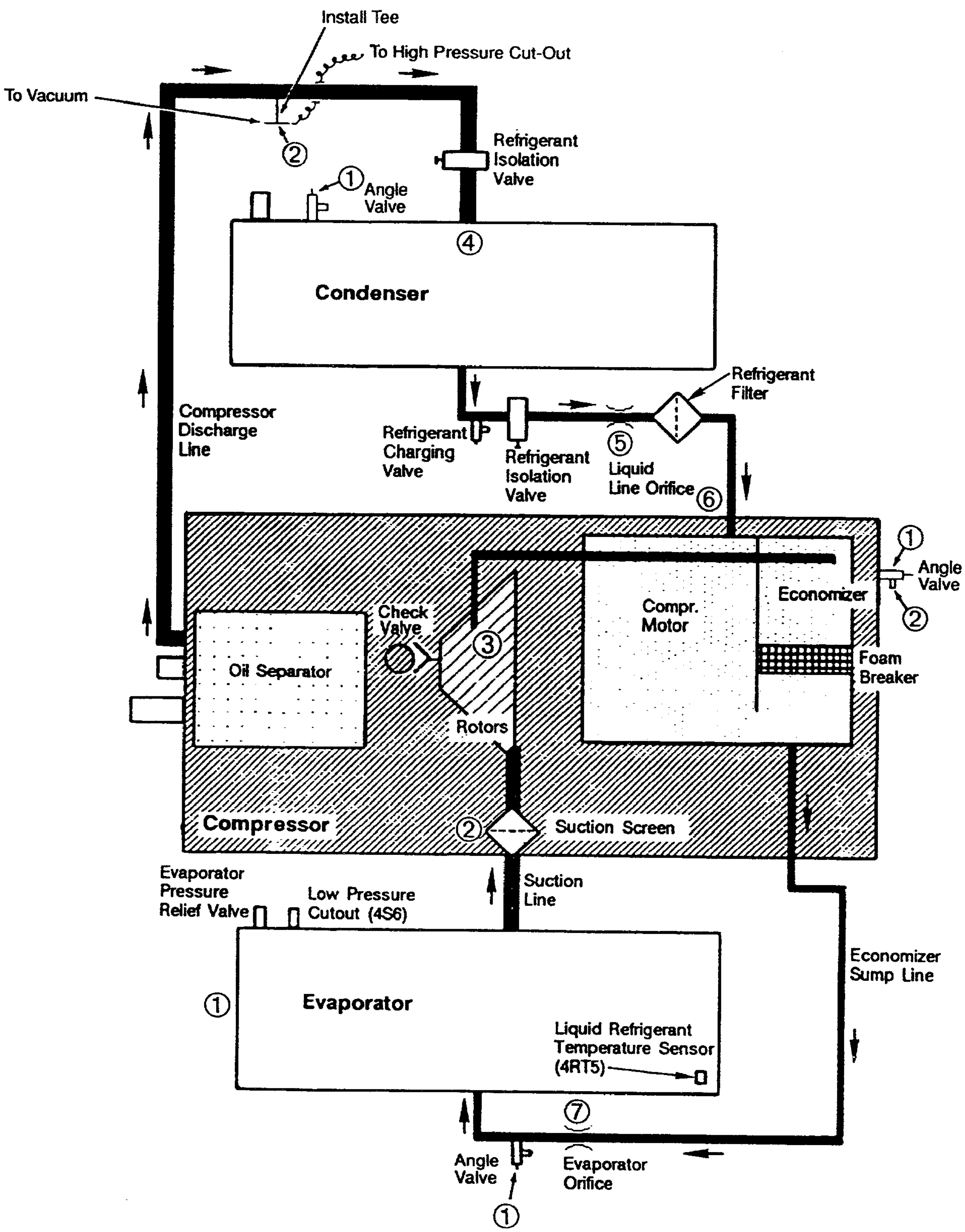


Figure 7-2
RTHA Evacuation Ports



Refrigerant Transfer

Literature File No.	RLC-SG-1
Section	7.3
Date	March 1991

Refrigerant Transfer

Caution: Water must be flowing through the tube bundles during this entire process. Refrigerant pressures below 70 psig can cause freezing and rupturing of the heat exchangers.

The transfer of the refrigerant from the low-side (evaporator, compressor, and piping) to the high-side (condenser and subcooler) is accomplished as follows:

1. Install a transfer line, as shown in Figure 7.3-1.

2. Allow condenser water to flow through the condenser at the lowest possible temperature and allow warm chilled water to run through the evaporator at temperatures up to, but not greater than, 95 F.

3. Close the liquid line butterfly valve on the outlet of the condenser. The refrigerant will naturally migrate to the condenser as it "boils" out of the evaporator. See Figure 7.3-1.

4. Use a portable refrigerant pump or reclaim system to transfer the remaining refrigerant into the condenser or reclaim system. Close the discharge butterfly valve before proceeding to pump the refrigerant.

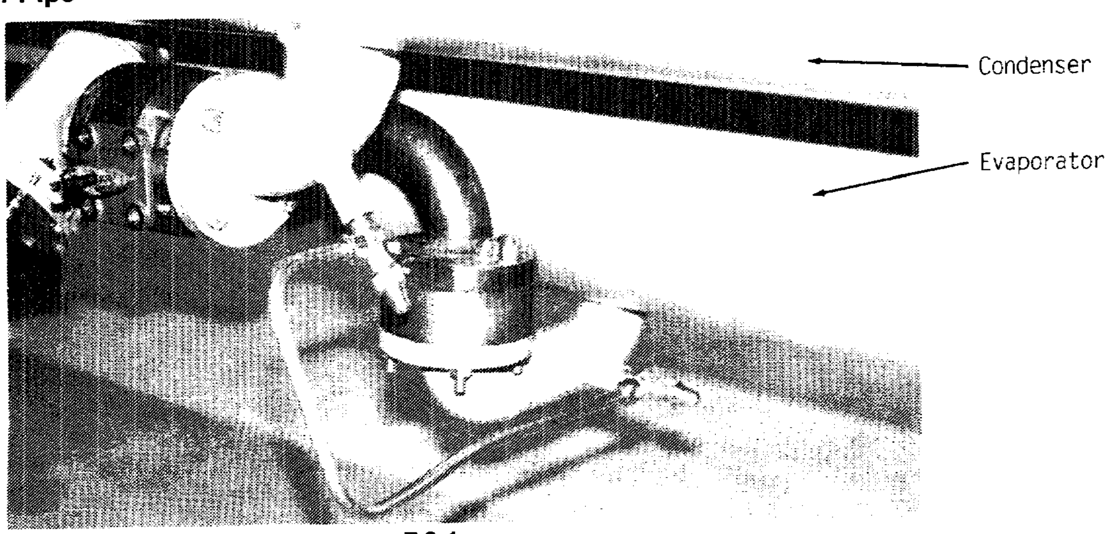
5. Open the main power disconnect switches.

6. After all of the refrigerant has been transferred, make sure the oil sump heater is "OFF".

7. Evacuate the low-side of the system to 500 microns, from the Schrader valve on the discharge line (high pressure cutout port) and the economizer cover.

8. Return the unit to atmospheric pressure, using dry nitrogen. This will help remove all traces of refrigerant and will minimize corrosion while work is being performed.

Figure 7.3-1
Refrigerant Transfer Pipe



TRANE

RTHA Evacuation Ports

Literature File No.	RLC-SG-1
Section	7.4
Date	March 1991

RTHA evacuation ports are shown in Figure 7.4-1. These are used for servicing under the conditions describe below.

1. If the system has lost its entire charge, including oil, open the angle valve on the suction line at the inlet to the evaporator and drain the remaining oil from the evaporator. Once the system is totally dry, pull a vacuum from these three locations:

a. the condenser angle valve located on the top, righthand side of condenser

b. the angle valve on the economizer cover

c. the angle valve on the suction inlet to the evaporator

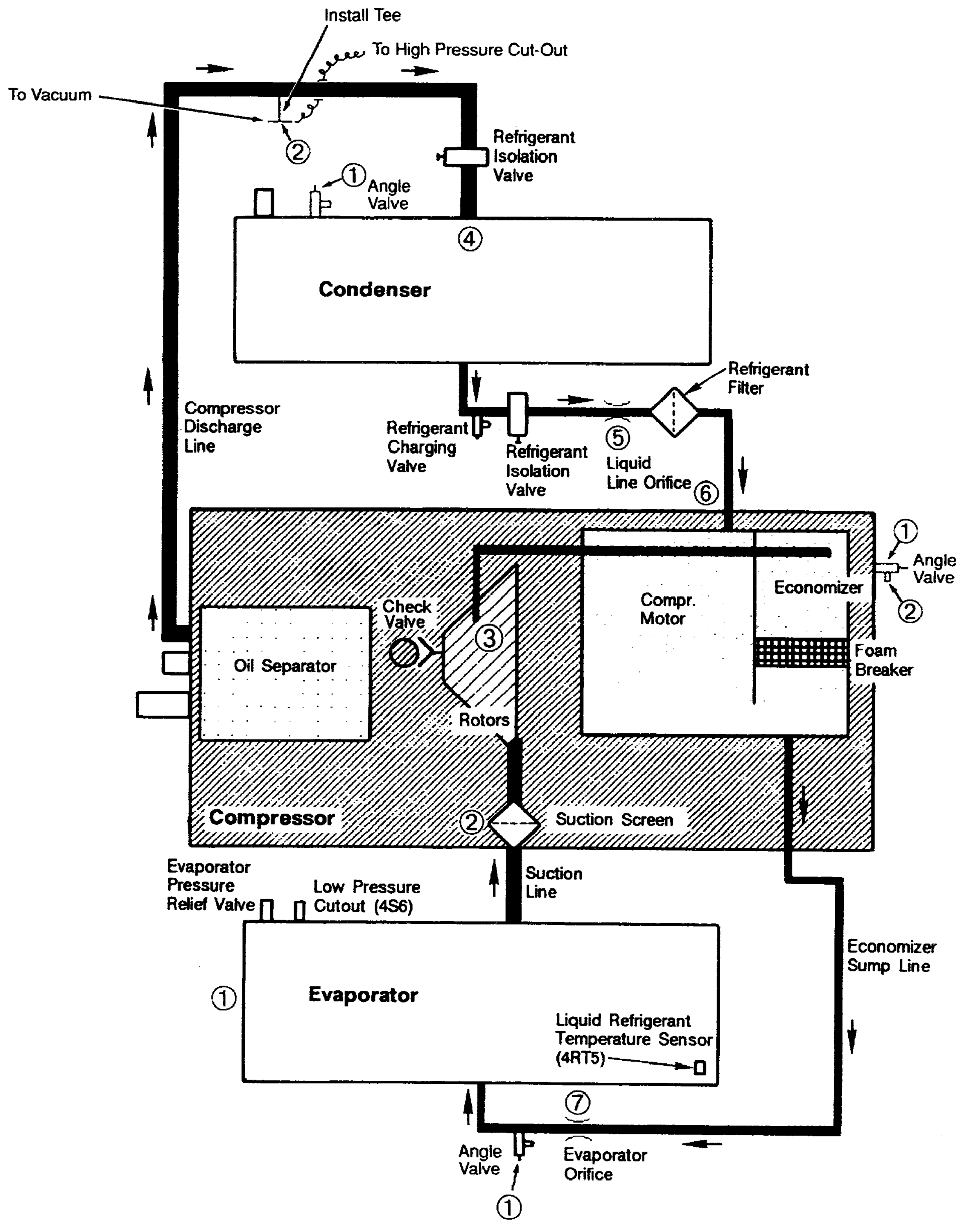
2. If the system is pumped down and the charge is isolated in the condenser, and the oil remains in the system, pull a vacuum from these two locations:

a. the angle valve on the economizer cover

b. Remove the high pressure cutout flare nut from the condenser discharge line. Install a tee-fitting and reconnect the high pressure cutout to one side of the tee-fitting and the vacuum pump to the other side.

Note: During any type of evacuation process, make sure a 115 VAC power source is connected to the master solenoid and load/unload solenoids. This will ensure that all hydraulic lines are open to a vacuum.

Figure 7.4-1
RTHA Evacuation Ports



TRANE

Refrigerant Charging Procedures for Units That Have Been Completely Evacuated

Literature File No.	RLC-SG-1
Section	7.5
Date	March 1991

Caution: Water must be flowing through the tube bundles during this entire process. Refrigerant pressures below 70 psig can cause freezing and rupturing of the heat exchangers.

Note: Refer to Figure 7.4-1 for charging port locations.

With the unit in STANDBY/RESET, use a refrigerant gas and charge the unit through the economizer cover angle valve until the pressure/temperature relationship is above 70 psig.

Caution: Do not charge refrigerant liquid into the unit unless the temperature/pressure relationship is above 70 psig.

Start the unit and add the remaining charge of liquid through the angle valve at the inlet of the evaporator, until the desired superheat is obtained.

Condenser and Evaporator Tube Removal and Replacement

Literature File No.	RLC-SG-1
Section	8.0
Date	June 1990

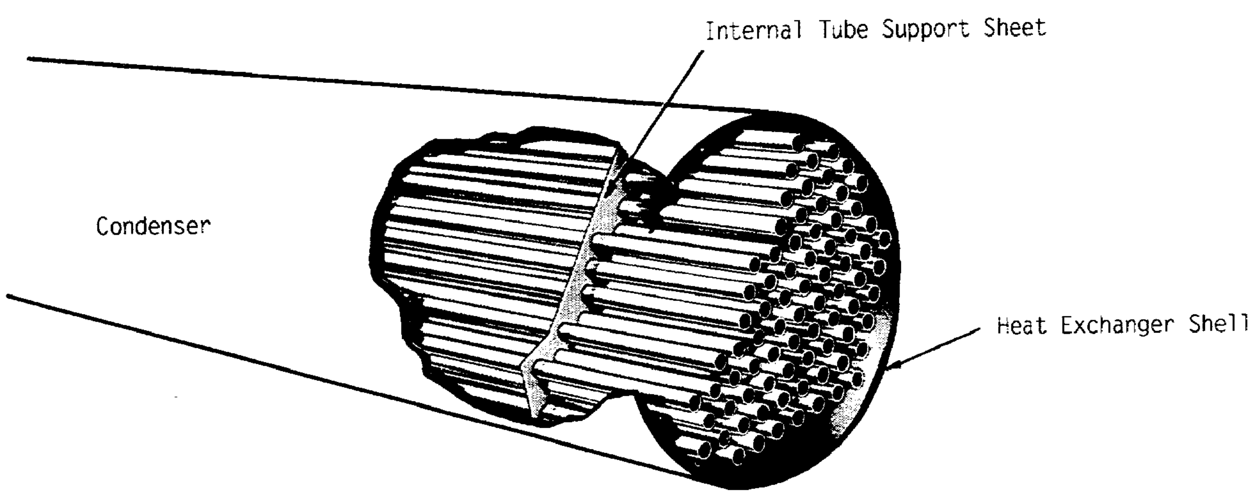
Heat Exchanger Construction

It is important to examine the design and construction of Trane heat exchangers prior to the removal and replacement of damaged tubes. Performing work on an exchanger, without knowledge of the tube material and how the tubes are held in place, can result in faulty repairs and/or damage to the exchanger.

Figure 8-1 illustrates a cutaway view of a typical Trane Series R heat exchanger. It has an outer cylindrical steel shell and thick steel tube sheets welded to each end. Inside the shell is an array of tubes. The ends of the tubes are secured to the tube sheets, using a press-fit procedure, to hold them in place and to seal them against leakage. Also inside the cylinder are thinner steel tube support sheets. These are placed at intervals along the length of the tubes to hold them in position and support them.

The tube material may be copper, copper alloy (such as copper/nickel in composition), or titanium, which is used when water conditions are extreme.

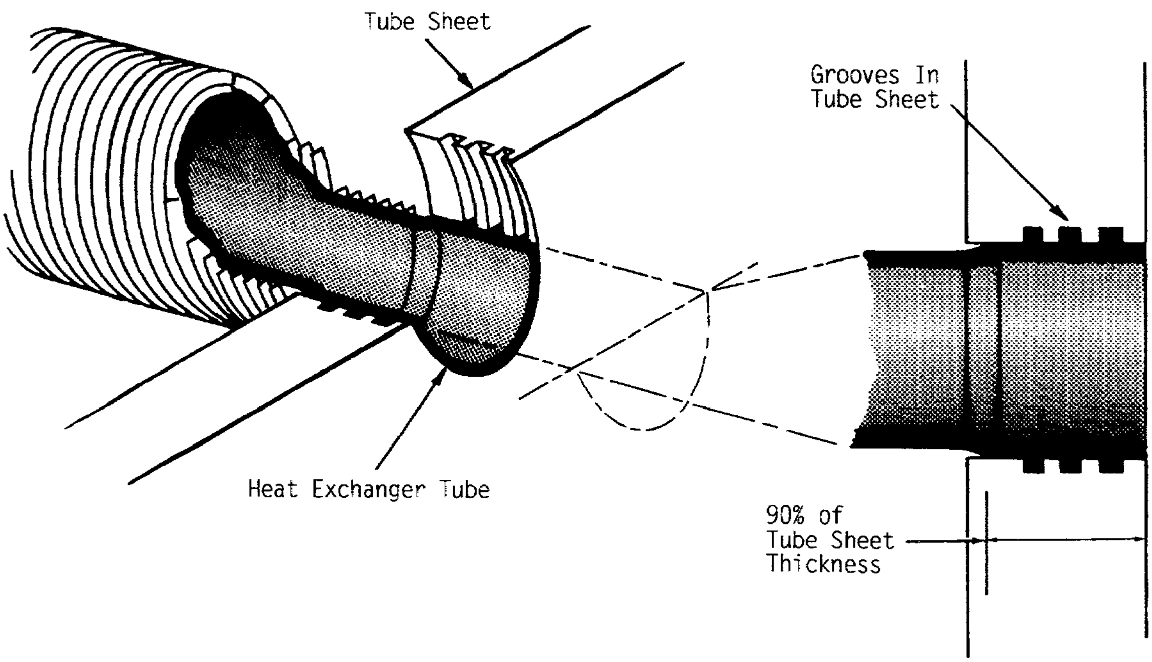
Figure 8-1



Copper has a high rate of thermal expansion, much greater than steel. During operation of the exchanger as the temperatures vary, tube expansion and contraction will try to work the tubes back and forth in the tube sheets. The method for preventing this is shown in Figure 8-2. The tubes are expanded into the grooves of the tube sheet and the ends are thus held in place.

When tubes expand while the ends are secured, there will be a bowing of the tubes within the exchanger. The tube support sheets will maintain tube alignment but there will still be some slight tube bowing, particularly at the inside face of the tube sheets. To eliminate the possibility of fracture where the edge of the tube sheet meets the tube, the press fit on the tubes extends only 90% in from the outside face of the tube sheet. This means that the last 10% will have some clearance between the tube and the sheet.

Figure 8-2
Heat Exchanger Tube Expanded Into Tube End Sheet



Tools, Techniques, and Procedures

Caution: On condensers in Design Sequence A thru H, there are clips inside which hold the tubes. These clips require that tubes be pulled out of the exchanger from the right end (as seen when you are facing the control panel) and that tubes only be inserted from the left end of the exchanger (as seen when you are facing the control panel).

Caution: Any clips that are pushed out of place in the heat exchanger must be removed before the unit is commissioned.

Note: On condensers in Design Sequence I and later and on all evaporators, the tubes may be pulled and replaced from either end. The condenser tubes are 3/4" dia. and the evaporator tubes are 1" dia.

It is important that no damage be done to the tube holes in the tube sheets. Much care and special tools are required to assure this.

The tool used to collapse the tube in the tube sheet is illustrated in Figure 8-3. It can be easily made by grinding a chisel into the shape shown and then hand-filing it to achieve smoothness. All sharp edges and burrs that might cause damage to the tube sheet hole must be removed.

Additional tools, a tube cutter, a tube roller, and a tube puller, are shown in Figures 8-4, 8-5, and 8-6, respectively. The tube cutter and tube roller are electrically driven and typically require a 110 VAC power supply. A heavy-duty impact wrench is also required.

Figure 8-3
Tube Collapsing Tool

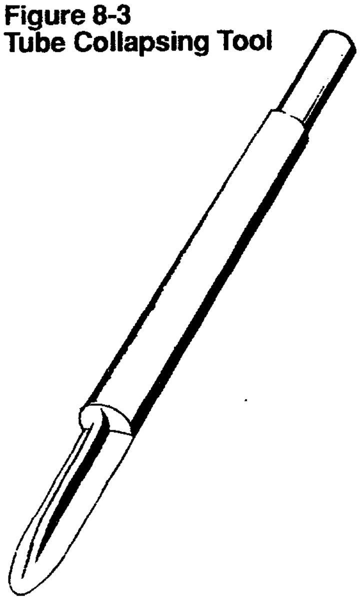


Figure 8-4
Tube Cutter

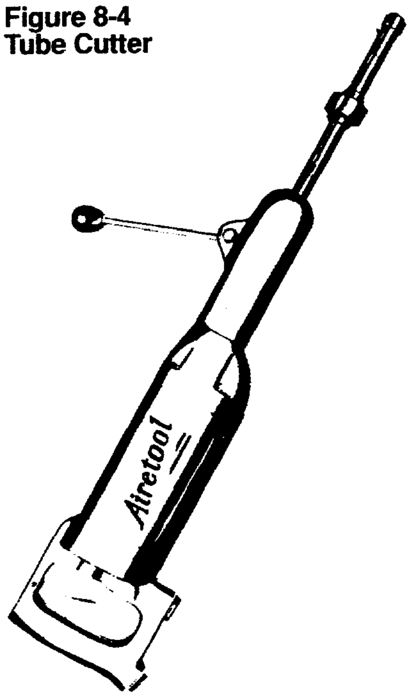


Figure 8-5
Tube Roller

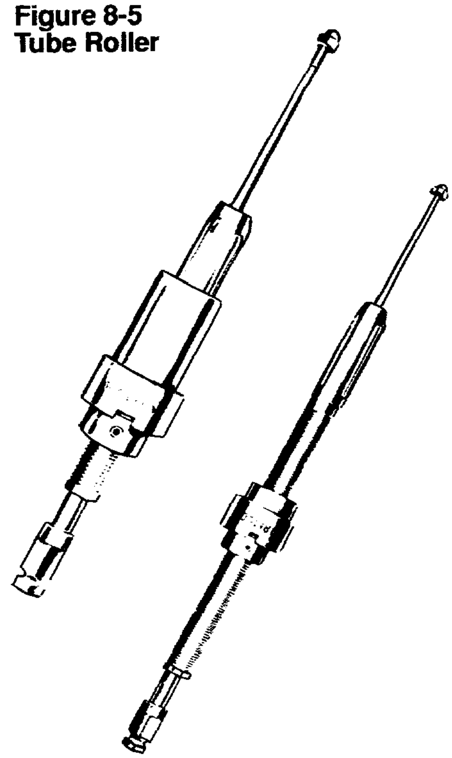


Figure 8-6
Tube Puller

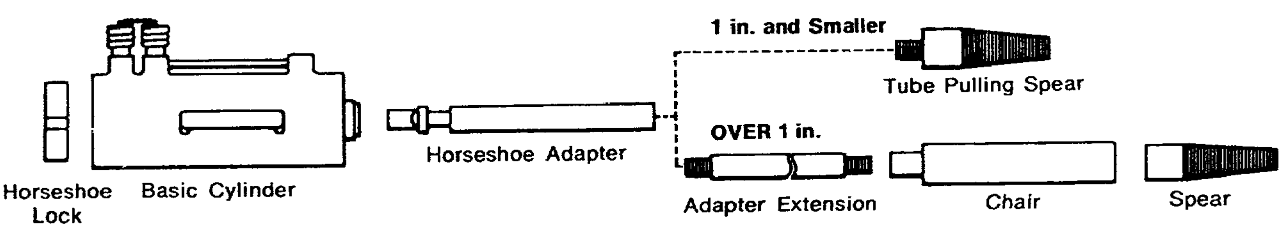
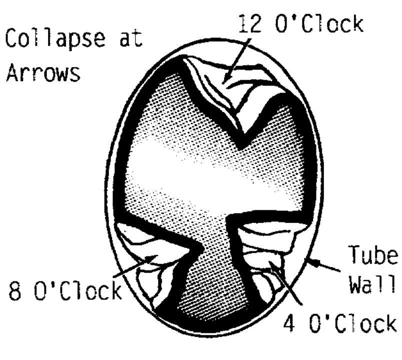


Figure 8-7
Initial Separation of Tube From Tube Sheet

STRIKE ONLY THE TUBE END,
DO NOT DAMAGE THE TUBE SHEET.
SEE DETAIL BELOW.



There are many methods used to remove exchanger tubes. The following are three types which are efficient and can be performed without much difficulty.

1. Collapsing the tube.

Using a tool as shown in Figure 8-3, collapse one end of the tube.

Caution: On condensers in Design Sequence A thru H, the end to be collapsed will be at the left end of the exchanger (as seen when you are facing the control panel) because the tubes must be pulled from the right end.

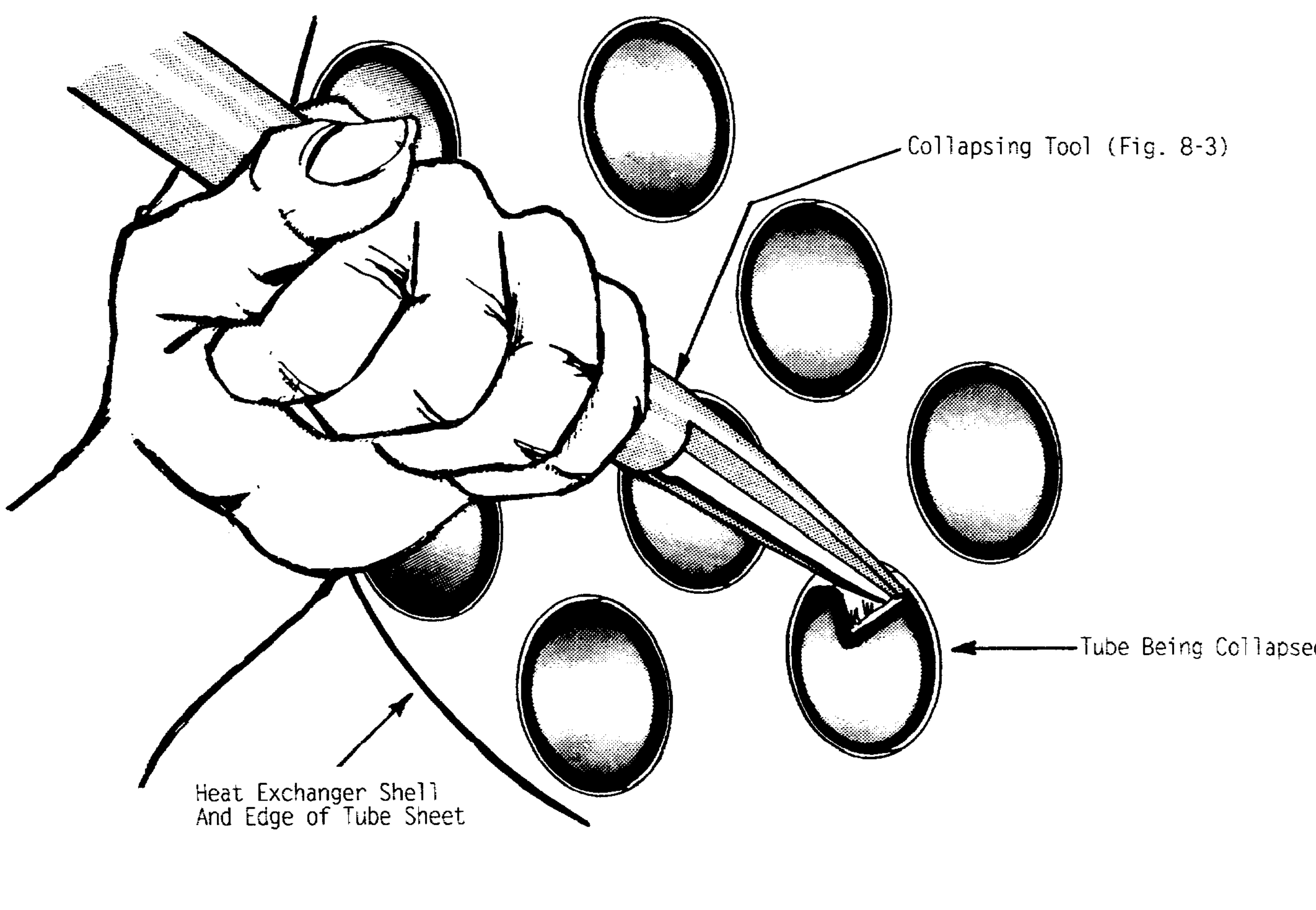
First, the tube must be separated from the tube sheet far enough to allow the collapsing tool to be inserted.

Caution: These separation points must be made at the "12 o'clock, 4 o'clock, and 8 o'clock" positions of the tube. See Figure 8-7.

Insert the collapsing tool into the separations and, using a mallet, drive the tool into the hole until the tube is approximately 50% collapsed at all three positions. See Figure 8-8. This procedure will also shear off the tube material that was press-fit into the grooves of the tube sheet holes. Collapsing the tube should free it from the tube sheet hole.

Caution: Care must be taken to only collapse the tube and to avoid any damage to the tube sheet.

Figure 8-8
Collapsing the Tube



Move to the other end of the tube, which is still attached to the tube sheet at the opposite end of the exchanger. Apply a thin coat of water-soluble oil to the inside of the tube end and also to the spear end of the tube puller. Using the impact wrench drive the spear into the end of the tube.

The tube puller should be set up as shown in Figure 8-9. Place the hydraulic ram unit over the spear shaft, tightly against the outside face of the tube sheet. Insert the horseshoe lock into the groove closest to the ram. Connect the hydraulic pump to the ram and actuate.

Note: Follow all of the ram operating instructions that are provided by the manufacturer.

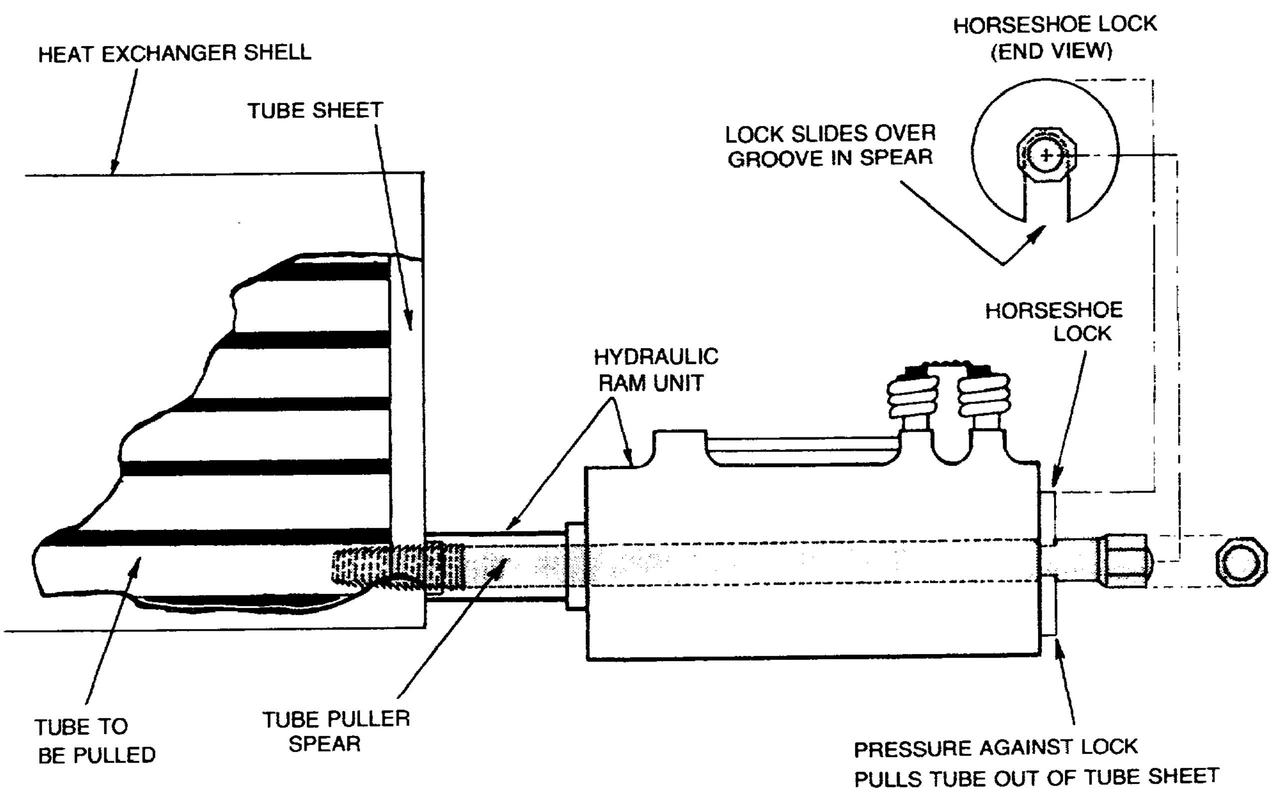
Note: If the spear slips or pulls out of the tube, re-insert it and start over. Continued slippage may require re-sharpening or replacement of the spear.

As pressure builds, the tube will be withdrawn from the tube sheet. If the tube is not free after full travel of the ram, it may be necessary to relieve the hydraulic pressure. remove the horseshoe lock, insert a spacer between the tube sheet and the ram, replace the horseshoe lock, and reapply pressure. Another method would be to use the hydraulic ram as an inertial tube puller.

Caution: After freeing the tube from the tube sheet at this end, withdraw the tube from the exchanger. Avoid any scoring or scratching of the tube sheet hole which might cause sealing problems when the new tube is installed.

Occasionally, the tube will get "hung up" on a tube support sheet. Rotation of the tube will free it.

Figure 8-9
Pulling the Tube



The inertial ram type of tube puller, as shown in Figure 8-10, is a variation of this tube pulling method. Set up of the spear is similar to that of the hydraulic ram. The pulling force on the tube is created by "ramming" the steel pipe ram against the horseshoe lock.

2. Tube cutting

This method is similar to the method described above except that instead of first collapsing the tube, the tube is cut off inside the tube sheet. The pulling procedure from the other end remains the same.

Caution: If this method is used, it is very important that care be taken to prevent particles of tubing created during the cutting operation from falling into the exchanger.

Caution: On condensers in Design Sequence A thru H, the end to be cut will be at the left end of the exchanger (as seen when you are facing the control panel) because the tubes must be pulled from the right end.

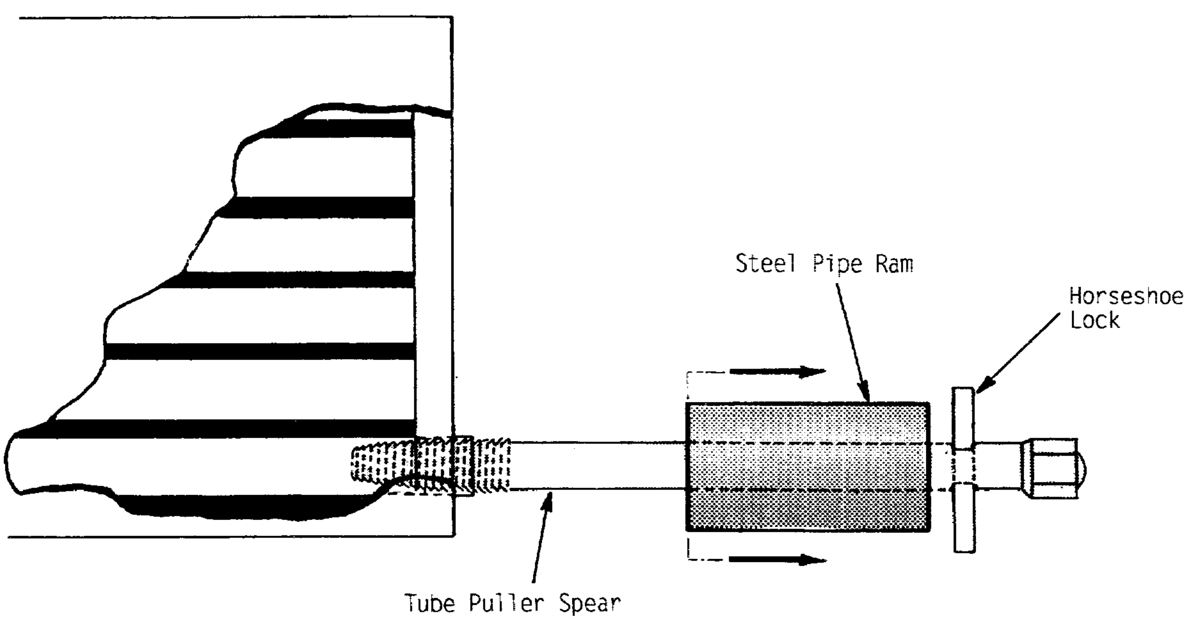
To cut off the tubing, use a tube cutting head especially designed for this purpose and an electric drill. The cutter must be adjusted so that it cuts the tube off approximately 1" inside the tube sheet.

