TECHNICAL MANUAL

OPERATOR, ORGANIZATIONAL AND DIRECT SUPPORT MAINTENANCE MANUAL

SERVICE UNIT, REFRIGERATION SYSTEM (MUST) (AMERTECH CORPORATION MODEL 1200-F-0001) NSN 4130-01-039-8124

HEADQUARTERS, DEPARTMENT OF THE ARMY
19 JANUARY 1979

WARNING

Caution should be exercised with fluorocarbon refrigerant gas (freon) as they can displace oxygen and thereby cause suffocation.

WARNING

Personnel with a history or other evidence of cardiac rhythm disturbances may be at increased risk of inducing further alterations of the cardiac rhythm as a result of exposure to fluorocarbon refrigerant gases (freons). Such individuals should be evaluated by local medical authorities before working in environments where potential freon exposure may occur.

WARNING

Refrigerant 114 has very low toxicity but is narcotic in high concentrations. Since it is a refrigerant gas normally under fairly high pressure, it will freeze tissue upon which it is directed. It may also decompose if brought into contact with an open flame or a red-hot surface and produce irritating and toxic decomposition products.

WARNING

Ensure that equipment is de-energized before removal or installation of components.

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No. 5-4130-235-13

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, *19 January 1979*

OPERATOR, ORGANIZATIONAL AND DIRECT SUPPORT MAINTENANCE MANUAL SERVICE UNIT, REFRIGERATION SYSTEM (MUST) (AMERTECH CORPORATION MODEL 1200-F-0001) NSN 4130-01-039-8124

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistake or if you know of a way to improve the procedures, please, let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms) or DA Form 2028-2 located in the back of this manual directly to: Commander, US Army Troop Support and Aviation Materiel Readiness Command, ATTN: DRSTS-MTPS, 4300 Goodfellow Blvd., St. Louis, MO 63120. A reply will be furnished to you.

Table of Contents

List of Illustrations

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1-1. Scope

This manual is for your use in operating and maintaining the Service Unit, Refrigeration System (MUST), Amertech Corporation Model 1200-F0001, NSN 4130-01-039-8124. Procedures are given for operating and servicing the unit and for the isolation, removal and replacement of malfunctioning or defective components.

1-2. Maintenance Forms and Records.

Department of the Army forms and procedures used for equipment maintenance will be those prescribed by TM 38-750, The Army Maintenance Management System (TAMMS).

1-3. Reporting Equipment Improvement Recommendations (EIR's).

EIR's can and must be submitted by anyone who is aware of an unsatisfactory condition with the equipment design or use. It is not necessary to show a new design or list a better way to perform a procedure, just simply tell why the design is unfavorable or why a procedure is difficult. EIR's may be submitted on DA Form SF 368. Mail directly to: Commander, U.S. Army Troop Support and Aviation Materiel Readiness Command, ATTN: DRSTS-MEM, 4300 Goodfellow Boulevard, St. Louis, MO 63120. A reply will be furnished to you.

Section II. EQUIPMENT DESCRIPTION

1-4. Equipment Purpose

The Service Unit,' Refrigeration System (MUST) is a portable service unit designed to provide all maintenance and service required by the (MUST) air conditioning system.

1-5. Capabilities and Features.

a. The service unit provides leak checking and evaluation of the (MUST) refrigeration system as well as evacuation, charging the system with oil and refrigerant. The four independent systems contained in the service unit are shown in figure 1-1.

b. The service unit is contained in a steel cabinet which is sealed against inclement weather conditions. The cabinet is equipped with shock isolator leg pads and tie-down provision for transportation.

1-6. Location and Description of Major Components.

Figure 1-2 gives the location and description of major components necessary for operation of the service unit.

1-7. Differences Between Models.

This manual was prepared for the Service Unit, Refrigeration System (MUST), Amertech Model 1200-F-0001. There are no differences in models.

1-8. Performance Data.

Electrical requirements....	115 VAC, 60 Hz single phase 15 amp
Refrigerant capacity	95 lb. (42 kgs) refrigerant 114 (Federal Specification BBF-1421)
Cabinet dimensions	30.25 in. x 26.00 in. x 37.5 in. (76 cm x 66 cm x 95 cm)
Weight	265 lb. (max) (120.42 kgs)

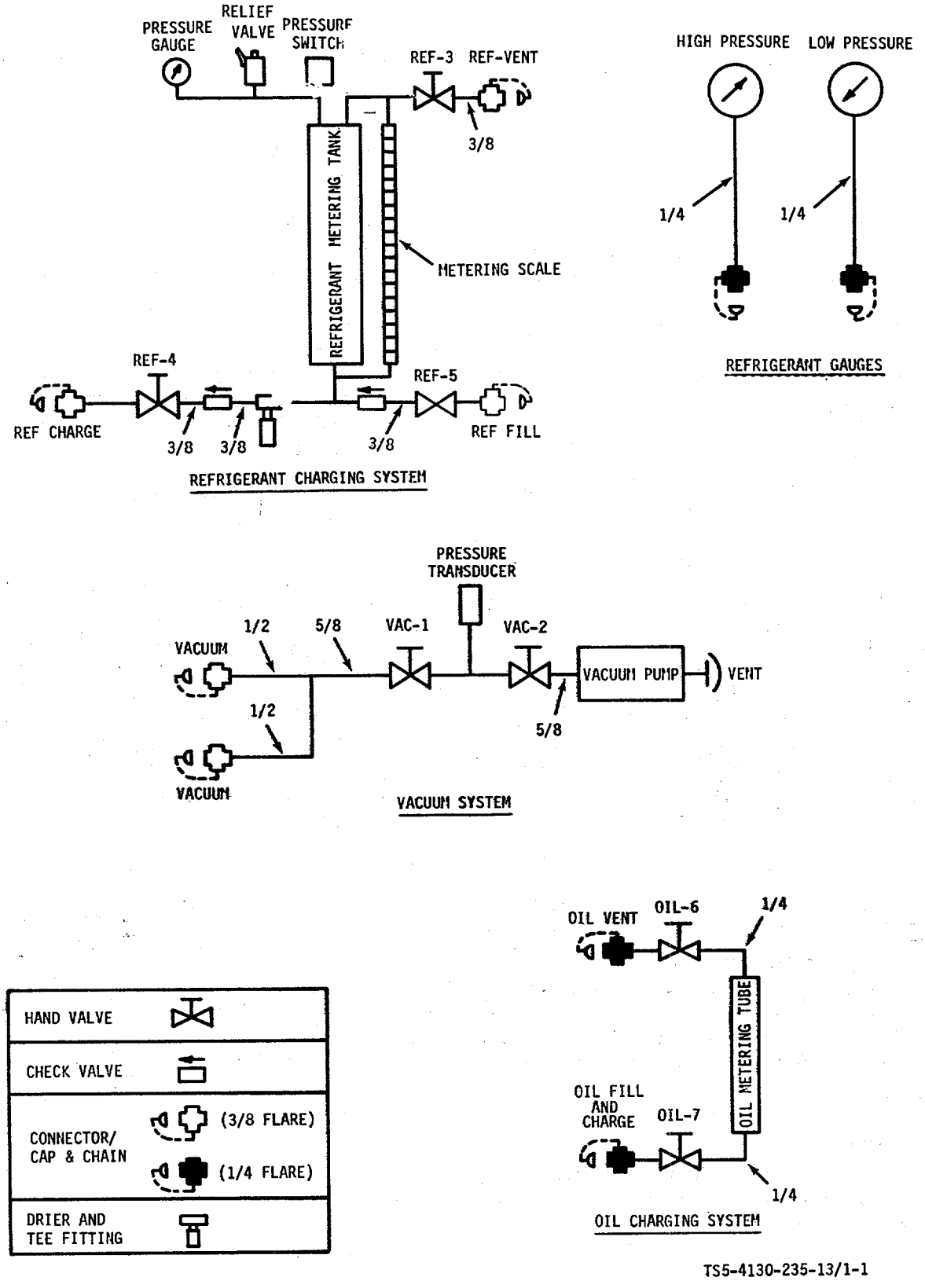
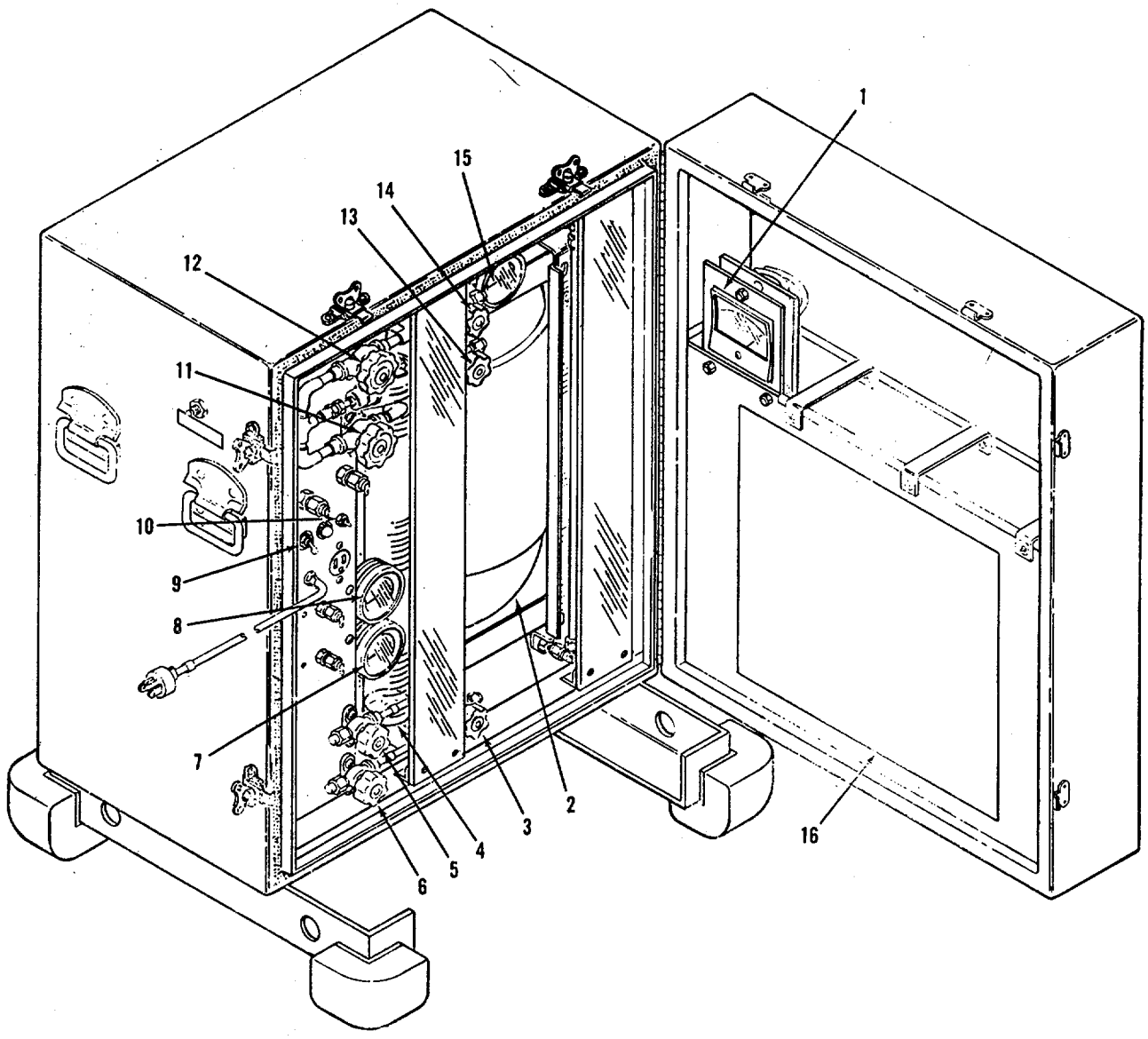


Figure 1-1. Functional diagram of refrigeration service unit.



1. VACUUM GAGE M1. Measures vacuum pressure from sensing element of thermistor.
2. TANK ASSEMBLY. Serves as a reservoir for refrigerant.
3. OIL FILL-CHARGE VALVE V7. Controls refrigerant oil flow from beaker.
4. BEAKER SG2. Scale on beaker displays quantity of refrigerant oil.
5. REFRIG. CHARGE VALVE V4. Controls charging of system with refrigerant.
6. REFRIG. CHARGE SYSTEM FILL VALVE V5. Controls filling of refrigerant reservoir.
7. REFRIGERANT PRESSURE GAGE GA2. Measures low pressure.
8. REFRIGERANT PRESSURE GAGE GA1. Measures high pressure.
9. CIRCUIT BREAKER CB1. Controls electrical power to service unit.
10. HEATER ON-OFF, VACUUM S1. Selects reservoir heater or vacuum pump for operation.
11. EVAC 1, VALVE V1. Controls vacuum at unions CP2 and CP4.
12. EVAC 2, VALVE V2. Controls vacuum at pump.
13. OIL VENT VALVE V6. Controls vent for refrigeration oil in beaker.
14. VENT/EVAC VALVE V3. Controls ventilation or evacuation of reservoir.
15. PRESSURE GAGE GA3. Measures pressure contained in reservoir.
16. DECAL. Contains operating instructions for the service unit.