After the tube is cut, pull the tube from the other end, using the ram method described in procedure 1, above. The ram may then be used to remove the stub of tubing left in the tube sheet when the tube was cut.

3. Pulling both tube ends

In this procedure, instead of collapsing or cutting the tube, the ram is used to pull the tube approximately 1/8", breaking the seal at that end. The ram is then installed at the other end of the tube, as described above, and the tube is removed.

Figure 8-10
Inertial Tube Puller



Preparing the Tube Holes and Tubes for Tube Replacement

The tube sheet holes must be thoroughly cleaned prior to tube replacement. Using a properly-size, soft wire wheel and an electric drill, clean all scale, dirt and debris out of the grooves in the tube hole. Make sure there are no burrs, scratches or gouges.The smoother the hole, the easier it will be to get a leak-free tube joint when the tube rolling procedure is performed.

The tube ends must also be carefully cleaned and inspected to insure that they are smooth and free of burrs, scratches, and gouges.

Determining Tube Expansion and Tube Wall Reduction

The replacement tubes are sealed into the tube sheet using the procedure called "tube rolling" or "tube expanding". The outside diameter of the tube (O.D.) is expanded to fill the tube sheet hole and the wall thickness of the tube is reduced as the tube is rolled from the inside and compressed against the tube sheet hole.

To obtain a proper joint or seal, the tube is expanded a predetermined amount so that it "flows" into the tube hole grooves. The following measurements and calculations must be made to determine the required inside diameter (I.D.) of the tube after the tube has been rolled. Figure 8-11 illustrate these measurements.

1. Determine the tube hole diameter (0.758").

2. Measure the O.D. of the tube (0.750").

3. By subtracting the tube O.D. (0.750) from the hole diameter (0.758), we calculate that the clearance between the tube and the hole is 0.008".

4. Measure the I.D. of the tube prior to rolling (0.680").

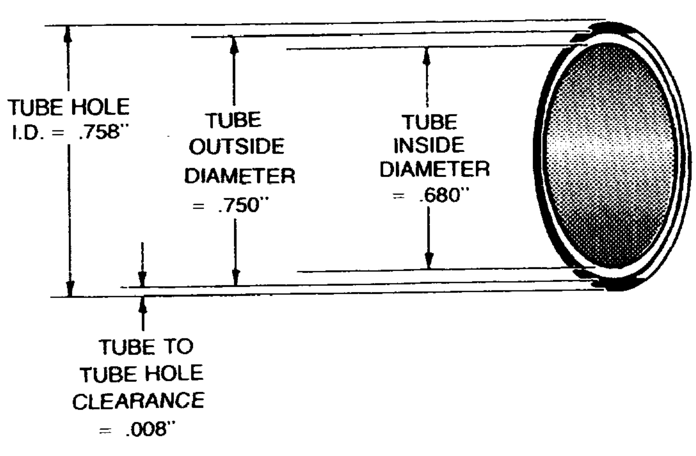
5. By subtracting the tube I.D. (0.680") from the tube O.D. (0.750'), we calculate that the tube wall thickness is 0.070".

In-order-to expand the tube so that it "flows" into the tube hole grooves, using the data above, we know that the tube must be rolled (expanded) to an I.D. of 0.688 just to meet the hole diameter. This dimension is the sum of the tube I.D. (0.680") and the clearance between the tube and the hole (0.008").

The wall thickness must also be reduced (compressed) to "flow" into the grooves, further increasing the tube I.D.. The required wall reduction for copper-tubed Series R exchangers is 8-1/2%. In this example, an 8-1/2% reduction of the wall thickness (0.070") is 0.0059".

From this, it can be determined that the final I.D. of the tube after rolling must be the total of the I.D. of the tube necessary to meet the hole diameter (0.688") plus the amount of wall reduction (0.0059"), or an final I.D. of .6939".

Figure 8-11
Measurements To Be Taken



Having determined the final I.D. of the tube, after rolling, this dimension is used to establish proper torque settings on the tube roller tools. The typical torque requirement for a Trane condenser is 60 in.-lbs. Torque for a Trane evaporator is 70 in.-lbs. Copper causes abrasive action during rolling and it is necessary that the tube and roller be well lubricated with a water soluble oil.

If titanium tubes are to be installed, the calculation steps to determine tube I.D. after rolling will be the same except that the wall reduction percentage to be used is approximately 4.5%. Rolling titanium tubes must be done quickly because titanium tubing tends to work-harden and little or no re-rolling should be done. Rolling tool motor speeds should be in the range of 400 to 750 RPM. Also, an expander with four or more rolls should be used to decrease distortion and help eliminate tube end cracking.

Under-rolling and Over-rolling the Tube

Under-rolling the tube will cause insufficient expansion and "flowing" of the tube into the tube sheet hole grooves. Although not as serious as over-rolling, it can lead to crevice erosion.

Over-rolling causes excessive wall reduction of the tube and possible splitting of the tube. It also can do additional damage to the exchanger itself, by reducing the dimensions of the tube sheet between adjacent tubes. This may result in a weakened and distorted tube sheet (beyond the normal bow or "warp" found in Trane exchangers) and may cause additional tube leakage.

Replacing the Tubes

When replacing tubes, begin by insert tubes in the bottom rows, one tube at a time. Insert the chamfered end of the tube in the end of the shell that is easiest to work from.

Caution: On condensers in Design Sequence A thru H, there are clips inside which hold the tubes. These clips require that tubes only be inserted from the left end of the exchanger (as seen when you are facing the control panel).

Caution: Any clips that are pushed out of place in the heat exchanger must be removed before the unit is commissioned.

Note: On condensers in Design Sequence I and later and on all evaporators, the tubes may be pulled and replaced from either end. The condenser tubes are 3/4" dia. and the evaporator tubes are 1" dia.

Check the tube alignment after each row of tubes has been inserted, to ensure that the tubes are in the correct tube support holes. A steel rod may be required to alleviate alignment difficulties.

Use a rubber mallet to tap the tubes into place, flush with the tube sheet's outside face.

Before inserting the tube roller, measure the thickness of the tube sheet and adjust the roller so that it expands the tube through only 90% of the tube sheet thickness. See Figure 8-2.

Caution: Trane exchanger design requires that tube rolling start with the tubes in the center of the tube sheet and proceed in a spiral pattern to the outside.

Once the depth of rolling is set and the tube end is flush with the tube sheet face, insert the tube expander into the tube end and apply power. Allow the tool to reach desired RPM before thrusting the mandrel forward. The tool will shut off automatically when the set torque amperage is achieved. Pulling back on the expander will reverse the rotation and permit removal.

First, roll all the tubes that have been tapped flush with the tube sheet at one end of the exchanger. Then move to the opposite end. Before rolling the tubes, trim them off to be flush with the face of the tube sheet.

Caution: Care must be taken to avoid any scratching of gouging of the tube sheet face when trimming the tube ends, particularly where a water box baffle contacts the tube sheet.

After the tubes at both ends of the exchanger have been rolled, pressure test the exchanger prior to reassembly and return to operation.

TRANE

Motor Terminal Replacement

Literature File No.	RLC-SG-1
Section	9.0
Date	June 1990

Caution: Water must be flowing through the tube bundles during this entire process. Refrigerant pressures below 70 psig can cause freezing and rupturing of the heat exchangers.

Pre-pumpdown Checks

Caution: These checks must be made before pumping down the system.

1. For Design Sequence "E" units and late, the hydraulic lines can be isolated from the rest of the system by closing the oil shutoff valves, located on the compressor. See the IOM for additional information. There is no need to pumpdown the unit to service the master solenoid, oil filter or oil flow switch.

2. Check to confirm that the oil level in the oil tank is 2½ to 3 inches high. Add oil, as required, before pumping down the unit.

3. Water must be flowing through the evaporator and condenser tube bundles during the pumpdown procedure.

Caution: Water must be flowing through the tube bundles during this entire process. Refrigerant pressures below 70 psig can cause freezing and rupturing of the heat exchangers.

Caution: To prevent damage to the heat exchangers due to freezing, start the condenser and evaporator water pumps before pumping down the unit.

Pumpdown Procedure

Caution: Do not deviate from the following pumpdown procedures.

1. Review all Pre-Pumpdown Checks, above. Be sure that the oil level is 2½ to 3 inches high.

2. Turn the Slide Valve Switch on the UCM to UNLOAD position.

3. Disconnect one of the electrical leads to the low pressure control (4S6).

4. Close the condenser refrigerant outlet isolation valve.

5. Allow the unit to pumpdown, until the evaporator pressure gauge indicates "15 psig".

Caution: Do not allow the pressure to fall below 15 psig.

Caution: To prevent compressor damage, do not allow the unit to pump down again. Otherwise catastrophic damage may result.

6. Immediately shutdown the chiller by turning the Chiller Switch on the UCM to the STANDBY/RESET position.

7. Close the condenser refrigerant inlet isolation valve.

8. Reclaim any refrigerant remaining in the low side of the system.

9. Reconnect the low pressure control (4S6) lead which was disconnected in step 3.

Caution: Do not pumpdown the unit more than one time in succession. To do so can result in catastrophic compressor *damage*.

10. Remove the motor/economizer cover.

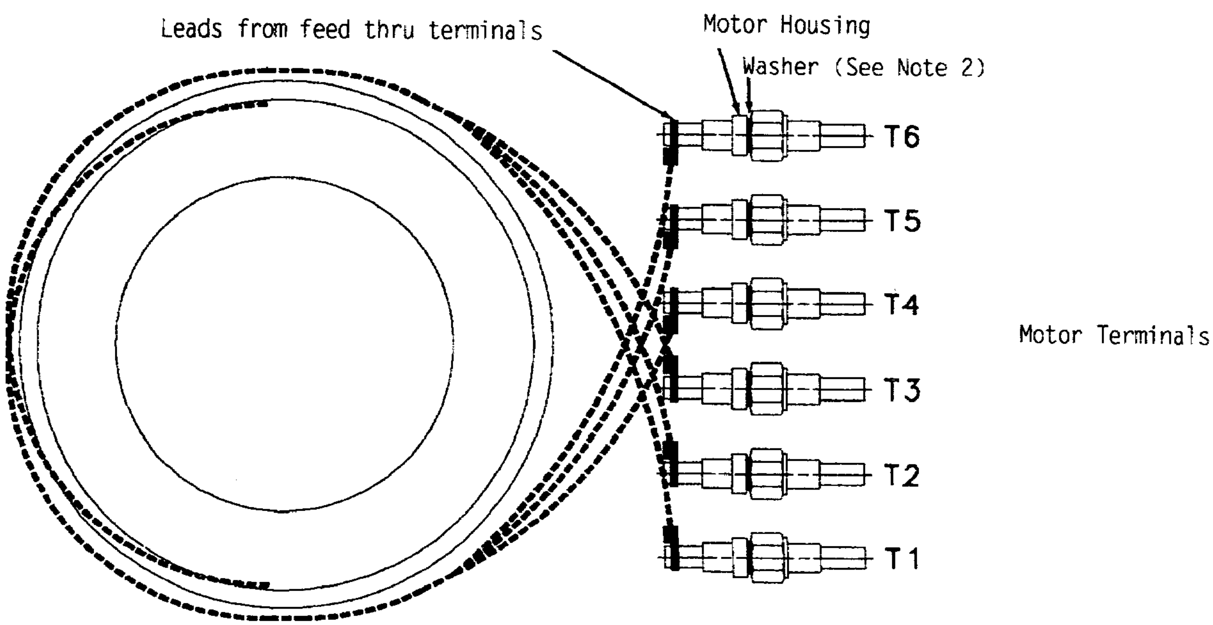
Caution:To prevent objects from dropping into the connecting piping while the motor/economizer cover is off, cover the refrigerant to evaporator at the bottom of the opening.

11. Remove the existing leads from the feed-thru terminals. Refer to Figure 9.0-1.

Figure 9.0-1
Motor To Terminal Connection Diagram (Viewed from Lead End)

NOTE:

1. Care must be taken when installing the wire ties to ensure that the motor protection leads do not touch or pass within .50 inch of the bare metal parts for the motor terminal leads.
2. For 150 and 130 use integral washers and torque to 45 ft-lbs. For 180 and up use copper washer and torque to 100 ft-lbs.
3. Use refrigerant locktite on terminals.



12. Remove the old motor terminals.

13. Apply refrigerant locktite on the new terminals.

14. Install new washers on the new terminals.

15. Install the new terminals on the motor housing and tighten to the torque specified in Figure 9.0-1.

16. Reconnect the leads to the replacement terminals.

17. Remove any materials used to prevent any objects from dropping in to the system and replace the motor/economizer cover. Be sure to use a new cover gasket and tighten the cover bolts. See Table 6.0-1 for torque specifications.

18. Evacuate the system using the access valve on the motor/economizer and the high pressure control (HPC) access above the condenser inlet isolation valve. The HPC access is used to remove any non-condensibles that may be between the internal compressor check valve and the condenser inlet isolation valve.

19. Remove the wiring to the load/unload solenoids and the master solenoid. Connect 115 VAC to the master solenoid and to the load/unload solenoids.

20. Evacuate the unit to 500 microns and isolate the vacuum pump.

21. Using refrigerant raise the evaporator pressure to what it was on the evaporator before it was relieved. This will give a fairly accurate refrigerant charge to the unit.

Caution: Do not charge refrigerant into the unit unless there is water flow.

Caution: Do not charge refrigerant into the unit unless the temperature/pressure relationship is above 70 psig.

22. Open the condenser inlet isolation valves and wait for the evaporator pressure to rise to 70 psig.

23. After evaporator pressure has reached 70 psig, slowly open the condenser outlet butterfly valve.

Caution: Water must be flowing through the tube bundles during this entire process. Refrigerant pressures below 70 psig can cause freezing and rupturing of the heat exchangers.

24. For recharging purposes, use the angle valve below the evaporator. Start the unit and charge a liquid directly into the evaporator while the unit is running.

TRANE

Load and Unload Solenoid Replacement

Literature File No.	RLC-SG-1
Section	9.1
Date	March 1991

How The Solenoids Control Loading and Unloading

Compressor capacity is regulated by the slide valve, which is moved to the desired position by the slide valve piston. Oil flows in to and out of the cylinder to move the slide valve piston and the oil flow is controlled by the loading and unloading of two solenoid valves (4L2 and 4L3).

The solenoid valves receive momentary pulsating "load" and "unload" voltage signals from the UCM, based on the system cooling requirements. Control power flows through the HGBP enable relay 1U1B(K1) to load and unload the solenoids.

Control of the valves is achieved via the two Traic switches Q7 (slide valve load) and Q8 (slide valve unload), located in the relay output module 1U1. Functionally, Q7 and Q8 operate like a set of contacts.

While the operation of both Triacs is automatically governed by micro module 1U3, manual control is possible by positioning the slide valve control switch to LOAD, HOLD, or UNLOAD.

Note: Manual loading or holding does not take precedence over the current limit (A 75), condenser limit (A 76) or evaporator limit (A 77) modes of operation.

To load the compressor, the UCM opens the load solenoid valve (4L2) and closes the unload solenoid valve (4L3). The pressurized oil flows into the cylinder and forces the piston toward the rotors.

The compressor is unloaded when the load solenoid valve (4L2) is closed and the unload solenoid valve (4L3) is opened. Oil "trapped" in the cylinder flows into the lower-pressure suction area of the compressor. As the pressure in the cylinder drops, the slide valve is gradually moved away from the rotors.

When both solenoid valves are closed, the piston cannot move and the present level of compressor loading is maintained.

When the compressor is shutdown, the unload solenoid valve is opened and a spring forces the slide valve to the fully-unloaded position. The unit will always start in a fully-unloaded mode.

Replacement of the Load and Unload Solenoids

Caution: Water must be flowing through the tube bundles during this entire process. Refrigerant pressures below 70 psig can cause freezing and rupturing of the heat exchangers.

Note: For 130 to 215 ton units, the unload solenoid is on the motor side on the compressor.

For 255 to 300 ton units, the unload solenoid is on the discharge side of the compressor.

Pre-pumpdown Checks

Caution: These checks must be made before pumping down the system.

1. For Design Sequence "E" units and late, the hydraulic lines can be isolated from the rest of the system by closing the oil shutoff valves, located on the compressor. See the IOM for additional information. There is no need to pumpdown the unit to service the master solenoid, oil filter or oil flow switch.

2. Check to confirm that the oil level in the oil tank is 2½ to 3 inches high. Add oil, as required, before pumping down the unit.

3. Water must be flowing through the evaporator and condenser tube bundles during the pumpdown procedure.

Caution: Water must be flowing through the tube bundles during this entire process. Refrigerant pressures below 70 psig can cause freezing and rupturing of the heat exchangers.

Caution: To prevent damage to the heat exchangers due to freezing, start the condenser and evaporator water pumps before pumping down the unit.

Pumpdown Procedure

Caution: Do not deviate from the following pumpdown procedures.

1. Review all Pre-Pumpdown Checks, above. Be sure that the oil level is 2½ to 3 inches high.

2. Turn the Slide Valve Switch on the UCM to UNLOAD position.

3. Disconnect one of the electrical leads to the low pressure control (4S6).

4. Close the condenser refrigerant outlet isolation valve.

5. Allow the unit to pumpdown, until the evaporator pressure gauge indicates "15 psig".

Caution: Do not allow the pressure to fall below 15 psig.

Caution: To prevent compressor damage, do not allow the unit to pump down again. Otherwise catastrophic damage may result.

6. Immediately shutdown the chiller by turning the Chiller Switch on the UCM to the STANDBY/RESET position.

7. Close the condenser refrigerant inlet isolation valve.

8. Reclaim any refrigerant remaining in the low side of the system.

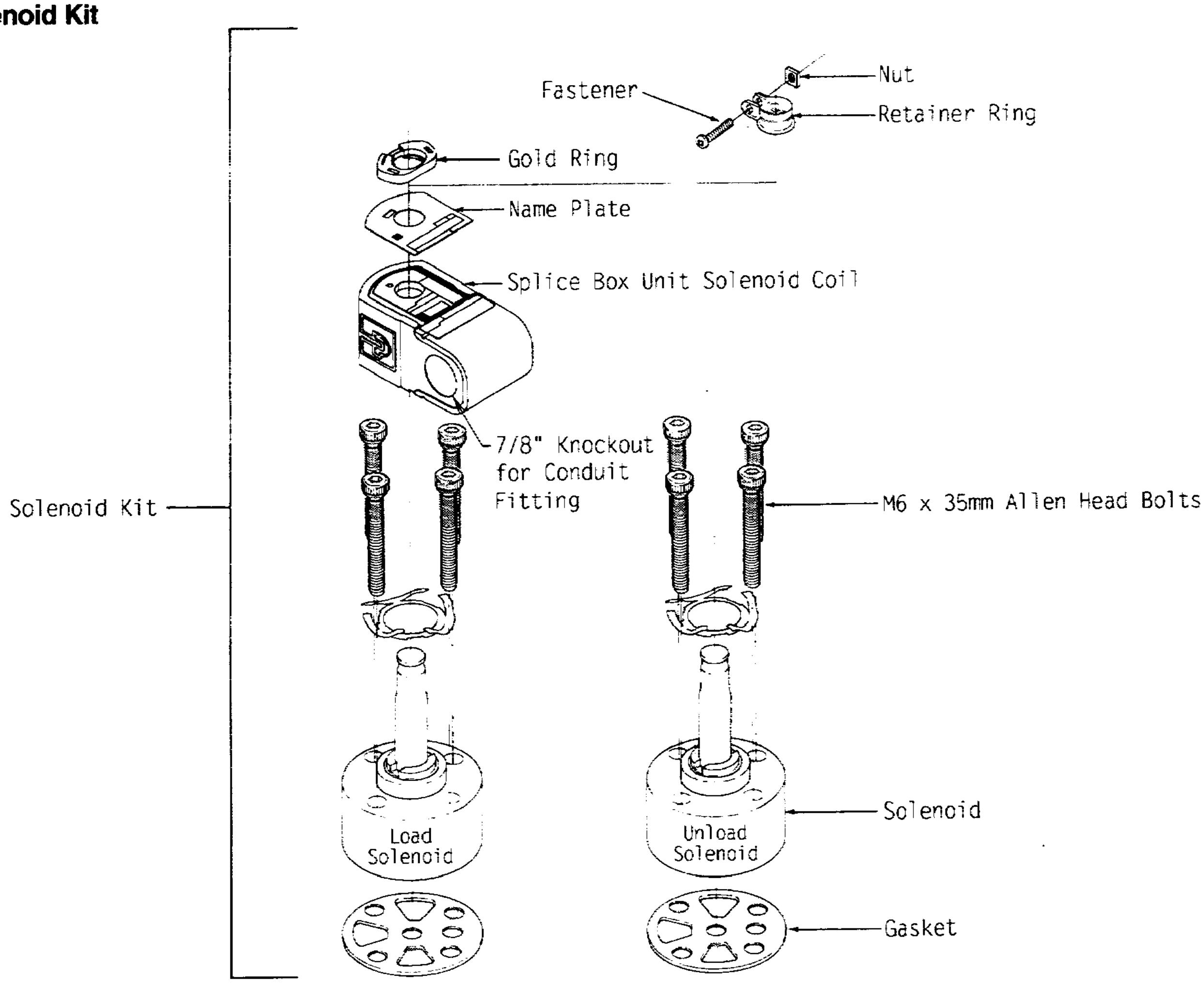
9. Reconnect the low pressure control (4S6) lead which was disconnected in Step 3.

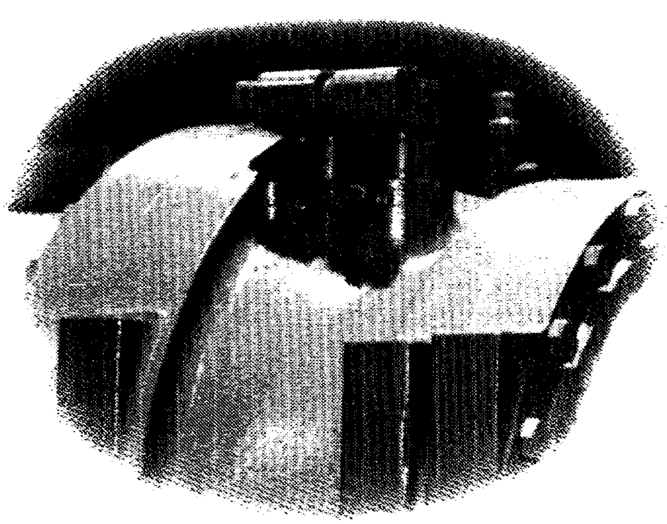
Caution: Do not pumpdown the unit more than one time in succession. To do so can result in catastrophic compressor damage.

10. Remove the wiring to the load/unload solenoids and the master solenoid.

11. Remove the solenoid and replace it with the kit, as shown in Figure 9.1-1.

Figure 9.1-1
Solenoid Kit





Rotor Housing

12. Evacuate the system using the access valve on the motor/economizer and the high pressure control (HPC) access above the condenser inlet isolation valve. The HPC access is used to remove any non-condensibles that may be between the internal compressor check valve and the condenser inlet isolation valve.

13. Remove the wiring to the load/ unload solenoids and the master solenoid. Connect to 115 VAC.

14. Evacuate the unit to 500 microns and isolate the vacuum pump. There should be no more than a 250 micron rise in ½ hour.

15. Using refrigerant raise the evaporator pressure to what it was on the evaporator before it was relieved. This will give a fairly accurate refrigerant charge to the unit.

Caution: Do not charge refrigerant into the unit unless there is water flow.

Caution: Do not charge refrigerant into the unit unless the temperature/pressure relationship is above freezing.

16. Open the condenser inlet isolation valves and wait for the evaporator pressure to rise to 70 psig.

17. After evaporator pressure has reached 70 psig, slowly open the condenser outlet butterfly valve.

Caution: Water must be flowing through the tube bundles during this entire process. Refrigerant pressures below 70 psig can cause freezing and rupturing of the heat exchangers.

18. For recharging purposes, use the angle valve below the evaporator. Start the unit and charge a liquid directly into the evaporator.

TRANE

Service Bulletins

Literature File No.	RLC-SG-1
Section	10.0
Date	June 1990

The service bulletins listed below are inserted following this page. They contain current information and instructions necessary for the proper installation, operation, and maintenance of the Series R CenTraVac® Chiller Units.

RTHA-SB-1 Ribbon Cable Abrasions

RTHA-SB-2 Oil Heater Block

RTHA-SB-3 Oil Line Modifications

RTHA-SB-4 Oil Cooler Modifications

RTHA-SB-5 Control Operation, Setup and Troubleshooting for RTHA Liquid Chiller Control Panel

RTHA-SB-5A Control Operation, Setup and Troubleshooting for RTHA Liquid Chiller Control Panel

RTHA-SB-6 Model RTHA Series R Centravac Superheat Parameters

RTHA-SB-7 Model RTHA Series R Centravac Designators

RTHA-SB-8 Model RTHA Series R Centravac Ice Making Panel

RTHA-SB-9 Model RTHA Series R Centravac Oil Screen Additions

TRANE

General Service Bulletin

RTHA-SB-1

Library	Service Literature
Product Section	Refrigeration
Product	Rotary Liquid Chillers
Model	RTHA
Literature Type	General Service Bulletin
Sequence	1
Date	December 7, 1988
File No.	SV-RF-RLC-RTHA-SB-1-1288
Supersedes	

Subject: UCM Ribbon Cable Abrasion on RTHA Units

Introduction:

UCM panels on early-production Series R CenTraVacs were manufactured with sharp edges on some of the assembly's sheet metal parts. Because of the location of these sharp edges, the ribbon cables that connect modules 1U1 and 1U2 to micro module 1U3 may be abraded.

Models affected by abrasion of the UCM ribbon cable(s) are RTHA-130 through -215 units with serial numbers up to (and including) *U88L00167*.

NOTE: The UCM cable abrasion discussed in this bulletin applies only to RTHA units; the UCM panels used on CVHE units are not affected.

Discussion:

Sharp edges on the UCM's sheet metal DIP switch cover and on the uppermost part of the UCM housing may scrape away the insulation on the UCM's ribbon cables as the cables rub against these edges. Electrical shorts to ground or open circuits may occur as a result of this abrasion.

Corrective Action:

To prevent the ribbon cables from contacting the sheet metal edges identified in Figure 1:

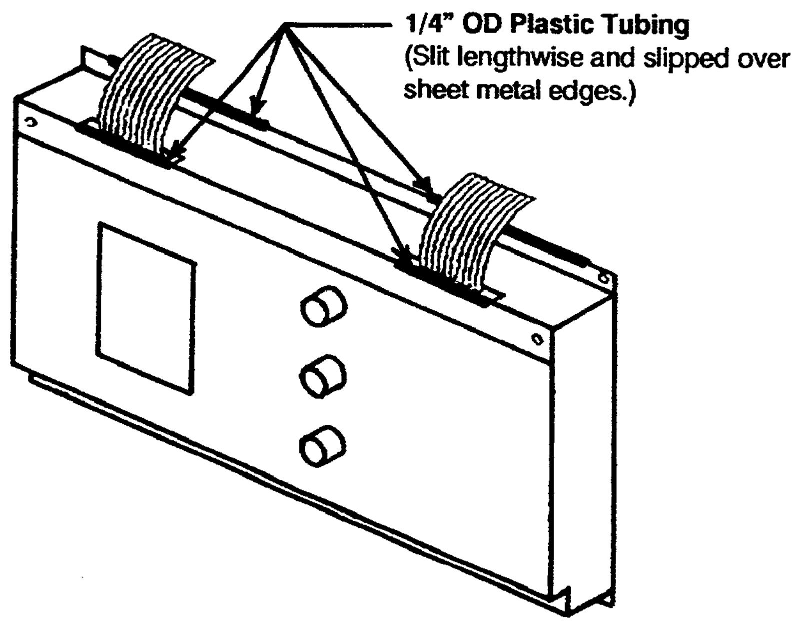
1. Obtain a 12" length of 1/4" OD plastic tubing from a local supplier.

2. Cut the tubing into (4) pieces. To determine the required lengths, refer to Figure 1 and the actual UCM panel.

3. Slit each tube lengthwise on one side; then slip the pieces of tubing over the sheet metal edges identified in Figure 1.

4. Carefully check the length of each ribbon cable to assure that it does not rest against any other component that might cause abrasion.

Figure 1



Current Production:

All RTHA units with serial numbers of *U88L00168 and later* were manufactured with enhancements that prevent ribbon cable abrasion.

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General Service Bulletin

RTHA-SB-2

Library	Service Literature
Product Section	Refrigeration
Product	Rotary Liquid Chillers
Model	RTHA
Literature Type	General Service Bulletin
Sequence	2
Date	7/20/89
File No.	SV-RF-RLC-SB-2-789
Supersedes	

Subject: Model RHTA Series R CenTraVac Compressor Oil Heater Block Replacement

Introduction:

The purpose of this service bulletin is to aid in the installation of the new block-heaters on RTHA Series R CenTraVac compressors. The heater block replaces all previous designs (di-cast aluminum, rubber heater for sound attenuation).

Discussion:

This service bulletin provides the service technician who is replacing an inoperative RTHA oil tank heater with instructions for properly positioning and installing the new design heater block.

Corrective Action

1. Secure the compressor electrically from operating (open and lock all electrical disconnects).

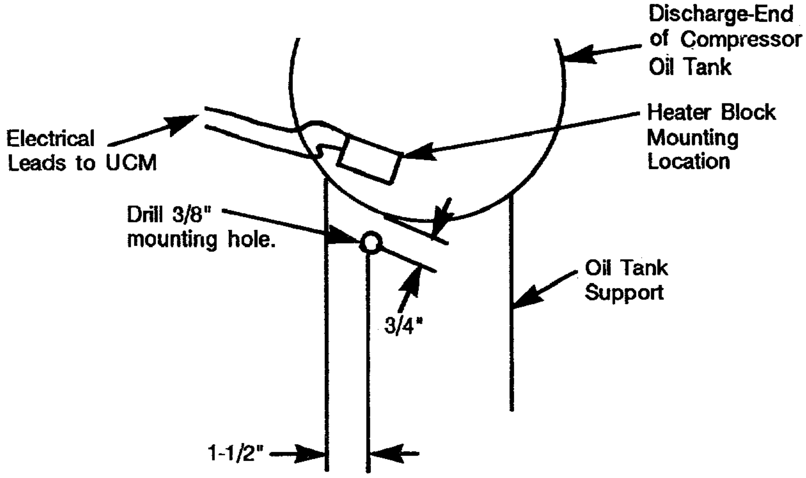
WARNING: To prevent injury or death be certain open electrical disconnects before installing oil heater.

2. Remove the old heater from the compressor oil tank.

3. Drill a 3/8-inch hole in the oil tank support bracket closest to the discharge end of the compressor. Locate the hole 3/4-inch away from the oil tank and 1-1/2-inches in from the left edge of the oil tank support (as viewed from the discharge end of the compressor). Refer to Figure 1.

Caution: To prevent compressor damage, drill through the oil tank support only. Do not drill through or weld on the oil tank.

Figure 1
Heater Block and Mounting Hole Locations



4. Insert the two (2) heater elements into the heater block. Tip the heater block up to prevent the heaters from falling out of the block.

Note: Steel wool can be packed around the heater elements to make them fit snuggly into the heater block.

5. Apply two (2) 1/8-inch beads of heat conductive compound to the back of the heater block. The compound will be between the heater block and oil tank (Figure 2).

6. Rotate the master solenoid coil 90-degrees counterclockwise from its present position and re-route the oil flow switch wiring so they will not interfere with positioning the heater block.

7. Press the heater block against the end of the oil tank at the location shown in Figures 1 and 2 and hold in position. Position the heater bock mounting bracket as shown in Figure 2 to hold the heater block in place and install the 8mm x 65mm bolt through the holes in the mounting bracket and the oil tank support using the 8mm nut and lockwasher provided.

8. Connect the heater leads to terminals 1TB2-4 and 1TB5-2 in the unit control panel. See Figure 3.

9. Close the unit disconnects to energize the heaters and bring the oil tank back up to normal operating temperature.

Caution: If oil has cooled completely, energize the oil tank heaters for a minimum of 8 hours before operating the unit.

Units Affected

The replacement heater block described by this service bulletin replaces all previous heater blocks used on Model RTHA 130 thru 300 units, design sequences A thru D.

Parts Ordering Information

This service bulletin is informational only and does not authorize any parts or labor. One oil tank heater kit is required for each RTHA oil heater to be replaced. Order these parts from La Crosse, "Ship from 31", and specify the following part number:

KIT-1491 = RTHA Oil Tank Heater Replacement Kit

The Trane Company
La Crosse, Wisconsin 54601-7599
Printed in U.S.A.