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Figure 1-2. Location and description of major components.

CHAPTER 2
OPERATING INSTRUCTIONS

Section I. DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INSTRUMENTS

2-1. Controls and Indicators.
A description of the operator's controls and instruments and their function is given in table 2-1. These controls and instruments are illustrated in figure 2-1.

Table 2-1. Description and Use of Operator's Controls and Instruments

Fig. 2-1 Key	Control or Indicator	Function
1	EVAC 1 V1 (valve)	Controls vacuum at unions CP2 and CP4.
2	EVAC 2 V2 (valve)	Controls vacuum at vacuum pump.
3	MT1 (thermistor)	A combination heater and thermocouple sensing element to provide a signal to gage M1.
4	SG2 (beaker)	Contains refrigerant oil. Scale on beaker indicates quantity of oil in beaker.
5	VENT/EVAC V3 (valve)	Controls ventilation or evacuation of reservoir.
6	OIL VENT V6 (valve)	Controls ventilation for refrigerant oil in beaker.
7	GA3 (gage)	Measures pressure contained in reservoir.
8	SG1 (scale)	Displays quantity of refrigerant contained in reservoir.
9	REFRIG. GAGE GA1	Measures high pressure.
10	REFRIG. GAGE GA2	Measures low pressure.
11	OIL FILL-CHARGE V7 (valve)	Controls the flow of refrigerant oil from beaker.
12	REFRIG. CHARGE SYS FILL	Controls filling of refrigerant reservoir. V5 (valve)
13	V8 (valve)	Valve to drain oil from vacuum pump.
14	REFRIG. CHARGE SYS V4 (valve)	Controls charging rate of refrigeration system with refrigerant.
15	Glass window on vacuum pump	Used to check oil level in vacuum pump.

Table 2-1. Description and Use of Operator's Controls and Instruments (Continued)

Fig. 2-1 Key	Control or Indicator	Function
16	Vented exhaust valve	Provides a controlled vent for the vacuum pump.
17	LOW PRESS CP2 (union)	Provides a connection from a pressure source to gage GA2.
18	HI PRESS CP1 (union)	Provides a connection from a pressure source to gage GA1.
19	OUTPUT Ji (connector)	Provides electrical connection for leak detector.
20	P1 (connector)	Provides service unit connection to source of electrical power.
21	HEATER ON OFF VAC ON S1 (switch)	Selects reservoir heater or vacuum pump for operation.
22	115 V60 HZ POWER ONOFF CB1 (circuit breaker)	Controls application of electrical power to the service unit.
23	115 V60 HZ PWR (lamp)	Indicates electrical power is applied to service unit when lit.
24	VAC CP4 (union)	Provides connection of refrigeration system to vacuum system.
25	VAC CP3 (union)	Provides connection of refrigeration system to vacuum system.
26	M1 (gage)	Measures vacuum pressure from sensing ele ment of thermistor MT1.

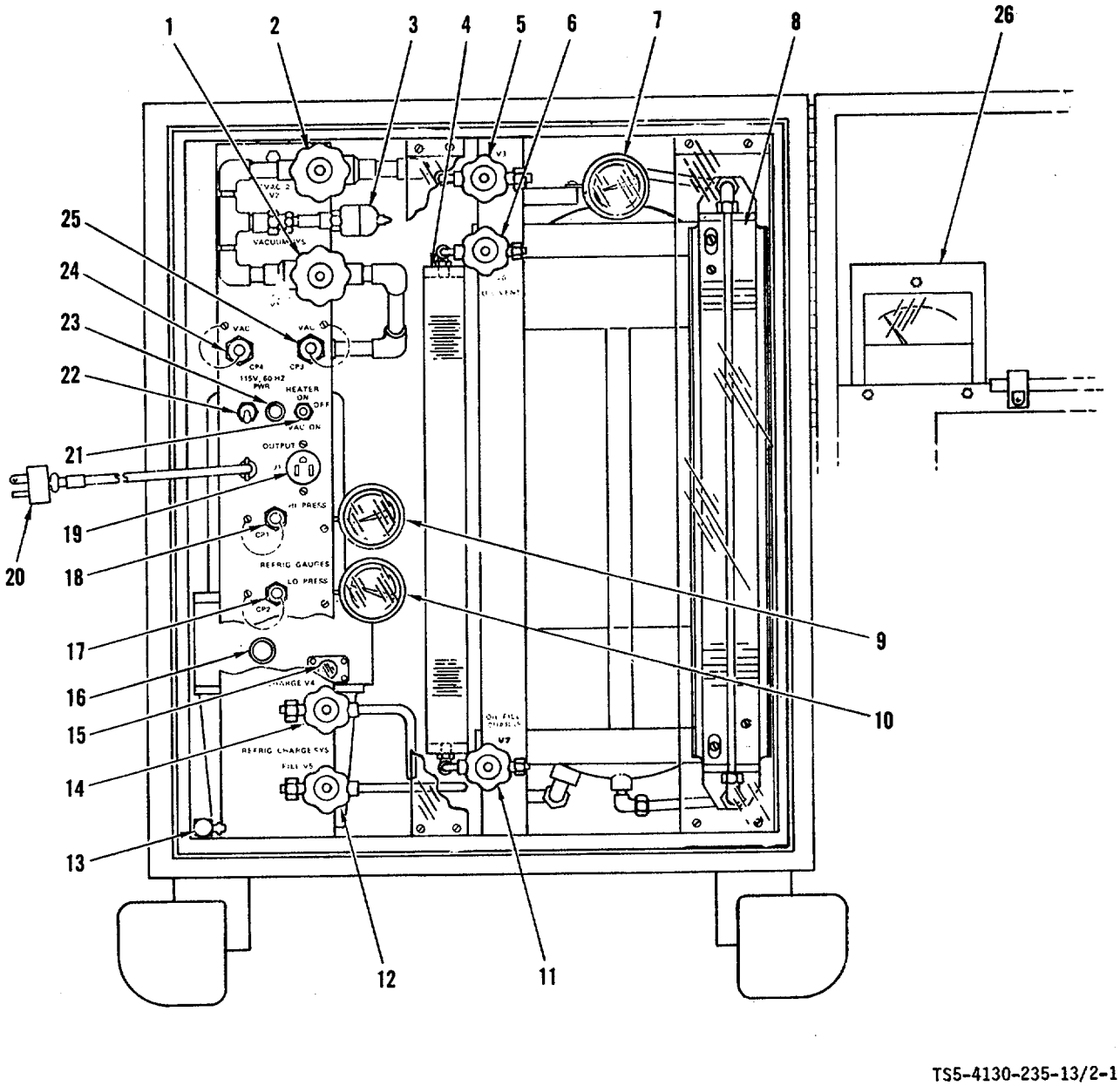


Figure 2-1. Controls, indicators and connections.

Section II. PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

2-2. General.

To insure that the Refrigeration Service Unit is ready for operation at all times, it must be inspected systematically so that defects may be discovered and corrected before they result in serious damage or failure. The required preventive maintenance checks and services to be performed are listed in table 2-2.

a. Before you operate. Always keep in mind the CAUTIONS and WARNINGS. Perform your before (B) PMCS.

***b. While you operate*.** Always keep in mind the CAUTIONS and WARNINGS. Perform your during (D) PMCS.

***c. After you operate*.** Be sure to perform your after (A) PMCS.

d. If your equipment fails to operate. Troubleshoot with proper equipment. Report any deficiencies using the proper forms, see TM 38750.

Table 2-2. Operator/Crew Preventive Maintenance Checks and Services

B--Before A--After M--Monthly
D--During W--Weekly

Item No.	Interval B	D	A	W	M	Item to be Inspected	Procedure	For Readiness Reporting, Equipment Is Not Ready/Available If:.
1	•					Refrigerant Gages	Inspect high and low pressure gages for broken glass and bent or missing pointers	Glass broken or pointers are bent, broken or missing
2	•					Metering Scale	Inspect metering scale for legi bility and other obvious damage.	Metering scale not legible.
3	•					Unions and Fittings	Inspect unions and fittings for dam aged or crossed threads which could cause leakage.	Unions or fittings leaking.
4	•	•	•			Vacuum Pump	Check oil level through glass disk. Level must be at bottom of disk. Level will be higher with pump running.	Oil level not correct.
5	•	•	•				Inspect oil for contamination through glass disk.	Vacuum pump oil contaminated.
6	•					Oil beaker	Inspect oil beaker for cracks and leakage.	Beaker cracked or leaking.
7	•					Wiring	Inspect wiring for burned, frayed insulation and loose or missing terminals.	Insulation burned or frayed. Terminal loose or missing.
8	•					Power cord	Inspect AC power cord for damage which would impair serviceability.	Power cord damaged.
9	•					Refrigerant Hoses	Inspect hoses for damaged or crossed threads and other obvious damage which would impair serviceability,	
10	•					Vacuum Hoses	Inspect hoses for damaged or crossed threads and other obvious damage which would impair serviceability	
11	•					Centrifuge Tube	Inspect tube for cracks and legi bility of markings.	Tube cracked.

Section III. OPERATION UNDER USUAL CONDITIONS

2-3. Assembly and Preparation for Use.

a. Position the service unit in an area that will permit the enclosure door to swing 180 degrees and provide connection for facility electrical power.

b. Before connecting electrical power to the service unit, be sure that circuit breaker (22, fig. 2-1) and switch (21) are in the OFF position.

c. Check vacuum pump oil level at glass disk (15). Oil level must be maintained within sight glass disk. Oil level will indicate higher while pump is running.

d. Close vent valve on upper left side of enclosure while service unit is in use or is in storage. Open this vent valve only when service unit is being shipped by air.

2-4. Initial Adjustments.

a. Check vacuum system in service unit as follows:

(1) Check that vacuum pump exhaust valve (16) is closed finger tight (clockwise).

(2) Close EVAC 1 valve V1 (1). Set circuit breaker (22) to ON; lamp (23) should light. Set switch (21) to VAC ON and observe gage M1 (26) located in enclosure door to make certain system will evacuate to 50 microns.

(3) Set switch (21) and circuit breaker (22) to OFF.

WARNING

Exercise care when flushing or cleaning parts with refrigerant. Refrigerant 114 has very low toxicity but is narcotic in high concentrations. Since it is a refrigerant gas normally under fairly high pressure, it will freeze tissue upon which it is directed. It may also decompose if brought into contact with an open flame or a red-hot surface and produce irritating and toxic decomposition products.

(4) Make certain all hose assemblies and lines are free of contamination. If any doubt exists as to the cleanliness of hose assemblies and lines, flush each part with refrigerant before connecting to the service unit or the (MUST) refrigeration system.

b. Fill Service unit reservoir with refrigerant as follows:

WARNING

When filling service unit reservoir, use only refrigerant 114.

NOTE

When service unit reservoir is partially full, omit steps (1) and (2) and proceed to step (3).

(1) Vent reservoir by uncapping and opening valves (5, 12, 14).

(2) Evacuate reservoir and lines as follows:

(a) Cap union (25).

(b) Connect hose! assembly (8, fig. 2-2) with gaskets (2, 3) between union (24, fig. 2-1) and valve (5).

(c) Open valves (1, 2). Close and cap valves (12, 14).

(d) Set circuit breaker (22) to ON and switch (21) to VAC ON. Evacuate system to200 microns as indicated on gage M1 (26).

(e) Close valve (5) and set switch (21) to OFF.

WARNING

If refrigerant bottle is heated in excess of 125°F (52°C) pressure relief device may function resulting in an uncontrolled release of freon.

(3) Warm or elevate liquid refrigerant bottle to expedite filling.

(4) Remove hose assembly between union (24) and valve (5), then remove cap from valve (12).

(5) Loosely connect hose assembly (5, fig. 2-2) with gaskets (3) to valve (12, fig. 2-1) and connect other end of hose assembly to the inverted refrigerant bottle.

(6) Crack the refrigerant bottle valve to purge the hose assembly of air, then tighten hose assembly fitting on valve (12).

(7) Open valve (12) and refrigerant bottle valve.

(8) Fill reservoir to desired level as indicated on scale (8). Slowly open valve (5) as required to expedite filling. Do not fill into the red zone.