Figure 2
Oil Tank Heater Block Mounting Detail

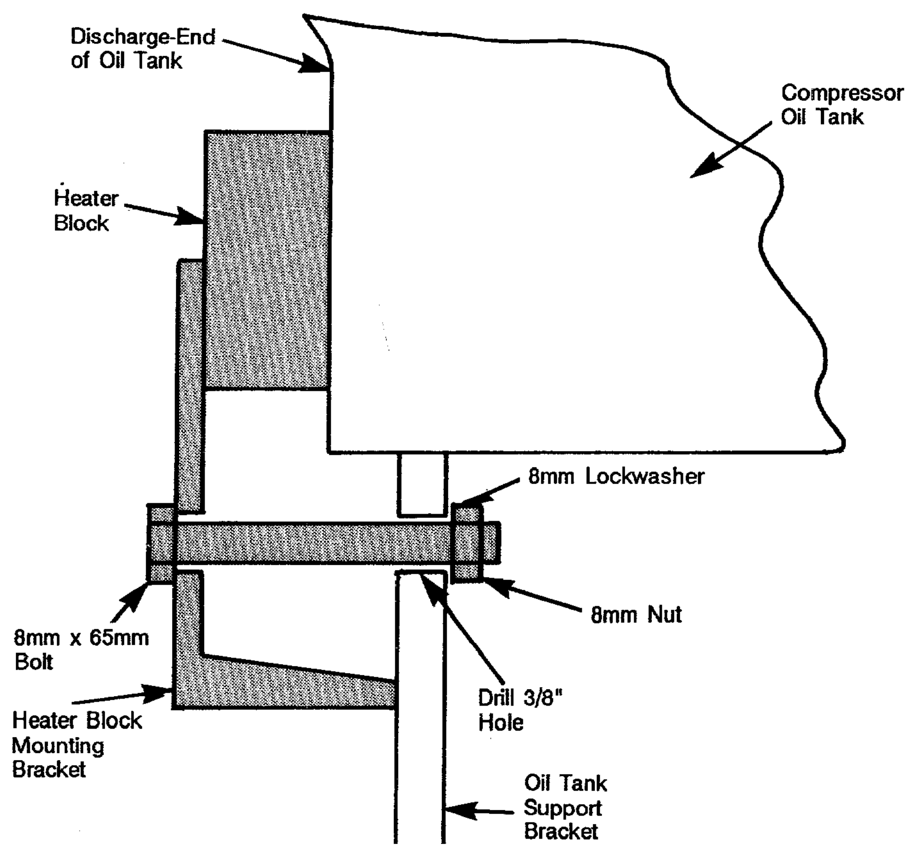
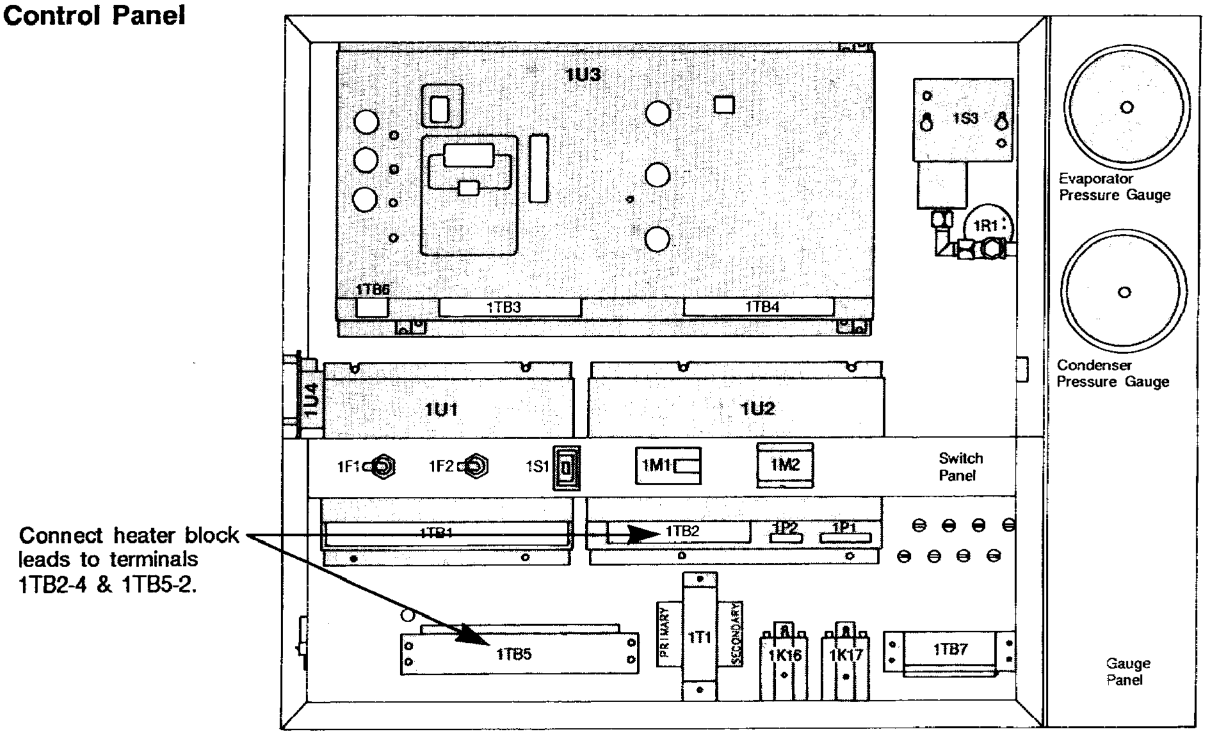


Figure 3
RTHA Unit Control Panel Layout



TRANE

General Service Bulletin

RTHA-SB-3

Library	Service Literature
Product Section	Refrigeration
Product	Rotary Liquid Chillers
Model	RTHA
Literature Type	General Service Bulletin
Sequence	3
Date	September 11, 1989
File No.	SV-RF-RLC-RTHA-SB-3-989
Supersedes	

Subject: Series R CenTraVac Oil Line Modification

Introduction:

A problem has been identified with the oil line which feeds oil to the compressor bearings. The problem that may occur is trip out on low oil flow (BF2). Units that are affected are "E" design sequence only (10th digit of unit model number).

Discussion:

On the "E" design sequence chillers, the external oil lines were rerouted to prevent possible shipping and installation damage. A portion of the tubing became marginally sized thus it may not deliver enough oil to activate the oil flow switch. The bearings do get the required amount of oil but you may get nusiance trips on low oil flow (BF2).

Corrective Action:

Caution: Insure that water is flowing through tube bundles during entire process. R-22 pressures below 65 psig can cause freezing and bursting of heat exchangers.

1. Set slide valve switch to unload.

2. Remove wire to low pressure control (4S6).

3. Close outlet condenser refrigerant isolation valve.

4. Allow machine to pump down evaporator to 15-20 psig.

5. Shut chiller off by moving chiller switch to standby/reset.

6. Close inlet condenser refrigerant isolation valve.

7. Allow machine to set for 15-20 minutes to allow remaining refrigerant to "gas-off". Evaporator should rise to 70-80 psig.

8. Open inlet condenser refrigerant isolation valve.

9. Start chiller by moving chiller switch to auto/local and pump evaporator down to 2 psig.

10. Shut chiller off by moving chiller switch to standby/reset.

11. Close inlet condenser refrigerant isolation valve. Figure 1 is an illustration of the existing oil system and Figure 2 illustrates the new oil system.

12. Close oil line isolation valves -- outlet of oil tank, side of rotor housing, bottom of motor housing.

13. Modify oil system from the existing oil system (Figure 1) to the new oil system (Figure 2).

    Caution: Do not use Teflon tape. Particles of the tape could plug orifices. Use "Locktite" refrigerant sealer, Trane Part No. SEL 0413, or equivalent on pipe threads.

    a. Remove tubing and fittings between the two valves.

Note: While steps b thru f are performed there will be refrigerant vapor purging from machine when valves are removed. This will insure no non-condensibles enter machine. If bleed rate is too high to work with, bleed the excessive pressure from schraeder valve behind evaporator pressure gauge.

    b. Remove angle valve on bottom of motor housing and replace .052 orifice with a .072 orifice. Drilling a 1/8" hole in the .052 orifice and screwing a sheet metal screw into it will help facilitate its removal.

Figure 1
Old Configuration 1/4"
Copper Tube Assembly

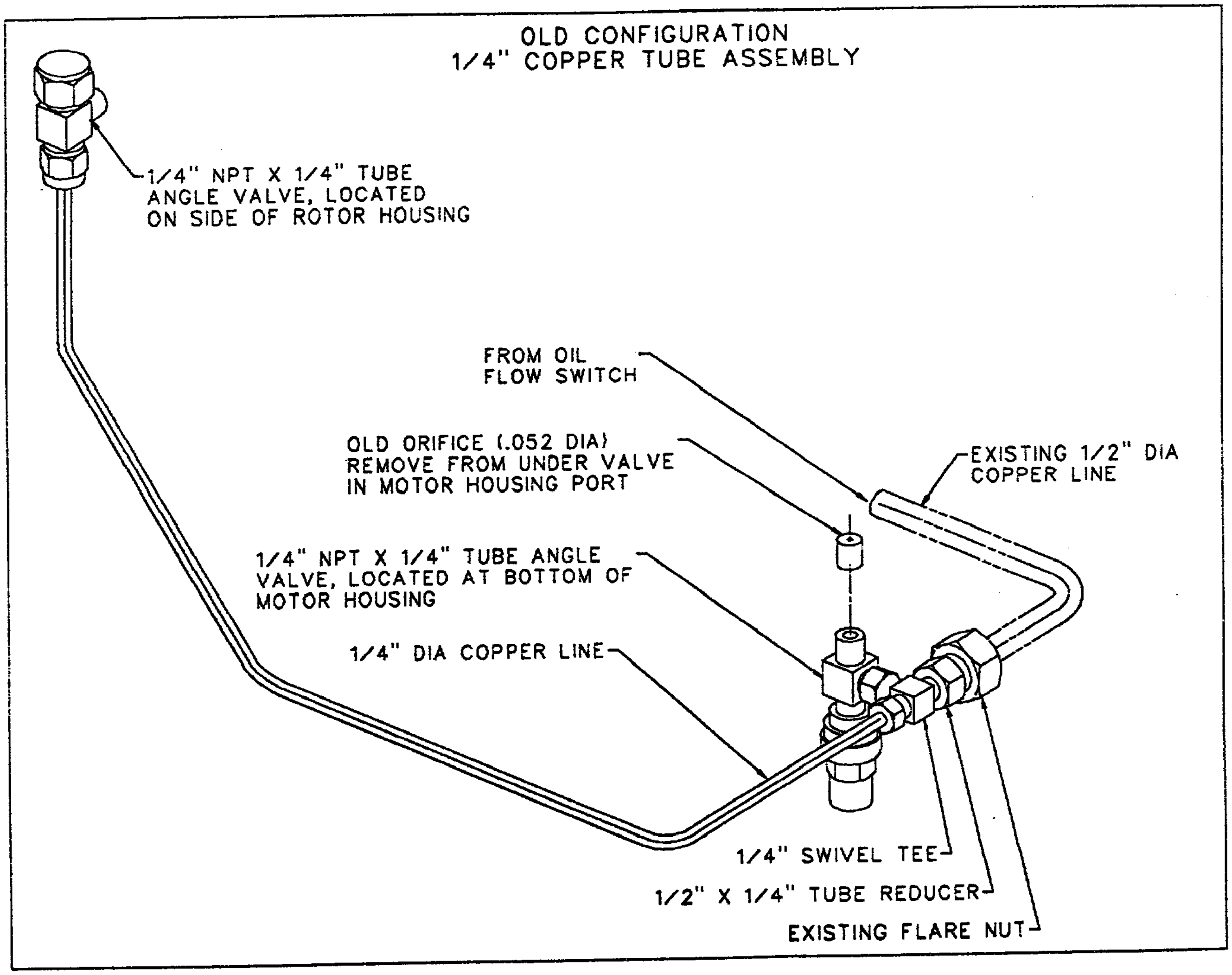
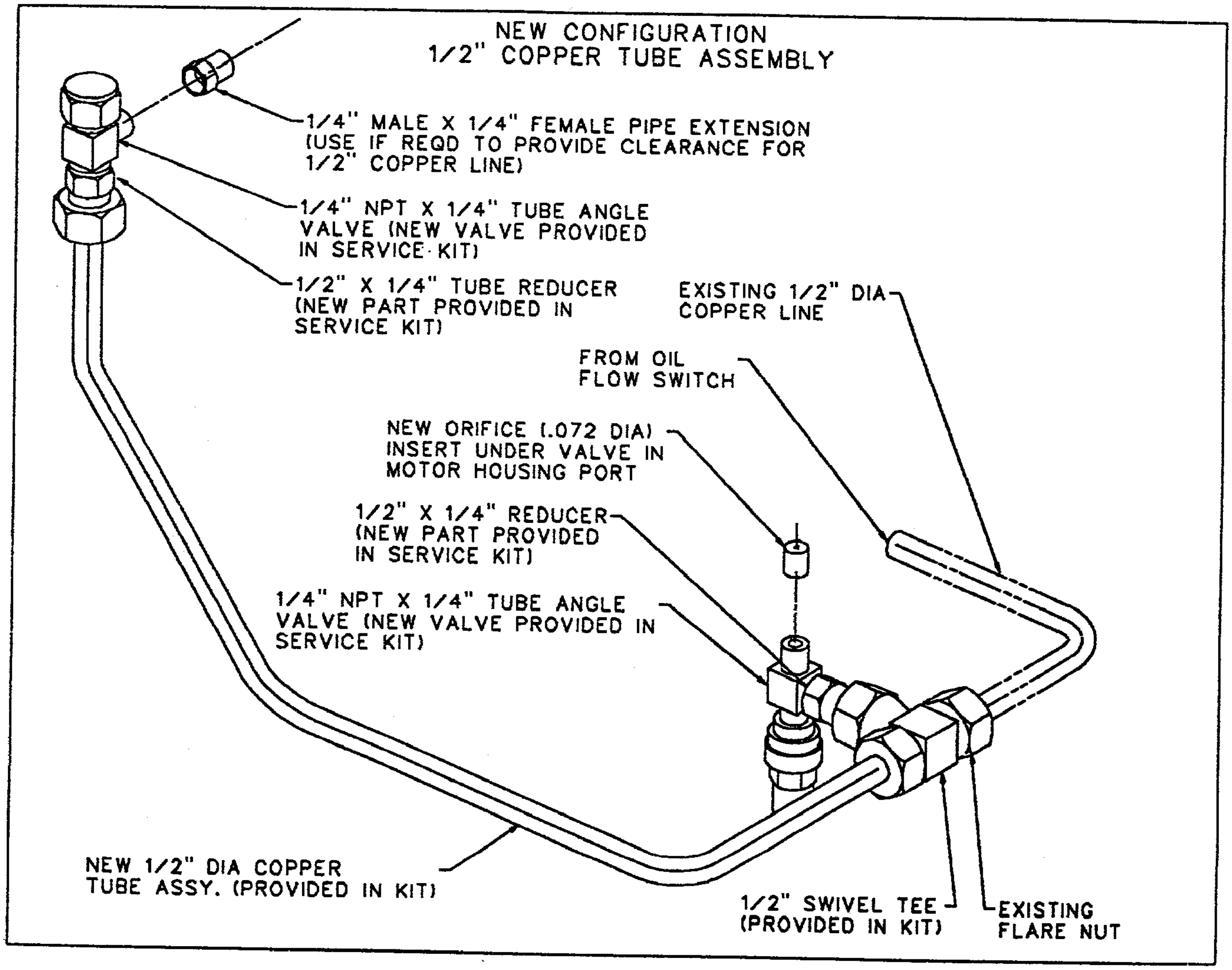


Figure 2
New Configuration 1/2"
Copper Tube Assembly



c. Install new angle valve on bottom of motor housing.
d. Remove angle valve on side of rotor housing.
e. Install pipe extension and new angle valve on side of rotor housing.
f. Install appropriate tubing and fittings between the two angle valves.
g. Bend existing 1/2" dia. line from oil switch to meet 1/2" swivel tee.
h. Purge tubing by cracking open the replacement valves and bleed refrigerant through the oil line back to the flare nut on the outlet of the flow switch.

14. Open all oil line isolation valves.
15. Reinstall wire that was removed to the low pressure control (4S6) that was disconnected in Step 2.
16. Open inlet and outlet condenser isolation valves.
17. Start and put chiller into operation.

Units Affected

RTHA 130-300 design sequence "E" only.

Example: RTHA 255FSEL

JH

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General Service Bulletin

RTHA-SB-4

Library	Service Literature
Product Section	Refrigeration
Product	Rotary Liquid Chillers
Model	RTHA
Literature Type	General Service Bulletin
Sequence	4
Date	11/10/89
File No.	SV-RF-RLC-RTHA-SB-4-1189
Supersedes	

Subject: Model RTHA Series R CenTraVac Oil Cooler Modification (Kit)

Introduction:

A problem has been identified with the oil cooler used on Series R CenTraVac units, Model RTHA 130 thru 215, design sequences A thru D. Since failure of the oil cooler can result in compressor mechanical failure, all units equipped with oil coolers will be identified and repaired immediately.

Discussion:

It has been determined that the vendor-supplied oil cooler used on RTHA 130 thru 215 units has been internally cracking, allowing refrigerant oil and water to mix. In addition to the strong probability that refrigerant oil will migrate to the water side of system, when excessive refrigerant and oil loss occurs on the refrigerant side, refrigerant-side pressure will fall below water-side pressure, allowing water leakage into the refrigeration system. This will result in catastrophic damage to the compressor. Present production RTHA units are not equipped with an oil cooler. The decision to exclude the oil cooler from the unit design was made before this problem was discovered. Extensive testing has indicated that the oil cooler is not required for reliable operation of the unit.

Units Affected:

All units, Model RTHA 130 thru 215, design sequences A thru D only.

Corrective Action

Caution: Insure that water is flowing through the tube bundles during entire process. R-22 pressures below 65 psig can cause freezing and bursting of heat exchangers.

Note: This procedure does not apply to units that have not been commissioned. For non-commisioned units, remove oil cooler water lines from the unit and cap flare connections on the water box heads. Do not cap water connections on the oil cooler. Once the unit has been commissioned, perform the retrofit procedure that follows.

Retrofit Procedure

1. With unit running, turn slide valve control switch on the UCM to UNLOAD.

2. Disconnect one wire from the low pressure control (4S6) at the UCM.

3. Close condenser refrigerant outlet isolation valve.

4. Allow the unit to pump the evaporator down to 15-20 psig.

5. Shut the unit off by moving chiller switch to STANDBY/RESET.

6. Close condenser refrigerant inlet isolation valve.

7. Let unit rest for 15-20 minutes to allow remaining refrigerant to "gas-off". Evaporator pressure should rise to 70-80 psig.

8. Open condenser refrigerant inlet isolation valve.

9. Start the unit by moving chiller switch to AUTO/LOCAL and pump evaporator down to 2 psig.

10. Shut the unit off by moving chiller switch to STANDBY/RESET.

11. Close condenser refrigerant inlet isolation valve.

12. Close angle valve on oil filter outlet.

13. Close both gate valves on either side of oil cooler and disconnect water lines at the oil cooler.

Note: Steps 14 through 16c must be performed as quickly as possible because refrigerant vapor will be purging from the system through the bearing oil supply line during these steps.

14. Disconnect oil lines at the oil cooler.

15. Remove the oil cooler from its mounting brackets.

16. Install the tubing assembly provided in KIT-1516, "U"-side up as shown in Figure 1 in place of the oil cooler as follows:

   a. Connect tubing assembly to flare nut on bearing oil line (Figure 1). Do not fully tighten nut.

   b. Connect flare nut on tubing assembly to oil flow switch outlet (Figure 1).

   c. Fully tighten both flare nuts.

   d. Using the tubing clamp provided in KIT-1516, secure the new tubing assembly at one of the existing oil cooler mounting brackets (Figure 1).

17. Remove existing oil cooler water lines all the way back to the condenser water boxes. Install the flare caps provided in KIT-1516 on the water box connections.

18. Open angle valve on oil filter outlet.

19. Open condenser refrigerant inlet and outlet isolation valves.

20. Reconnect low pressure control (4S6) wire at the UCM (disconnected in Step 2).

21. Put unit back into operation.

Parts Ordering Information

One RTHA oil cooler retrofit kit is required for each RTHA unit affected. Order these parts from La Crosse, "Ship from 31", and specify the following part number:

KIT-1516 = RTHA Oil Cooler Retrofit Kit

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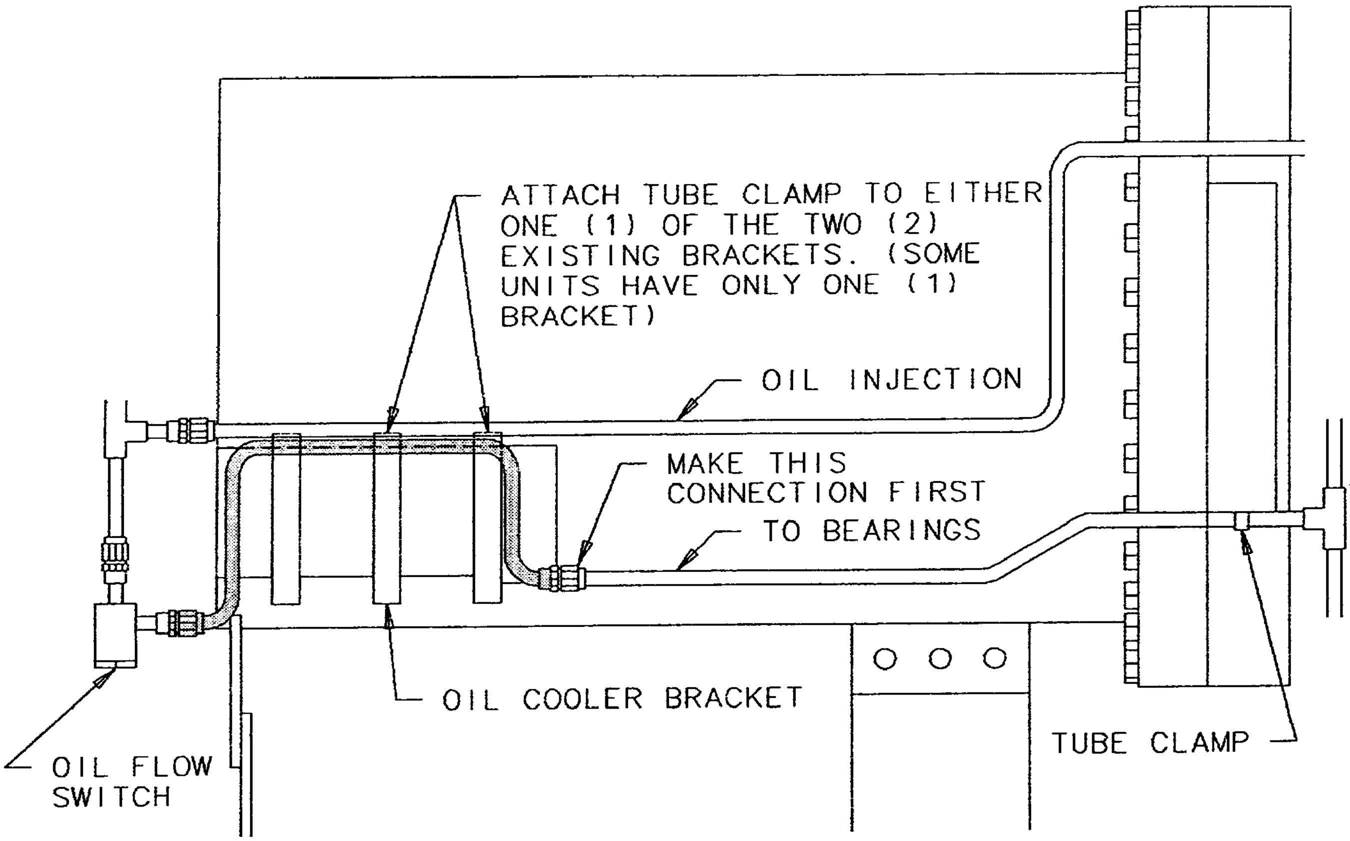
Figure 1
Tubing Assembly Installation for RTHA Oil Cooler Retrofit



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General Service Bulletin

RTHA-SB-5A

Library	Service Literature
Product Section	Refrigeration
Product	Rotary Liquid Chillers - Water-Cooled
Model	RTHA
Literature Type	General Service Bulletin
Sequence	5A
Date	February 7, 1991
File No.	SV-RF-RLC-RTHA-SB-5A-291
Supersedes	RTHA-SB-5-5/5/90

Literature Change History:
RTHA-SB-5 (5/90) – Original Service Bulletin
RTHA-SB-5A (2/91) -- Bulletin revised to update electrical schematics and provide additional information on UCM Dip switch settings.

Subject: Control Operation, Setup and Troubleshooting for RTHA (Series R) Liquid Chiller Control Panel.

Introduction:

The purpose of this Service Bulletin is to provide control operation and general troubleshooting information for Trane CenTraVac model RTHA microprocessor control panels.

Discussion:

This bulletin is intended to serve as a supplement to the operation and maintenance literature for RTHA units. Subjects covered in this bulletin are intended to provide more comprehensive information for RTHA units.

Caution: Be sure to refer to wiring diagrams that apply specifically to the design sequence of the unit being serviced.

Note:

The Trane Company urges all HVAC servicers working on Trane equipment, or any manufacturer's products, make every effort to eliminate, if possible, or vigorously reduce the emission of CFC, HCFC and HFC refrigerants to the atmosphere resulting from installation, operation, routine maintenance, or major service on this equipment. Always act in a responsible manner to conserve refrigerants for continued use even when acceptable alternatives are available.

Table of Contents

3 **Control Panel Codes and Menu Charts**
3 UCP Overview

6 **RTHA Compressor Electrical Phasing**
7 –Correcting Improper Electrical Phase Sequence

7 **Phase Monitor Operation for Remote and Unit Mounted Starts**
7 2U1 United Mounted Starter Phase Reversal Monitor
7 4U1 Remote Mounted Starter Phase Reversal Monitor

7 **RTHA Electrical Diagrams**

16 **Factory Setup for UCM Dip Switches**
16 Switch Block S11: Unit Address
16 Switch Block S9: Unit Identification; Temperature Range; Unit of Measure
16 –Hot Gas Bypass
16 –Pressure
17 –Temperature Range
17 –Unit of Measure
17 Switch Block S3: Frequency; Phase Imbalance
17 –Frequency Adjustment (50/60 Hz)
17 –Unit of Measure
17 Switch Block S1: Rated Load Amps (RLA) Setpoint

21 **Input Connections (and Terminal Designations)**
21 Terminal Strip 1TB6: Bidirectional Communications Link
21 Terminal Strip 1TB3
21 –Leaving Evaporator Water Temperature Sensor (1TB3-1, -2)
22 –Entering Evaporator Water Temperature Sensor (1TB3-3, -4)
22 –Spare Temperature Sensors (1TB3-5, -6; 1TB3-7, -8)
22 –Condenser Refrigerant Pressure Transducer (1TB3-9, -10, -11)
22 –Evaporator Refrigerant Temperature Sensor (1TB3-12, -13)
23 –Ambient Temperature Sensor (1TB3-14, -15)
23 –External Inhibit (1TB3-16, -17)
24 –Proof of Chilled Water Flow (1TB3-20, 21)
24 –Proof of Condenser Water Flow (1TB3-22, 23)
24 –Low Pressure Cutout (1TB3-24, -25)
25 Terminal Strip 1TB4
–Proving Oil Flow (1TB4-1, -2)
25 –Running External Interlock (1TB4-3, -4)
25 –"Transition Complete" Contacts (1TB4-5, -6)
25 –3-Phase Current-Sensing Input (1TB4-7 thru -12)
26 –Discharge Temp Sensor (1TB4-19, -20)
26 –Motor Winding Temperature Sensors (1TB4-15 thru -18)

27 **Temperature Sensor Checkout Procedure**

35 **Troubleshooting with Control Panel Diagnostics**
35 b A3 Evaporator Refrigerant Temperature Range
35 b A4, A7, A8 Motor Temperature Sensors
36 b Ab Leaving (Evaporator) Water Temperature Sensor)
36 b Ad Evaporator Refrigerant Temperature Sensor
36 b AE Ambient Temperature Sensor (Optional)
36 b d9 Extended Power Loss
36 b dc Condenser Water Flow Overdue
37 b E2 Momentary Power Loss
37 b E3 Phase Imbalance (Optional)
37 b E4 Phase Loss
39 b E5 Phase Reversal
39 b E7 High Motor Temperature
39 b F2 Proving Oil Flow
39 b E8 Oil Flow Switch Closed
40 b E9 Stop Relay
40 b EC Running Overload
40 b Ed Chilled Water Flow
41 b FO Transition
42 b F1 Running External Interlock

42 **Power Supply Checkout Procedure**
42 Overview
42 –Power Supply Output Module 1U2 Checkout (Figure 8)
45 –Power Transformer (1T1) Checkout (Figure 8)

47 **Compressor Transition Relay 1U2K5 and Current Transformer Checkout Procedures**
48 Faulty current-sensing inputs (1TB4-7 thru -12)
48 Defective micro module (1U3)
48 Defective power supply output module (1U2)
48 Faulty starter component(s) or wiring
48 Faulty "proof-of-transition" circuit

49 **1U2K5 Checkout Procedure**

49 **Current Transformer Checkout**

52 **Checkout Procedure for Slide Valve Operation**
52 Slide Valve Control Switch
52 Pressure Gauge
52 Load
52 Hold
52 Unload
52 Auto

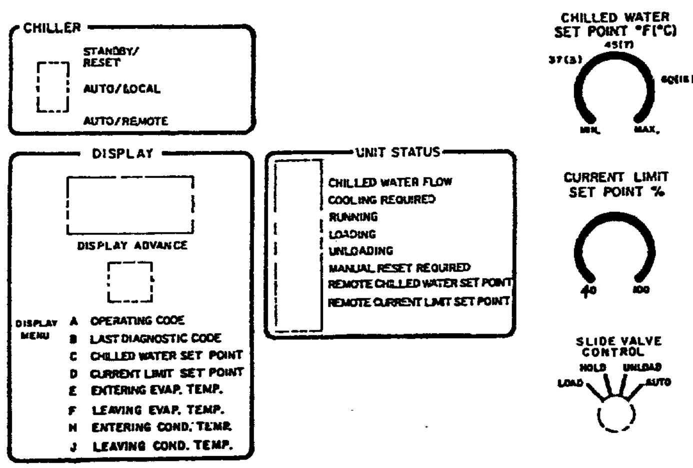
52 **Condenser Water Pump Relay Checkout**
52 Relay Operation
52 Relay Troubleshooting

Control Panel Codes And Menu Charts

UCP Overview

The microprocessor-based, UCP control panel visually indicates chiller operating and diagnostic codes at the display window; see Figure 1. If the UCM (i.e., unit control module) detects a diagnostic condition, it alternately flashes the 3-digit unit operating mode (i.e., code prefix A) at the time the unit shutdown and the 3-digit diagnostic code (i.e., code prefix B) on the display.

Figure 1
UCP Micro Module 1U3



Note: A latching diagnostic condition (i.e., one requiring manual reset) detected by the unit control panel cannot be cleared from a higher level device (i.e., an SCP, Tracer or generic BAS). A manual reset must be performed at the UCP control panel.

Complete listings of the codes used to identify RTHA operating modes and diagnostic conditions, along with the display menus, are provided in Tables 1, 2 and 3, respectively.

Table 1
Codes for Unit Operating Modes

3-Character Code	Description of Operating Mode
Blank	Power Off
A 0	Standby/Reset
A 1	Auto (Local or Remote)
A 70	Restart Inhibit
A 71	Establish Condenser Water Flow
A 72	Start
A 74	Run: Normal
A 75	Run: Current Limit (1)
A 76	Run: Condenser Limit (2)
A 77	Run: Evaporator Limit (3)
A 7A	Run: Hot Gas Bypass
A 100	External Inhibit
A 7C	Stop: Minimum Off Time
A 88	Reset

Notes:
1. As the current limit setpoint is approached, the UCM restricts further advancing of the compressor slide valve.
2. As the condenser limit setpoint is reached, the UCM restricts additional compressor loading to avoid shutdown on high condenser pressure (b F5), and initiates a "head relief request" (i.e., optional relay).
3. The UCM restricts further retraction of the compressor slide valve to avoid a unit shutdown on low evaporator refrigerant temperature (b Fb).

Table 2
Unit Diagnostic Codes

3-Character Code	Diagnostic Description	System Reset
b A3	Evaporator Refrigerant Temp. Range	Manual
b A4	Sensor Failure - Motor Temp. Sensor #1	Manual
b A7	Sensor Failure - Motor Temp. Sensor #2	Manual
b A8	Sensor Failure - Motor Temp. Sensor #3	Manual
b Ab	Sensor Failure - Evap. Leaving Water Temperature Sensor	Manual
b Ac	Sensor Failure - Condenser Refrigerant Pressure Sensor	Manual
b Ad	Sensor Failure - Evaporator Refrigerant Temperatur Sensor	Manual
b AE	Sensor Failure - Ambient Temperature Sensor (Opt.)	Manual
b 80	Sensor Failure - Discharge Gas. Temp. Sensor	Manual
b b5	Low Evaporator Refrigerant Pressure	Manual
b d9	Extended Power Loss	Automatic
b dc	Condenser Water Flow Overdue	Manual
b E2	Momentary Power-Loss	Automatic
b E3	Phase Imbalance	Manual
b E4	Phase Loss	Manual
b E5	Phase Reversal	Manual
b E7	High Motor Temperature	Manual
b E8	Oil Flow Switch Closed	Manual
b E9	Stop Relay	Manual
b Ec	Running Overload	Manual
b Ed	Chilled Water Flow Failure	Automatic
b F0	Starter Transition Failure	Manual
b F1	Running External Interlock (Opt.)	Manual
b F2	Low Oil Flow	Manual
b F5	High Condenser Refrigerant Pressure	Manual
b F7	Condenser Water Flow Failure	Automatic
b F8	Improper Unit Identification	Manual
b Fb	Low Evaporator Refrigerant Temperature	Manual
b FF	Unit Control Module	Manual
b 84	High Discharge Gas Temperature	Manual

Notes:
1. Check the "Manual Reset Required" status indicator light to determine if manual reset is necessary.
2. It is not possible to clear a latching diagnostic condition (i.e., one requiring manual system reset) at the unit from a higher level device (e.g., a system control panel, Tracer, or generic BAS).

Table 3
Display Menus

Operator's Menu		Serviceman's Menu (1, 3) (Slide Valve Control Switch at "Hold")	
Code Prefix	Parameter Description and Display Range	Code Prefix	Parameter Description Diagnostic Code and Display Range
A	Operating Mode (see Table 3)	A	Operating Mode (see Table 3)
b	Last Diagnostic (see Table 4)	b	Last Diagnostic (see Table 4)
C	Chilled Water Setpoint Standard-range: 37 thru 60 F Extended-range: 20 thru 70 F	⊢	Panel Chilled Water Setpoint Range: ---, 20 thru 70 F ---
d	Active Current Limit Setpoint Range: 40 thru 100% RLA	‾	Panel Current Limit Setpoint Range: ---, 40 thru 100% RLA ---
E	Entering Evaporator Water Temperature (Opt.) Range: ---, 12 thru 91 F ---	_	Evaporator Refrigerant Temp. (2) Diag. Code: b Ad Range: -4 thru 42 F ---
F	Leaving Evap Water Temp. Diag. Code: b Ab Range: 12 F thru 91 F	L	Control Response Setpoint Range: 1 thru 237
H	Entering Condenser Water Temperature (Opt.) Range: ---, 28 thru 142 F	□	Start Differential Setpoint Range: 2 thru 10F
J	Leaving Condenser Water Temperature (Opt.) Range: ---, 28 thru 142 F, --	P	Condenser Limit Setpoint Range: 80 thru 120% HPC
(Blank)		U	Evaporator Refrigerant "Trip" Setpoint (Diag. Code: b A3) Standard-range = 29 thru 34 F Extended-range = 0 thru 34 F

Notes:
1. To switch from "operator's menu" to the "serviceman's menu" on the UCM display, turn the Slide Valve Control Switch to "Hold". To switch back to "operator's menu", turn the switch to any position other than "Hold".
2. For further information on any of the items listed in the "serviceman's menu", contact a qualified service organization.

RTHA Compressor Electrical Phasing

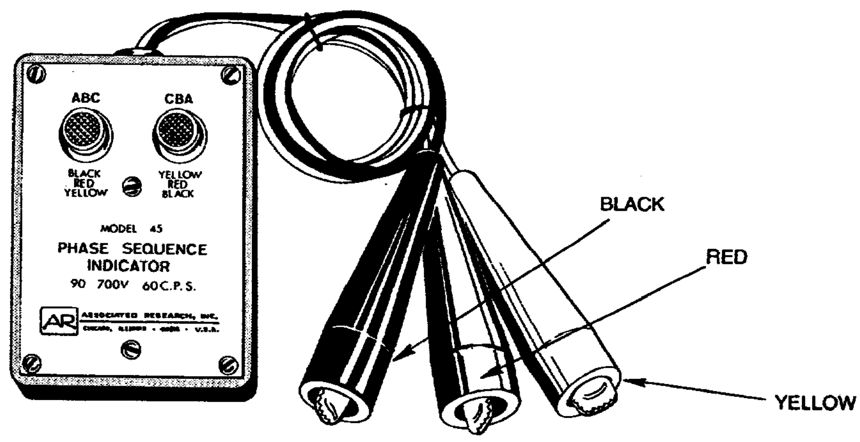
Note: It is essential that proper rotation of the RTHA compressor be established before the machine is started. Proper motor rotation requires confirmation of the electrical phase sequence of the power supply. The motor is internally connected for clockwise rotation with the inlet power supply phased A, B, C.

To confirm the correct phase sequence (ABC), use a Model 45 Associated Research Phase Indicator or equivalent. See Figure 2.

Basically, voltages generated in each phase of a polyphase alternator or circuit are called phase voltages. In a three-phase circuit, three sine wave voltages are generated, differing in phase by 120 electrical degrees. The order in which the three voltages of a three-phase system succeed one another is called phase sequence or phase rotation. This is determined by the direction of rotation of the alternator. When rotation is clockwise, phase sequence is usually called "ABC", when counterclockwise, "CBA".

This direction may be reversed outside the alternator by interchanging any two of the line wires. It is this possible interchange of wiring that makes a phase sequence indicator necessary if the operator is to quickly determine the phase rotation of the motor.

Figure 2
Associated Research Model 45 Phase Sequence Indicator



Note: It is essential to confirm that proper phase rotation is established, Phase A to L1, Phase B to L2, and Phase C to L3. It is extremely important that phase rotation be checked with a phase sequence indicator before start-up of chiller due to the possibility of catastrophic damage to compressor occurring if rotation is reversed.