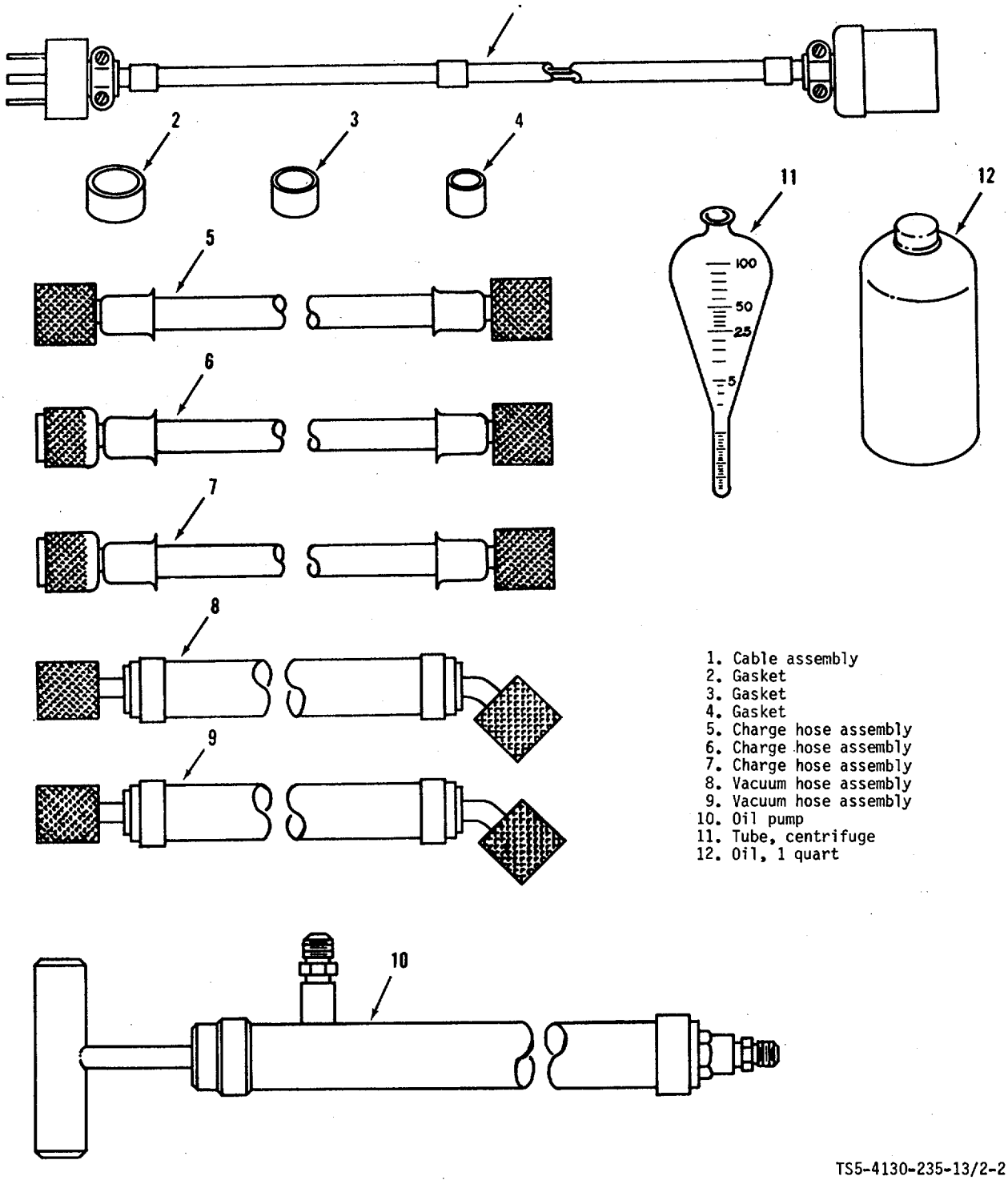


Figure 2-2. Refrigeration service unit accessories.

WARNING

Exercise care in disconnecting hose assembly from refrigerant bottle and valve. Refrigerant 114 has very low toxicity but is narcotic in high concentrations. Since it is a refrigerant gas normally under fairly high pressure, it will freeze tissue upon which it is directed. It may also decompose if brought into contact with an open flame or a red-hot surface and produce irritating and toxic decomposition products.

(9) Close valves (5, 12) and refrigerant bottle valve. Disconnect hose assembly and cap valves (5, 12).

2-5. Operating Procedures.

WARNING

Refrigerant and oil charging lines and hoses should be capped when not in use to prevent contamination with dirt and moisture. If it is suspected that lines or hoses are contaminated, they should be flushed with refrigerant prior to charging a refrigeration unit. Check all fittings for cleanliness before connecting. Operate vacuum pump with ballast valve open. This allows freon to be purged from the vacuum pump oil. This does not appreciably affect pump efficiency. Close valve when pump is off.

a. Leak Checking (MUST) Refrigeration System.

(1) Pressurize unit to approximately 15 psig with nitrogen and refrigerant, or refrigerant which will obtain 15 psig.

(2) Connect (MUST) refrigeration system charge valve to union CP1 (18), using hose assembly (6, fig. 2-2) and gaskets (3, 4).

(3) Use available leak detector to check refrigeration system for leakage, obtaining power for the detector from connector J1 (19, fig. 2-1).

(4) Ventilate area being leak-checked to locate source of leak.

(5) Repair all leaks. If (MUST) refrigeration system has been opened, replace compressor filter assembly and filter drier.

(6) Repressurize system and recheck with leak detector.

NOTE

Check vacuum pump oil level prior to starting. Check vacuum pump oil contamination by capping union CP3 (25) and CP4 (24). Open valve V2 (2) and close valve VI (1) and verify that vacuum system will evacuate below 50 microns. Check for leaks and change oil if necessary.

b. Evacuation of (MUST) Refrigeration System.

(1) Open suction and receiver valves of the (MUST) refrigeration system and purge the system with dry nitrogen.

(2) Connect hose assembly (8, fig. 2-2) with gaskets (2, 3) between (MUST) refrigeration system receiver charge valve and union CP3 (25, fig. 21) on service unit.

(3) Connect hose assembly (9, fig. 2-2) between (MUST) refrigeration system suction valve and union CP4 (24, fig. 2-1) on service unit.

(4) Open (MUST) refrigeration system receiver and suction valves and valves V1 and V2 (1, 2) on service unit.

(5) Set circuit breaker (22) on service unit to ON and switch (21) to VAC ON.

(6) Evacate (MUST) refrigeration system for two hours to 200 microns or lower as indicated on gage M1 (26).

NOTE

To determine level of vacuum in refrigeration system,, close valve V2 (2) and observe indication on gage Ml (26).

(7) At the end of the two hour evacuation period, close the (MUST) refrigeration system suction and receiver valves. Set switch (21) and circuit breaker (22) on the service unit to OFF.

(8) Remove hose assemblies and proceed directly to charging the (MUST) refrigeration system with oil or refrigerant.

c. Charging (MUST) Refrigeration System with OiL

CAUTION

Use care in storage and handling of refrigeration oil to prevent absorption

of moisture and other atmospheric contaminants.

(1) Uncap and open valve V6 (6) on service unit.

(2) Open valves V1 and V2 (1, 2), cap union CP3 (25) and uncap union CP4 (24).

(3) Connect hose assembly (6, fig. 2-2) between union CP4 (24, fig. 2-1) and valve V3 (5) using a 1/2 x 3/8 inch reducer on union CP4 (24).

(4) Cap and close valve V7 (11).

(5) Connect hose assembly (7, fig. 2-2) with gaskets (3, 4) between valve V7 (11, fig. 2-1) and container filled with refrigeration oil.

(6) Set circuit breaker (22) to ON and switch (21) to VAC ON.

(7) Observe gage M1 (26) until reading is slightly below 1000 microns; then close valve V1 (1). Slowly open valve V7 (11) and observe scale on beaker (4) until oil level reaches 1000 ML graduation mark. Close valves V6 and V7 (6, 11).

(8) Set switch (21) and circuit breaker (22) on service unit to OFF.

(9) Disconnect hose assemblies from oil container and union CP4 (24) and open valve V6 (6).

(10) Loosely connect other end of hose assembly from valve V7 (11) to (MUST) refrigeration system receiver valve.

(11) Slowly open valve V7 (11) until oil starts leaking from (MUST) refrigeration system receiver valve, then tighten fitting on hose assembly and crack receiver valve.

(12) Open (MUST) refrigeration system receiver valve and charge system with the specified amount of oil from beaker (4).

(13) When the specified amount of oil has been put into the system, close the (MUST) refrigeration system receiver valve and valve V7 (11) on the service unit. Remove hose assemblies and proceed to refrigerant charging procedure.

d. Charging (MUST) Refrigeration System with Refrigerant.

(1) Set circuit breaker (22) on service unit to ON and switch (21) to HEATER ON.

(2) Cap and close valves V3 and V5 (5, 12).

(3) Close valve V4 (14) and connect hose assembly (5, fig. 2-2) with gasket (3) to valve V4 (14, fig. 2-1).

(4) Connect other end of hose assembly loosely on (MUST) receiver valve.

(5) Allow pressure to stabilize at 59 to 69 psig as indicated on gage GA3 (7, fig. 2-1).

(6) Crack valve V4 (14) to purge air from hose assembly; then tighten fitting on hose assembly at (MUST) system receiver valve.

(7) Open valve V4 (14) fully and note liquid level on scale SG1 (8). Open (MUST) system receiver valve fully to charge (MUST) refrigeration system with the specified amount of refrigerant as measured on scale SG1 (8).

(8) When system is charged, close valve V4 (14), then close (MUST) refrigeration system receiver valve.

WARNING

Exercise care in disconnecting hose assembly from refrigerant bottle and valve. Refrigerant 114 has very low toxicity but is narcotic in high concentrations. Since it is a refrigerant gas normally under fairly high pressure, it will freeze tissue upon which it is directed. It may also decompose if brought into contact with an open flame or a red-hot surface and produce irritating and toxic decomposition products.

(9) Remove hose assembly and recap and close valve V4 (14).

e. Checking Oil Quantity in (MUST) Refrigeration System.

(1) Operate (MUST) refrigeration system for 15 minutes to mix refrigerant thoroughly with the oil.

(2) Connect charge line to service valve on (MUST) refrigeration system receiver.

WARNING

Do not hold centrifuge tube by the stem. Hold the tube with gloves or cloth to protect hands from cold refrigerant.

(3) Open service valve and direct flow of refrigerant and oil mixture into centrifuge tube (11, fig. 2-2).

(4) Close service valve when level in centrifuge tube reaches 100 cc.

(5) Place tube in a warm area and allow liquid refrigerant to boil off.

(6) Oil remaining in tube should read at a specific quantity.

2-6. Operation of Auxiliary Equipment.

Auxiliary equipment and accessories which are part of the end item are shown in figure 2-2. Operation of this equipment is incorporated in the operating procedures contained in paragraph 2-5.

CHAPTER 3
OPERATOR/CREW MAINTENANCE INSTRUCTIONS

Section I. LUBRICATION INSTRUCTIONS

3-1. General.

Lubrication of the refrigeration system service unit consists of filling, changing and flushing the vacuum pump oil.'

3-2. Fill Vacuum Pump With Oil.

NOTE

The vacuum pump oil level indication through the glass disk (15, fig. 2-1) will be slightly higher with the pump running than when the pump is stopped. Overfilling the pump above the glass disk level will tend to create splashing during the passage of free air through the pump. Do not overfill.

Remove cap (39, fig. 3-1) and using oil from container (12, fig. 2-2), fill pump to indicate on bottom of glass disk.

3-3. Flushing and Charging Vacuum Pump Oil.

NOTE

Oil will drain more easily if oil is warm. To accelerate draining, operate vacuum pump to warm the oil.

a. Partially close vacuum pump exhaust valve (16, fig. 2-1).

b. Set circuit breaker (22) to ON, set switch (21) to VAC ON and operate pump for five minutes.

c. Place a container of at least one-half gallon capacity under drain hose (20, fig. 3-1).

d. Stop vacuum pump and open drain valve (13) to drain oil.

CAUTION

Do not completely close exhaust valve (16, fig. 2-1), undue pressure will be built up in the pump.

e. To accelerate oil draining, operate vacuum pump and partially cover exhaust valve (16) with finger. After completion of oil draining, stop vacuum pump and close drain valve (22, fig. 3-1).

CAUTION

Do not use solvents or light flushing oils. Their complete removal is difficult and their higher vapor pressure will prevent obtaining a good vacuum.

f. To flush the vacuum pump, remove cap and pour 3 to 4 ounces of clean oil from container (12, fig. 2-2) into pump. Leave exhaust valve (16, fig. 2-1) open and operate vacuum pump for a short period to completely circulate the new oil. Open drain valve (22, fig. 3-1) and force out residue.

g. Repeat flushing procedures until flushing oil remains clean and free from discoloration and foreign matter. Stop vacuum pump and close exhaust valve.

h. Remove cap (39) on vacuum pump and using oil from container (12, fig. 2-2), fill vacuum pump to indication bottom of glass disk (15, fig. 2-1). Replace cap.

i. Start vacuum pump. A gurgling noise is characteristic when high pressure air is drawn through a vacuum. This noise should disappear quickly as the intake pressure is reduced. If vacuum pump continues to gurgle, the oil level may be low. Add oil until glass disk indicates the proper level. The oil level must be maintained within the limits of the glass disk with the vacuum pump running.

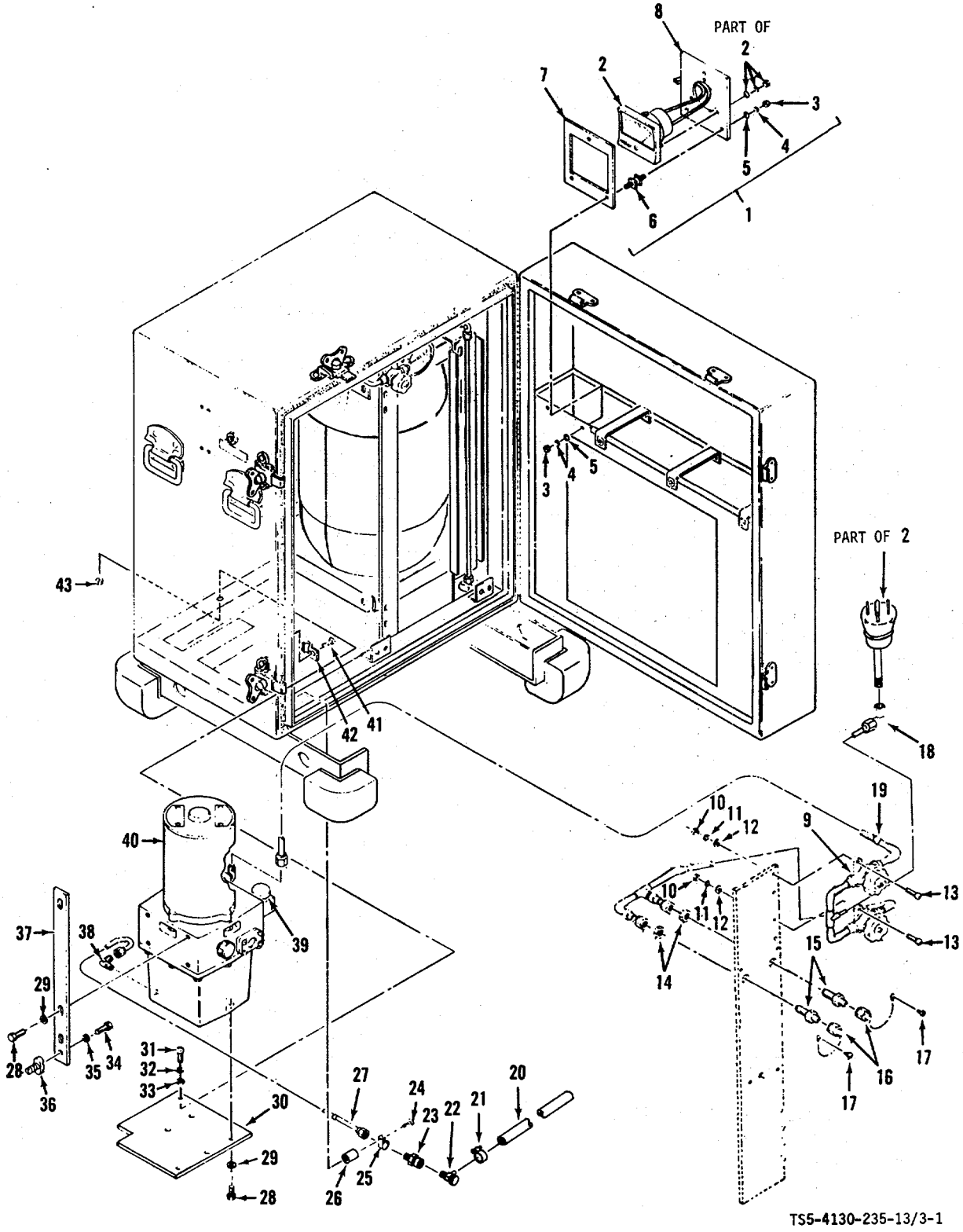


Figure 3-1. Vacuum system

Key to figure 3-1:

1. Vacuum gage assembly
2. Thermocouple gage control
3. Nut
4. Washer
5. Washer
6. Shock isolator
7. Panel
8. Bracket
9. Evacuation valve assembly
10. Nut
11. Washer
12. Washer
13. Screw
14. Nut
15. Union
16. Cap and chain
17. Screw
18. Elbow
19. Tape
20. Hose
21. Clamp
22. Drain valve
23. Reducer
24. Screw
25. Clamp
26. Spacer
27. Drain tube
28. Screw
29. Washer
30. Plate
31. Bolt
32. Washer
33. Washer
34. Screw
35. Washer
36. Nut
37. Bracket
38. Elbow
39. Pump, oil fill
40. Vacuum pump
41. Screw
42. Hose clip
43. Nut

Section II. PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

3-4. General.

To insure that the refrigeration service unit is ready for operation at all times, it must be systematically inspected so that defects may be discovered and corrected before they result in serious damage or failure of the equipment. The required preventive maintenance checks and services to be performed are listed in table 3-1.

Table 3-1. Operator/Crew Preventive Maintenance Checks and Services

B-Before D.-During | A-After W-Weekly | M-Monthly

Item No.	Interval B	D	A	W	M	Item to be Inspected	Procedure	For Readiness Reporting, Equipment Is Not Ready/Available If:
1	•			•	·	Cover, door	Inspect inner and outer surfaces for dents and obvious damage which would impair service ability.	
2	•			•		Panels	Inspect panels for obvious damage and security of attachment.	
						Refrigerant Charge System		
3	•					Refrigerant Gages	Inspect high and low pressure gages for broken or missing pointers and security of attachment.	Glass is broken or pointers bent, broken or missing.
4	•					Metering Scale	Inspect metering scale for leg ibility secur ity of attach ment and other obvious damage.	Metering scale broken or not legible.
5	•					Unions and Fittings	Inspect unions and fittings for damaged or crossed threads which may cause leakage.	Unions or fittings leaking.
6	•					Valves	Inspect refrig eration valves for binding and security of attachment.	
						Vacuum System		
7	•	•	•			Vacuum pump	Check oil level through glass disk. Level must be at bottom of disk.	Oil level not correct.
8	•	•	•				Inspect oil for contamination.	Oil contaminated.
9	•					Unions and Fittings	Inspect unions and fittings for damaged or crossed threads which may cause leakage.	Unions or fittings leaking.

Table 3-1. Operator/Crew Preventive Maintenance Checks and Services (Continued)

B-Before D-During A-After W-Weekly M-Monthly

Item No.	Interval B	D	A	W	M	Item to be	Procedure Inspected	For Readiness Reporting, Equipments Not Ready/Available:
10	•					Valves	Inspect vacuum valves for binding and security of attachment.	
11	•					Vent valve	Insure that vent valve on vacuum pump is closed.	
						Oil Charge System		
12	•					Oil beaker for cracks and leakage.	Inspect oil beaker or leaking.	Oil beaker cracked
13	•					Valves	Inspect oil charge valves for binding and security of attachment.	
14	•					Unions and fittings	Inspect unions and fittings for damaged or crossed threads which may cause leakage.	Unions or fittings leaking.
						Electrical System		
15	•					Wiring	Inspect wiring for burned, frayed insulation and loose or missing terminals.	Insulation burned or frayed. Terminals loose or missing.
						Accessories		
16	•					Power cord	Inspect AC power cord for damage which would impair serviceability.	Power cord damaged.
17	•					Refrigerant Hoses	Inspect hoses for damaged or crossed threads and other obvious damage which would im pair serviceability.	
18	•					Vacuum Hoses	Inspect hoses for damaged or crossed threads and other obvious damage which would impair ser vice ability.	
19	•					Centrifuge Tube	Inspect tube for cracks and legi bility of markings.	Tube cracked.
20	•					Oil Pump	Inspect oil pump for damage which would impair ser viceability.	

Section III. TROUBLESHOOTING

3-5. General.

This section contains troubleshooting information for locating and correcting most of the operating troubles which may develop in: the refrigeration system service unit. Each malfunction for an individual component, unit or system is followed by a list of tests or inspections which will help you to determine the probable cause and the corrective actions to take. You should perform the tests/inspections and corrective actions in the order listed.

3-6. Malfunctions.

This manual cannot list all malfunctions that may occur, nor all the tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

3-7. Troubleshooting Table.

The troubleshooting table lists the common malfunctions which you may find during the operation or maintenance of the refrigeration system service unit or its components. You should perform the tests/inspections and corrective actions in the order listed.

NOTE

Before you use this table, be sure you have performed applicable operating checks.

Table 3-2. Troubleshooting

Malfunction Test or Inspection Corrective Action
SERVICE UNIT FAILS TO REACH ULTIMATE VACUUM
Step 1. After vacuum pump has been running for at least 15 minutes, check the oil level through the glass window. The oil level must be within sight of the glass window while the pump is in operation. In general, the oil level will be slightly higher while the pump is running. If the oil level is not within the glass window, stop the pump and fill to proper level by removing cap (39, fig. 3-1) and using oil from container (12, fig. 2-2), fill pump to indicate on bottom of glass disk.
Step 2. Inspect oil for contamination through glass window. If oil appears cloudy or appears to contain particles of foreign matter, tile oil is contaminated and the pump should be drained and flushed. Drain, flush and replace vacuum pump oil in accordance with the procedures contained in paragraph 3-3.

Section IV. MAINTENANCE PROCEDURES

3-8. Maintenance Procedures.

Perform periodic maintenance of service unit as follows:

a. Inspect inner and outer surfaces of cabinet and door for dents and obvious damage which would impair serviceability.

b. Inspect vacuum pump oil for proper level within glass window and for contamination.

c. Inspect gages for broken glass and for bent, broken or missing pointers.

d. Clean all indicators with a lint-free cloth.

e. Clean all plumbing and components with a lint-free cloth.

f. Inspect electrical wiring for burns, damaged insulation or broken-wires and loose or missing terminals.

g. Clean and check condition of accessory equipment (1 through 12, fig. 2-2).

CHAPTER 4
DIRECT SUPPORT MAINTENANCE INSTRUCTIONS

Section I. REPAIR PARTS, SPECIAL TOOLS AND EQUIPMENT

4-1. Repair Parts.

Repair parts for the service unit are listed and illustrated in the repair parts and special tools list covering direct support maintenance for this equipment in TM 5-4130-235-23P.

4-2. Special Tools and Equipment.

No special tools or equipment are required.

Section II. TROUBLESHOOTING

4-3. General.

a. This section contains troubleshooting information for locating and correcting most of the operating troubles which may develop in the Service Unit, Refrigeration System (MUST). Each malfunction for an individual component, unit or system is followed by a list of tests or inspections which will help you to determine corrective actionsdd to take. You should perform the tests/inspections and corrective actions in the order listed.

b. This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

c. The table lists the common malfunctions which you may find during the operation or maintenance of the service unit, or its components. You should perform the tests/inspections and corrective actions in the order listed.

Table 4-1. Troubleshooting

Malfunction
Test or Inspection
Corrective Action

1. PRESSURE FAILS TO RISE IN RESERVOIR WHEN HEATER IS ON.

Step 1. Test pressure switches as follows:

Connect a 120 volt light bulb between terminals 1 and 4A of terminal board TB1. (See figure 4-1 for wiring diagram). Set circuit breaker on service unit to ON and heater switch to ON. Allow tank heater to cycle on and off while observing gage above tank. Light should go on and remain on until gage indication exceeds 69 5 psig at which time light should go out. If pressure switch falls this test, it is defective and must be replaced.

Replace defective pressure switch(s) as follows:

a. Disconnect wires from terminal board TBI. Disconnect tube assembly (41, fig. 4-2) from tee (40).
b. Remove screws (43), washers (44, 45) and remove switches from bracket (50).
c. Position new switch(s) on mounting bracket and secure bracket to enclosure with screws (43) and washers (44, 45).
d. Connect tube (41) to tee (40). Route wires and connect to terminal board TBI.

Step 2. Test for defective heater as follows:

Fill reservoir with refrigerant in accordance with paragraph 2-4. Connect a jumper wire across terminals 1 and 5 of terminal board TB1. Set power circuit breaker and heater switches to ON.

Allow reservoir to heat until a pressure of 85.5 psig is indicated on gage above tank.

Failure of gage to reach this pressure within one hour indicates a defective tank heater.

Replace defective tank heater in accordance with Chapter 4, paragraph 4-8.

Step 3. Test for defective gage GA3.

Check gage against certified gage. Service unit gage must indicate within two percent of certified gage.

Replace defective gage as follows:

a. Disconnect tube assembly from connector (3, fig. 4-2).
b. Remove nut (9), washers (7, 8) and screw (4), then remove clamp (5) and gage (6). Remove clamp from gage. Remove connector (3) from gage (6).
c. Install connector (3) on back of gage (6).
d. Install clamp (5) around gage (6) and secure clamp and gage to bracket with screw (4), washers (7, 8) and nut (9).
e. Connect tube assembly to connector (3) on back of gage (6).