Do not rely on the phase sequence relay in the starter panel (remote or unit mounted) or motor terminal box to indicate phase rotation on initial start-up or if building power has been modified. If rotation is incorrect, change the phasing at the incoming power to the starter. Do not attempt to change rotation at the motor terminals.

Correcting Improper Electrical Phase Sequence

Proper compressor motor electrical phasing can be quickly determined and corrected before starting the unit. Use a quality instrument such as an Associated Research Model 45 Phase Sequence Indicator and follow this procedure:

1. Turn chiller switch on the UCM to STOP/RESET position.

2. Open the electrical disconnect or circuit protection switch that provides line power to the line power terminal block (2CB1 or 2TB2) in the control panel or to the unit-mounted disconnect.

3. Connect the phase sequence indicator leads to 2CB1 or 2TB2 (or disconnect) as follows:

Phase Seq. Lead	2CB1 or 2TB2 Terminal
Black (Phase A)	1
Red (Phase B)	2
Yellow (Phase C)	3

4. Turn power on by closing the unit supply power fused disconnect switch.

5. Read the phase sequence displayed on the indicator. The "ABC" LED on the face of the phase indicator will glow if phase sequence is ABC.

WARNING! To prevent injury or death due to electrocution, take extreme care when performing service procedures with electrical power energized.

6. If the "CBA" indicator glows instead, open the unit main power disconnect and switch two line leads on 2CB1 or 2TB2. Re-close the main power disconnect and re-check phasing.

7. Reopen the unit disconnect and disconnect the phase indicator.

Phase Monitor Operation for Remote and Unit Mounted Starters

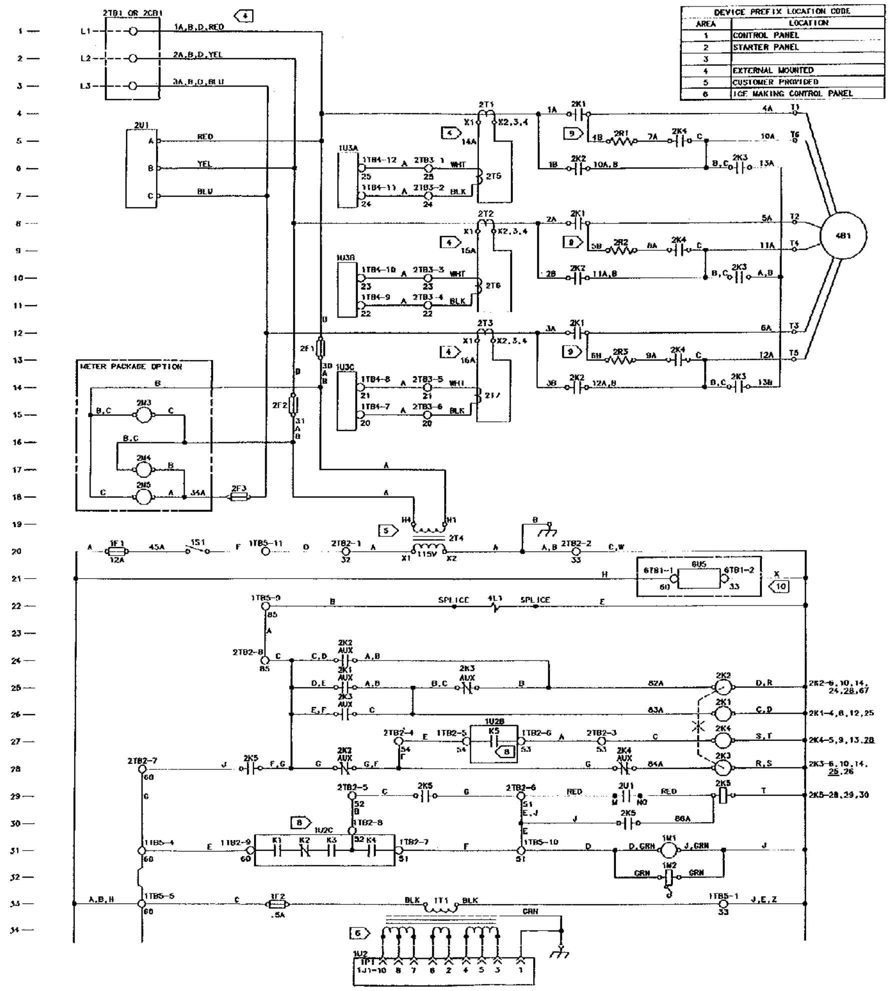
2U1 Unit Mounted Starter Phase Reversal Monitor will look at incoming power to make sure that a clockwise rotation is confirmed. If phasing is correct Pilot Relay (2K5) will pull in and begin the start procedure. In the event of a counterclockwise rotation, Phase Reversal Monitor (2U1) will not close its contact which will not allow Pilot Relay (2K5) to energize, therefore the start procedure will not occur. In some cases, when the C.T.'s do not sense current draw but a start is initiated and the Phase Monitor locks out (2K5), a phase-loss diagnostic may occur.

4U1 Remote Mounted Starter Phase Reversal Monitor monitors phasing at motor terminals T1, T2, and T3. When the starter contactor pulls in and phasing is incorrect the contactor will instantaneously drop out. When 4U1 detects a counterclockwise rotation 4U1 contacts will close, energizing 4K18. One contact of the Phase Reversal Lockout Relay (4K18) will open and the other set of contacts will close causing the Phase Reversal Indicator to light and lock in 4K18. When the normally closed contact of 4K18 opens, power is no longer allowed to 1U2 to continue the start procedure.

RTHA Electrical Diagrams

Refer to Figures 3 through 6 for typical RTHA wiring schematics and connection *diagrams.*

Figure 3
System Schematic Diagram for RTHA Units with Unit Mounted "Wye-Delta" Starter (Page 1)



DEVICE PREFIX LOCATION CODE	
AREA	LOCATION
1	CONTROL PANEL
2	STARTER PANEL
3	
4	EXTERNAL MOUNTED
5	CUSTOMER PROVIDED
6	ICE MAKING CONTROL PANEL

	LEGEND	
DEVICE DESIGNATION	DESCRIPTION	LINE NUMBER
1F1	FUSE, CONTROL CIRCUIT	20
1F2	FUSE, 1T1 PRIMARY	33
1J1–1J4	JACK	
1P1–1P4	PLUG	
1K16	RELAY 5S2 INTERFACE	45
1K17	RELAY 5S3 INTERFACE	46
1M1	HOUR METER	32
1M2	START METER	31
1R1	COND. PRESS. TRANSDUCER	75
1S1	SERVICE SWITCH	20
1S3	HIGH PRESSURE CUTOUT	96
1T1	POWER SUPPLY TRANSFORMER	33
1TB1	TERM BLOCK REL OUTPUT	
1TB2	TERM BLOCK POWER SPLY	
1TB3	TERM BLOCK MICRO-MOD INPUT	
1TB4	TERM BLOCK MICRO-MOD INPUT	
1TB5	TERM BLOCK CONTROL PNL	
1TB6	TERM BLOCK MICRO-MOD INPUT	
1TB7	TERM BLOCK CUSTOMER CONNECT	
1U1A–C	RELAY, OUTPUT MOD	SHEET 2
1U1 K1	RELAY, HOT GAS BYPASS ENABLE	38
1U1 K3	RELAY, HEAD RELIEF REQUEST	88
1U1 K4	RELAY, ALARM	85
1U1 K6	RELAY, COND, WATER PUMP	82
1U1 Q7	SLIDE VALVE–LOAD	38
1U1 Q8	SLIDE VALVE–UNLOAD	39
1U2A–E	POWER SUPPLY OUTPUT MODULE	SHEET 2
1U2 K1	RESET RELAY	31
1U2 K2	STOP RELAY	31
1U2 K3	OVERLOAD RELAY	31
1U2 K4	COMPR. START RELAY	31
1U2 K5	COMP. TRANSITION RELAY	27
1U2 K6	OIL HEATER RELAY	48
1U3A–D	MICRO MODULE	SHEET 2
1U4	BAS CHILLED WTR RESET	80
2CB1	STARTER CIRCUIT BREAKER	1
2F1,2F2,2F3	FUSE, 2T4 PRIMARY	17–18
2K1	START CONTACTOR	26
2K2	RUN CONTACTOR	25
2K3	SHORTING CONTACTOR	28
2K4	TRANSITION CONTACTOR	27
2K5	PILOT RELAY	29
2M3,4,5	VOLT METER	15,17,18
2M6,7,8	AMP METER	51,54,57
2R1–9	TRANSITION RESISTOR	5,9,13
2T1–3	CURRENT TRANSFORMER, LARGE	4,8,12
2T4	CONTROL POWER TRANSFORMER	19
2T5–7	CURRENT TRANSFORMER, SMALL	6,10,14
2TB1	LINE TERMINAL BLOCK	1
2TB2	CONTROL TERMINAL BLOCK	
2TB3	LOW VOLTAGE TERMINAL BLOCK	
2U1	PHASE REVERSAL MONITOR	4
4B1	COMPRESSOR MOTOR	8
4B1R2,3,4	MOTOR WINDING TEMP SENSOR	72,73,75
4HR1	OIL TANK HEATER	47
4HR2	OIL TANK HEATER	48
4L1	MASTER SOLENOID VALVE	22
4L2	LOAD SOLENOID VALVE	38
4L3	UNLOAD SOLENOID VALVE	39
4L9	HOT GAS BYPASS VALVE	40
4S5	OIL FLOW SWITCH	65
4S6	LOW PRESSURE CUTOUT	67
4RT1	LEAVING EVAP SENSOR	102
4RT2	ENTERING EVAP SENSOR	69
4RT3	ENTERING COND SENSOR	71
4RT4	LEAVING COND SENSOR	73
4RT5	EVAP REF TEMP SENSOR	78
4RT6	AMBIENT TEMP SENSOR	80
4RT8	DISCHARGE TEMP SENSOR	76
4RT9	LEAVING ICE BANK TEMP SENSOR	97
5K1	EVAP WATER PUMP CONT AUX	45
5K2	COND WATER PUMP CONT AUX	82
5S2	WATER FLOW SWITCH	45
5S3	WATER FLOW SWITCH	46
5S4	RUN SPARE FAULT SWITCH	68
6U5	ICE MAKING CONTROL PANEL	21,40 67,82,97
6TB1	TERM BLOCK HIGH VOLTAGE ICE CONTROL	21,40 99,100
6TB2	TERM BLOCK CONTROL SIGNAL ICE CONTROL	67,68,97 99,82,83 100

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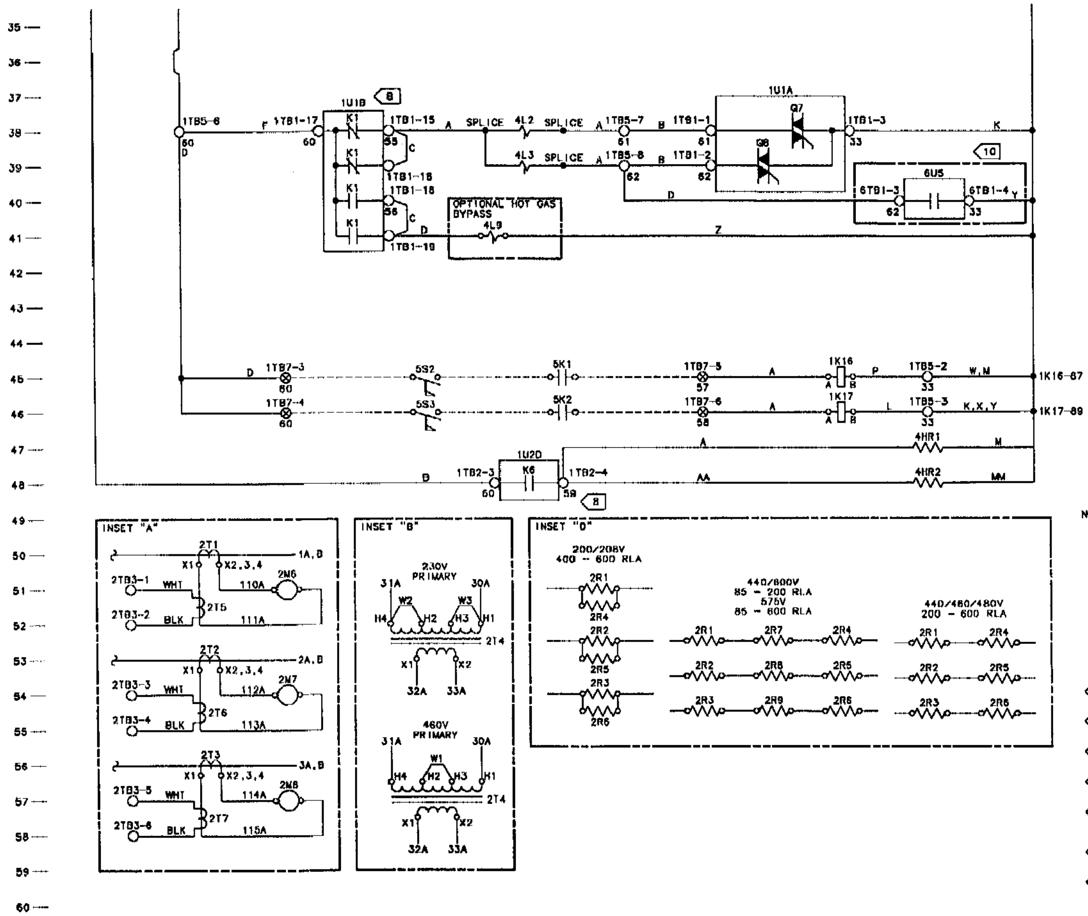

⚠ **WARNING**

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⚠ **AVERTISSEMENT**

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FAUTE DE DECONNECTER LA SOURCE ELECTRIQUE AVANT D'EFFECTUER L'ENTRAINER DES BLESSURES CORPORELLES SEVERES OU LA MORT PAR ELECTROCUTION.

⚠ **IMPORTANT**

USE COPPER CONDUCTORS ONLY TO PREVENT EQUIPMENT DAMAGE. UNIT TERMINALS ARE NOT DESIGNED TO ACCEPT ANY OTHER WIRING.

NOTES:

1. UNLESS OTHERWISE NOTED, ALL SWITCHES ARE SHOWN AT 25°C (77°F), AT ATMOSPHERIC PRESSURE, AT 50% RELATIVE HUMIDITY, WITH ALL UTILITIES TURNED OFF AND AFTER A NORMAL SHUTDOWN HAS OCCURED.
2. SOLID LINES INDICATE TRANE WIRING. DASHED LINES INDICATE FIELD WIRING. PHANTOM LINES INDICATE OPTIONAL FEATURES.
3. NUMBERS ALONG THE RIGHT SIDE OF THE SCHEMATIC DESIGNATE THE LOCATION OF THE CONTACTS BY LINE NUMBER. AN UNDERLINED NUMBER INDICATES A NORMALLY CLOSED CONTACT. AN OPEN ARROWHEAD BELOW THE LINE NUMBER POINTING UPWARD INDICATES A TIMED CONTACT WHICH BEGINS TIMING WHEN ENERGIZED.

4 IF METER PACKAGE OPTION IS REQUIRED SEE INSET "A".

5 200/575 VOLT PRIMARY SHOWN. SEE INSET "B" FOR OTHER VOLTAGES.

6 SEE SERVICE MANUAL FOR INDIVIDUAL SECONDARY VOLTAGES.

7 THREE PHASE POWER SUPPLY VOLTAGE SEE UNIT NAMEPLATE.

8 RELAY COILS NOT SHOWN. CONTACTS ARE CONTROLLED BY THE LOGIC OF THE MICRO-MODULE (1U3). SEE SEQUENCE OF OPERATION LINES 102-115 PAGE 2.

9 RESISTOR SHOWN FOR 200/208V AND 200-400 RLA. FOR OTHER VOLTAGES AND RLA SEE INSET "D".

10 OPTIONAL ICE MAKING CONTROL(6U5).

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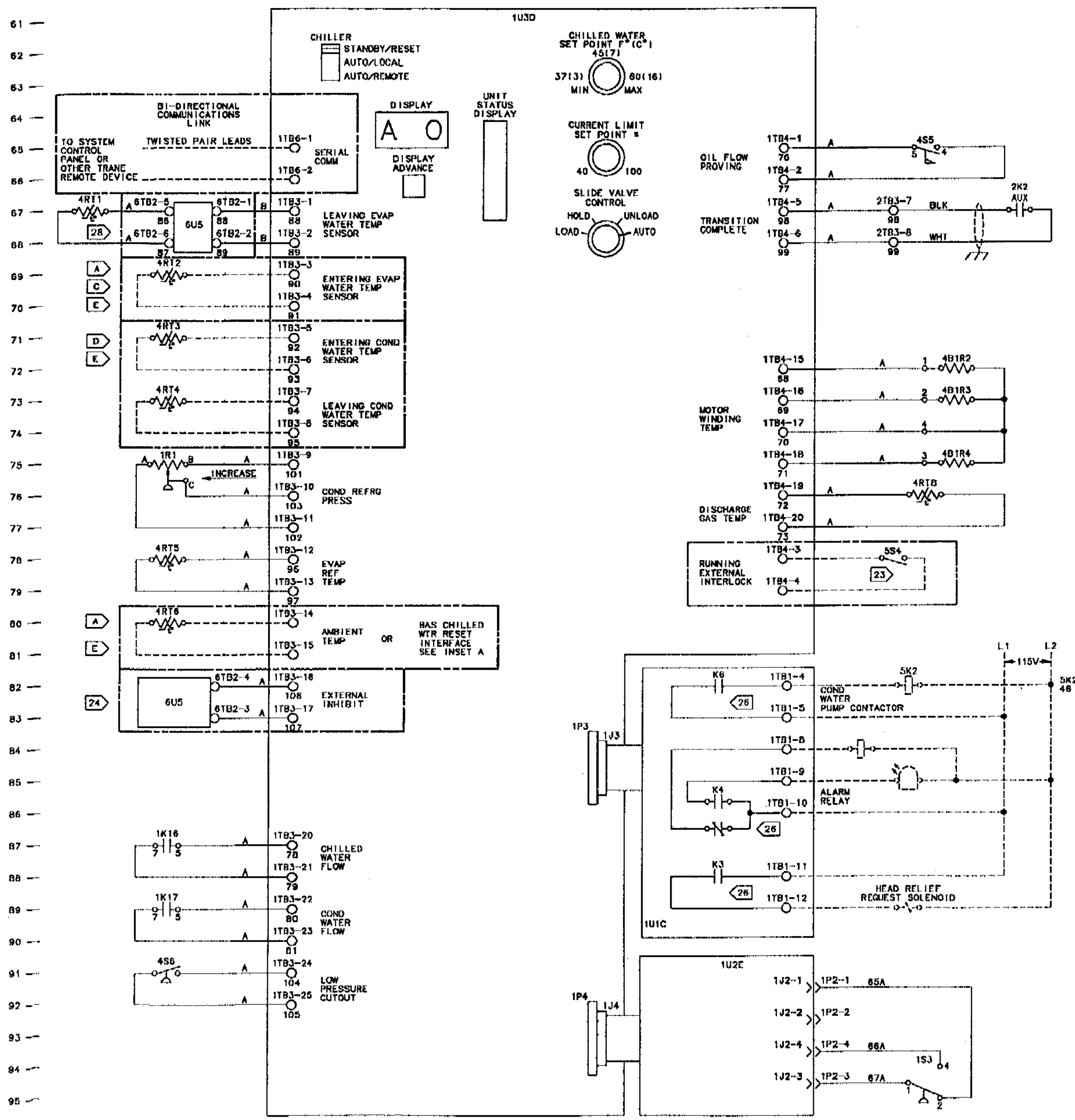
Figure 4
Unit Mounted Wye Delta Starter



NOTES:

21. DASHED LINED INDICATE FIELD WIRING BY OTHERS. PHANTOM LINES INDICATE ALTERNATE CIRCUITRY OR AVAILABLE SALES OPTION. CHECK SALES ORDER TO DETERMINE IF WIRING IS REQUIRED FOR SPECIFIC OPTIONS.

22. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE (NEC), STATE AND LOCAL REQUIREMENTS. OTHER COUNTRIES APPLICABLE NATIONAL AND/OR LOCAL REQUIREMENTS SHALL APPLY. ALL WIRING TO 1TB3, 1TB4 & 1TB6 IS LOW VOLTAGE (30 VOLTS MAX) ONLY.

23. MANUAL RESET IS ACCOMPLISHED BY MOVING THE CHILLER SWITCH, LINE 62, FROM "STANDBY/RESET" TO "AUTO". MANUAL RESET IS ALSO REQUIRED FOR A TRIP-OUT DUE TO THE RUNNING EXTERNAL INTERLOCK, LINE 78.

24. AUXILIARY TERMINAL CONNECTIONS FOR A CUSTOMER SPECIFIED OR INSTALLED NON-LATCHING UNIT START/STOP SIGNAL. TERMINALS 1TB3-16 AND 1TB3-17 MUST BE JUMPERED IF EXTERNAL INTERLOCK OR ICE MAKING CONTROL IS NOT USED.

25. THE FOLLOWING CAPABILITIES ARE OPTIONAL - THEY ARE IMPLEMENTED AND WIRED AS REQUIRED FOR SPECIFIC SYSTEM APPLICATION.

- A. CHILLED WATER RESET- REQUIRES MATCHED PAIR OF THERMISTORS FOR 4RT1 & 4RT2, LINES 67 & 88. IF AMBIENT TEMP BASED CHILLED WATER RESET IS REQUIRED, USE STD SUPPLIED LEAVING EVAP WATER TEMP SENSOR (4RT1 LINE 87) FOR 4RT6 LINE 80 AS AN AMBIENT TEMP SENSOR.
- C. ENTERING EVAP TEMP SENSOR -- REQUIRES MATCHED PAIR OF THERMISTORS 4RT1 & 4RT2, LINES 67 & 69.
- D. ENTERING AND LEAVING CONDENSER WATER TEMP SENSORS MATCHED PAIR OF THERMISTORS FOR 4RT3 & 4RT4 LINES 71 & 73.
- E. TRACER MONITORING PACKAGE INCLUDES OPTIONS C AND D.
- F. REMOTE GENERIC BAS CHILLED WTR RESET INTERFACE. MUST BE USED WITH CHILLED WATER RESET INTERFACE PANEL OPTION.

26. RELAY COILS NOT SHOWN. CONTACTS ARE CONTROLLED BY THE LOGIC OF THE MICROMODULE (1U3). SEE SEQUENCE OF OPERATION LINES 102 - 115.

27. NEGATIVE SIGNAL INPUTS ARE GROUNDED TO UCP ENCLOSURE. FOR CORRECT OPERATION, EXTERNAL EQUIPMENT SIGNALS SHALL BE ISOLATED OR FLOATING WITH RESPECT TO UCP ELECTRICAL SERVICE GROUND AND ISOLATED FROM EACH OTHER. SPECIAL CONSIDERATION MUST BE GIVEN TO 4-20 mA SIGNALS. IF THE CURRENT SOURCE REGULATES CURRENT FLOW ON THE NEGATIVE LEAD USE A SEPARATE POWER SUPPLY FOR EACH CHANNEL. IN SOME APPLICATIONS IT MAY BE NECESSARY TO INSTALL A LOOP ISOLATOR IN EACH CHANNEL TO PREVENT LOOP INTERFERENCE.

28. OPTIONAL ICE MAKING CONTROL SHOWN SEE INSET B FOR WIRING WHEN OPTION IS NOT USED.

29. LEAVING ICE BANK SENSOR IS TRANE SUPPLIED BUT FIELD INSTALLED.

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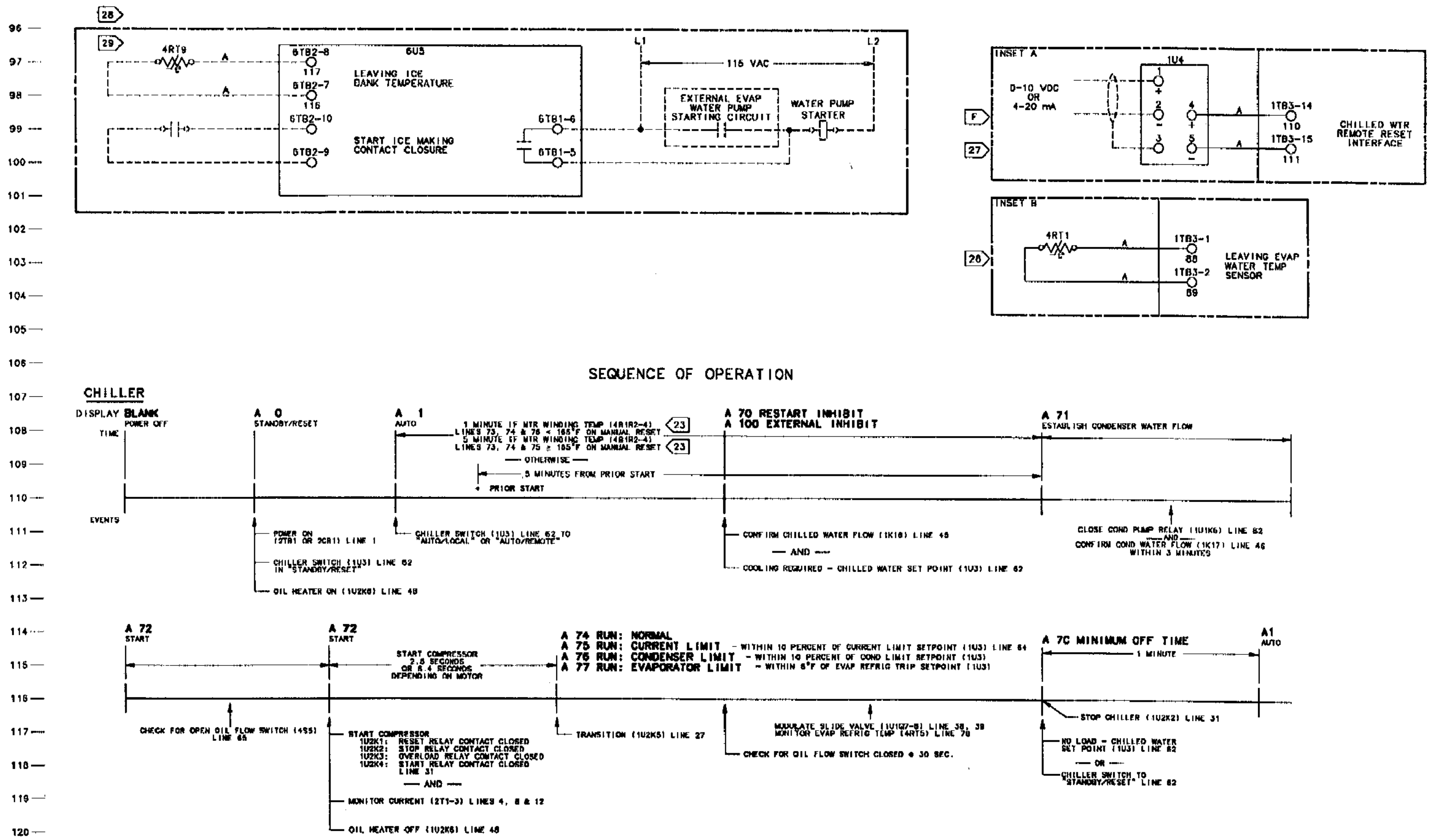

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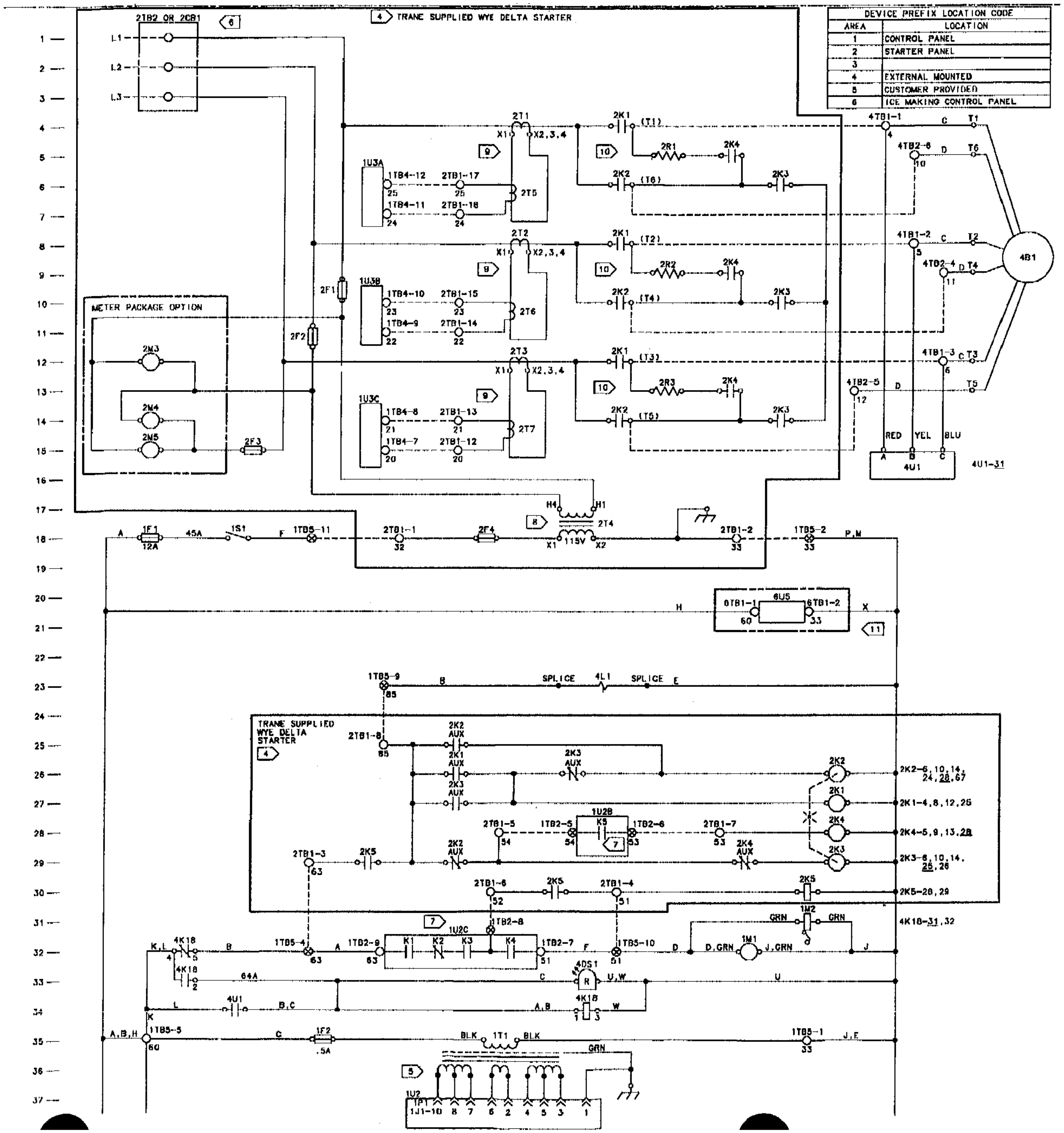
Figure 5
System Schematic for RTHA units with Remote-Mounted "Wye-Delta" Starter (Page 1)



DEVICE PREFIX LOCATION CODE	
AREA	LOCATION
1	CONTROL PANEL
2	STARTER PANEL
3	
4	EXTERNAL MOUNTED
5	CUSTOMER PROVIDED
6	ICE MAKING CONTROL PANEL

LEGEND		
DEVICE DESIGNATION	DESCRIPTION	LINE NUMBER
1F1	FUSE, CONTROL CIRCUIT	18
1F2	FUSE, 1T1 PRIMARY	35
1J1-1J4	JACK	
1P1-1P4	PLUG	
1K16	RELAY 5S2 INTERFACE	45
1K17	RELAY 5S3 INTERFACE	46
1M1	HOUR METER	31
1M2	START METER	30
1R1	COND. PRESS. TRANSDUCER	75
1S1	SERVICE SWITCH	18
1S3	HIGH PRESSURE CUTOUT	96
1T1	POWER SUPPLY TRANSFORMER	34
1TB1	TERM BLOCK REL OUTPUT	
1TB2	TERM BLOCK POWER SPLY	
1TB3	TERM BLOCK MICRO-MOD INPUT	
1TB4	TERM BLOCK MICRO-MOD INPUT	
1TB5	TERM BLOCK CONTROL PNL	
1TB6	TERM BLOCK MICRO-MOD INPUT	
1TB7	TERM BLOCK CUSTOMER CONNECT	
1U1A-C	RELAY, OUTPUT MOD	SHEET 2
1U1 K1	RELAY, HOT GAS BYPASS ENABLE	39
1U1 K3	RELAY, HEAD RELIEF REQUEST	88
1U1 K4	RELAY, ALARM	85
1U1 K6	RELAY, COND, WATER PUMP	82
1U1 Q7	SLIDE VALVE-LOAD	39
1U1 Q8	SLIDE VALVE-UNLOAD	40
1U2A-E	POWER SUPPLY OUTPUT MODULE	SHEET 2
1U2 K1	RESET RELAY	31
1U2 K2	STOP RELAY	31
1U2 K3	OVERLOAD RELAY	31
1U2 K4	COMPR. START RELAY	31
1U2 K5	COMP. TRANSITION RELAY	27
1U2 K6	OIL HEATER RELAY	48
1U3A-D	MICRO MODULE	SHEET 2
1U4	BAS CHILLED WTR RESET	80
2CB1	STARTER CIRCUIT BREAKER	1
2F1,2F2,2F3	FUSE, 2T4 PRIMARY	10,11,15
2F4	FUSE, 2T4 SECONDARY	18
2K1	START CONTACTOR	26
2K2	RUN CONTACTOR	25
2K3	SHORTING CONTACTOR	28
2K4	TRANSITION CONTACTOR	27
2K5	PILOT RELAY	29
2M3,4,5	VOLT METER	12,14,15
2M6,7,8	AMP METER	51,54,57
2R1-9	TRANSITION RESISTOR	5,9,13
2T1-3	CURRENT TRANSFORMER, LARGE	4,8,12
2T4	CONTROL POWER TRANSFORMER	17
2T5-7	CURRENT TRANSFORMER, SMALL	6,10,14
2TB1	CONTROL TERMINAL BLOCK	1
2TB2	LINE TERMINAL BLOCK	
4B1	COMPRESSOR MOTOR	8
4B1R2,3,4	MOTOR WINDING TEMP SENSOR	72,73,75
4DS1	PHASE REVERSAL INDICATOR	32
4HR1	OIL TANK HEATER	47
4HR2	OIL TANK HEATER	48
4K18	PHASE REVERSAL LOCKOUT RELAY	30
4L1	MASTER SOLENOID VALVE	22
4L2	LOAD SOLENOID VALVE	39
4L3	UNLOAD SOLENOID VALVE	40
4L9	HOT GAS BYPASS VALVE	41
4RT1	LEAVING EVAP SENSOR	67
4RT2	ENTERING EVAP SENSOR	69
4RT3	ENTERING COND SENSOR	71
4RT4	LEAVING COND SENSOR	73
4RT5	EVAP REF TEMP SENSOR	78
4RT6	AMBIENT TEMP SENSOR	80
4RT8	DISCHARGE TEMP SENSOR	76
4RT9	LEAVING ICE BANK TEMP SENSOR	97
4S5	OIL FLOW SWITCH	65
4S6	LOW PRESSURE CUTOUT	67
4TB1,2	COMPRESSOR TERM. BLOCK	
4U1	PHASE SEQUENCE MONITOR	15
5K1	EVAP WATER PUMP CONT AUX	
5K2	COND WATER PUMP CONT AUX	82
5S2	WATER FLOW SWITCH	45
5S3	WATER FLOW SWITCH	46
5S4	RUN SPARE FAULT SWITCH	88
6U5	ICE MAKING CONTROL PANEL	21,42 67,82,97
6TB1	TERM BLOCK HIGH VOLTAGE ICE CONTROL	20,42 99,100
6TB2	TERM BLOCK CONTROL SIGNAL ICE CONTROL	67,68,82 83,97,98 99,100

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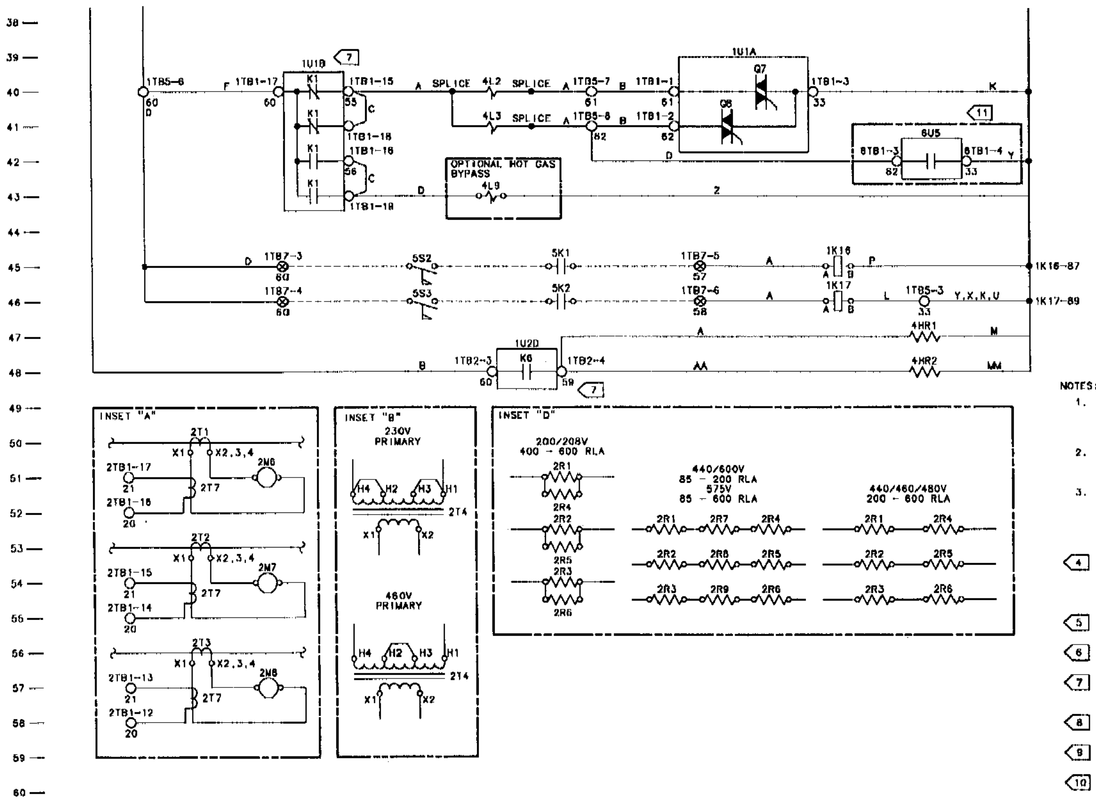

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NOTES:

1. UNLESS OTHERWISE NOTED, ALL SWITCHES ARE SHOWN AT 25°C (77°F), AT ATMOSPHERIC PRESSURE, AT 50% RELATIVE HUMIDITY, WITH ALL UTILITIES TURNED OFF AND AFTER A NORMAL SHUTDOWN HAS OCCURED.
2. SOLID LINES INDICATE TRANE WIRING. DASHED LINES INDICATE FIELD WIRING. PHANTOM LINES INDICATE OPTIONAL FEATURES.
3. NUMBERS ALONG THE RIGHT SIDE OF THE SCHEMATIC DESIGNATE THE LOCATION OF THE CONTACTS BY LINE NUMBER. AN UNDERLINED NUMBER INDICATES A NORMALLY CLOSED CONTACT. AN OPEN ARROWHEAD BELOW THE LINE NUMBER POINTING UPWARD INDICATES A TIMED CONTACT WHICH BEGINS TIMING WHEN ENERGIZED.