2. PRESSURE IN RESERVOIR FAILS TO STABILIZE AT APPROXIMATELY 65 PSIG.

Step 1. Check pressure switches same as item 1, step 1, of troubleshooting.

Step 2. Check relief valve in top of tank assembly.

Replace valve (37) with a valve known to be good.

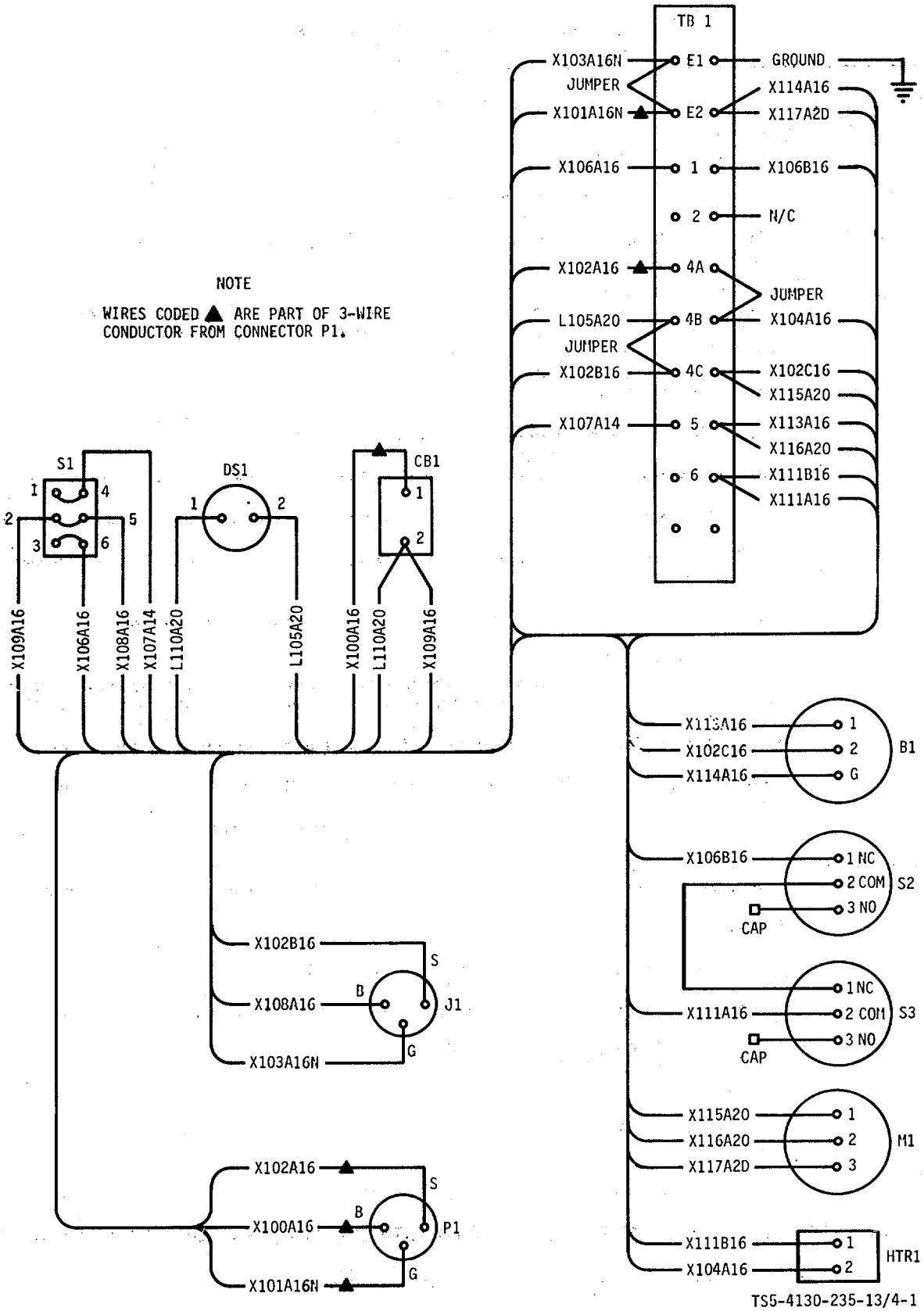


Figure 4-1. Electrical wiring diagram

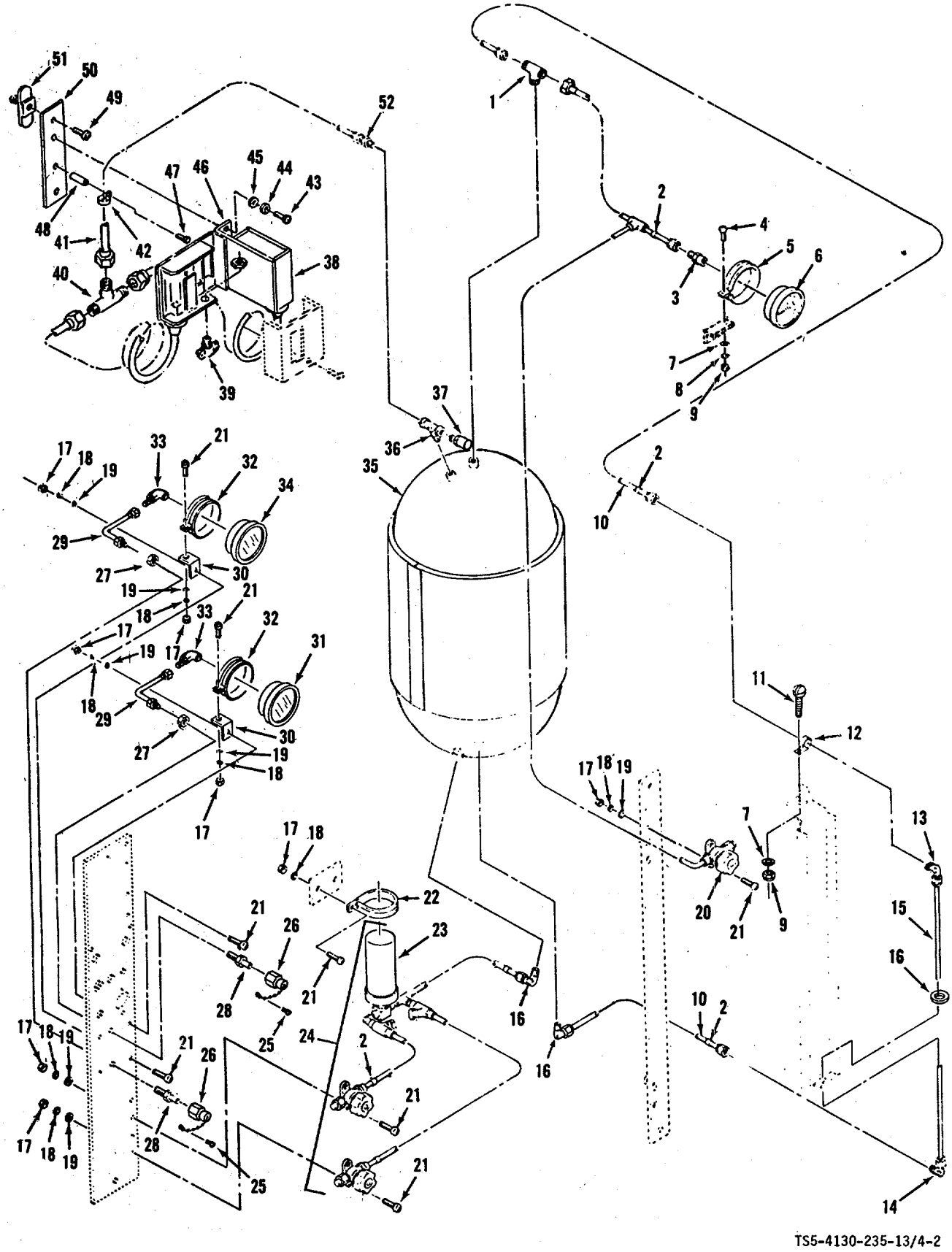


Figure 4-2. Refrigeration charge system.

Key to figure 4-2:

1. Tee
2. Tape
3. Connector
4. Screw
5. Clamp
6. Gage
7. Washer
8. Washer
9. Nut
10. Tube assembly
11. Nut
12. Washer
13. Screw
14. Clamp
15. Elbow
16. Tubing
17. Bushing
18. Washer
19. Washer
20. Refrigeration vent valve assy
21. Screw
22. Clamp
23. Filter drier
24. Refrigeration plumbing assy
25. Screw
26. Cap and chain
27. Nut
28. Union
29. Tube assembly
30. Bracket
31. Gage
32. Clamp
33. Elbow
34. Gage
35. Tank assembly
36. Tee
37. Relief valve
38. Pressure switch
39. Box connector
40. Tee
41. Tube assembly
42. Clamp
43. Screw
44. Washer
45. Washer
46. Bracket
47. Screw
48. Spacer
49. Screw
50. Mounting bar
51. Nut
52. Connector

Table 4-1. Troubleshooting (Continued)

Malfunction Test or Inspection Corrective Action

3. VACUUM PUMP FAILS TO OPERATE.

Step 1. Check for defective wiring or defective pump motor switch.
If required, repair wiring or replace pump motor switch.

Step 2. Check for defective wiring or defective circuit breaker.
If required, repair wiring or replace circuit breaker.

Step 3. Refer to Chapter 2, paragraph 2-4 and check vacuum pump.
If required, replace vacuum pump in accordance with Chapter 4, paragraph 4-5.

4. VACUUM GAGE FAILS TO INDICATE LEVEL OF VACUUM.

Step 1. Check thermocouple gage control M1.
Connect service unit to source of electrical power and connect a certified vacuum gage to union CP3 and cap union CP4.
Open valves V1 and V2, set circuit breaker to ON and switch to VAC ON.

Table 4-1. Troubleshooting (Continued)

Malfunction Test or Inspection Corrective Action	
4. VACUUM GAGE FAILS TO INDICATE LEVEL OF VACUUM (Continued)	
Compare vacuum indication between gage MI and certified gage at 1000, 500, 50 and 20 microns. The minimum accuracy of gage Ml must be 500 4 50 microns. Close valve V1. Gage M1 must indicate less than 50 microns. If gage M1 fails this test, replace entire thermocouple gage control assembly in accordance with Chapter 4, paragraph 4-7.	
Step 2. Check for leak in vacuum system. If required, repair leak.	
Step 3. Check for defective wiring in vacuum gage wiring circuit. See Figure 4-1 for wiring diagram and figure 5-1 for electrical schematic diagram. If required, repair or replace defective wiring in accordance with Chapter 5, paragraph 5-2.	
5. SERVICE UNIT FAILS TO REACH ULTIMATE VACUUM.	
Step 1. Check plumbing for leaks using leak detector. If leakage is detected, isolate and repair leak.	
Step 2. Inspect vacuum pump for oil leaks between motor and pump, oil case and sight glass. If leakage is found, replace vacuum pump in accordance with Chapter 4, paragraph 4-5.	
6. VAPOR SLUDGES FORM IN VACUUM PUMP SIGHT GLASS.	
Step 1. Check for contamination in vacuum pump oil. If required, flush and refill vacuum pump oil in accordance with Chapter 3, paragraph 3-3.	
Step 2. Check for oil leakage at vacuum pump case or shaft seal. If leakage is found, replace entire vacuum pump in accordance with Chapter 4, paragraph 4-5.	

Section III. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS

4-4. Control Panel Assembly,

a. Removal.

(1) Remove nut (18, fig. 4-3), washers (14, 15), screws (7) and shield (8) covering oil beaker.

(2) Tag and disconnect electrical leads going from the control panel assembly to terminal board TB1.

(3) Disconnect tube on refrigeration plumbing assembly (24, fig. 4-4) from elbow (16) in bottom of tank assembly (35).

(4) Remove clamp (22) from filter drier (23).

(5) Disconnect electrical connector from thermocouple gage control (2, fig. 4-5); then disconnect tube on evacuation valve assembly (9) from vacuum pump (40).

(6) Remove screw (10, fig. 4-3) and washer (11). Remove nut (26), washers (27, 28) and bolt (25); tab, remove assembled control panel (24) from enclosure.

b. Installation.

(1) Position assembled control panel (24) in place on enclosure and secure with bolt (25); washers (27, 28), nut (26), washer (11) and screw (10).

(2) Connect tube from evacuation valve assembly (9, fig. 4-5) to vacuum pump (40).

(3) Connect electrical connector to thermocouple gage control (2).

(4) Connect refrigeration plumbing assembly (20, fig. 4-4) to elbow (16) in bottom of tank assembly (35).

(5) Install clamp (22) on filter drier (23) and secure with screws (21), washers (18) and nut (17).

(6) Route electrical leads from control panel assembly and connect to terminal board TB1. See figure 4-6 for electrical wiring diagram.

4-5. Vacuum Pump.

a. Removal.

(1) Remove assembled control panel in accordance with the instructions given in paragraph 4-4a., in order to gain access to the vacuum pump.

(2) Disconnect electrical wires on vacuum pump from terminal board TB1.

(3) Remove screw (41, fig. 4-5) and clamp (42) to release drain tube (20) from enclosure.

(4) Place a container of at least one-half gallon capacity under drain tube (20), open drain valve (22) and drain oil from vacuum pump.

(5) Remove screw (24), clamp (25) and spacer (26) from tube (27).

(6) Remove tube (27) from elbow (38) on vacuum pump (40).

(7) Remove bolts (31), washers (32, 33) and nuts (43).

(8) Remove bolts (34), washers (35), then remove vacuum pump (40) with base plate (30) and brackets (37) attached.

(9) Remove bolts (28), washers (29) and brackets (37) from vacuum pump.

(10) Remove bolts (28), washers (29) then remove base plate (30) from vacuum pump (40).

b. Installation.

(1) Position base plate (30) on bottom of vacuum pump (40) and secure with washers (29) and bolts (30).

(2) Position brackets (37) on vacuum pump and secure with washers (29) and bolts (28).

(3) Position vacuum pump with brackets (37) and base plate (30) attached in enclosure. Secure base plate to enclosure with bolts (32), washers (33) and nuts (43).

NOTE

Holes in brackets (37) are slotted to facilitate secure mounting of base plate and pump in enclosure.

(4) Secure brackets (37) to enclosure with bolts (34) and washers (35).

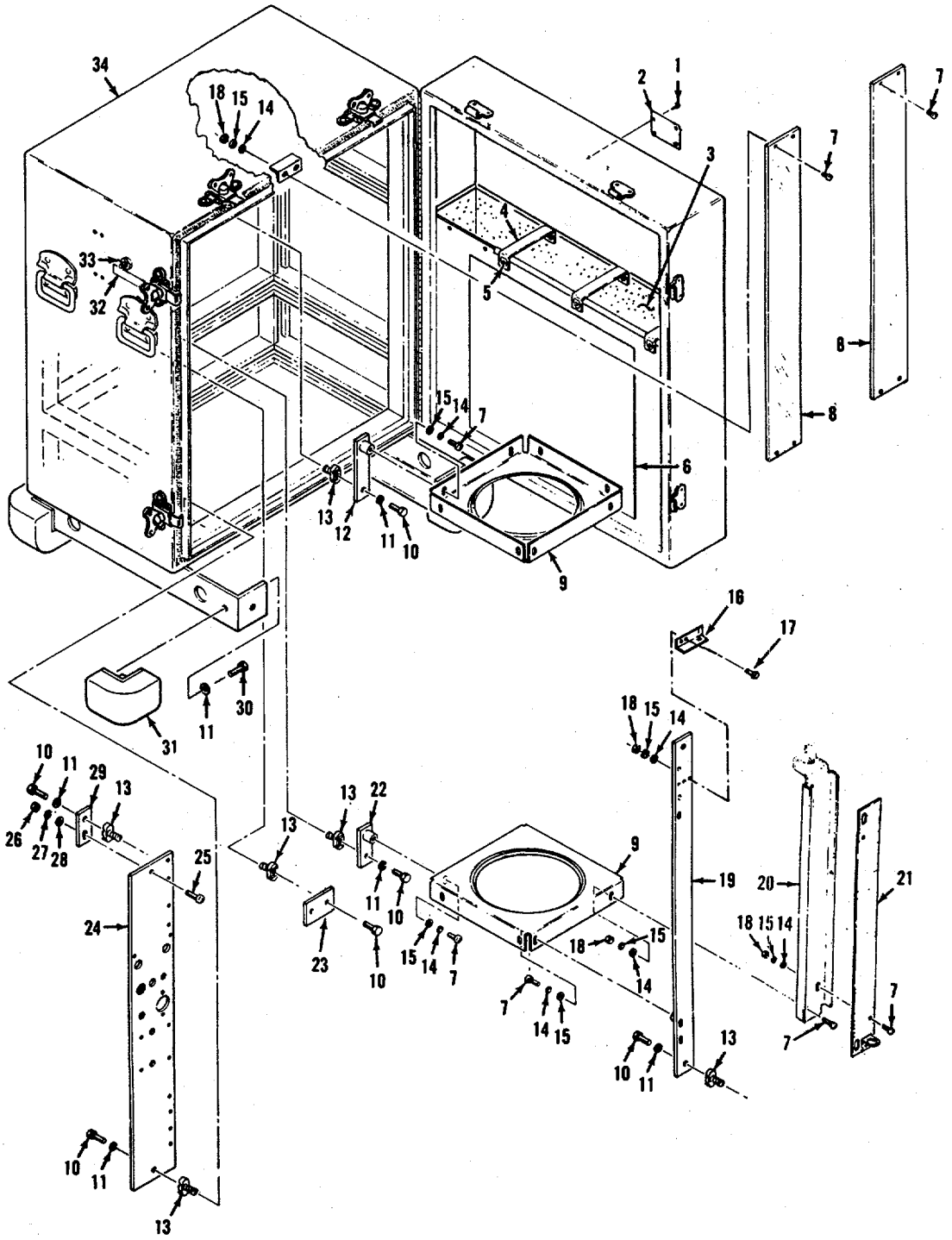
(5) Connect tube (27) to elbow (38) on vacuum pump and tube to enclosure with spacer (26), clamp (25) and screw (24).

(6) Secure drain tube (20) to enclosure with clamp (42) and screw (41).

(7) Connect electrical wires from vacuum pump to terminal board TB1. See figure 4-4 for electrical wiring diagram.

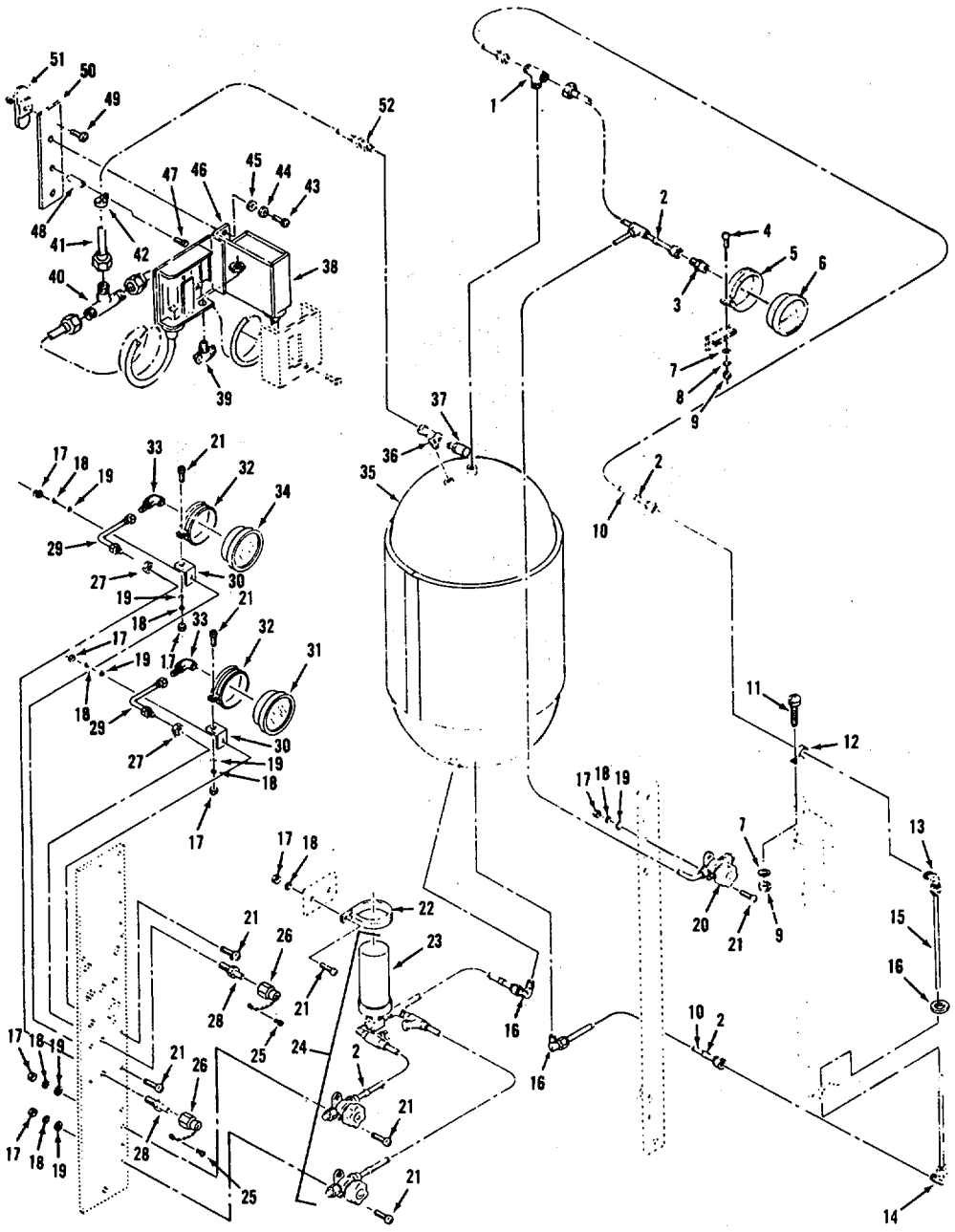
(8) Reinstall assembled control panel in accordance with instructions given in paragraph 4-4b.

(9) Insure that drain valve (22) is closed and fill vacuum pump with oil in accordance with Chapter 3, paragraph 3-2.



1. Screw
2. Identification plate
3. Polyurethane foam
4. Strasp
5. Stud
6. Instruction decal
7. Screw
8. Shield
9. Bracket
10. Screw
11. Washer
12. Bracket
13. Nut
14. Washer
15. Washer
16. Bracket
17. Screw
18. Nut
19. Panel
20. Bracket
21. Scale
22. Bracket
23. Bracket
24. Panel
25. Bolt
26. Nut
27. Washer
28. Washer
29. Bracket
30. Screw
31. Foot
32. Warning decal
33. Valve
34. Enclosure

Figure 4-3. Cover, door and panels.



1. Tee
2. Tape
3. Connector
4. Screw
5. Clamp
6. Gage
7. Washer
8. Washer
9. Nut
10. Tube assembly
11. Nut
12. Washer
13. Screw
14. Clamp
15. Elbow
16. Tubing
17. Bushing
18. Washer
19. Washer
20. Refrigeration vent valve assy
21. Screw
22. Clamp
23. Filter drier
24. Refrigeration plumbing assy
25. Screw
26. Cap and chain
27. Nut
28. Union
29. Tube assembly
30. Bracket
31. Gage
32. Clamp
33. Elbow
34. Gage
35. Tank assembly
36. Tee
37. Relief valve
38. Pressure switch
39. Box connector
40. Tee
41. Tube assembly
42. Clamp
43. Screw
44. Washer
45. Washer
46. Bracket
47. Screw
48. Spacer
49. Screw
50. Mounting bar
51. Nut
52. Connector

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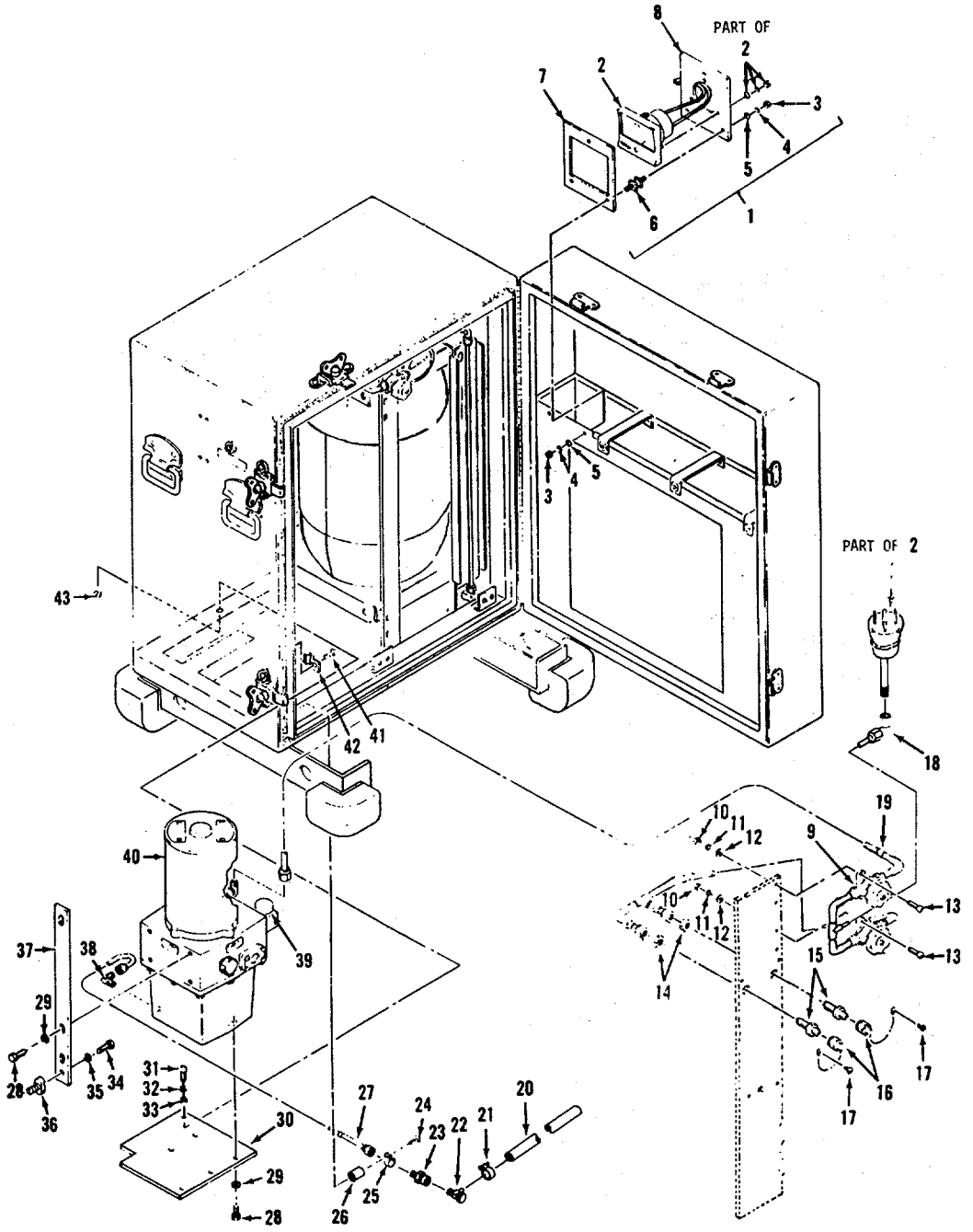
Figure 4-4. Refrigeration charge system.