4. REMOTE Y-Δ STARTER SHOWN AND WIRING BETWEEN CONTROL PANEL AND STARTER REMAIN SIMILAR FOR VARIOUS TYPES OF STARTERS. SEE STARTER MANUFACTURES WIRING DIAGRAM FOR SPECIFIC STARTER WIRING.

5. SEE SERVICE MANUAL FOR INDIVIDUAL SECONDARY VOLTAGES.

6. THREE PHASE POWER SUPPLY VOLTAGE SEE UNIT NAMEPLATE.

7. RELAY COILS NOT SHOWN. CONTACTS ARE CONTROLLED BY THE LOGIC OF THE MICRO-MODULE (1U3). SEE SEQUENCE OF OPERATION LINES 102-115 PAGE 2.

8. 200/575 VOLT PRIMARY SHOWN. SEE INSET "B" FOR OTHER VOLTAGES.

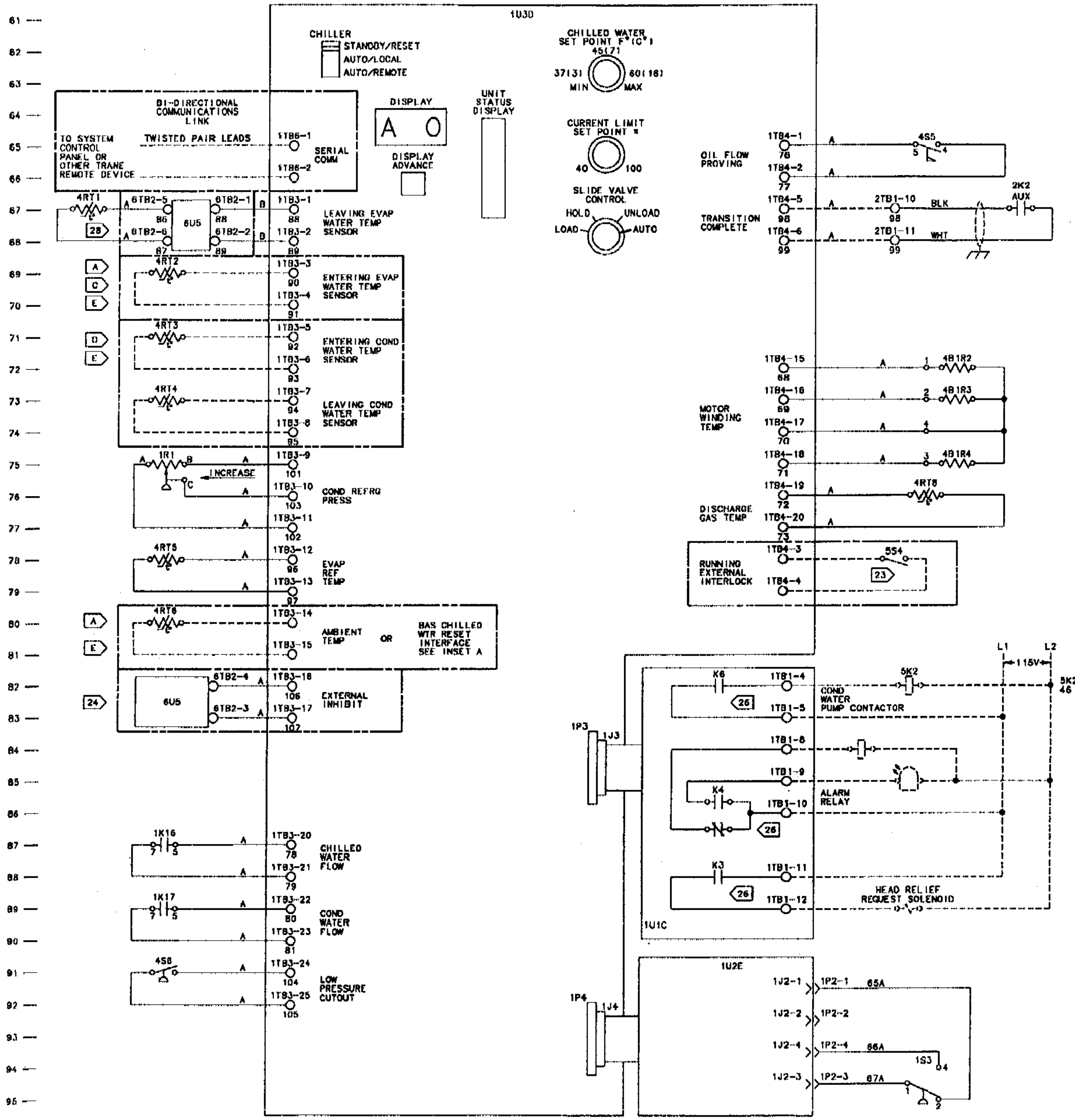
9. IF METER PACKAGE OPTION IS REQUIRED SEE INSET "A".

10. RESISTOR SHOWN FOR 200/208V AND 200-400 RLA. FOR OTHER VOLTAGES AND RLA SEE INSET "D".

11. OPTIONAL ICE MAKING CONTROL (6U5).

X39530061A

Figure 6
System Schematic for RTHA units with Remote-Mounted "Wye-Delta" Starter (Page 1)



NOTES:

21. DASHED LINED INDICATE FIELD WIRING BY OTHERS. PHANTOM LINES INDICATE ALTERNATE CIRCUITRY OR AVAILABLE SALES OPTION. CHECK SALES ORDER TO DETERMINE IF WIRING IS REQUIRED FOR SPECIFIC OPTIONS.

22. ALL FIELD WIRING MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE (NEC). STATE AND LOCAL REQUIREMENTS. OTHER COUNTRIES APPLICABLE NATIONAL AND/OR LOCAL REQUIREMENTS SHALL APPLY. ALL WIRING TO 1TB3, 1TB4 & 1TB6 IS LOW VOLTAGE (30 VOLTS MAX) ONLY.

23. MANUAL RESET IS ACCOMPLISHED BY MOVING THE CHILLER SWITCH, LINE 62, FROM "STANDBY/RESET" TO "AUTO". MANUAL RESET IS ALSO REQUIRED FOR A TRIP-OUT DUE TO THE RUNNING EXTERNAL INTERLOCK, LINE 78.

24. AUXILIARY TERMINAL CONNECTIONS FOR A CUSTOMER SPECIFIED OR INSTALLED NON-LATCHING UNIT START/STOP SIGNAL. TERMINALS 1TB3-16 AND 1TB3-17 MUST BE JUMPERED IF EXTERNAL INTERLOCK OR ICE MAKING CONTROL IS NOT USED.

25. THE FOLLOWING CAPABILITIES ARE OPTIONAL – THEY ARE IMPLEMENTED AND WIRED AS REQUIRED FOR SPECIFIC SYSTEM APPLICATION.

- A. CHILLED WATER RESET- REQUIRES MATCHED PAIR OF THERMISTORS FOR 4RT1 & 4RT2, LINES 67 & 88. IF AMBIENT TEMP BASED CHILLED WATER RESET IS REQUIRED, USE STD SUPPLIED LEAVING EVAP WATER TEMP SENSOR (4RT1 LINE 87) FOR 4RT6 LINE 80 AS AN AMBIENT TEMP SENSOR.
- C. ENTERING EVAP TEMP SENSOR – REQUIRES MATCHED PAIR OF THERMISTORS 4RT1 & 4RT2, LINES 67 & 69.
- D. ENTERING AND LEAVING CONDENSER WATER TEMP SENSORS MATCHED PAIR OF THERMISTORS FOR 4RT3 & 4RT4 LINES 71 & 73.
- E. TRACER MONITORING PACKAGE INCLUDES OPTIONS C AND D.
- F. REMOTE GENERIC BAS CHILLED WTR RESET INTERFACE. MUST BE USED WITH CHILLED WATER RESET INTERFACE PANEL OPTION.

26. RELAY COILS NOT SHOWN. CONTACTS ARE CONTROLLED BY THE LOGIC OF THE MICRO-MODULE (1U3). SEE SEQUENCE OF OPERATION LINES 102 – 115.

27. NEGATIVE SIGNAL INPUTS ARE GROUNDED TO UCP ENCLOSURE. FOR CORRECT OPERATION, EXTERNAL EQUIPMENT SIGNALS SHALL BE ISOLATED OR FLOATING WITH RESPECT TO UCP ELECTRICAL SERVICE GROUND AND ISOLATED FROM EACH OTHER. SPECIAL CONSIDERATION MUST BE GIVEN TO 4-20 mA SIGNALS. IF THE CURRENT SOURCE REGULATES CURRENT FLOW ON THE NEGATIVE LEAD USE A SEPARATE POWER SUPPLY FOR EACH CHANNEL. IN SOME APPLICATIONS IT MAY BE NECESSARY TO INSTALL A LOOP ISOLATOR IN EACH CHANNEL TO PREVENT LOOP INTERFERENCE.

28. OPTIONAL ICE MAKING CONTROL SHOWN SEE INSET B FOR WIRING WHEN OPTION IS NOT USED.

29. LEAVING ICE BANK SENSOR IS TRANE SUPPLIED BUT FIELD INSTALLED.

⚠ WARNING

HAZARDOUS VOLTAGE!

DISCONNECT ALL ELECTRIC POWER SUPPLY BEFORE SERVICING.

FAILURE TO DISCONNECT POWER SUPPLY BEFORE SERVICING CAN CAUSE SEVERE PERSONAL INJURY OR DEATH DUE TO ELECTRICAL SHOCK.

⚠ AVERTISSEMENT

VOLTAGE HASARDEUX!

DECONNECTEZ TOUS LES INTERRUPTEURS AVANT D'EFFECTUER L'ENTRETIEN.

FAUTE DE DECONNECTER LA SOURCE ELECTRIQUE AVANT D'EFFECTUER L'ENTRAINER DES BLESSURES CORPORELLES SEVERES OU LA MORT PAR ELECTROCUTION.

⚠ IMPORTANT

USE COPPER CONDUCTORS ONLY TO PREVENT EQUIPMENT DAMAGE. UNIT TERMINALS ARE NOT DESIGNED TO ACCEPT ANY OTHER WIRING.

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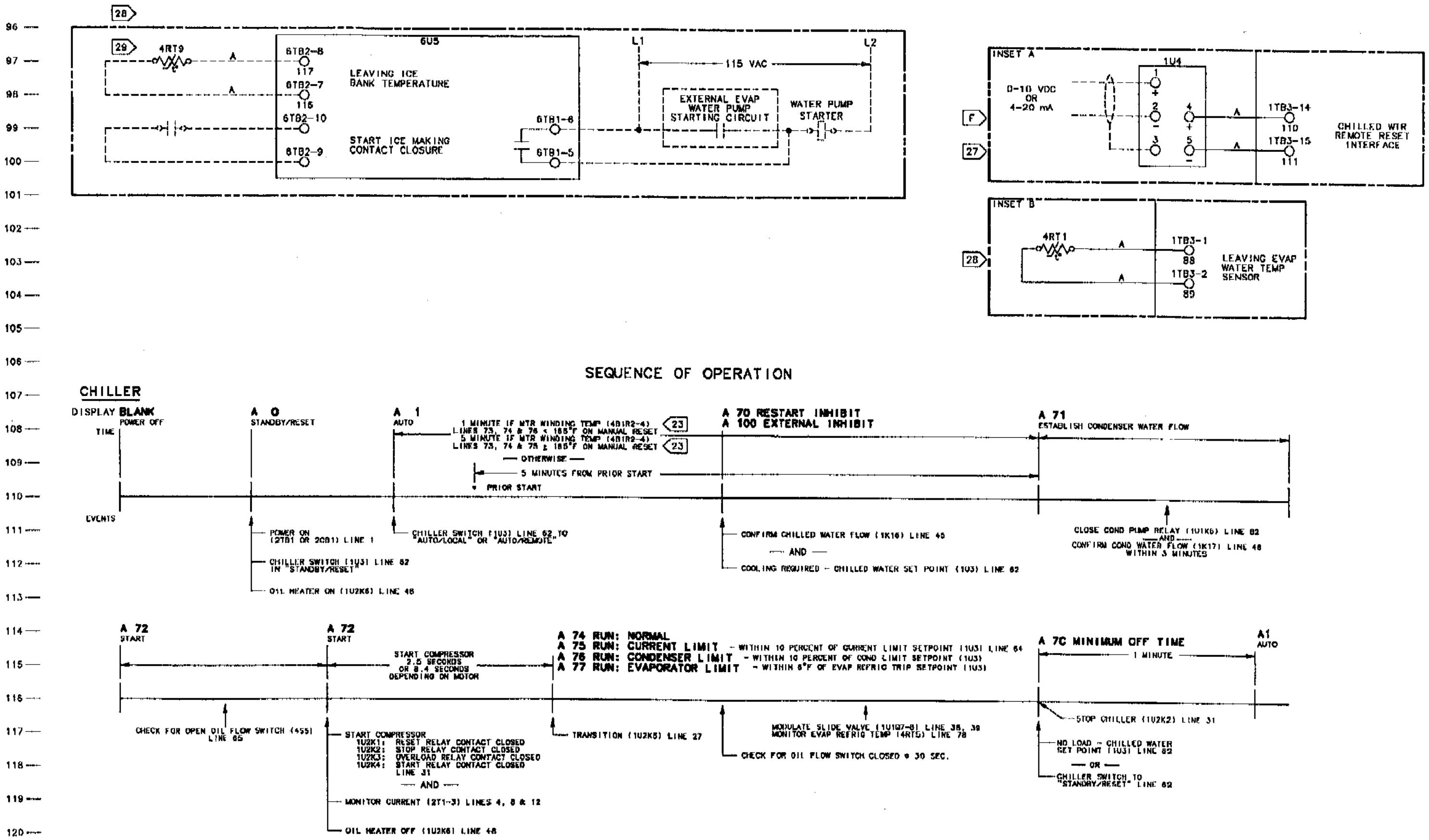


X39530062A

Factory Setup for UCM DIP Switches

Controls included in this section are factory-set, and do not require adjustment at initial start-up or during operation of the unit. Use the information provided here only to check the switch setting at initial start-up, or when a new micro module (1U3) is installed.

To access the UCM control components described below, open the unit control panel door and remove the access cover strip located at the top of the micro module. All of the necessary factory inputs are accomplished via 4 DIP switch blocks.

Switch Block S11: Unit Address

This DIP switch block must be set when the unit is used in conjunction with an SCP system control panel. The switches are adjusted to "tag" the chiller with a binary address of either "1", "2", or "3" as indicated below:

Dip Switch Settings						Corresponding Binary Unit Address
1	2	3	4	5		
On	On	On	On	Off	=	1
On	On	On	Off	On	=	2
On	On	On	Off	Off	=	3

Note: Remember that all units communicating with an SCP must have separate, unique addresses. If 2 or more units connected to an SCP share the same address, communications are automatically terminated.

Switch Block S9: Unit Identification; Temperature Range; Unit of Measure

Position	Description	On	Off
S9-1	SCP I.D.	RTHA	----
S9-2	Hot Gas Bypass	Not Installed	Installed
S9-3	Pressure	Standard	Heat Recovery
S9-4	Temp Range	Standard	Extended
S9-5	Unit of Measure	English	SI

System Control Panel (SCP) Identification
The position of DIP Switch No. 1 on switch block S9 must be ON when the chiller UCM is connected to a SCP (System Control Panel). This is applicable with UCM's that have a UCM I.D. No. of X13650329 (stamped on the right side of the UCM). If UCM has an I.D. No. of X13650401, this switch is not used.

Hot Gas Bypass
The position of DIP switch No. 2 on switch block S9 determines if the unit will operate in the Hot Gas Bypass mode.

Pressure
The position of DIP switch No. 3 on switch block S9 determines the limit of condenser pressure. Standard pressure selection will cause the 100% condenser limit to be 270 psig. Heat Recovery units will operate with a 100% condenser limit of 360 psig.

Note: When description is either "not used" or "not installed", DIP switch can be either off or on.

Temperature Range

The position of DIP switch No. 4 on switch block S9 determines the range of adjustability for the chilled water and evaporator refrigerant "trip" point potentiometers. The standard temperature range for the chilled water setpoint is 37 F to 60 F, and that of the evaporator refrigerant "trip" point is 29 F to 34 F. When the extended temperature range function is enabled, however, these control ranges are expanded to include 20 F to 70 F for the chilled water setpoint, and 0 F to 34 F for the evaporator refrigerant "trip" point.

Caution: DIP switch No. 4 should be On unless the unit is designed to operate beyond the standard temperature range. Improper chiller operation at "extended" temperature range conditions may result in catastrophic equipment failure.

Unit of Measure

DIP Switch No. 5 on switch block S9 determines whether the temperatures shown on the micro module's display are indicated in degrees F or degrees C. DIP switch No. 5 should remain in the "On" position for all domestic chiller applications.

Switch Block S3: Frequency; Phase Imbalance

Position	Description	On	Off
S3-1	Transition Time	2.8 Seconds	8.4 Seconds
S3-2	Transition Time	2.8 Seconds	8.4 Seconds
S3-3	Transition Time	2.8 Seconds	8.4 Seconds
S3-4	Transition Time	2.8 Seconds	8.4 Seconds
S3-5	Transition Time	2.8 Seconds	8.4 Seconds
S3-4	Transition Time	2.8 Seconds	8.4 Seconds
S3-5	Transition Time	2.8 Seconds	8.4 Seconds
S3-6	Frequency	50 Hertz	60 Hertz
S3-7	Phase Imbalance	Overridden	Operational

Transition Time

This is the time allotted from initial motor starting to the time the UCM initiates starter transition to place the motor across line (i.e., auto-transformer and Wye Delta starters). Transition time on an RTHA is strictly a function of time.

Dip Switches Nos. 1 thru 5 on switch block S3:

On UCM's with ID # of X13650329 (Right hand side of UCM) these switches are not used. The transition time of these UCM's is 2.8 seconds and is not adjustable.

On UCM's with ID # of X13650401 (Right hand side of UCM) October '90 and later production) these switches will determine transition time.

All 5 switches ON = 2.8 seconds for RTHA 130-215.
All 5 switches OFF = 8.4 seconds for RTHA 255-450.

All 5 switches must be set alike (i.e., all 5 ON or all 5 OFF).

Frequency Adjustment (50/60 Hz)

DIP switch No. 6 on switch block S3 allows the UCM to accept either 50- or 60-hertz supply power, depending on its position. This DIP switch must be configured to match incoming power.

Phase Imbalance

DIP switch No. 7 of switch block S3 determines whether or not this motor protection function is operational. DIP switch No. 7 should remain in the "Off" position. However, if jobsite conditions cause nuisance "trips", this protection may be overridden temporarily until the problem is diagnosed and corrected.

Switch Block S1: Rated Load Amps (RLA) Setpoint

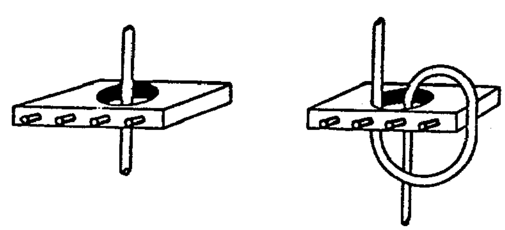
The RLA setpoint is factory set using DIP switches No. 1 through 8 of switch block S1, and is based on nameplate RLA, current transformer ratio selection, and other design constants. RLA "trip" point is based on current transformer (CT) selection, and adjustment resolution is 1% of RLA minimum. To determine the appropriate DIP switch setting combination, review the data provided in Tables 4 and 5. Use Steps 1 through 5 along with Table 4 to determine the appropriate RLA "factor" for your unit; then locate that "factor" in Table 5 to verify that the factory set *S1 DIP switch arrangement is correct.*

Table 4
Unit RLA/Meter Scale Conversion

RLA Range	CT Ratio (1)	Primary Turns (2)	Meter Scale (3)
28.6 to 35.7	150 : 5	3	50
35.8 to 42.8	180 : 5	3	60
42.9 to 53.5	150 : 5	2	75
53.6 to 64.2	180 : 5	2	90
64.2 to 71.4	200 : 5	2	100
71.5 to 89.2	250 : 5	2	125
89.3 to 107.1	150 : 5	1	150
107.2 to 128.5	180 : 5	1	180
128.6 to 142.8	200 : 5	1	200
142.9 to 178.5	250 : 5	1	250
178.6 to 214.2	300 : 5	1	300
214.3 to 250.0	350 : 5	1	350
250.1 to 285.7	400 : 5	1	400
285.8 to 357.1	500 : 5	1	500
357.2 to 428.5	600 : 5	1	600
428.6 to 500.0	700 : 5	1	700
500.1 to 571.4	800 : 5	1	800
571.5 to 714.2	1000 : 5	1	1000
714.3 to 857.1	1200 : 5	1	1200
857.2 to 1071.4	1500 : 5	1	1500
1071.5 to 1285.7	1800 : 5	1	1800
1285.8 to 1500	2100 : 5	1	2100
1500.1 to 1785.7	2500 : 5	1	2500

Notes:
1. The CT (current transformer) ratio represents the size of the current transformers used with the specified RLA range.
2. Each "primary turns" (PRI) value indicates the number of times that the main power line passes through its current transformer.

Examples: PRI = 1 PRI = 2



3. If ampmeters are used with the CTs, their full-scale deflection will equal the "meter scale" values in this table.

Note: $$\text{Meter Scale} = \frac{\text{CT Ratio (1)}}{\text{Primary Turns (2)}}$$

Table 5
RLA Factor/S1 DIP Switch Settings Conversion

	Switch Block S1 DIP Switches							
RLA Factor	1	2	3	4	5	6	7	8
0.799964	Off	Off	Off	Off	Off	Off	Off	Off
0.801220	Off	Off	Off	Off	Off	Off	Off	On
0.802480	Off	Off	Off	Off	Off	Off	On	On
0.803743	Off	Off	Off	Off	Off	On	Off	On
0.805011	Off	Off	Off	Off	Off	On	On	On
0.805022	Off	Off	Off	Off	On	Off	Off	Off
0.806294	Off	Off	Off	Off	On	Off	Off	On
0.807570	Off	Off	Off	Off	On	Off	On	On
0.808850	Off	Off	Off	Off	On	On	Off	On
0.810134	Off	Off	Off	Off	On	On	On	On
0.810180	Off	Off	Off	On	Off	Off	Off	Off
0.811468	Off	Off	Off	On	Off	Off	Off	On
0.812761	Off	Off	Off	On	Off	Off	On	On
0.814058	Off	Off	Off	On	Off	On	Off	On
0.815359	Off	Off	Off	On	Off	On	On	On
0.815370	Off	Off	Off	On	On	Off	Off	Off
0.816676	Off	Off	Off	On	On	Off	Off	On
0.817985	Off	Off	Off	On	On	Off	On	On
0.819299	Off	Off	Off	On	On	On	Off	On
0.820220	Off	Off	Off	On	Off	Off	Off	Off
0.820617	Off	Off	Off	On	On	On	On	On
0.821541	Off	Off	On	Off	Off	Off	Off	On
0.822867	Off	Off	On	Off	Off	Off	On	On
0.824197	Off	Off	On	Off	Off	On	Off	On
0.825531	Off	Off	On	Off	Off	On	On	On
0.825543	Off	Off	On	Off	On	Off	Off	Off
0.826881	Off	Off	On	Off	On	Off	Off	On
0.828224	Off	Off	On	Off	On	Off	On	On
0.829572	Off	Off	On	Off	On	On	Off	On
0.830924	Off	Off	On	Off	On	On	On	On
0.830972	Off	Off	On	On	Off	Off	Off	Off
0.832328	Off	Off	On	On	Off	Off	Off	On
0.833689	Off	Off	On	On	Off	Off	On	On
0.835055	Off	Off	On	On	Off	On	Off	On
0.836425	Off	Off	On	On	Off	On	On	On
0.836437	Off	Off	On	On	On	Off	Off	Off
0.837812	Off	Off	On	On	On	Off	Off	On
0.839192	Off	Off	On	On	On	Off	On	On
0.840576	Off	Off	On	On	On	On	Off	On
0.841964	Off	Off	On	On	On	On	On	On
0.842654	Off	On	Off	Off	Off	Off	Off	Off
0.844050	Off	On	Off	Off	Off	Off	Off	On
0.845450	Off	On	Off	Off	Off	Off	On	On
0.846855	Off	On	Off	Off	Off	On	Off	On
0.848265	Off	On	Off	Off	Off	On	On	On
0.848278	Off	On	Off	Off	On	Off	Off	Off
0.849692	Off	On	Off	Off	On	Off	Off	On
0.851112	Off	On	Off	Off	On	Off	On	On
0.852536	Off	On	Off	Off	On	On	Off	On
0.853965	Off	On	Off	Off	On	On	On	On
0.854016	Off	On	Off	On	Off	Off	Off	Off
0.855450	Off	On	Off	On	Off	Off	Off	On
0.856889	Off	On	Off	On	Off	Off	On	On
0.858333	Off	On	Off	On	Off	On	Off	On
0.859782	Off	On	Off	On	Off	On	On	On
0.859794	Off	On	Off	On	On	Off	Off	Off

	Switch Block S1 DIP Switches							
RLA Factor	1	2	3	4	5	6	7	8
0.861248	Off	On	Off	On	On	Off	Off	On
0.862707	Off	On	Off	On	On	Off	On	On
0.864171	Off	On	Off	On	On	On	Off	On
0.865198	Off	On	On	Off	Off	Off	Off	Off
0.865640	Off	On	Off	On	On	On	On	On
0.866670	Off	On	On	Off	Off	Off	Off	On
0.868148	Off	On	On	Off	Off	Off	On	On
0.869631	Off	On	On	Off	Off	On	Off	On
0.871119	Off	On	On	Off	Off	On	On	On
0.871132	Off	On	On	Off	On	Off	Off	Off
0.872625	Off	On	On	Off	On	Off	Off	On
0.874123	Off	On	On	Off	On	Off	On	On
0.875627	Off	On	On	Off	On	On	Off	On
0.877136	Off	On	On	Off	On	On	On	On
0.877189	Off	On	On	On	Off	Off	Off	Off
0.878704	Off	On	On	On	Off	Off	Off	On
0.880223	Off	On	On	On	Off	Off	On	On
0.881748	Off	On	On	On	Off	On	Off	On
0.883278	Off	On	On	On	Off	On	On	On
0.883292	Off	On	On	On	On	Off	Off	Off
0.884828	Off	On	On	On	On	Off	Off	On
0.886369	Off	On	On	On	On	Off	On	On
0.887916	Off	On	On	On	On	On	Off	On
0.889468	Off	On	On	On	On	On	On	On
0.890515	On	Off	Off	Off	Off	Off	Off	Off
0.892076	On	Off	Off	Off	Off	Off	Off	On
0.893643	On	Off	Off	Off	Off	Off	On	On
0.895216	On	Off	Off	Off	Off	On	Off	On
0.896794	On	Off	Off	Off	Off	On	On	On
0.896808	On	Off	Off	Off	On	Off	Off	Off
0.898392	On	Off	Off	Off	On	Off	Off	On
0.899981	On	Off	Off	Off	On	Off	On	On
0.901577	On	Off	Off	Off	On	On	Off	On
0.903178	On	Off	Off	Off	On	On	On	On
0.903234	On	Off	Off	On	Off	Off	Off	Off
0.904841	On	Off	Off	On	Off	Off	Off	On
0.906454	On	Off	Off	On	Off	Off	On	On
0.908073	On	Off	Off	On	Off	On	Off	On
0.909697	On	Off	Off	On	Off	On	On	On
0.909712	On	Off	Off	On	On	Off	Off	Off
0.911342	On	Off	Off	On	On	Off	Off	On
0.912979	On	Off	Off	On	On	Off	On	On
0.914621	On	Off	Off	On	On	On	Off	On
0.916270	On	Off	Off	On	On	On	On	On
0.915773	On	Off	On	Off	Off	Off	Off	Off
0.917426	On	Off	On	Off	Off	Off	Off	On
0.919084	On	Off	On	Off	Off	Off	On	On
0.920749	On	Off	On	Off	Off	On	Off	On
0.922420	On	Off	On	Off	Off	On	On	On
0.922435	On	Off	On	Off	On	Off	Off	Off
0.924112	On	Off	On	Off	On	Off	Off	On
0.925795	On	Off	On	Off	On	Off	On	On
0.927485	On	Off	On	Off	On	On	On	Off
0.929180	On	Off	On	Off	On	On	On	On
0.929241	On	Off	On	On	Off	Off	Off	Off
0.930943	On	Off	On	On	Off	Off	Off	On

Table 5 (Concluded)

RLA Factor	Switch Block S1 DIP Switches 1	2	3	4	5	6	7	8
0.932652	On	Off	On	On	Off	Off	On	On
0.934367	On	Off	On	On	Off	On	Off	On
0.936088	On	Off	On	On	Off	On	On	On
0.936103	On	Off	On	On	On	Off	Off	Off
0.937831	On	Off	On	On	On	Off	Off	On
0.939566	On	Off	On	On	On	Off	On	On
0.941307	On	Off	On	On	On	On	Off	On
0.943054	On	Off	On	On	On	On	On	On
0.943922	On	On	Off	Off	Off	Off	Off	Off
0.945680	On	On	Off	Off	Off	Off	Off	On
0.947444	On	On	Off	Off	Off	Off	On	On
0.949214	On	On	Off	Off	Off	On	Off	On
0.950992	On	On	Off	Off	Off	On	On	On
0.951008	On	On	Off	Off	On	Off	Off	Off
0.952792	On	On	Off	Off	On	Off	Off	On
0.954583	On	On	Off	Off	On	Off	On	On
0.956381	On	On	Off	Off	On	On	Off	On
0.958185	On	On	Off	Off	On	On	On	On
0.958249	On	On	Off	On	Off	Off	Off	Off
0.960061	On	On	Off	On	Off	Off	Off	On
0.961880	On	On	Off	On	Off	Off	On	On
0.963706	On	On	Off	On	Off	On	Off	On
0.965539	On	On	Off	On	Off	On	On	On
0.965555	On	On	Off	On	On	Off	Off	Off
0.967395	On	On	Off	On	On	Off	Off	On
0.969242	On	On	Off	On	On	Off	On	On
0.971097	On	On	Off	On	On	On	Off	On
0.972958	On	On	Off	On	On	On	On	On
0.972397	On	On	On	Off	Off	Off	Off	Off
0.974264	On	On	On	Off	Off	Off	Off	On
0.976138	On	On	On	Off	Off	Off	On	On
0.978019	On	On	On	Off	Off	On	Off	On
0.979907	On	On	On	Off	Off	On	On	On
0.979924	On	On	On	Off	On	Off	Off	Off
0.981820	On	On	On	Off	On	Off	Off	On
0.983723	On	On	On	Off	On	Off	On	On
0.985634	On	On	On	Off	On	On	Off	On
0.987553	On	On	On	Off	On	On	On	On
0.987621	On	On	On	On	Off	Off	Off	Off
0.989547	On	On	On	On	Off	Off	Off	On
0.991481	On	On	On	On	Off	Off	On	On
0.993423	On	On	On	On	Off	On	Off	On
0.995372	On	On	On	On	Off	On	On	On
0.995389	On	On	On	On	On	Off	Off	Off
0.997347	On	On	On	On	On	Off	Off	On
0.999312	On	On	On	On	On	Off	On	On
1.001284	On	On	On	On	On	On	Off	On
1.003265	On	On	On	On	On	On	On	On

1. Check the unit nameplate (or design specifications) to establish the chiller's RLA.

2. Determine the appropriate "meter scale" value from Table 4. To do this, compare the unit RLA with the RLA range values in Table 4; select the appropriate RLA range and read across the table to find the corresponding meter scale value.

3. Use the following equation to determine the "RLA factor".

$$\text{RLA Factor} = \frac{\text{RLA} \times 1.4}{\text{Meter Scale}}$$

4. Use Table 5 to find the S1 DIP switch settings that correspond to the RLA factor determined in Step 3. Select the RLA factor in Table 5 that is closest to the RLA factor calculated in Step 3.

5. Compare the DIP switch settings identified in Table 5 (Step 4) with the factory set S1 DIP switch setting combination.

Input Connections (and Terminal Designations)

All electrical connections made at micro module 1U3 are low voltage (i.e., 30 volts AC or less); never connect wires carrying more than 30 volts to terminal strips 1TB6, 1TB3 or 1TB4. Further, never route wiring carrying voltages exceeding 30 volts through the upper half of the unit control panel!