1. Vacuum gage assembly
2. Thermocouple gage control
3. Nut
4. Washer
5. Washer
6. Shock isolator
7. Panel
8. Bracket
9. Evacuation valve assembly
10. Nut
11. Washer
12. Washer
13. Screw
14. Nut
15. Union
16. Cap and chain
17. Screw
18. Elbow
19. Tape
20. Hose
21. Clamp
22. Drain valve
23. Reducer
24. Screw
25. Clamp
26. Spacer
27. Drain tube
28. Screw
29. Washer
30. Plate
31. Bolt
32. Washer
33. Washer
34. Screw
35. Washer
36. Nut
37. Bracket
38. Elbow
39. Pump, oil fill
40. Vacuum pump
41. Screw
42. Hose clip
43. Nut

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Figure 4-5. Vacuum system.

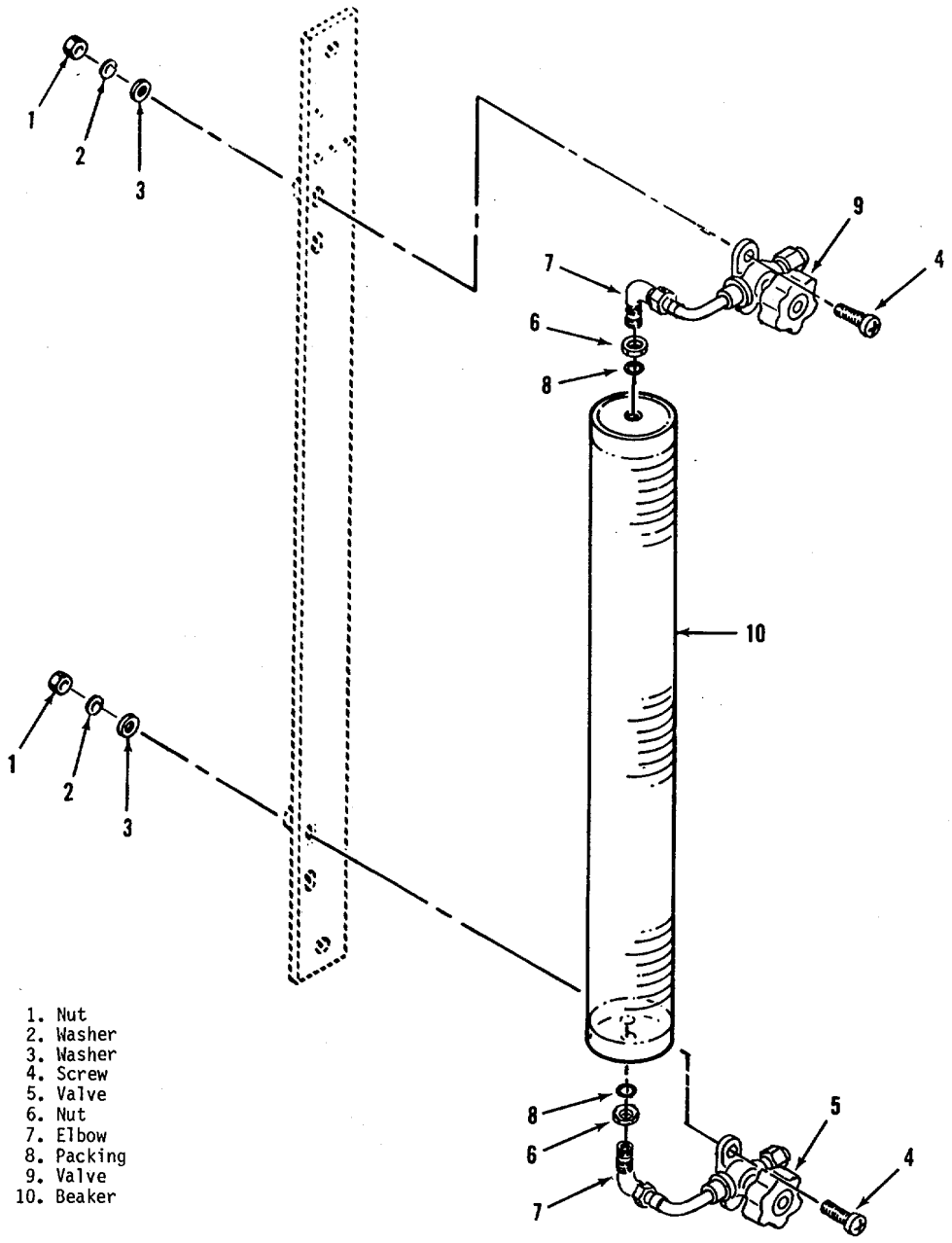

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Figure 4-6. Oil charge system.

4-6. Oil Beaker.

a. Removal.

(1) Remove plastic shield (8, fig. 4-3) from in front of oil beaker by removing nuts (18), washers (14, 15) and screws (7).

(2) Remove nuts (1, fig. 4-6), washers (2, 3) and screws (4) from valves (5) and (9), then remove assembled oil beaker and valves from enclosure.

(3) Remove valves (5) and (9) from beaker (10) by removing nuts (6), elbow (7) and packing (8).

b. Installation.

(1) Assemble valves (5) and (9) on beaker (10) with packing (8), elbow (7) and nut (6).

(2) Position assembled oil beaker and valves on bracket (19, fig. 4-3) and secure valves (5, fig. 46) and (9) to brackets with screws (14), washers (2, 3) and nuts (1).

(3) Place plastic shield (8, fig. 4-3) in front of oil beaker and secure with screws (7), washers (14, 15) and nuts (18).

4-7. Thermocouple Gage Control.

a. Removal.

(1) Remove M1 gage wires from terminals E2, 4C and 5 of terminal board TB1.

(2) Unplug thermistor half (part of 2, fig. 4-5) located on elbow (18).

(3) Cut wire ties and remove thermistor and wiring leading to gage.

(4) Remove shock isolators (6), brackets (8) and gage (2) from panel (7).

b. Installation.

(1) Install gage (2) with bracket (8) on panel (7) with shock isolators (6).

(2) Route wiring with thermistor (part of (2)) to elbow (18). Unplug thermistor half, lubricate threads of thermistor and thread into elbow (18). Plug thermistor halves together.

(3) Route wires from gage to terminals E2, 4C and 5 of terminal board TB1. See figure 4-1 for electrical wiring diagram.

4-8. Tank Assembly and Heater.

a. Removal.

(1) Remove plastic shield (8, fig. 4-3) from in front of oil beaker by removing nuts (18), washers (14, 15) and screws (7).

(2) Disconnect tube assembly leading from gage (6, fig. 4-4) at tee (1).

(3) Remove bolts (10, fig. 4-3), washers (11); then remove bracket (19) with oil beaker, valves and gage attached.

(4) Disconnect tube assembly (10, fig. 4-4) from tee (1).

(5) Disconnect tube assembly (41) from connector (52).

(6) Disconnect tube assembly (10) from elbow (16) at bottom of tank assembly (35).

(7) Disconnect tube assembly leading from refrigeration plumbing assembly (24) at other elbow (16) in bottom of tank assembly.

(8) Disconnect wires from tank heater at terminal board TB1. See figure 4-1 for electrical wiring diagram.

(9) Remove screws (7, fig. 4-3), washers (14, 15) and remove tank bracket (9) from top of tank assembly.

(10) Raise tank assembly and remove from lower bracket (9) and from enclosure.

(11) Remove tape (23, fig.4-7), then remove insulation (24, 25).

(12) Peel heating element (26) from bottom of tank assembly.

b. Installation.

(1) Spread a thin layer of RTV 156 (red) 1/32" over tank surface to be covered by heater.

(2) Attach heater so there is no air space and seal heater to tank with RTV 156.

(3) Position lower insulation (25) on lower part of tank assembly.

(4) Wrap insulation (24) around tank. Tuck lower insulation (25) under (24) and tape all insulation seams with Polyken tape.

(5) Position tank assembly into lower support brackets (9, fig. 4-3). Place upper support bracket (9) on top assembly and secure to enclosure with screws (7) and washers (14, 15).

(6) Route wires from tank heater and connect to terminal board TB1. See figure 4-1 for electrical wiring diagram.

(7) Connect tube assembly leading from refrigeration plumbing assembly (24, fig. 4-4) to elbow (16) in bottom of tank assembly (35).

(8) Connect tube assembly (10) to remaining elbow (16) in bottom of tank assembly.

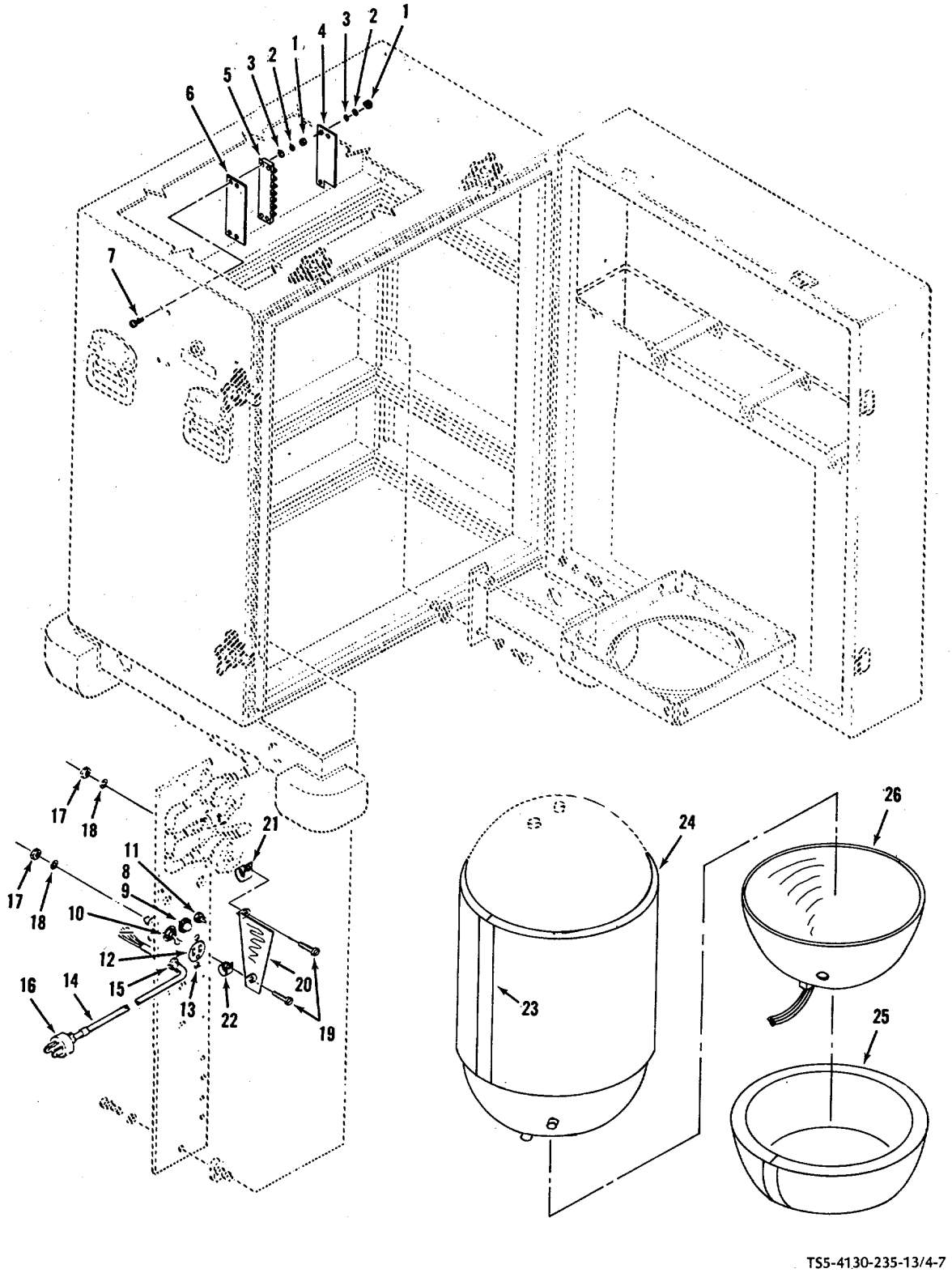


Figure 4-7. Electrical components and tank heater.