Caution: Connecting any device or wiring that carries more than 30 volts to 1TB6, 1TB3 or 1TB4 will destroy micro module 1U3.

Terminal strip connections for the micro module are illustrated in Figures 4 and 6 of this bulletin and are described in the following paragraphs.

Terminal Strip 1TB6: Bidirectional Communications Link (1TB6-1, -2)

This connection port is provided for a twisted-pair communications link; this link may be used with another machine, or with a higher level control panel (e.g., an SCP system control panel).

Note: Remember that there are no polarity requirements when connecting communication wires.

Terminal Strip 1TB3

Note: See sensor charts section of this bulletin for a breakdown of temperature and pressure input accuracies; only "displayed" accuracies are indicated below.

Leaving Evaporator Water Temperature Sensor (1TB3-1, -2)

Standard thermistor 4RT1, which monitors the temperature of the chilled water leaving the unit, is connected to these terminals.

Sensor and input specifications are as follows:

[ ] Operating Range
15 F to 90 F

[ ] Displayed Accuracy;
+/- 1.5 F from 20 F thru 70 F
+/- 2.5 F from 70 F thru 90 F and,
+/- 2.5 F from 15 F thru 20 F

[ ] Indication
At front panel display (i.e., item "F" of operator's menu).

[ ] Open
Diagnostic (on startup bAb)

[ ] Shorted
No diagnostic; display reads "—".

[ ] Leaving Water Temperature Low Limit
35.3 F for standard-range units only.

Note: The UCM's "differential-to-stop" criteria are typically used to cycle off the chiller - not this "low limit" function! Notice, too, that the "Cooling Required" status indicator light goes out when a "low limit" occurs; no diagnostic is generated.

Entering Evaporator Water Temperature Sensor (1TB3-3, -4)

The optional thermistor (4RT2) connected to these terminals monitors the temperature of the chilled water entering the unit.

Sensor and input specifications are as follows:

[ ] Operating Range
15 F to 90 F
[ ] Displayed Accuracy
+/- 1.5 F from 20 F to 70 F
+/- 2.5 F from 70 F to 90 F and,
+/- 2.5 F from 15 F to 20 F
[ ] Indication
At front panel display (i.e., item "E" of operator's menu).
[ ] Shorted
No diagnostic; display reads "—".
[ ] Open
No diagnostic; display reads "—".

Spare Temperature Sensors (1TB3-5, -6; 1TB3-7, -8)

Thermistors (i.e., 4RT3 and 4RT4) connected to terminals 5 through 8 on 1TB3 are optional. These "spare temperature" inputs are expected to be used for monitoring entering (1TB3-5, 1TB3-6) and leaving (1TB3-7, 1TB3-8) condenser water temperatures. Actual sensor temperatures can then be viewed on the UCM display (i.e., menu item "H" for entering condenser water, and "J" for leaving condenser water).

Sensor and input specifications are as follow:

[ ] Operating Range
30 F to 140 F
[ ] Displayed Accuracy
+/- 1.8 F from 60 F to 110 F
+/- 2.5 F from 30 F to 60 F and,
+/- 2.5 F from 110 F to 140 F
[ ] Indication
At front panel display (i.e., items "H" and "J" of operator's menu).
[ ] Shorted
No diagnostic; display reads "—".
[ ] Open
No diagnostic; display reads "—".

Condenser Refrigerant Pressure Transducer (1TB3-9, -10, -11)

This pressure transducer (1R1) is mounted inside the unit control panel and is "T'd" into the condenser gauge line. Transducer output is of the 3-wire, variable resistance type. To assure proper operation, these 3 wires must be connected to terminals 9, 10 and 11 of 1TB3.

Pressure transducer and input specifications follow:

[ ] Operating Range
0 psig to 500 psig
[ ] Indication
None
[ ] Shorted (1TB3-10 TO -11)
Diagnostic b AC
[ ] Open
No diagnostic

Evaporator Refrigerant Temperature Sensor (1TB3-12, -13)

This standard thermistor (4RT5) monitors evaporator refrigerant temperature.

Sensor and input specifications follow:

[ ] Operating Range
-5 to 150 F
[ ] Displayed Accuracy
+/- 1.0 F at 29.0 F
+/- 1.5 F at 30.0 F
+/- 2.5 F from 0 F thru 28 F
+/- 2.5 F from 31 F thru 34 F
+/- 5.5 from -5 F thru -1 F and,
+/- 5.5 F from 35 F thru 40 F

The UCP displays evaporator refrigerant temperatures ranging from - 4 F thru 42 F. See "Temperature Sensor Checkout Procedure" in this bulletin for accuracies outside the display range.

[ ] Indication
At front panel display (i.e., item " " of serviceman's menu).
[ ] Shorted
Diagnostic b Ad; must not trip < 150 F
[ ] Open
Diagnostic b Ad; must not trip > -5 F

Ambient Temperature Sensor (1TB3-14, -15)

This optional thermistor (4RT6) is used with the optional, ambient-based, chilled water reset function. A visual indication (i.e., on the UCM's display) of the temperature registered by this sensor is not available.

Sensor and input specifications follow:

[ ] Operating Range
-40 F to 150 F; see sensor conversion data for accuracies.
[ ] Indication
None
[ ] Shorted
Diagnostic b AE; must not trip < 150 F
[ ] Open
No diagnostic

Note: Input terminals 1TB3-14 and -15 are also used when the chiller is controlled by an SCP System Control Panel equipped with the condenser limit option. (For further information, refer to the appropriate SCP installation manual and operator's guide.)

External Inhibit (1TB3-16, -17)

Auxiliary terminal connections for a customer specified or installed non-latching unit start/stop signal. Terminals 1TB3-16 and 1TB3-17 must be jumpered if this external interlock is not used.

Note:

If the unit is supplied with Ice-Making Control, the external inhibit terminals will be occupied by ice-making controls.

Diagnostic A100. Refer to Figures 4 and 6, notice that the unit ships from the factory with a jumper installed between the external inhibit terminals. The unit will not operate unless Terminals 1TB3-16 and 1TB3-17 are shorted.

External inhibit input specifications follow:

[ ] Circuit is monitored by a 12 VDC, 45 mA current.

[ ] Customer-supplied devices connected to these terminals must be compatible with current described above; gold-plated contacts are recommended to avoid oxidation resistance.

Note: Use an isolation relay to limit electrical noise interference, and to reduce the possibility of feeding voltage into micro module 1U3.

Proof of Chilled Water Flow (1TB3-20, -21)

These terminals monitor the status of the chilled water pump relay (1K16) contacts.

If the contacts of 1K16 are closed (i.e., terminals 1TB3-20 and -21 are shorted), proof of closure is signalled by the illumination of the "chilled water flow" status indicator light. (These contacts must only close when there is actually chilled water flow - i.e., both chilled water flow switch 5S2 and auxiliary chilled water pump contactor 5K1 are closed.) A built-in time delay of two seconds (i.e. maximum without flow) is designed to eliminate nuisance tripouts caused by a fluttering flow.

If 1K16's contacts are open, the input at terminals 1TB3-20 and -21 should also be open and the "chilled water flow" status indicator light off. Nonlatching diagnostic b Ed is generated if the chiller switch is set at one of the "Auto" positions and a start-up is attempted at this time. (The UCM will not generate a b Ed diagnostic if the chiller switch is set at "Standby/Reset".)

Note: 1K16's contacts must open whenever the chilled water flow rate is either below the minimum acceptable level, or nonexistent (i.e., 5S2 or 5K1 are open).

Remember that the customer-supplied flow/pressure switch and pump interlock circuit must be connected to terminals 1TB7-5 and 1TB7-3 in the high-voltage section of the unit control panel; this circuit powers chilled water pump relay 1K16.

Caution: Do not connect the 120V flow switch interlock circuit to terminals 1TB3-20 and -21, or micro module 1U3 will be damaged.

Proof of Condenser Water Flow (1TB3-22, -23)

These terminals monitor the status of the condenser water pump relay (1K17) contacts.

If the contacts of 1K17 are closed (i.e., input terminals 1TB3-22 and -23 are shorted), proof of closure is signalled by advancement from operating code A 71 (i.e., "establish condenser water flow") to A 72 (i.e., "start").

Note: 1K17's contacts must only close when there is actually condenser water flow (i.e., proven by closure of both condenser water flow switch 5S3 and auxiliary condenser water pump contactor 5K2).

If 1K17's contacts are open, the input at terminals 1TB3-22 and -23 should also be open. In the event that condenser water flow is lost during chiller operation, the unit is shut down on nonlatching diagnostic b F7 and a restart is attempted. Latching diagnostic b dC is generated if condenser water flow is not established within 3 minutes of initiation of operating mode A 71.

Note: 1K17's contacts must open whenever condenser water flow is either below the minimum acceptable rate, or nonexistent (i.e. both 5S3 and 5K2 are open).

Remember that the customer-supplied flow/pressure switch and pump interlock circuit must be connected to terminals 1TB7-6 and 1TB7-4 in the high-voltage section of the unit control panel; this circuit powers condenser water pump relay 1K17.

Caution: Do not connect the 120V flow switch interlock circuit to terminals 1TB3-22 and -23, or micro module 1U3 will be damaged beyond repair.

Low Pressure Cutout (1TB3-24, -25)

These terminals monitor the pressure in the evaporator. If the pressure falls below 45 +/- 10 psig for design sequence A thru E closure of 4S6 between 1TB3-24 and 1TB3-25 will shut down the unit giving a latching diagnostic (b b5). For design sequence F and on the low pressure cutout is 26 +/- 10 psig.

Terminal Strip 1TB4

Proving Oil Flow (1TB4-1, -2)
Sufficient oil flow through bearing oil supply system must be confirmed within 30 seconds by closing oil flow switch 4S5, or unit locks out on low oil flow b F2.

Note: If 4S5 is closed before compressor start-up, b E8 is displayed. This checks for an oil flow switch that is not functioning properly.

Running External Interlock (1TB4-3, -4)
Terminals 3 and 4 of 1TB4 accept a switch input that indicates a system fault (i.e., detected by a customer-supplied remote device) requiring a unit shutdown. This function is only active when the unit is running and transition is complete.

Notice that as long as the micro "sees" an open input at Terminals 3 and 4, no fault is detected. If the input is shorted, however, a fault requiring unit shutdown occurred, and micro module 1U3 responds by initiating latching diagnostic condition b F1. Unit requires manual reset.

Specifications for the running external interlock input are as follows:

[ ] This fault circuit is monitored by a 12 VDC, 45 mA current.

[ ] Customer-supplied devices connected to these terminals must be compatible with the current described above; gold-plated contacts are recommended to avoid oxidation resistance.

Notes: Use an isolation relay to limit noise interference, and to reduce the possibility of feeding voltage into micro module 1U3.

"Transition Complete" Contacts (1TB4-5, -6)
This terminal input allows the micro module to monitor the main run starter contactor (2K2) to determine whether transition has occurred. A shorted input indicates that transition is complete, while an open input "tells" the micro that transition is not occurred.

Note: The shield wire must be taped off at the 2K2 contacts and grounded to a ground lug provided in the starter panel (i.e., at the 2TB1 terminal strip end of these leads). These leads are not shielded between the starter panel and unit control panel.

Following is the specification for the "transition complete" input to micro module 1U3:

[ ] The "transition complete" circuit is monitored by a 12 VDC, 45 mA current.

3-Phase Current-Sensing Input (1TB4-7 thru -12)
These 6 terminals accept 3 AC signal inputs that are representative of the compressor motor's AC current draw. Line current is stepped down by 2 sets of current transformers. Each set of current transformers contains 3 transformers; the first steps the line current down to a 0-5 amp signal, and the second further steps down the 0-5 amp signal to a milliampere (mA) signal.

Caution: Do not connect the 0-5 amp output signal of the primary transformer directly to micro module 1U3, or destruction of the module will result.

Following are specifications for the 3-phase current-sensing input:

[ ] Overall Accuracy
5 to 140 +/- 5% RLA

[ ] Open
Diagnostic b E2 (i.e., momentary power loss), diagnostic b E4 (i.e., phase loss), or diagnostic b E5 (i.e., phase reversal).

Connections at terminals 7 through 12 are as follows:

[ ] Terminals 1TB4-7 and -8 are connected to secondary transformer 2T7 on L3.
[ ] Terminals 1TB4-9 and -10 are connected to secondary transformer 2T6 on L2.
[ ] Terminals 1TB4-11 and -12 are connected to secondary transformer 2T5 on L1.

Note: It is essential that the correct polarity is maintained in all current transformer connections. Consult the appropriate starter wiring diagram to confirm that proper connection polarity is established.

Discharge Temp Sensor (1TB4-19, -20)

The temperature sensor that monitors compressor discharge temperature (i.e., thermistor 4RT8) is connected to these terminals.

Note: Remember that the discharge temperature setting is not adjustable.

Specifications for the discharge temperature sensor input are as follows:

[ ] Operating Range
40 F to 250 F
[ ] Shorted
Diagnostic b A9; must not trip < 195 F
[ ] Open
Diagnostic b A9; must not trip > 90 F
[ ] Discharge Temp Sensor "Off" Point
205 F; results in a latching diagnostic b 80

Motor Winding Temperature Sensors (1TB4-15 thru -18)

The leads of the 3 temperature sensors (4B1R2, 4B1R3, 4B1R4) buried in the compressor motor windings are connected to these input terminals. Check the unit wiring diagram to properly identify individual sensor wires.

Note: Notice that the "common" leg of each sensor is connected to terminal 1TB4-17.

Specifications for the motor winding temperature sensor inputs are as follows:

[ ] Operating Range
50 F to 310 +/- 5 F
[ ] Open
Diagnostic b A4, b A7 or b A8, as applicable
[ ] Shorted
No diagnostic
[ ] Winding Temp≥165 F - 5 min
Start Delay (operating code A70)
[ ] Winding Temp≤165 F - 2 min
Start Delay (operating code A70)
[ ] Trip Point Temp = 265 +/- 5 F

Temperature Sensor Checkout Procedure

With the exception of the resistance sensors embedded in the compressor motor windings, all of the temperature sensors used with the UCM (i.e., unit control module) are thermistors. Micro module 1U3 "reads" the temperature at each sensor by sending a current through it and then measuring the voltage that develops across the sensor.

Use the procedure described below to check the thermistors and micro module (1U3) for proper operation:

WARNING: To prevent injury or death due to electrical shock, use care when measurements, adjustments, or other service-related operations are performed with power on.

Note: Micro module sensor inputs are "slew-rate limited"; because of this, they may respond slowly to changes in temperature. When using the diagnostic procedure described below, be certain that the temperature reading is stable.

1. Measure the temperature at the sensor using an accurate thermometer; record the temperature reading observed.

2. With the sensor leads connected to micro module 1U3, and 1U3 powered, measure the DC voltage across the sensor leads at the terminal strip; record the voltage observed.

Note: Always use a meter with a 10-megohm (or greater) input resistance to avoid interference with sensor resistance. Using a meter with a smaller input resistance will result in misleading voltage/resistance variances.

3. Select the appropriate sensor from Tables 6 through 12. Then, compare the temperature (in the table) corresponding to the voltage reading recorded in Step 2 with the actual temperature observed in Step 1. If the actual temperature measured falls within the allowable tolerance range, both the sensor and micro module 1U3 are operating properly. However, if the actual temperature is outside the allowable sensor tolerance range, proceed to Step 4.

4. Again, measure the temperature at the sensor with an accurate thermometer; record the temperature reading observed.

5. Remove the sensor leads from the 1U3 terminal strip and measure the resistance through the sensor with a digital volt-ohmmeter. Record the resistance observed.

6. Select the appropriate sensor table at the end of this section and locate the resistance value recorded in Step 5. Verify that the temperature corresponding to this resistance value matches (i.e., within the tolerance range specified for that sensor) the temperature measured with the thermometer in Step 4.

If the sensor temperature is out of range, replace the sensor. However, if the sensor temperature is within tolerance while the temperature determined by the voltage reading in Steps 1 through 3 is out of tolerance, micro module 1U3 is defective and must be replaced.

Table 6
Sensor Conversion Data: Optional Condenser Refrigerant Pressure (1R1) on RTHA

Actual Pressure (Psig)	Actual Resistance (Ohms)		Input Voltage at 1TB3-10, -11 (Volts)
	1TB3-10, -11	1TB3-9, -10	
0.000	8000.000	2000.000	4.356436
4.000	7940.000	2060.000	4.323763
8.000	7880.000	2120.000	4.291089
12.000	7820.000	2180.000	4.258416
16.000	7760.000	2240.000	4.225742
20.000	7700.000	2300.000	4.193069
24.000	7640.000	2360.000	4.160396
28.000	7580.000	2420.000	4.127723
32.000	7520.000	2480.000	4.095050
36.000	7460.000	2540.000	4.062376
40.000	7400.000	2600.000	4.029703
44.000	7340.000	2660.000	3.997030
48.000	7280.000	2720.000	3.964356
52.000	7220.000	2780.000	3.931683
56.000	7160.000	2840.000	3.899010
60.000	7100.000	2900.000	3.866337
64.000	7040.000	2960.000	3.833663
68.000	6980.000	3020.000	3.800990
72.000	6920.000	3080.000	3.768317
76.000	6860.000	3140.000	3.735644
80.000	6800.000	3200.000	3.702970
84.000	6740.000	3260.000	3.670297
88.000	6680.000	3320.000	3.637624
92.000	6620.000	3380.000	3.604950
96.000	6560.000	3440.000	3.572277
100.000	6500.000	3500.000	3.539604
104.000	6440.000	3560.000	3.506931
108.000	6380.000	3620.000	3.474257
112.000	6320.000	3680.000	3.441585
116.000	6260.000	3740.000	3.408911
120.000	6200.000	3800.000	3.376238
124.000	6140.000	3860.000	3.343564
128.000	6080.000	3920.000	3.310891
132.000	6020.000	3980.000	3.278218
136.000	5960.000	4040.000	3.245545
140.000	5900.000	4100.000	3.212872
144.000	5840.000	4160.000	3.180198
148.000	5780.000	4220.000	3.147525
152.000	5720.000	4280.000	3.114852
156.000	5660.000	4340.000	3.082178
160.000	5600.000	4400.000	3.049505
164.000	5540.000	4460.000	3.016832
168.000	5480.000	4520.000	2.984159
172.000	5420.000	4580.000	2.951485
176.000	5360.000	4640.000	2.918812
180.000	5300.000	4700.000	2.886139
184.000	5240.000	4760.000	2.853466
188.000	5180.000	4820.000	2.820792
192.000	5120.000	4880.000	2.788119
196.000	5060.000	4940.000	2.755446
200.000	5000.000	5000.000	2.722772
204.000	4940.000	5060.000	2.690099
208.000	4880.000	5120.000	2.657426
212.000	4820.000	5180.000	2.624753
216.000	4760.000	5240.000	2.592079
220.000	4700.000	5300.000	2.559406
224.000	4640.000	5360.000	2.526733
228.000	4580.000	5420.000	2.494059
232.000	4520.000	5480.000	2.461386
236.000	4460.000	5540.000	2.428713
240.000	4400.000	5600.000	2.396039
244.000	4340.000	5660.000	2.363366
248.000	4280.000	5720.000	2.330693
252.000	4220.000	5780.000	2.298020
256.000	4160.000	5840.000	2.265347
260.000	4100.000	5900.000	2.232673
264.000	4040.000	5960.000	2.200000
268.000	3980.000	6020.000	2.167327
272.000	3920.000	6080.000	2.134654
276.000	3860.000	6140.000	2.101980
280.000	3800.000	6200.000	2.069307
284.000	3740.000	6260.000	2.036634
288.000	3680.000	6320.000	2.003960
292.000	3620.000	6380.000	1.971287
296.000	3560.000	6440.000	1.938614
300.000	3500.000	6500.000	1.905941
304.000	3440.000	6560.000	1.873267
308.000	3380.000	6620.000	1.840594
312.000	3320.000	6680.000	1.807921
316.000	3260.000	6740.000	1.775248
320.000	3200.000	6800.000	1.742574
324.000	3140.000	6860.000	1.709901
328.000	3080.000	6920.000	1.677228
332.000	3020.000	6980.000	1.644555
336.000	2960.000	7040.000	1.611881
340.000	2900.000	7100.000	1.579208
344.000	2840.000	7160.000	1.546535
348.000	2780.000	7220.000	1.513861
352.000	2720.000	7280.000	1.481188
356.000	2660.000	7340.000	1.448515
360.000	2600.000	7400.000	1.415842
364.000	2540.000	7460.000	1.383168
368.000	2480.000	7520.000	1.350495
372.000	2420.000	7580.000	1.317822
376.000	2360.000	7640.000	1.285149
380.000	2300.000	7700.000	1.252475
384.000	2240.000	7760.000	1.219802
388.000	2180.000	7820.000	1.187129
392.000	2120.000	7880.000	1.154456
396.000	2060.000	7940.000	1.121782
400.000	2000.000	8000.000	1.089109

Table 7
Sensor Conversion Data:
Evaporator Leaving Water Temperature (4RT1)
Optional Evaporator Entering Water Temperature (4RT2)

Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Note 3)	Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Note 3)
15.000	54,635.59	4.236	53.000	18,420.49	2.992
16.000	52,987.21	4.208	54.000	17,939.01	2.957
17.000	51,393.36	4.180	55.000	17,471.74	2.922
18.000	49,852.12	4.152	56.000	17,018.23	2.887
19.000	48,361.55	4.123	57.000	16,578.03	2.852
20.000	46,919.86	4.094	58.000	16,150.71	2.817
21.000	45,525.32	4.064	59.000	15,735.84	2.782
22.000	44,176.24	4.034	60.000	15,333.03	2.747
23.000	42,871.04	4.004	61.000	14,941.88	2.713
24.000	41,608.12	3.973	62.000	14,562.03	2.678
25.000	40,386.01	3.942	63.000	14,193.10	2.643
26.000	39,203.26	3.911	64.000	13,834.75	2.609
27.000	38,058.56	3.879	65.000	13,486.65	2.575
28.000	36,950.50	3.847	66.000	13,148.46	2.541
29.000	35,877.84	3.814	67.000	12,819.88	2.507
30.000	34,839.39	3.782	68.000	12,500.59	2.473
31.000	33,833.91	3.749	69.000	12,190.32	2.440
32.000	32,861.74	3.715	70.000	11,888.77	2.406
33.000	31,935.73	3.683	71.000	11,595.68	2.373
34.000	31,039.07	3.649	72.000	11,310.78	2.340
35.000	30,170.77	3.616	73.000	11,033.81	2.308
36.000	29,329.83	3.582	74.000	10,764.53	2.275
37.000	28,515.28	3.549	75.000	10,502.71	2.243
38.000	27,726.22	3.515	76.000	10,248.11	2.211
39.000	26,961.78	3.481	77.000	10,000.51	2.179
40.000	26,221.09	3.446	78.000	9,759.70	2.148
41.000	25,503.33	3.412	79.000	9,525.47	2.117
42.000	24,807.73	3.377	80.000	9,297.62	2.086
43.000	24,133.52	3.343	81.000	9,075.96	2.055
44.000	23,479.98	3.308	82.000	8,860.30	2.024
45.000	22,846.40	3.273	83.000	8,650.45	1.994
46.000	22,232.11	3.238	84.000	8,446.26	1.964
47.000	21,636.47	3.203	85.000	8,247.54	1.935
48.000	21,058.83	3.168	86.000	8,054.13	1.906
49.000	20,498.61	3.133	87.000	7,865.87	1.877
50.000	19,955.21	3.098	88.000	7,682.62	1.848
51.000	19,428.09	3.062	89.000	7,504.22	1.820
52.000	18,916.69	3.027	90.000	7,330.53	1.791

Notes:

1. Sensor 4RT1 is connected between Terminals 1TB3-1 and -2 on micro module 1U3; optional sensor 4RT2 is connected between Terminals 1TB3-3 and -4.
2. Overall accuracy for sensors 4RT1 and 4RT2 is as follows:
   - ± 1 F from 20 F to 70 F;
   - ± 2 F from 70 F to 90 F; and,
   - ± 2 F from 15 F to 20 F.
3. As you compare a thermistor resistance (or input voltage) reading with the "actual" temperature indicated by the thermometer, be sure to consider the precision of the thermometer when you decide whether or not the thermistor is out of range.

Table 8
Sensor Conversion Data: Optional Condenser Entering (4RT3) and Leaving (4RT4) Water Temperature

Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Note 3)	Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Note 3)
30.000	34,839.39	4.553	65.000	13,486.65	3.642
31.000	33,833.91	4.532	66.000	13,148.46	3.612
32.000	32,861.74	4.511	67.000	12,819.88	3.581
33.000	31,935.73	4.489	68.000	12,500.59	3.551
34.000	31,039.07	4.467	69.000	12,190.32	3.520
35.000	30,170.77	4.445	70.000	11,888.77	3.489
36.000	29,329.83	4.422	71.000	11,595.68	3.458
37.000	28,515.28	4.399	72.000	11,310.78	3.427
38.000	27,726.22	4.376	73.000	11,033.81	3.396
39.000	26,961.78	4.352	74.000	10,764.53	3.364
40.000	26,221.09	4.327	75.000	10,502.71	3.333
41.000	25,503.33	4.304	76.000	10,248.11	3.302
42.000	24,807.73	4.280	77.000	10,000.51	3.270
43.000	24,133.52	4.255	78.000	9,759.70	3.238
44.000	23,479.98	4.230	79.000	9,525.47	3.207
45.000	22,846.40	4.205	80.000	9,297.62	3.175
46.000	22,232.11	4.179	81.000	9,075.96	3.143
47.000	21,636.47	4.153	82.000	8,860.30	3.112
48.000	21,058.83	4.127	83.000	8,650.45	3.080
49.000	20,498.61	4.100	84.000	8,446.26	3.048
50.000	19,955.21	4.073	85.000	8,247.52	3.016
51.000	19,428.09	4.046	86.000	8,054.13	2.985
52.000	18,916.69	4.019	87.000	7,865.87	2.953
53.000	18,420.49	3.991	88.000	7,682.62	2.921
54.000	17,939.01	3.963	89.000	7,504.22	2.890
55.000	17,471.74	3.935	90.000	7,330.53	2.859
56.000	17,018.23	3.907	91.000	7,161.41	2.827
57.000	16,578.03	3.878	92.000	6,996.74	2.795
58.000	16,150.71	3.850	93.000	6,836.36	2.764
59.000	15,735.84	3.820	94.000	6,680.17	2.733
60.000	15,333.03	3.791	95.000	6,528.05	2.702
61.000	14,941.88	3.762	96.000	6,379.86	2.671
62.000	14,562.03	3.732	97.000	6,235.50	2.640
63.000	14,193.10	3.702	98.000	6,094.87	2.609
64.000	13,834.75	3.672	99.000	5,957.84	2.578

Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Note 3)	Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Note 3)
100.000	5,824.32	2.548	120.000	3,756.95	1.973
101.000	5,694.22	2.517	121.000	3,678.12	1.947
102.000	5,567.42	2.487	122.000	3,601.11	1.921
103.000	5,443.84	2.457	123.000	3,526.48	1.895
104.000	5,323.39	2.427	124.000	3,453.62	1.869
105.000	5,205.97	2.397	125.000	3,382.47	1.844
106.000	5,091.51	2.368	126.000	3,313.00	1.819
107.000	4,979.91	2.338	127.000	3,245.16	1.794
108.000	4,871.11	2.309	128.000	3,178.90	1.769
109.000	4,765.02	2.280	129.000	3,114.19	1.745
110.000	4,661.56	2.251	130.000	3,050.99	1.721
111.000	4,560.67	2.222	131.000	2,989.25	1.697
112.000	4,462.27	2.194	132.000	2,928.94	1.673
113.000	4,366.29	2.165	133.000	2,870.02	1.650
114.000	4,272.67	2.137	134.000	2,812.45	1.627
115.000	4,181.34	2.109	135.000	2,756.20	1.604
116.000	4,092.24	2.082	136.000	2,701.24	1.581
117.000	4,005.31	2.054	137.000	2,647.54	1.559
118.000	3,920.49	2.027	138.000	2,595.05	1.536
119.000	3,837.72	2.000	139.000	2,543.76	1.515
			140.000	2,493.62	1.493

Notes:

1. Optional sensor 4RT3 is connected between Terminals 1TB3-5 and -6 on micro module 1U3, while sensor 4RT4 is connected between 1TB3-7 and -8.
2. Overall accuracy for sensors 4RT3 and 4RT4 is as follows:
   - ± 1 F from 60 F to 110 F;
   - ± 2 F from 30 F to 60 F; and,
   - ± 2 F from 110 F to 140 F.
3. As you compare a thermistor resistance (or input voltage) reading with the "actual" temperature indicated by the thermometer, be sure to consider the precision of the thermometer when you decide whether or not the thermistor is out of range.

Table 9
Sensor Conversion Data:
Evaporator Refrigerant Temperature (4RT5)

Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Note 3)	Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Note 3)	Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Note 3)	Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Note 3)
-5.000	102,906.40	4.082	75.000	10,502.71	1.379	35.000	30,170.77	2.655	115.000	4,181.34	0.652
-4.000	99,604.04	4.052	76.000	10,248.11	1.354	36.000	29,329.83	2.618	116.000	4,092.24	0.640
-3.000	96,417.76	4.022	77.000	10,000.51	1.330	37.000	28,515.28	2.581	117.000	4,005.31	0.628
-2.000	93,343.04	3.991	78.000	9,759.70	1.305	38.000	27,726.22	2.545	118.000	3,920.49	0.616
-1.000	90,375.79	3.960	79.000	9,525.47	1.282	39.000	26,961.78	2.508	119.000	3,837.72	0.604
+0.000	87,511.82	3.928	80.000	9,297.62	1.258	40.000	26,221.09	2.471	120.000	3,756.95	0.593
1.000	84,747.29	3.896	81.000	9,075.96	1.236	41.000	25,503.33	2.435	121.000	3,678.12	0.582
2.000	82,078.42	3.864	82.000	8,860.30	1.213	42.000	24,807.73	2.399	122.000	3,601.11	0.571
3.000	79,501.66	3.831	83.000	8,650.45	1.191	43.000	24,133.52	2.363	123.000	3,526.48	0.561
4.000	77,013.47	3.798	84.000	8,446.26	1.169	44.000	23,479.98	2.328	124.000	3,453.62	0.550
5.000	74,610.62	3.764	85.000	8,247.54	1.147	45.000	22,846.40	2.292	125.000	3,382.47	0.540
6.000	72,290.00	3.730	86.000	8,054.13	1.126	46.000	22,232.11	2.257	126.000	3,313.00	0.530
7.000	70,048.44	3.700	87.000	7,865.87	1.105	47.000	21,636.47	2.222	127.000	3,245.16	0.520
8.000	67,883.04	3.661	88.000	7,682.62	1.085	48.000	21,058.83	2.187	128.000	3,178.90	0.511
9.000	65,790.95	3.626	89.000	7,504.22	1.065	49.000	20,498.61	2.153	129.000	3,114.19	0.501
10.000	63,769.60	3.591	90.000	7,330.53	1.045	50.000	19,955.21	2.119	130.000	3,050.99	0.492
11.000	61,816.30	3.555	91.000	7,161.41	1.026	51.000	19,428.09	2.085	131.000	2,989.25	0.483
12.000	59,928.60	3.520	92.000	6,996.74	1.007	52.000	18,916.69	2.052	132.000	2,928.94	0.474
13.000	58,104.07	3.484	93.000	6,836.36	0.988	53.000	18,420.49	2.019	133.000	2,870.02	0.466
14.000	56,340.49	3.447	94.000	6,680.17	0.970	54.000	17,939.01	1.986	134.000	2,812.45	0.457
15.000	54,635.59	3.411	95.000	6,528.05	0.951	55.000	17,471.74	1.953	135.000	2,756.20	0.449
16.000	52,987.21	3.374	96.000	6,379.86	0.934	56.000	17,018.23	1.921	136.000	2,701.24	0.440
17.000	51,393.36	3.337	97.000	6,235.50	0.916	57.000	16,578.03	1.889	137.000	2,647.54	0.432
18.000	49,852.12	3.300	98.000	6,094.87	0.899	58.000	16,150.71	1.858	138.000	2,595.05	0.425
19.000	48,361.55	3.262	99.000	5,957.84	0.882	59.000	15,735.84	1.827	139.000	2,543.76	0.417
20.000	46,919.86	3.225	100.000	5,824.32	0.866	60.000	15,333.03	1.796	140.000	2,493.62	0.409
21.000	45,525.32	3.187	101.000	5,694.22	0.850	61.000	14,941.88	1.766	141.000	2,444.62	0.402
22.000	44,176.24	3.149	102.000	5,567.42	0.834	62.000	14,562.03	1.736	142.000	2,396.72	0.395
23.000	42,871.04	3.111	103.000	5,443.84	0.818	63.000	14,193.10	1.706	143.000	2,349.89	0.387
24.000	41,608.12	3.073	104.000	5,323.39	0.803	64.000	13,834.75	1.677	144.000	2,304.11	0.380
25.000	40,386.01	3.035	105.000	5,205.97	0.788	65.000	13,486.65	1.648	145.000	2,259.35	0.374
26.000	39,203.26	3.000	106.000	5,091.51	0.773	66.000	13,148.46	1.619	146.000	2,215.59	0.367
27.000	38,058.56	2.959	107.000	4,979.91	0.758	67.000	12,819.88	1.591	147.000	2,172.80	0.360
28.000	36,950.50	2.920	108.000	4,871.11	0.744	68.000	12,500.59	1.563	148.000	2,130.95	0.354
29.000	35,877.84	2.882	109.000	4,765.02	0.730	69.000	12,190.32	1.536	149.000	2,090.03	0.347
30.000	34,839.39	2.844	110.000	4,661.56	0.717	70.000	11,888.77	1.508	150.000	2,050.01	0.341
31.000	33,833.91	2.806	111.000	4,560.67	0.703	71.000	11,595.68	1.482			
32.000	32,861.74	2.768	112.000	4,462.27	0.690	72.000	11,310.78	1.455			
33.000	31,935.73	2.730	113.000	4,366.29	0.677	73.000	11,033.81	1.429			
34.000	31,039.07	2.693	114.000	4,272.67	0.664	74.000	10,764.53	1.404			

Notes:

1. Sensor 4RT5 is connected between terminals 1TB3-12 and -13 on micro module 1U3.
2. Overall accuracy of sensor 4RT5 is as follows:
   - ± 0.80 F at 29.0 F;
   - ± 1.0 F at 30.0 F;
   - ± 2.0 F from 0 F to 28 F, and from 31 F to 34 F;
   - ± 5.0 F from -10 F to -1 F, and from +35 F to 70 F.
3. As you compare a thermistor resistance (or input voltage) reading with the "actual" temperature indicated by the thermometer, be sure to consider the precision of the thermometer when you decide whether or not the thermistor is out of range.

Table 10
Sensor Conversion Data:
Optional Ambient Temperature (4RT6)

Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Note 3)	Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Note 3)
- 5.000	102,906.40	4.449	65.000	13,486.65	1.963
- 4.000	99,604.04	4.421	66.000	13,148.46	1.931
- 3.000	96,417.76	4.393	67.000	12,819.88	1.900
- 2.000	93,343.04	4.364	68.000	12,500.59	1.868
- 1.000	90,375.79	4.335	69.000	12,190.32	1.837
+ 0.000	87,511.82	4.305	70.000	11,888.77	1.807
1.000	84,747.29	4.274	71.000	11,595.68	1.777
2.000	82,078.42	4.244	72.000	11,310.78	1.747
3.000	79,501.66	4.212	73.000	11,033.81	1.718
4.000	77,013.47	4.181	74.000	10,764.53	1.688
5.000	74,610.62	4.149	75.000	10,502.71	1.660
6.000	72,290.00	4.116	76.000	10,248.11	1.631
7.000	70,048.44	4.083	77.000	10,000.51	1.604
8.000	67,883.04	4.050	78.000	9,759.70	1.576
9.000	65,790.95	4.016	79.000	9,525.47	1.549
10.000	63,769.60	3.982	80.000	9,297.62	1.522
11.000	61,816.30	3.948	81.000	9,075.96	1.496
12.000	59,928.60	3.913	82.000	8,860.30	1.470
13.000	58,104.07	3.878	83.000	8,650.45	1.444
14.000	56,340.49	3.843	84.000	8,446.26	1.419
15.000	54,635.59	3.807	85.000	8,247.54	1.394
16.000	52,987.21	3.771	86.000	8,054.13	1.369
17.000	51,393.36	3.734	87.000	7,865.87	1.345
18.000	49,852.12	3.698	88.000	7,682.62	1.321
19.000	48,361.55	3.661	89.000	7,504.22	1.300
20.000	46,919.86	3.623	90.000	7,330.53	1.275
21.000	45,525.32	3.590	91.000	7,161.41	1.252
22.000	44,176.24	3.548	92.000	6,996.74	1.230
23.000	42,871.04	3.510	93.000	6,836.36	1.208
24.000	41,608.12	3.472	94.000	6,680.17	1.186
25.000	40,386.01	3.434	95.000	6,528.05	1.165
26.000	39,203.26	3.395	96.000	6,379.86	1.144
27.000	38,058.56	3.357	97.000	6,235.50	1.123
28.000	36,950.50	3.318	98.000	6,094.87	1.103
29.000	35,877.84	3.279	99.000	5,957.84	1.083

Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Note 3)	Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Note 3)
30.000	34,839.39	3.240	100.000	5,824.32	1.063
31.000	33,833.91	3.201	101.000	5,694.22	1.044
32.000	32,861.74	3.162	102.000	5,567.42	1.025
33.000	31,935.73	3.123	103.000	5,443.84	1.007
34.000	31,039.07	3.085	104.000	5,323.39	0.988
35.000	30,170.77	3.046	105.000	5,205.97	0.970
36.000	29,329.83	3.008	106.000	5,091.51	0.953
37.000	28,515.28	2.969	107.000	4,979.91	0.935
38.000	27,726.22	2.931	108.000	4,871.11	0.918
39.000	26,961.78	2.893	109.000	4,765.02	0.902
40.000	26,221.09	2.855	110.000	4,661.56	0.885
41.000	25,503.33	2.816	111.000	4,560.67	0.869
42.000	24,807.73	2.778	112.000	4,462.27	0.853
43.000	24,133.52	2.741	113.000	4,366.29	0.838
44.000	23,479.98	2.703	114.000	4,272.67	0.822
45.000	22,846.40	2.665	115.000	4,181.34	0.807
46.000	22,232.11	2.628	116.000	4,092.24	0.793
47.000	21,636.47	2.591	117.000	4,005.31	0.778
48.000	21,058.83	2.553	118.000	3,920.49	0.764
49.000	20,498.61	2.517	119.000	3,837.72	0.750
50.000	19,955.21	2.480	120.000	3,756.95	0.736
51.000	19,428.09	2.444	121.000	3,678.12	0.723
52.000	18,916.69	2.407	122.000	3,601.11	0.710
53.000	18,420.49	2.372	123.000	3,526.48	0.697
54.000	17,939.01	2.336	124.000	3,453.62	0.684
55.000	17,471.74	2.300	125.000	3,382.47	0.672
56.000	17,018.23	2.265	126.000	3,313.00	0.660
57.000	16,578.03	2.231	127.000	3,245.16	0.648
58.000	16,150.71	2.196	128.000	3,178.90	0.636
59.000	15,735.84	2.162	129.000	3,114.19	0.625
60.000	15,333.03	2.128	130.000	3,050.99	0.614
61.000	14,941.88	2.094	131.000	2,989.25	0.602
62.000	14,562.03	2.061	132.000	2,928.94	0.592
63.000	14,193.10	2.028	133.000	2,870.02	0.581
64.000	13,834.75	1.995	134.000	2,812.45	0.571
			135.000	2,756.20	0.560

Notes:
1. Optional sensor 4RT6 is connected between Terminals 1TB3-14 and -15 on micro module 1U3.
2. Overall accurary of sensor 4RT6 is as follows:
   - ± 3 F from 0 F to 70 F;
   - ± 5 F from -5 F to 0 F; and,
   - ± 8 F from 70 F to 135 F.
3. As you compare a thermistor resistance (or input voltage) reading with the "actual" temperature indicated by the thermometer, be sure to consider the precision of the thermometer when you decide whether or not the thermistor is out of range.

Table 11
Sensor Conversion Data: Discharge Temperature 4RT8

Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Note 3)	Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Note 3)
32.000	32,861.74	5.211	107.000	4,979.91	4.028
33.000	31,935.73	5.203	108.000	4,871.11	4.004
34.000	31,039.07	5.195	109.000	4,765.02	3.980
35.000	30,170.77	5.187	110.000	4,661.56	3.956
36.000	29,329.83	5.179	111.000	4,560.67	3.931
37.000	28,515.28	5.170	112.000	4,462.27	3.907
38.000	27,726.22	5.161	113.000	4,366.29	3.882
39.000	26,961.78	5.152	114.000	4,272.67	3.857
40.000	26,221.09	5.143	115.000	4,181.34	3.832
41.000	25,503.33	5.134	116.000	4,092.24	3.807
42.000	24,807.73	5.124	117.000	4,005.31	3.782
43.000	24,133.52	5.114	118.000	3,920.49	3.756
44.000	23,479.98	5.104	119.000	3,837.72	3.731
45.000	22,846.40	5.094	120.000	3,756.95	3.705
46.000	22,232.11	5.084	121.000	3,678.12	3.679
47.000	21,636.47	5.073	122.000	3,601.11	3.654
48.000	21,058.83	5.062	123.000	3,526.48	3.628
49.000	20,498.61	5.051	124.000	3,453.62	3.602
50.000	19,955.21	5.040	125.000	3,382.47	3.580
51.000	19,428.09	5.029	126.000	3,313.00	3.550
52.000	18,916.69	5.017	127.000	3,245.16	3.524
53.000	18,420.49	5.005	128.000	3,178.90	3.498
54.000	17,939.01	4.993	129.000	3,114.19	3.471
55.000	17,471.74	4.981	130.000	3,050.99	3.445
56.000	17,018.23	4.969	131.000	2,989.25	3.419
57.000	16,578.03	4.956	132.000	2,928.94	3.392
58.000	16,150.71	4.943	133.000	2,870.02	3.366
59.000	15,735.84	4.930	134.000	2,812.45	3.339
60.000	15,333.03	4.916	135.000	2,756.20	3.313
61.000	14,941.88	4.903	136.000	2,701.24	3.286
62.000	14,562.03	4.889	137.000	2,647.54	3.259
63.000	14,193.10	4.875	138.000	2,595.05	3.233
64.000	13,834.75	4.861	139.000	2,543.76	3.206
65.000	13,486.65	4.846	140.000	2,493.62	3.179
66.000	13,148.46	4.831	141.000	2,444.62	3.153
67.000	12,819.88	4.816	142.000	2,396.72	3.126
68.000	12,500.59	4.801	143.000	2,349.89	3.099
69.000	12,190.32	4.786	144.000	2,304.11	3.073
70.000	11,888.77	4.770	145.000	2,259.35	3.046
71.000	11,595.68	4.754	146.000	2,215.59	3.020

Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Note 3)	Actual Temp. (F)	Actual Resistance (Ohms)	Thermistor Voltage (Note 3)
72.000	11,310.78	4.738	147.000	2,172.78	2.993
73.000	11,033.81	4.721	148.000	2,130.95	2.966
74.000	10,764.53	4.705	149.000	2,090.03	2.940
75.000	10,502.71	4.688	150.000	2,050.01	2.913
76.000	10,248.11	4.671	151.000	2,010.87	2.887
77.000	10,000.51	4.653	152.000	1,972.58	2.861
78.000	9,759.70	4.636	153.000	1,935.13	2.834
79.000	9,525.47	4.618	154.000	1,898.49	2.808
80.000	9,297.62	4.600	155.000	1,862.65	2.782
81.000	9,075.96	4.581	156.000	1,827.59	2.756
82.000	8,860.29	4.563	157.000	1,793.28	2.730
83.000	8,650.45	4.544	158.000	1,759.71	2.704
84.000	8,446.26	4.525	159.000	1,726.86	2.678
85.000	8,247.54	4.506	160.000	1,694.72	2.652
86.000	8,054.13	4.486	161.000	1,663.26	2.626
87.000	7,865.87	4.467	162.000	1,632.47	2.601
88.000	7,682.62	4.447	163.000	1,602.34	2.575
89.000	7,504.22	4.426	164.000	1,572.85	2.550
90.000	7,330.53	4.406	165.000	1,543.97	2.524
91.000	7,161.41	4.385	166.000	1,515.71	2.499
92.000	6,996.74	4.365	167.000	1,488.04	2.474
93.000	6,836.36	4.344	168.000	1,460.96	2.449
94.000	6,680.17	4.322	169.000	1,434.43	2.424
95.000	6,528.05	4.301	170.000	1,408.47	2.399
96.000	6,379.86	4.279	171.000	1,383.04	2.375
97.000	6,235.50	4.257	172.000	1,358.14	2.350
98.000	6,094.87	4.235	173.000	1,333.75	2.326
99.000	5,957.84	4.213	174.000	1,309.87	2.302
100.000	5,824.32	4.191	175.000	1,286.48	2.278
101.000	5,694.22	4.168	176.000	1,263.57	2.254
102.000	5,567.42	4.145	177.000	1,241.13	2.230
103.000	5,443.84	4.122	178.000	1,219.15	2.206
104.000	5,323.39	4.099	179.000	1,197.61	2.183
105.000	5,205.97	4.075	180.000	1,176.52	2.159
106.000	5,091.51	4.052			

Notes:
1. Discharge sensor 4RT8 is connected between Terminals 1TB4-13 and -14 on micro module 1U3; overall accuracy is as follows:
   ± 2 F from 100 F to 180 F; and,
   ± 5 F from 32 F to 100 F.
2. Optional bearing temperature sensors are connected between Terminals 1TB4-19 and -20 (4RT8), and 1TB4-21 and -22 (4RT9); sensor accuracy is ± 2 F.
3. As you compare a thermistor resistance (or input voltage) reading with the "actual" temperature indicated by the thermometer, be sure to consider the precision of the thermometer when you decide whether or not the thermistor is out of range.

Table 12
Sensor Conversion Data:
Winding Temperature (4B1R2, 4B1R3, 4B1R4)

Actual Temp. (F)	Sensor Voltage (Volts)	Nominal Resistance (Ohms)	Acceptable Resistance Values (Ohms)	
			Minimum	Maximum
50	0.321 ± 0.05	70.1 ± 2.7	67.4	72.8
55	0.326 ± 0.05	71.1 ± 2.7	68.4	73.8
60	0.330 ± 0.05	72.1 ± 2.7	69.4	74.8
65	0.334 ± 0.05	73.1 ± 2.7	70.4	75.8
70	0.338 ± 0.05	74.0 ± 2.6	71.4	76.6
75	0.342 ± 0.05	75.0 ± 2.6	72.4	77.6
80	0.347 ± 0.05	76.0 ± 2.6	73.4	78.6
85	0.351 ± 0.05	77.0 ± 2.6	74.4	79.6
90	0.355 ± 0.05	78.0 ± 2.6	75.4	80.6
95	0.359 ± 0.05	79.0 ± 2.6	76.4	81.6
100	0.364 ± 0.05	80.0 ± 2.6	77.4	82.6
110	0.372 ± 0.05	82.0 ± 2.5	79.5	84.5
120	0.381 ± 0.05	84.0 ± 2.5	81.5	86.5
130	0.390 ± 0.05	86.0 ± 2.5	83.5	88.5
140	0.397 ± 0.05	88.0 ± 2.5	85.5	90.5
150	0.407 ± 0.05	90.2 ± 2.4	87.8	92.6
160	0.415 ± 0.05	92.2 ± 2.4	89.8	94.6
170	0.424 ± 0.05	94.3 ± 2.3	92.0	96.6
180	0.433 ± 0.05	96.5 ± 2.3	94.2	98.8
190	0.441 ± 0.05	98.5 ± 2.3	96.2	100.8
200	0.450 ± 0.05	100.8 ± 2.3	98.5	103.1
210	0.459 ± 0.05	103.0 ± 2.2	100.8	105.2
220	0.468 ± 0.05	105.1 ± 2.2	102.9	107.3
230	0.476 ± 0.05	107.2 ± 2.1	105.1	109.3
240	0.486 ± 0.05	109.5 ± 2.0	107.5	111.5
250	0.494 ± 0.05	111.6 ± 2.0	109.6	113.6
260	0.504 ± 0.05	114.0 ± 2.0	112.0	116.0
270	0.514 ± 0.05	116.4 ± 2.1	114.3	118.5
280	0.523 ± 0.05	118.7 ± 2.2	116.5	120.9
290	0.532 ± 0.05	121.1 ± 2.2	118.9	123.3
300	0.542 ± 0.05	123.6 ± 2.3	121.3	125.9
310	0.552 ± 0.05	126.1 ± 2.3	123.8	128.4

Notes:

1. Sensor 4B1R2 is connected between Terminals 1TB4-15 and -17 on micro module 1U3; sensor 4B1R3 is connected between Terminals 1TB4-16 and -17, and sensor 4B1R4 is connected between Terminals 1TB4-18 and -17. Overall accurary of these sensors is ± 15 F.
2. As you compare a thermistor resistance (or input voltage) reading with the "actual" temperature indicated by the thermometer, be sure to consider the precision of the thermometer when you decide whether or not the thermistor is out of range.

For those sensors with readings displayed at the front panel (i.e., entering and leaving evaporator water temperatures, entering and leaving condenser water temperatures, and evaporator refrigerant temperature), check the displayed temperature plus 0.5 F against the measured temperature. If the sensor checks out okay but the module reads in error, 1U3 must be replaced.

Note: In all instances where module replacement is indicated, perform these tests before module change out:

a. Check the power supply according to the information in Power Supply Checkout Procedure.

b. Repeat the checkout procedure using a new sensor.

b A3 Evaporator Refrigerant Temperature Range

Diagnostic b A3 appears on the control panel display when the setpoint determined by the "evaporator refrigerant trip" potentiometer is below the minimum allowable setting. A minimum setpoint of 29 F is permitted for standard range units; this value drops to 0 F for extended range unit applications.

To check the evaporator trip setpoint:

1. Turn the evaporator refrigerant "trip" setpoint potentiometer fully clockwise.

2. Adjust the chiller switch to "Standby/Reset". (If the chiller switch is already at "Standby/Reset", flip it to one of the "Auto" positions, then back to "Standby/Reset". This should clear the diagnostic and display operating code AO.

3. Turn the slide valve control to "Hold".

4. Press the display advance push button until the evaporator trip setpoint code prefix I_I appears on the display. Latching diagnostic b A3 occurs if the setpoint is out-of-range low.

5. With the chiller switch still in "Standby/Reset" and the slide valve control knob at "Hold", readjust the evaporator refrigerant trip setpoint by turning the potentiometer screw until the desired setpoint is reached.

If the display does not change when this adjustment is made, interrupt control panel power for a minute or so; then restore power and repeat Step 4. If the display still does not respond, the micro module (1U3) may be defective. Use the Power Supply Checkout Procedure to determine whether the module must be replaced.

b A4, A7, A8 Motor Temperature Sensors

Any one of these diagnostics i.e., b A4, b A7 or b A8) is displayed, and the unit shut down, when the temperature measured at the corresponding sensor input (Table 13) is above 265 ± F. To determine whether the sensor is open or malfunctioning, or if micro module 1U3 is defective, follow the checkout procedure outlined in "Temperature Sensor Checkout".

Table 13
Motor Temperature Sensors

Sensor Designation	Electrical Designation	Electrical Connections (1U3)	Diagnostic Code*
Sensor #1	4B1R2	1TB4-15, -17	b A4
Sensor #2	4B1R3	1TB4-16, -17	b A7
Sensor #3	4B1R4	1TB4-18, -17	b A8

*These diagnostics occur only when the unit is not running--or when the chiller is reset.

b Ab Leaving (Evaporator) Water Temperature Sensor

Latching diagnostic b Ab occurs whenever the temperature measured by the leaving evaporator water temperature sensor (4RT1) drops below 15 F. (A leaving water temperature "low limit" stops chiller operation at 35.3 F on standard range units only.)

Use the instructions in "Temperature Sensor Checkout" to determine whether sensor 4RT1 is open or malfunctioning. (The sensor leads are connected to terminals 1TB3-1 and 1TB3-2 on micro module 1U3.)

If the results of the sensor checkout indicate that 4RT1 is functioning properly, determine why the leaving water temperature is so low; among the possible causes to consider are:

Chilled water flow problems (e.g., plugged strainers or heat exchangers, bypassed water, pump malfunction, or erratic return water temperature).

b Ad Evaporator Refrigerant Temperature Sensor

The evaporator refrigerant temperature sensor (4RT5) is factory-installed in a bulbwell located below the unit control panel, near the bottom of the evaporator shell. A latching diagnostic condition, b Ad, is initiated if 4RT5 senses an evaporator refrigerant temperature below -5 F or above 150 F.

Should this occur, use the sensor checkout procedure in "Temperature Sensor Checkout" to determine whether 4RT5 is open/shorted or malfunctioning. (4RT5 is connected to terminals 1TB3-12 and 1TB3-13 on micro module 1U3.)

Note: The b Ad sensor diagnostic normally occurs only during a nonoperating mode, since the evaporator trip setpoint is much higher than -5 F. No normal machine operating conditions will yield an evaporator refrigerant temperature lower than -5 F.

b AE Ambient Temperature Sensor (Optional)

Latching diagnostic b AE occurs when the optional ambient temperature sensor (4RT6) registers an outdoor air temperature exceeding 150 F. If b AE appears on the display, determine whether or not 4RT6 is shorted or malfunctioning. (Follow the sensor checkout procedure in Temperature Sensor Checkout section.)

The optional ambient temperature sensor is connected between micro module (1U3) terminals 1TB3-14 and 1TB3-15.

b d9 Extended Power Loss

Occurrence of this nonlatching "power-up" diagnostic indicates that the UCM detected a power loss lasting more than 30 line-cycles. Once power is restored, the b d9 diagnostic is retained in the "Last Diagnostic Code" register, and the UCM automatically indicates a "power-on" reset. See "b E2: Momentary Power Loss" for further information.

b dc Condenser Water Flow Overdue

During the start sequence, the UCM closes condenser water pump relay K6 (i.e., located between terminals 1TB1-4 and 1TB1-5 on relay output module 1U1). Closure of the K6 contacts issues a signal to start the condenser water pump. As the UCM checks for condenser water flow, the operating code appearing on the display changes from A 70 (restart inhibit) to A 71 (establish condenser water flow).

If flow is not proven (i.e., condenser water flow switch 5S3 does not close) within 3 minutes of K6 contact closure, the unit will shut down on latching diagnostic b dc.

A number of component malfunctions and operating problems can result in a "condenser water flow overdue" diagnostic; below is a partial list.

1. Faulty condenser water pump relay (K6).
2. Faulty condenser water pump contactor (5K2).
3. Faulty condenser water pump auxiliary contactor (5K2).
4. Faulty condenser water flow switch (5S3).
5. Faulty condenser water pump relay (1K17).
6. Closed condenser water circuit valves.
7. Condenser water circuit valves are open to too many machines.
8. Plugged condenser water circuit strainers.

Before restarting the chiller, determine why condenser water flow was not established and correct the problem.

Note: To troubleshoot the condenser water pump electrical circuit (i.e., Items 1 through 5 above), refer to checkout procedure for condenser water pump relay.

b E2 Momentary Power Loss

Occurrence of this nonlatching diagnostic indicates that there was a brief loss of power. Keep in mind that the power interruption must last at least 2 or 3 line-cycles in order for the micro module to detect it; 1U3 will then take the chiller off-line within 6 line-cycles (i.e., including detection time). Momentary power losses of this type are usually caused by an automatic switching gear in the main power lines.

A power loss lasting from 1 to 30 line-cycles results in a normal unit shutdown. The UCM undergoes a "power-on" reset and follows the normal start-up criteria. Diagnostic b E2 is then stored in the "Last Diagnostic Code" entry of the display menu.

If the power interruption lasts more than 30 line-cycles, the UCM identifies this as an "extended power loss" and initiates a "power-on" reset after power is restored. The b d9 diagnostic is retained in the "Last Diagnostic Code" register, and the unit follows the normal start-up criteria (e.g., restart inhibit, differential-to-start, etc.) (See b d9: Extended Power Loss.)

Note: The UCM identifies a "momentary power loss" condition when the incoming current is below 15% of the rated load amps (RLA) and the "main run" starter contactor (2K1) is closed.

b E3 Phase Imbalance (Optional)

Latching diagnostic b E3 occurs when a phase imbalance exceeding 15% occurs. The UCM recognizes that a phase imbalance condition exists when the following criteria are met:

[ ] The chiller is operating in one of the "run" modes (see Table 1);

[ ] The imbalance exists for longer than 1 second; and,

[ ] the percent of imbalance is greater than 15%.

Note: The percent of imbalance is calculated using this equation–

$$\frac{I_{Ph\#} - I_{Avg}}{I_{Avg}} * 100$$

where $I_{Ph\#}$ is one of the 3 phases, and $I_{Avg} = \frac{I_{Ph1} + I_{Ph2} + I_{Ph3}}{3}$

Two possible (but not the only) causes of a phase imbalance are: (1) a voltage imbalance of the incoming power, and (2) a resistance imbalance of the compressor motor windings. (The latter is very rare because of the stringent specifications employed by the motor manufacturer during the winding and testing of new motors.)

To determine whether the fault lies with the line power or the motor, follow the procedures outlined below.

WARNING: To prevent injury or death due to electrical shock, use extreme care when working with energized electrical equipment.

Note: Amperage measured must be line current (not phase current), and should be measured at the line side of the starter (i.e., incoming power lines). Measure voltage at the motor terminals while the unit is operating; any voltage imbalance related to the starter or to wiring resistance will be included in the imbalance calculations.

1. Voltage imbalance can be caused by a voltage drop across any of the starter panel components:

a. Measure voltage across each of the starter components to the motor terminals on each phase while the unit is operating.

b. Use the low (i.e., 0 to 5 volts) scale of a volt-ohmmeter to read the voltage on either side of the same electrical phase on all contactors, fuses, circuit breakers, leads, etc. There should not be any appreciable voltage drop across any of these circuits.

If a measured voltage drop is observed across a lead or contactor, a poor connection or worn contact is indicated. Repair or replace as necessary.

c. If the results of Steps 1a and 1b indicate that the voltage imbalance is not caused by the starter or motor leads, contact the power company.

2. If there is a current imbalance with no measurable voltage imbalance, determine whether a motor or line problem exists. To do this, rotate the line leads twice since the RTHA compressor is not designed to run backwards.

If the current imbalance follows one set of phase leads, the incoming power is at fault and may be the result of unbalanced impedance or resistance somewhere in the power system. Contact the power company for assistance.

If the current imbalance remains with a particular motor winding, contact the Pueblo Technical Service Department with complete nameplate information.

Note: To override the phase imbalance feature, move DIP switch no. 7 on DIP switch block S3 to the ON position.

b E4 Phase Loss

Occurrence of this latching diagnostic indicates that 1 leg of the 3-phase power supply has been lost. The phase loss "threshold" recognized by the UCM is any phase that drops below 15% of the RLA for more than 1 second.

A variety of causes can result in a phase loss condition; three of these include: (1) a blown fuse or breaker in one leg; (2) an incomplete or open line connector to one leg; and (3) a burned or open motor winding. Be sure to determine and correct the fault condition that created the phase loss before restarting the unit.

b E5 Phase Reversal

(Unit should not be started until phase rotation has been determined to be clockwise). Latching diagnostic b E5 is generated by the UCM within 1 second of its detection of a counterclockwise phase rotation in the incoming power. (For proper machine operation, the incoming power must be phased or clockwise rotation.)

Note: It is essential to check proper phase rotation prior to start-up.

Possible reasons for a phase reversal condition include, but are not limited to, these:

1. Incoming power is phased or counterclockwise rotation;
2. Current transformer polarity (i.e., primary or secondary) is reversed;
3. A current transformer wiring error; and,
4. An electrical connection error between the current transformer and micro module 1U3.

If phase rotation is incorrect, the unit will shut down on the b E5 diagnostic when a start-up is attempted. To reverse the rotation, change the phasing at the incoming power to the starter. Do not attempt to change rotation at the motor terminals!

WARNING: To prevent injury or death due to electrical shock, open chiller disconnect switch before reversing phasing.

If you determine that the incoming power is phased correctly, conduct a thorough checkout of the current transformer polarity and wiring. (Some additional information on current transformer checkout is provided in this service guide, i.e., "Checkout Procedure for Compressor Transition Relay".)

b E7 High Motor Temperature

Three RTD-type sensors embedded in the motor windings enable the UCM to monitor the temperature of the compressor motor. If the UCM detects a motor winding temperature exceeding 265 F (i.e., +/- 15 F, UCM error only), it initiates a latching diagnostic. Code b E7 flashes on the control panel display and the unit is shut down.

Below is a list of some of the circumstances that can result in a "high motor temperature" diagnostic:

1. Inaccurate sensor response or open sensor (i.e., check the sensors and micro module 1U3 using the instructions in the sensor conversation data.
2. "Low voltage" condition, resulting in over-amperage.
3. Motor operation in excess of the RLA.
4. Short cycling of motor (insufficient time between when motor sees LRA).

b F2 Proving Oil Flow

Sufficient oil flow through the bearing oil supply system must be confirmed within 30 seconds after start-up by closing flow switch 4S5, or the unit locks out on low oil flow. (Latching diagnostic b F2 will flash alternately with operating code A 74 on the display.) If latching diagnostic b F2 appears, check oil filter and service valves.

b E8 Oil Flow Switch Closed

If 4S5 oil flow switch is closed before start-up, b E8 diagnostic is displayed. This checks for an oil flow switch that is not functioning properly. Check for flashing between b E8/A 72. Check for defective 4S5.

b E9 Stop Relay

This latching diagnostic is generated if you attempt to shut down the chiller, but the UCM continues to detect current; when this situation occurs, the UCM takes the chiller off-line by opening the overload relay.

b EC Running Overload

Latching diagnostic b EC is generated by the UCM when the average 3-phase current drawn by the compressor motor exceeds 107% of the RLA. The "time-to-trip" interval graduates from 20 seconds to 107% RLA to 1 second at 140% RLA. Chiller control near the compressor RLA is comprised of a 5-step "corrective action" control sequence designed to minimize the likelihood of overload lockouts caused by normal operating fluctuations in amperage. The 5 steps in this corrective action sequence are:

1. Slide valve loading limited
2. Slide valve loading prevented
3. Modulated slide valve unloading
4. Hard slide valve unload
5. Chiller shut down on latching diagnostic b EC

b Ed Chilled Water Flow

Code b Ed represents a nonlatching diagnostic condition caused when the chilled water flow interlock circuit opens. A built-in time delay of 2 seconds (i.e., maximum without flow) is designed to eliminate nuisance tripouts caused by a fluttering flow switch.

Because this diagnostic is nonlatching, the chiller automatically attempts to restart when the interlock circuit closes. The b Ed code is then stored in the "Last Diagnostic Code" register of the display menu. Manual (i.e., from a remote source) start-up of the chilled water pump(s) is required.

Use the steps outlined below to determine why the chilled water flow diagnostic occurred:

1. Verify that the chilled water pump is turned on.

a. If the pump is not running, check for blown fuses, open disconnect switches, etc.

b. If the pump is running, check for plugged strainers. Also, ensure that pump capacity is sufficient to handle all of the chillers piped into the chilled water circuit.

2. Check the status of chilled water flow switch 5S2; if it is open, see Step 1b. In addition, be sure that the proper pressure drop is provided to the unit. If the flow rate is correct, flow switch 5S2 may be defective.

3. Check the status of the chilled water pump contactor auxiliary (5K1); it should be closed whenever the pump is running.

4. Verify that chilled water pump relay 1K16 (i.e., located in the unit control panel;) is energized and that its contacts are closed. Relay 1K16's contacts are connected between terminals 1TB3-20 and 1TB3-21 on micro module 1U3.

5. Determine whether micro module 1U3 is functioning correctly. To do this, install a jumper between terminals 1TB3-20 and 1TB3-21, and set the chiller switch at one of the "Auto" positions.

If the b Ed diagnostic code is cleared from this display, 1U3 is operating properly. However, if b Ed remains on the display, micro module 1U3 is defective and must be replaced.

Caution: To ensure proper chiller protection, never start the unit when the chilled water flow interlock circuit is jumpered! If jumper installation clears the diagnostic, remove the jumper immediately. If the diagnostic does not clear within 3 minutes, remove the jumper and replace 1U3.

b F0 Transition

Latching diagnostic b F0 occurs when the starter fails to complete transition. Micro module 1U3 monitors the status of a normally-open set of auxiliary contacts on the "run" contactor (2K2). (Relay 2K2 is located in the starter panel.) If these contacts do not close within 2.8 seconds +/- 10% after the transition signal is sent to the starter, the UCM shuts down unit operation on the b F0 diagnostic.

Notice that the auxiliary on contactor 2K2 is tied to terminals 2TB3-7 and 2TB3-8 in the starter panel and, from there, to terminals 1TB4-5 and 1TB4-6 on micro module 1U3 in the unit control panel. See Figures 3 through 6.

Among the possible reasons for a failure to transition are these:

[ ] Faulty wiring or bad connections in the proof-of-transition circuit.

Note: Be sure to verify that the normally-open 2K2 auxiliary contacts located between terminals 2TB3-7 and -8 close to provide a "transition complete" signal to micro module 1U3. If a voltage signal is present at terminals 1TB4-5 and -6 but 1U3 fails to recognize it, 1U3 is defective and must be replaced.

WARNING: Use extreme care when performing this checkout procedure with power on; carelessness can result in injury or death due to electrical shock.

[ ] Defective "run" contactor auxiliary (2K2).

Check for closure of the 2K2 auxiliary contacts when the main contactor closes. This circuit is monitored by a 12 VDC, 45 mA current. 2K2 auxiliary contacts connected to these terminals must be compatible with current described above: gold-plated contacts are recommended to avoid oxidation resistance.

[ ] Defective compressor transition relay (K5; located on power supply output module 1U2 in the unit control panel).

Note: Micro module 1U3 will not generate a b F0 diagnostic unless it sees the conditions necessary for transition and initiates the transition signal.

Monitor the status of the K5 relay contacts at terminals 1TB2-5 and 1TB2-6 on power supply output module 1U2. If the K5 contacts do not close, follow the transition relay troubleshooting instructions provided in Compressor Transition Relay Checkout Section. (This will isolate the malfunction at either 1U2 or 1U3.)

If the K5 contacts do close, the problem lies either in the starter or in the wiring connections to the starter. Use the "Electrical Sequence of Operation" in the unit Operation/Maintenance manual and the wiring diagrams provided with the starter as a guide for determining proper starter operation.

b F1 Running External Interlock

The UCM generates latching diagnostic condition b F1 when the field-supplied and field-installed run spare fault switch (5S4) closes during chiller operation. This switch input becomes active 1 second after transition, but is ignored by micro module 1U3 before and during start-up.

In the event that a b F1 diagnostic occurs, check the electrical connections made at terminals 1TB4-3 and 1TB4-4. Verify that these terminals are not jumpered, and that the device connected to them, if any, is functioning properly.

If the external circuit appears to be okay, remove the wires from 1TB4-3 and 1TB4-4 and operate the chiller. Disappearance of the b F1 diagnostic indicates that the problem is somewhere in the external circuit, while its reoccurrence implies that micro module 1U3 is defective and must be replaced.

Power Supply Checkout Procedure

Overview

Refer to Figure 7. Notice that the UCP control panel contains a power supply transformer (1T1) and a power supply output module (1U2) that furnish power to micro module 1U3. The information in this section describes a method for verifying that both of these components (i.e., 1T1 and 1U2) are operating properly. For your reference, a typical control panel connection diagram and electrical schematic for a standard RTHA unit (with unit-mounted starter and remote mounted starter) are illustrated in Figures 3 through 6.

Note: It is good practice to check the power supply components (i.e., 1T1 and 1U2) whenever troubleshooting the micro module. An improper voltage input to 1U3 can cause a good micro module to produce erratic output responses.

Power Supply Output Module 1U2 Checkout (Figure 8)

Refer to Figure 7 when performing the following steps for a power supply output module checkout.

1. Remove the cover strip located along the top of micro module 1U3, and find ribbon cable connector 1P4. See Figure 7. Verify that ribbon cable 1P4 is firmly and correctly connected to 1J4.

Note: Notice that, in this instance, the pins are numbered from left to right.

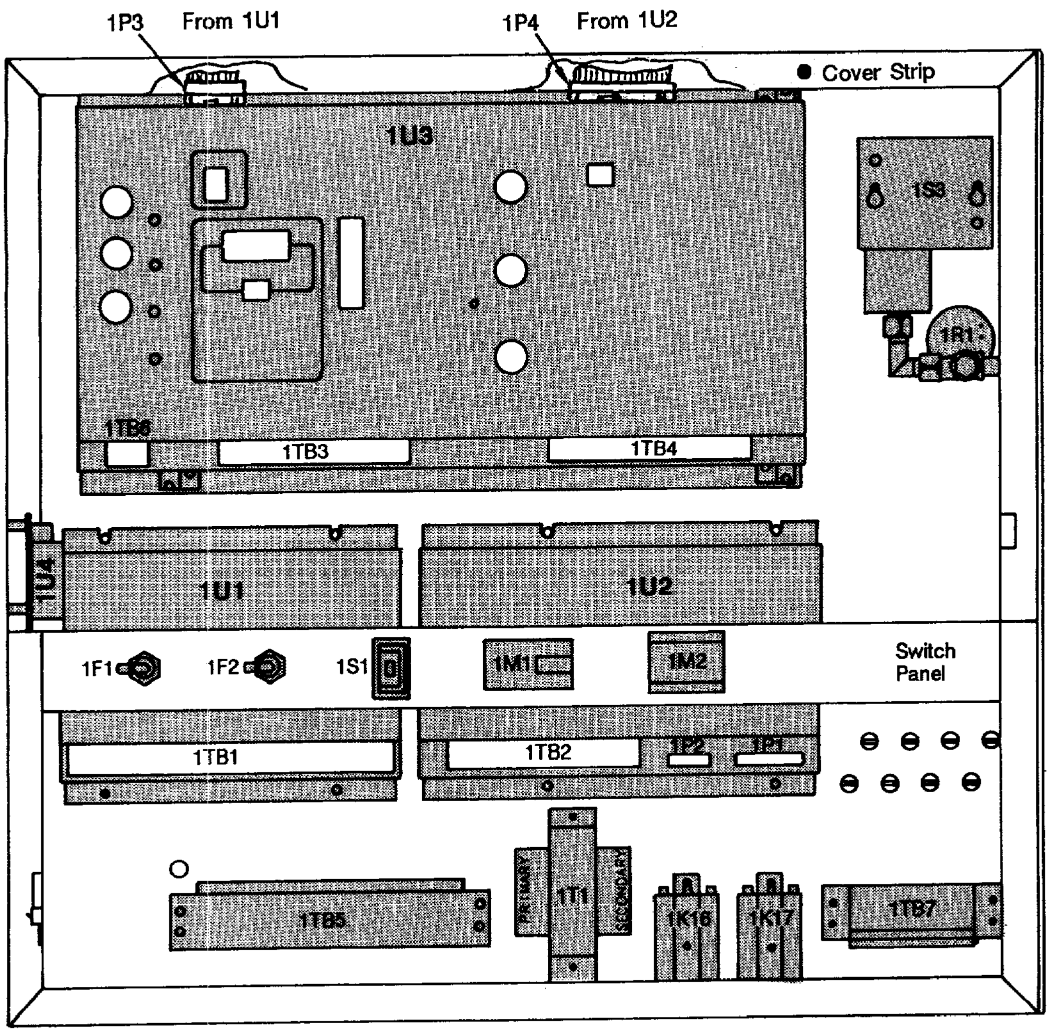
2. Using a digital VOM set to register DC voltage signals, connect the black (negative) VOM lead to Pin 1P4-14 (Figure 8).

3. Measure the voltages at Pins 1P4-10, -11, -12, -13, -16, -18, -19 and -20. Compare these voltage readings with the allowable voltage signal indicated in Figure 8.

4. Set the VOM to register AC voltage signals; then connect the black VOM lead to Pin 1P4-11 and the red VOM lead to Pin 1P4-10. Measure the voltage between these pins, and compare this value to the "AC component" range shown for Pins 10 and 11 in Figure 8.

Note: If any of the voltages measured in Steps 3 and 4 are out of range, and the power transformer checked out okay, a problem with the power supply output module is indicated.

Figure 7
UCP Layout



Legend

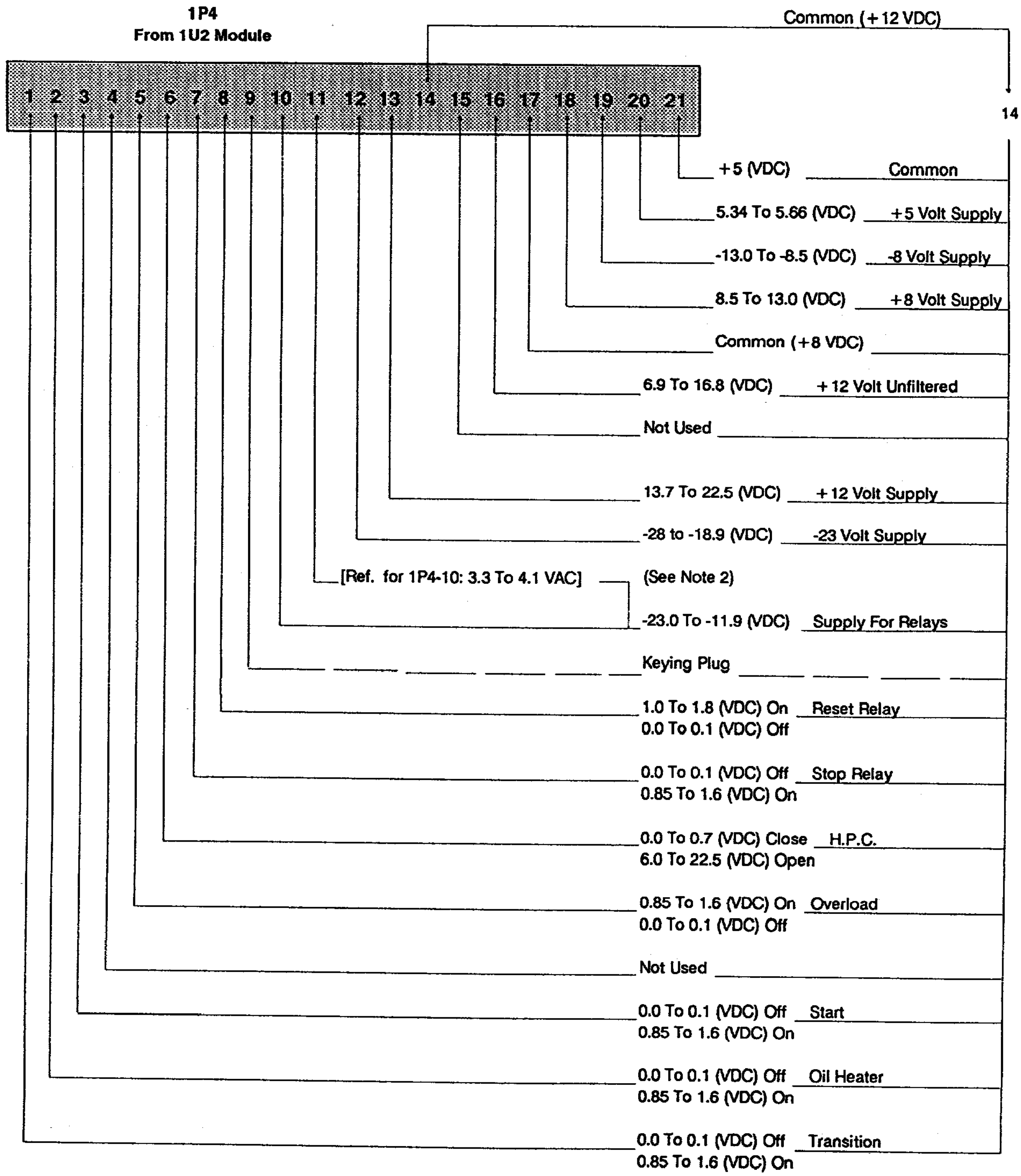
1F1 = Control Circuit Fuse
1F2 = 1T1 Primary Fuse
1K16 = Chilled Water Flow Switch Relay
1K17 = Condenser Water Flow Switch Relay
1M1 = Hour Meter
1M2 = Start Counter
1R1 = Condenser Pressure Transducer
1P1 = 1U2 Power Supply Plug
1P2 = 1U2 Power Supply Plug
1S1 = Unit Service Switch
1S3 = High Pressure Cutout

1T1 = Power Supply Transformer
1TB1 = 1U1 Terminal Block
1TB2 = 1U2 Terminal Block
1TB3 = 1U3 Terminal Block
1TB4 = 1U3 Terminal Block
1TB5 = Control Voltage Terminal Block
1TB6 = 1U3 Terminal Block
1TB7 = Control Voltage Terminal Block
1U1 = Relay Output Module
1U2 = Power Supply Output Module
1U3 = Micro Module
1U4 = Chilled Water Reset Interface Module

6U5 - Ice Maker Optional
6U6 - Ice Maker Latch Panel

5706-0925D

Figure 8
Checkout Schematic for output module 1U2
Ribbon Cable 1P4 Identification and Voltages



Notes:

1. Voltage values in this table apply <u>only</u> when ribbon connector 1P4 is connected to 1J4 of micro module 1U3. All voltage signal values shown are with respect to Terminal 1P4-14 unless otherwise indicated.
2. Reference 1P4-11 To 1P4-14 (-23.0 To -11.9 VDC).

Power Transformer (1T1) Checkout (Figure 9)

1. Check branch circuit fuse 1F2 for continuity.

2. Confirm that 120 VAC power is available across the 2 black leads of transformer 1T1.

3. Verify that the output cable (1P1) from power supply transformer 1T1 is firmly and correctly attached to 1J1 on power supply output module 1U2.

Before proceeding to Steps 4, 5 and 6, keep these points in mind when taking the requested measurements: (1) the pins on 1P1 are numbered from right to left; and (2) be sure that good contact is made with the metal of the pin.

4. Connect the black (negative) lead of a digital VOM-set to measure DC voltage to pin 1P1-1 (i.e., chassis common). Then, measure the voltages at Pins 1P1-2 thru -10, and compare the measured values with the allowable signal ranges shown in Figure 9.

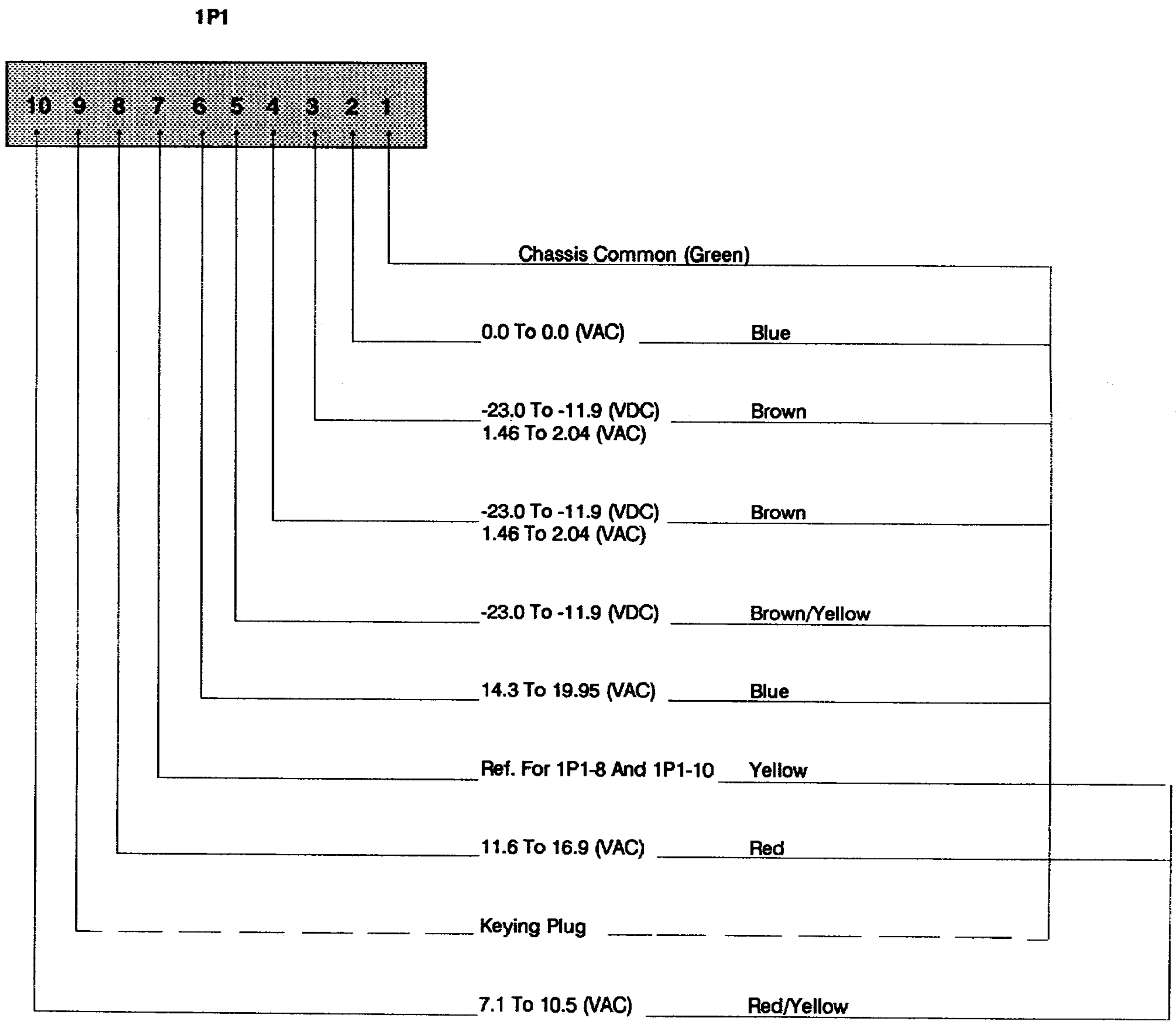
Note: If any of the voltages measured in Step 4 are out of range, and the voltages measured in Steps 5 and 6 are in range, transformer 1T1 is okay but power supply output module 1U2 may be malfunctioning. Check 1U2's output before replacing either component.

5. Switch the digital VOM to register AC voltages, and, with the black VOM lead still connected to PIN 1P1-1, measure the voltages at Pins 1P1-2, -3, -4, -6 and -8. Compare these measured voltages with the allowable signal ranges indicated in Figure 9.

6. Move the black (negative) lead of the VOM to Pin 1P1-7; then measure the voltages at Pins 1P1-8 and -10. Compare the voltage readings obtained with the allowable signal ranges indicated in Figure 9.

Note: If any of the voltages measured in Steps 5 and 6 are out of range, a problem with power supply transformer 1T1 is indicated. Before replacing 1T1, use the blade of a small screwdriver to press the wires of 1J1 firmly into their sockets. Occasionally, the wire insulation is not cut completely when the wires were initially inserted into the connector.

Figure 9
Power Supply Transformer (1T1) Checkout.
Ribbon Cable Plug 1P1 Identification and Voltages.



Notes:

VAC are measured with respect to 1P1-7
VDC are measured with respect to 1P1-1

Compressor Transition Relay 1U2K5 and Current Transformer Checkout Procedures

To effectively use the compressor transition relay (1U2K5) and current transformer (2T1, 2T2, 2T3, 2T5, 2T6 and 2T7) checkout procedures described in this section, it is important to first understand the normal operation of the control panel during start-up. Review the start sequence (along with the typical electrical schematic in Figures 3 thru 6 before attempting to check the integrity of 1U2K5.

1. Micro module 1U3 initiates a "start" signal.

Once all of the prestart criteria are satisfied (i.e., condenser and chilled water flows proven, etc.), micro module 1U3 initiates a "start" signal by "telling" the K1, K2, K3 and K4 relay contacts in power supply output module 1U2 to close.

Proper response to all 4 sets of contacts allows control voltage to flow from Terminal 1TB2-9 to 1TB2-7; from there, current passes to Terminal 1TB5-10 (and 2TB2-6) where it energizes the coil to pilot relay 2K5 in the starter panel.

2. "Start" windings of chiller compressor motor 4B1 energize.

Once energized, pilot relay 2K5 begins the compressor motor start process by energizing the coil of shorting contactor 2K3; this, in turn, energizes start contactor 2K1. Closure of 2K1's normally-open contacts allows line voltage to flow through the "start" windings of the compressor motor (4B1).

3. Micro module 1U3 initiates transition.

Milliampere signal inputs at Terminals 1TB4-7 through -12 allow micro module 1U3 to monitor compressor motor amperage draw via 3 pairs of current transformers.

Keep in mind that 1U3's control logic prevents it from initiating transition unless these two conditions are met:

a. First, motor amp draw must exceed 15% of the rated load amps (RLA); and,

b. 2.8 seconds must elapse after initiation of start signal.

If both of these requirements are satisfied, 1U3 initiates transition by energizing the compressor transition relay (1U2K5) in the power supply output module.

Note: 1U2K5 is energized when the voltage signal at Pin 1 (with respect to Pin 14) on ribbon connector 1P4 is 0.85 to 1.6 VDC. (See Figure 8).

4. Transition occurs successfully, and compressor motor 4B1 is operating in the normal run configuration.

Closure of the K5 compressor transition relay contacts in 1U2 allows current to reach the coil of the starter panel's transition contactor (2K4). As 2K4 energizes, its normally-closed auxiliary contacts open to de-energize shorting contactor 2K3.

Run contactor 2K2 energizes when 2K3's normally-closed auxiliary contacts re-close (Notice that the 2K4 transition contactor de-energizes as soon as the normally-open 2K2 auxiliary contacts in the transition circuit.)

When line voltage flows across the now-closed 2K2 contacts to the "delta" windings of 4B1, the compressor motor is in its normal "run" configuration.

5. Micro module 1U3 confirms that transition was successfully completed.

Notice that a normally-open set of auxiliary contacts on run contactor 2K2 is located in a "proof-of-transition" circuit connected to micro module input Terminals 1TB4-5 and -6.

Closure of these auxiliary 2K2 contacts "tells" micro module 1U3 that transition occurred successfully.

If these contacts do not close within 2 seconds after the transition signal is sent to the starter (see Step 3), micro module 1U3 assumes that the compressor motor failed to transition, and shuts down unit operation on latching diagnostic b F0.

Faulty current-sensing inputs (1TB4-7 thru -12)

Recall that in Step 3 of the preceding start sequence, 1U3 monitors the milliampere signals it receives at input Terminals 1TB4-7 through -12 to determine whether or not compressor motor amp draw exceeds 15% or RLA. Control logic prevents 1U3 from initiating the transition signal unless this prerequisite is met.

Faulty current-sensing inputs may prevent 1U3 from "seeing" this amp draw (i.e., causing it to shut down unit operation on b E4 phase loss or b E2 momentary power loss).

Defective micro module (1U3)

Latching diagnostic b F0 can occur if micro module 1U3 receives the appropriate current-sensing inputs at Terminals 1TB4-7 through -12, but fails to issue a "close" signal to the normally-open 1U2K5 contacts because of an internal malfunction.

(Review Step 3 of the start sequence again. Notice that the existence of a 0.85 to 1.6 VDC voltage signal at Pin 1P4-1, with respect to Pin 1P4-14, confirms that 1U3 did tell the 1U2K5 contacts to close.)

Defective power supply output module (1U2)

Even though motor amp draw requirements are satisfied and 1U3 successfully transmits a "transition" signal to the power supply output module (1U2), transition will not occur if 1U2 is defective and fails to close its K5 compressor transition relay contacts.

Faulty starter component(s) or wiring

Refer again to Step 4 of the start sequence. Notice that closure of the 1U2K5 contacts should provide current to transition contactor 2K4 (and, ultimately, run contactor 2K2) in the starter panel. If the electrical connections between 1U3 and the starter panel are faulty, or if either 2K4, 2K3 or 2K2 is defective, transition will not occur, and 1U3 will generate a b F0 or b E2 ("momentary power loss") diagnostic.

Faulty "proof-of-transition" circuit

Keep in mind that the existence of a b F0 diagnostic may not necessarily mean that the starter failed to transition. It is equally possible that transition was completed successfully, but micro module 1U3 is not receiving "proof of transition" at input Terminals 1TB4-5 and -6. In this situation, either the auxiliary 2K2 contacts are malfunctioning, or the "transition complete" electrical circuit is defective.

Note: The 2K2 auxiliary contacts are rated for a dry circuit. Ensure that contacts are rated as such.

Whenever a b F0 (or, in some cases a b E4 or b E2) chiller diagnostic condition exists, use the following checkout procedure to isolate the source of the transition-related failure.

Note: The micro module checks for a faulty (shorted) transition contact before entering start sequence (b F0 diagnostic). The micro module allows 2 seconds to receive a confirmation of transition complete after transition is initiated.

1U2K5 Checkout Procedure

Note: The steps in this procedure were purposely arranged for ease of completion, and do not reflect the sequence of events previously described for a normal, attempted start-up.

WARNING: Use extreme care when performing this checkout procedure while the chiller is energized. Carelessness can result in injury or death.

1. Connect the voltmeter to Terminals 1TB2-5 and -6, and check for closure of the K5 contacts during the chiller start sequence.

If the K5 contacts do not close, go to Step 2 and complete the step-by-step instructions that follow to isolate the malfunction at power supply output module 1U2, micro module 1U3, or the current transformers (i.e., 2T1, 2T2, 2T3, 2T5, 2T6 and 2T7).

Note: If the K5 compressor transition relay contacts do close during the start sequence, the problem lies either in: (1) the starter itself, or (2) the wiring connections to the starter.

2. Set a digital VOM to register DC voltage; then connect the black (negative) VOM lead to Pin 1P4-14 and the red lead to Pin 1P4-1.

3. Repeat the chiller start sequence and check the VDC signal at Pin 1P4-1 when at most 2.8 seconds have elapsed since initiation of start signal.

If the signal measured at Pin 1P4-1 does not increase from 0.0-0.1 VDC to 0.85-1.6 VDC when the 2.8 seconds have elapsed, replace micro module 1U3.

Note: If input voltage at Pin 1P4-1 does increase to 0.85-1.6 VDC, but the 1U2K5 contacts do not close, power supply output module 1U2 may be defective. Perform the power supply checkout procedure described in this service guide. (An improper voltage input to 1U2 can cause a good micro module to produce eratic output responses.)

Current Transformer Checkout

Each phase of the incoming power supply to the compressor motor is provided with line (2T1, 2T2, 2T3) and auxiliary (2T5, 2T6, 2T7) current transformers. All of these CTs are mounted in the starter panel; current transformer connections are shown in Figure 10.

Note: Polarity is critical for proper setup of both line and auxiliary current transformers. Be sure to check each CT for proper polarity, and all CT wiring for faulty connections, before performing the checkout procedure described below. Use Table 14 to verify that correct line CT's are in use and check that proper terminals are connected using Figure 10.

WARNING: Use extreme care when performing this checkout procedure while the chiller is energized. Carelessness can result in injury or death.

1. Use the units's design RLA value in conjunction with the data in Factory Set-up to verify that:

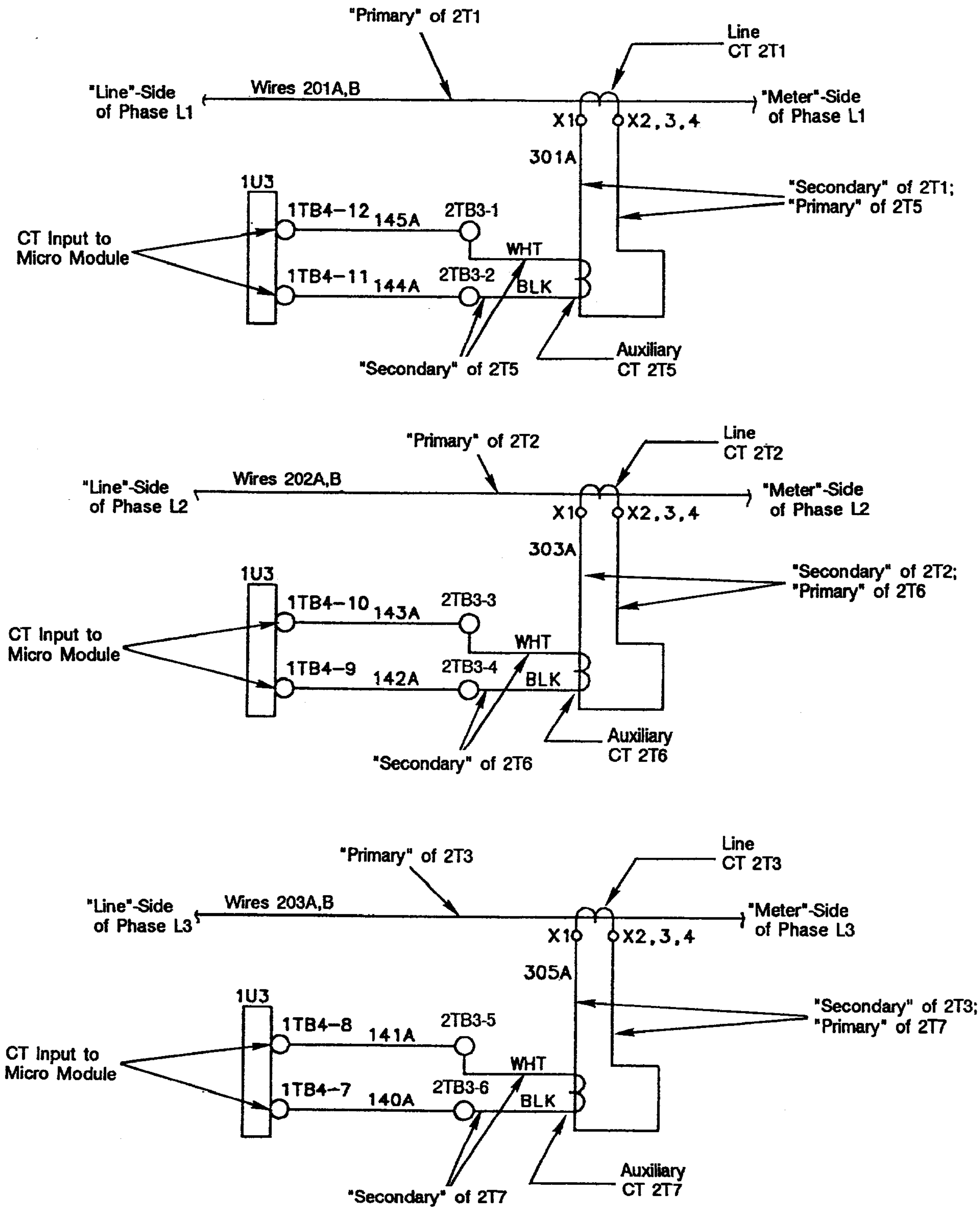
a. The primary current transformers (CTs; 2T1, 2T2 and 2T3) are properly sized.

b. Each primary CT is provided with the correct number of "primary turns" (i.e., number of times that the main power line passes through its CT); and,

c. The DIP switches used to establish the unit's RLA setpoint (i.e., DIP switch block S1, switch numbers 1 through 8) are properly positioned. (A step-by-step RLA-setpoint verification procedure is provided in this service guide.)

2. Use a series ammeter to monitor the output of Phase 1's line current transformer (2T1).

Figure 10
Current Transformer (CT) Connections



Note: This check cannot be made reliably with a clamp-on ammeter; always use a series ammeter on the CT secondary! In order to check the CT input and output voltages, CT line and secondary amp flows must be monitored while the unit is running.

3. Check the voltage at Terminals 1TB4-11 and -12 on micro module 1U3, and compare this value to the corresponding auxiliary CT primary amperage value shown in Table 14 to verify the integrity of 2T5.

4. Repeat Steps 1 through 3 for Phase 2 and Phase 3.

5. Check the integrity of auxiliary CT 2T6 and 2T7 as described in Step 3 by measuring the voltage at Terminals 1TB4-9 and -10, and Terminals 1TB4-7 and -8, respectively.

Table 14
Current Transformer Inputs to Micro Module 1U3 (1)

Primary Current (I1) to Auxiliary CTs 2T5, 2T6 and 2T7	Input Voltage at: 1TB4-11, -12; 1TB4-9, -10; and 1TB4-7, -8, Respectively (See Note 3)
0.50 amps RMS	1.34 ± 0.05 volts RMS
1.00 amps RMS	1.83 ± 0.05 volts RMS
1.25 amps RMS	2.06 ± 0.05 volts RMS
1.50 amps RMS	2.28 ± 0.05 volts RMS
1.75 amps RMS	2.51 ± 0.05 volts RMS
2.00 amps RMS	2.73 ± 0.05 volts RMS
2.25 amps RMS	2.95 ± 0.05 volts RMS
2.50 amps RMS	3.17 ± 0.05 volts RMS
2.75 amps RMS	3.39 ± 0.05 volts RMS
3.00 amps RMS	3.62 ± 0.05 volts RMS
3.25 amps RMS	3.84 ± 0.05 volts RMS
3.50 amps RMS	4.06 ± 0.05 volts RMS
3.75 amps RMS	4.28 ± 0.05 volts RMS
4.00 amps RMS	4.51 ± 0.05 volts RMS
4.25 amps RMS	4.71 ± 0.05 volts RMS
4.50 amps RMS	4.93 ± 0.05 volts RMS
4.75 amps RMS	5.14 ± 0.05 volts RMS
5.00 amps RMS	5.37 ± 0.05 volts RMS
5.50 amps RMS	5.80 ± 0.05 volts RMS
6.00 amps RMS	6.24 ± 0.05 volts RMS
8.00 amps RMS	7.96 ± 0.05 volts RMS

Notes:

1. To calculate primary current (I1), use the following equation:

$$(I1) = \frac{\text{Line Current}}{\text{CTRA}} \times 5$$

where: (I1) is the primary current to the auxiliary current transformer (CT); the "CTRA" value is for 2T1, 2T2 and 2T3, respectively (see Table 2): and "Line Current" is the primary current thru the line CTs (2T1, 2T2 and 2T3).

To calculate % RLA, measure line current directly; then use the following equation:

$$\% \text{ RLA} = \frac{\text{Line Current}}{\text{100\% of Unit RLA Rating}} \times 100\%$$

2. Accuracy of the line CT is ± 1%.
3. Excludes meter error.
4. RMS = root mean square (i.e., standard AC meter units).

Checkout Procedure For Slide Valve Operation

Slide Valve Control Switch

A 4-position, compressor slide valve control switch is located beneath the current limit setpoint control. Each switch position is described below.

Note: For 130 to 215 ton unload solenoid is on motor side of compressor.
For 255 to 300 ton unload solenoid is on discharge side of compressor.

Pressure Gauge

Connect a pressure gauge at the Schrader valve by the Load/Unload solenoids.

Load

With the switch in LOAD position, the slide valve load relay (1U1Q7) is continuously energized, manually loading the compressor. Manual load overrides automatic slide valve control during Normal Run mode (A 74). Verify that the pressure reading of the gauge approaches condensing pressure. If pressure remains the same or falls to evaporator pressure, check wiring at solenoid valve coils.

Manual load will not override automatic slide valve control during three other running modes. They are:

Operating Code	Operating Mode
A 75	Run - Current Limit
A 76	Run - Condenser Limit
A 77	Run - Evaporator Limit

Hold

With the slide valve control switch in HOLD position, both slide valve load relay (1U1Q7) and slide valve unload relay (1U1Q8) are de-energized (closed). The slide valve remains in present position. HOLD overrides automatic slide valve control during Normal Run mode (A74). Read pressure gauge and verify that pressure remains constant and does not fluctuate HOLD will not override automatic slide valve control during three other running modes. They are:

Operating Code	Operating Mode
A 75	Run - Current Limit
A 76	Run - Condenser Limit
A 77	Run - Evaporator Limit

Note: Turning the slide valve control switch to HOLD changes UCM display from Operators menu to Serviceman's Menu. (See "Display" and Table 3.)

Unload

With slide valve control switch to UNLOAD position, slide valve unload relay (1U1Q8) is continuously energized. Manual unload overrides all other operating modes. Read pressure gauge and verify that pressure reading approaches evaporator pressure. If remains the same or rises to condenser pressure, check wiring and solenoid.

Auto

With slide valve control switch in AUTO (normal operating position), slide valve position is automatically controlled by the UCM. Gauge pressure will be somewhere between condenser and evaporator pressure.

Condenser Water Pump Relay Checkout

Relay Operation

Operation of the condenser water pump is controlled by a set of normally-open contacts (K6) on the control panel's relay output module (1U1). When operating code A 71 (i.e., establish condenser water flow) appears on the control panel display, micro module 1U3 "directs" 1U1 to close its K6 contacts, and these contacts should remain closed until unit operation is terminated.

Once these contacts close, continuity is established between terminals 1TB1-4 and 1TB1-5; this energizes the remotely-mounted condenser water pump contactor (5K2) which, in turn, energizes the condenser water pump.

When the condenser water pump is energized, micro module 1U3 monitors the contacts of condenser water pump interlock relay 1K17. If these contacts do not close (i.e., flow is not established) within 3 minutes of the K6 contact closure, the chiller will shut down on latching diagnostic b dC (i.e., condenser water flow overdue).

Note: This diagnostic code will flash alternately with operating code A 71 on the display.

Relay Troubleshooting

WARNING: To prevent injury or death due to electrical shock, use care when measurements, adjustments or other service-related operations are performed with power on.

Note: Micro module 1U3 must be "calling" for condenser pump operation while using the following procedure to check the condenser water pump control circuit. To "prompt" this signal, either:

a. Manually start the condenser pump; then start the unit (i.e., the K6 contacts should be closed when the unit is operating); or,

b. Go through a normal start sequence. When the display reads A71, the K6 contacts should be closed. (Remember that the K6 contacts will only remain closed for 3 minutes if the condenser interlock circuit does not "make").

If condenser water flow is not established within 3 minutes:

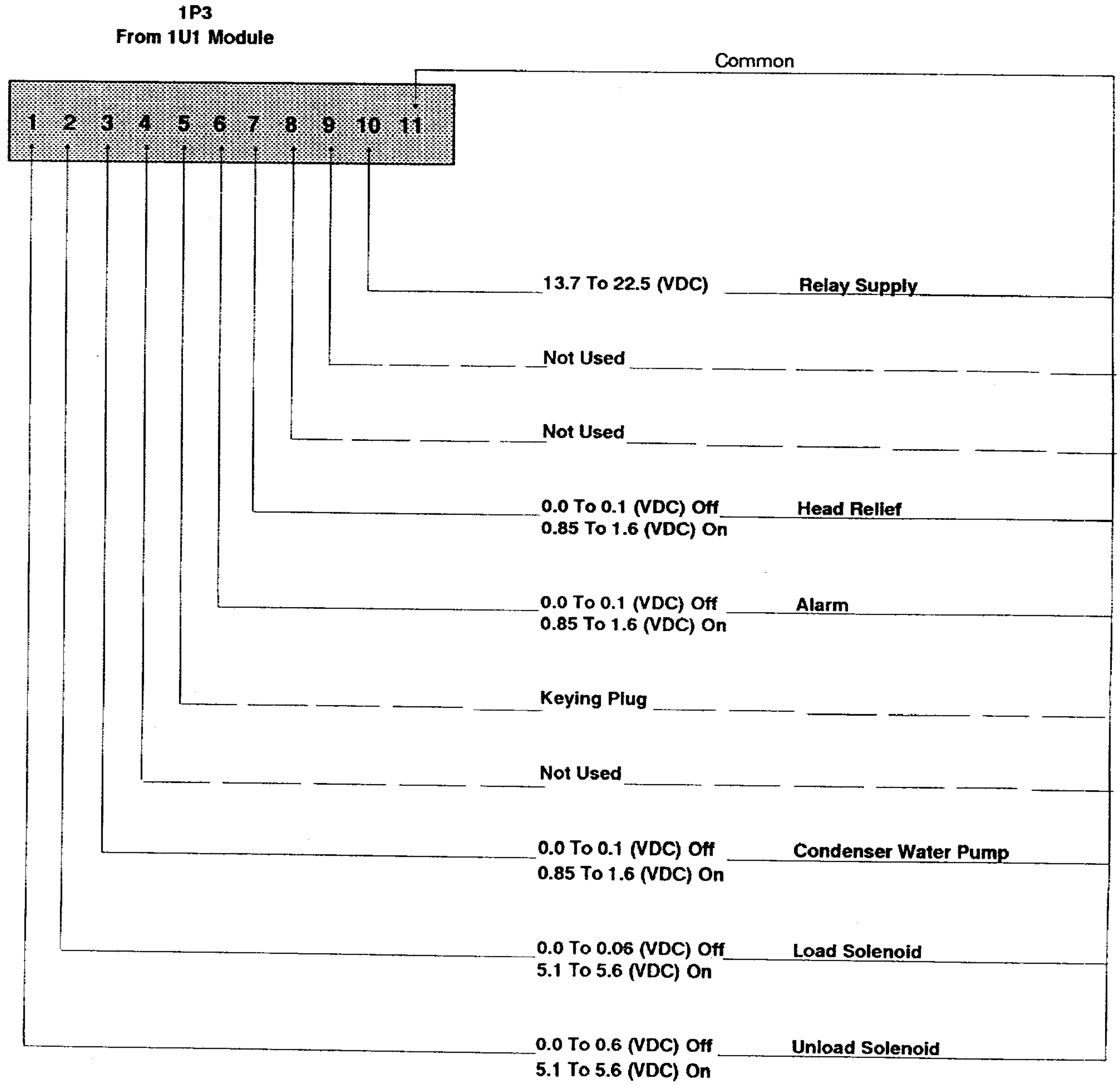
1. Measure the DC voltage at pins 3 and 11 on ribbon connector 1P3 (Figure 11) at micro module 1U3. Remember that A 71 must be on the display!

If the voltage reading is 0.0 to 0.1 VDC, 1U3 is failing to send a "close" signal to the K6 contacts on 1U1. Replace micro module 1U3.

Note: Always check the power supply output module before replacing micro module 1U3.

A voltage reading of 0.85 to 1.6 VDC indicates that 1U3 is functioning normally (i.e., is sending a "close" signal to the (1U1) K6). Check for closure of the K6 contacts (Step 2).

Figure 11
Checkout Schematic for Output Module (1U1), Ribbon Cable Plug 1P3 Pin Identification and Voltages



Note:
All voltages are D.C. with respect to 1P3-11

2. Check for continuity between terminals 1TB1-4 and 1TB1-5 on 1U1 to determine if the normally-open K6 contacts are closed.

If the K6 contacts are still open, relay output module 1U1 is defective and must be replaced.

Note: Always check the power supply output module before replacing relay output module 1U2.

Closure of the K6 contacts indicates that the problem is outside of the UCP control panel; see Step 3.

3. Below is a partial list of the control components to check if the K6 contacts are closed:

[ ] Check for blown fuses or open circuit breakers in the condenser water pump circuit.

[ ] Verify that the condenser water pump contactor (5K2) is energized, and that its contacts are starting the pump.

[ ] Ensure that the valves in the condenser water circuit are open to allow flow through the chiller.

[ ] Verify that the condenser water flow switch (5S3) is functioning properly.

[ ] Check the auxiliary contacts on the condenser water pump contactor (5K2); they should close when the pump starts.

4. If the external portion of the condenser pump circuit is functioning properly a 110-volt signal should return to the control panel at terminal 1TB7-6. Verify that this circuit is energizing condenser water pump relay 1K17. Next, determine whether or not relay 1K17 is providing a "closed circuit" input to terminals 1TB3-22 and 1TB3-23 on micro module 1U3.

If the 1K17 contacts do not close between terminals 1TB3-22 and -23 when there is a 110-volt signal at 1TB7-6, the condenser water pump relay (1K17) is defective and must be replaced.

Unit shutdown on diagnostic b dC (i.e., condenser water flow overdue) in spite of closure of the 1K17 contacts within 3 minutes indicates that micro module 1U3 is malfunctioning and must be replaced.