Key to figure 4-7:

1. Nut
2. Washer
3. Washer
4. Cover
5. Terminal board
6. Insulation strip
7. Screw
8. Lamp
9. Lamp assembly
10. Circuit breaker
11. Switch
12. Connector
13. Screw
14. Conductor
15. Cord grip
16. Plug
17. Nut
18. Washer
19. Screw
20. Shield
21. Clamp
22. Clamp
23. Tape
24. Insulation
25. Insulation
26. Heater, tank

(9) Connect tube assembly (41) to connector (52) and tube assembly (10) to tee (1).

(10) Position brackets (19, fig. 4-3) with oil beaker, valves and gage attached in enclosure and secure with bolts (10) and washers (11).

(11) Position plastic shield on enclosure in front of oil beaker and secure with screws (7), washers (14, 15) and nuts (18).

CHAPTER 5
REPAIR OF THE SERVICE UNIT, REFRIGERATION SYSTEM (MUST)

5-1. General.

Repair of the Service Unit, Refrigeration System (MUST) consists of removing and replacing malfunctioning or defective components. When required, the suspect component or assembly should be tested in the system before replacement.

5-2. Electrical Wiring.

a. Replace defective electrical wires as may be required with 19 strand, AWG 18, high temperature insulated wire of the same color and length as that being replaced. See figure 5-1 for electrical wiring diagram and figure 5-2 for electrical schematic diagram of the service unit.

b. Replace defective solid wires as may be required with AWG 18 wire of the same color and length as that being replaced.

c. Replace defective wire lugs as required.

5-3. Thermocouple Gage Control (M1, MT1).

a. Inspection. Verify thermocouple gage control (2, fig. 5-3) for defects or inaccuracy before replacement as follows: (Refer to reference designators M1 and MT1 on schematic diagram, figure 5-2).

(1) Connect service unit to source of electrical power (115 VAC, 60 Hz).

(2) Connect a certified vacuum gage to CP3 (25, fig. 2-1) and cap CP4 (24).

(3) Open valves V1 (1) and V2 (2). Set circuit breaker (22) to ON and switch (21) to VAC ON.

(4) Compare vacuum indication between service unit gage and certified gage at 1000, 500, 50 and 20 microns. The minimum accuracy of service unit gage must be 500/50 microns.

(5) Close valve V1 (1). Service unit gage must indicate less than 50 microns.

(6) If service unit gage fails this test, replace entire thermocouple gage control.

b. Removal

(1) Remove M1 wires from terminals E2, 4C and 5 of terminal board TB1.

(2) Unplug thermistor half (part of 2, fig. 5-3) located on elbow (18).

(3) Cut wire ties and remove thermistor and wiring leading to gage M1 (2).

(4) Remove shock isolators (6), brackets (8) and gage (2) from panel (7).

c. Installation.

(1) Install gage (2) with bracket (8) on panel (7) with shock isolators (6).

(2) Route wiring with thermistor (part of 2) to elbow (18). Unplug thermistor half, lubricate threads of thermistor and thread into elbow (18). Plug thermistor halves together.

(3) Route wires from gage to terminals E2, 4C and 5 of terminal board TB1. See figure 5-1 for electrical wiring diagram.

5-4. Evacuation Valve Assembly.

a. Inspection. Leak check the evacuation valve assembly (9, fig. 5-3) as follows:

(1) Connect hose assemblies (8, 9, fig. 5-4) with gaskets (2, 3) to unions CP3 and CP4. Connect other end of hose assemblies together using a male union.

(2) Open valve V1 and V2, set circuit breaker to ON and selector switch to VAC ON.

(3) Allow vacuum pump to operate for 15 minutes and observe indication on vacuum gage M1.

(4) If vacuum gage indicates more than 100 microns, leakage is excessive.

(5) Check tightness of tube fittings on unions (15, fig. 4-3) and at connection to vacuum pump (40).

(6) If leakage persists, replace entire evacuation valve assembly.

b. Removal.

(1) Unplug thermistor half (part of 2), then hold elbow (18) and remove remaining half of thermistor from elbow

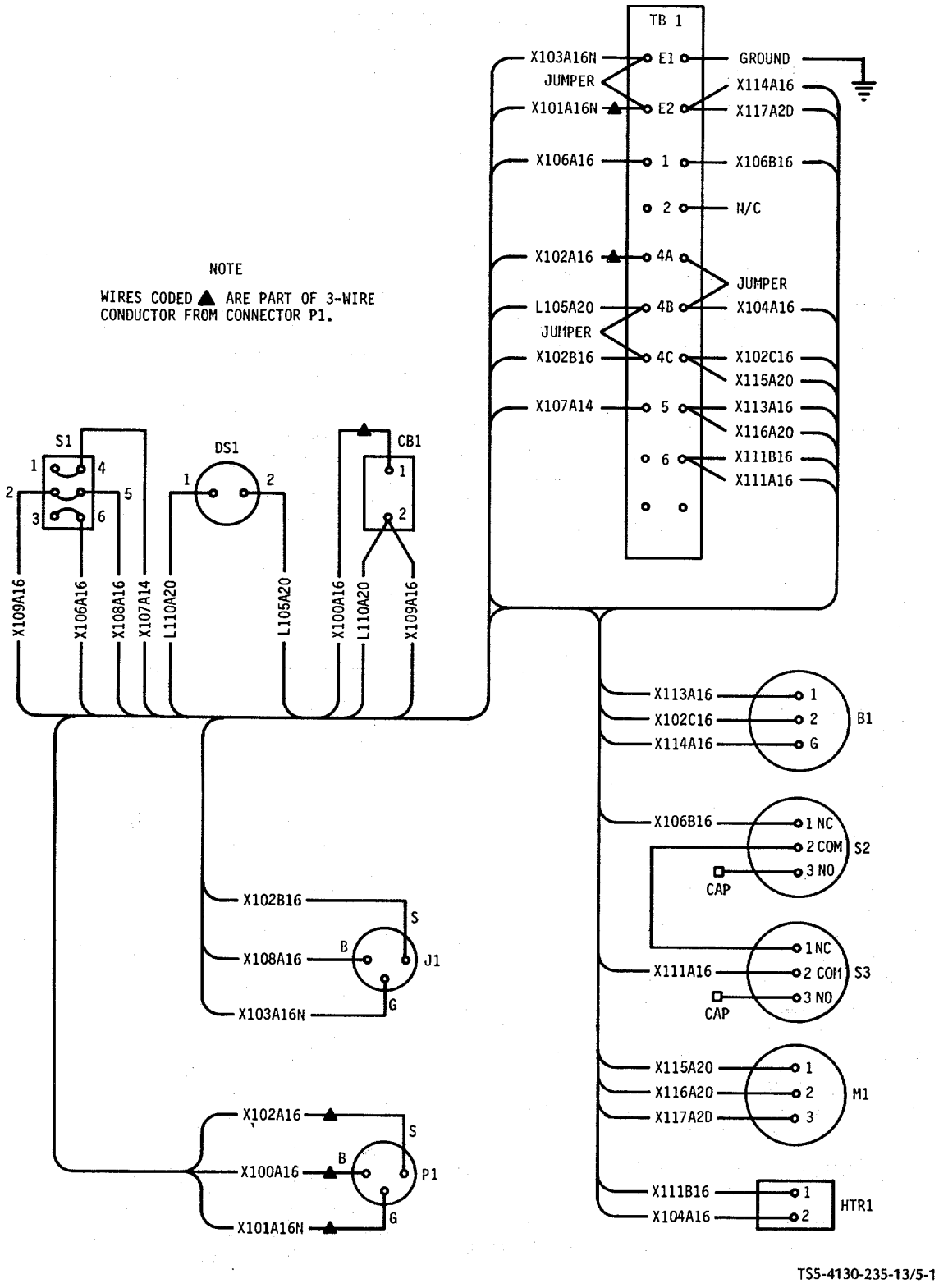


Figure 5-1. Electrical wiring diagram

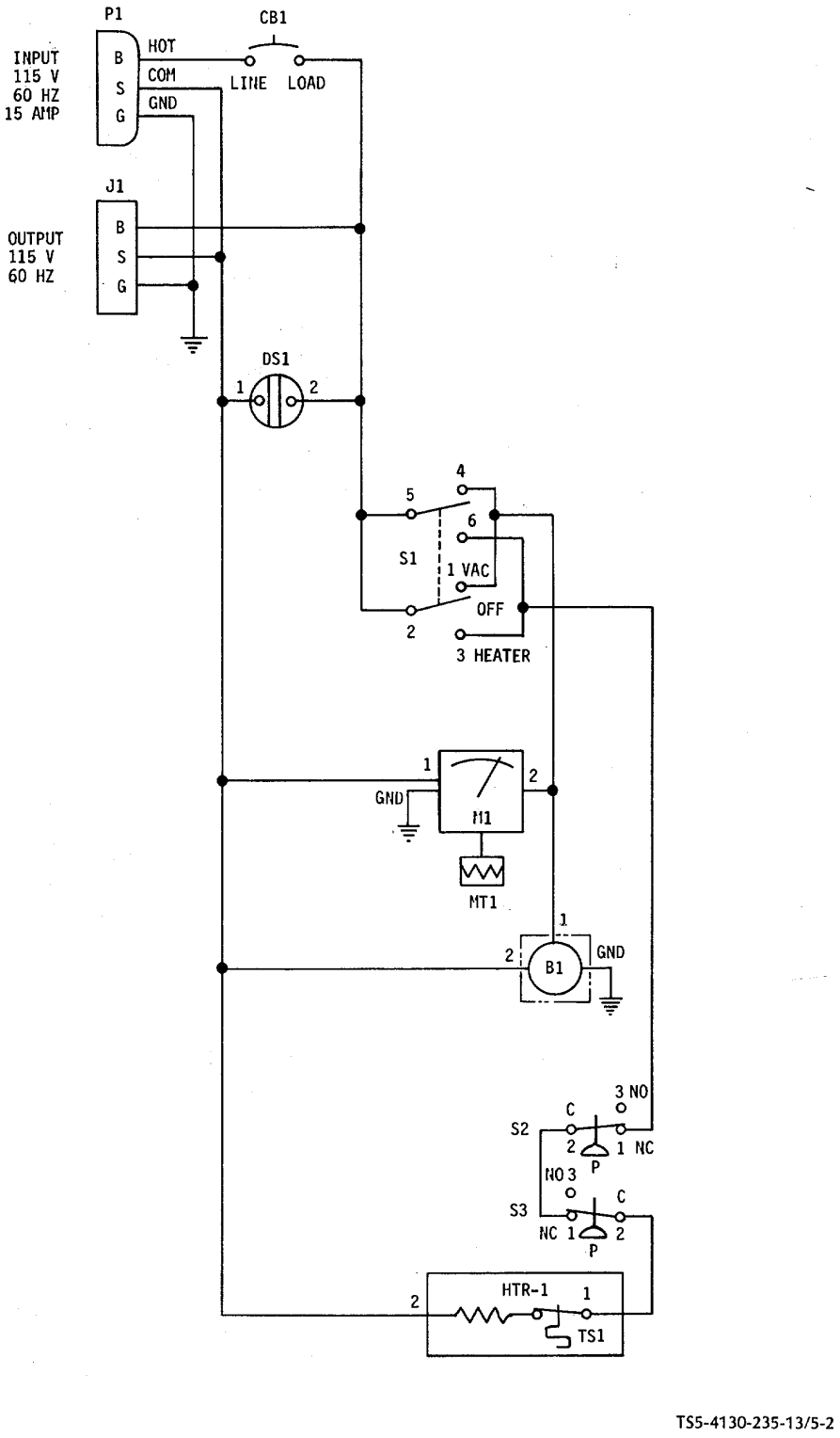
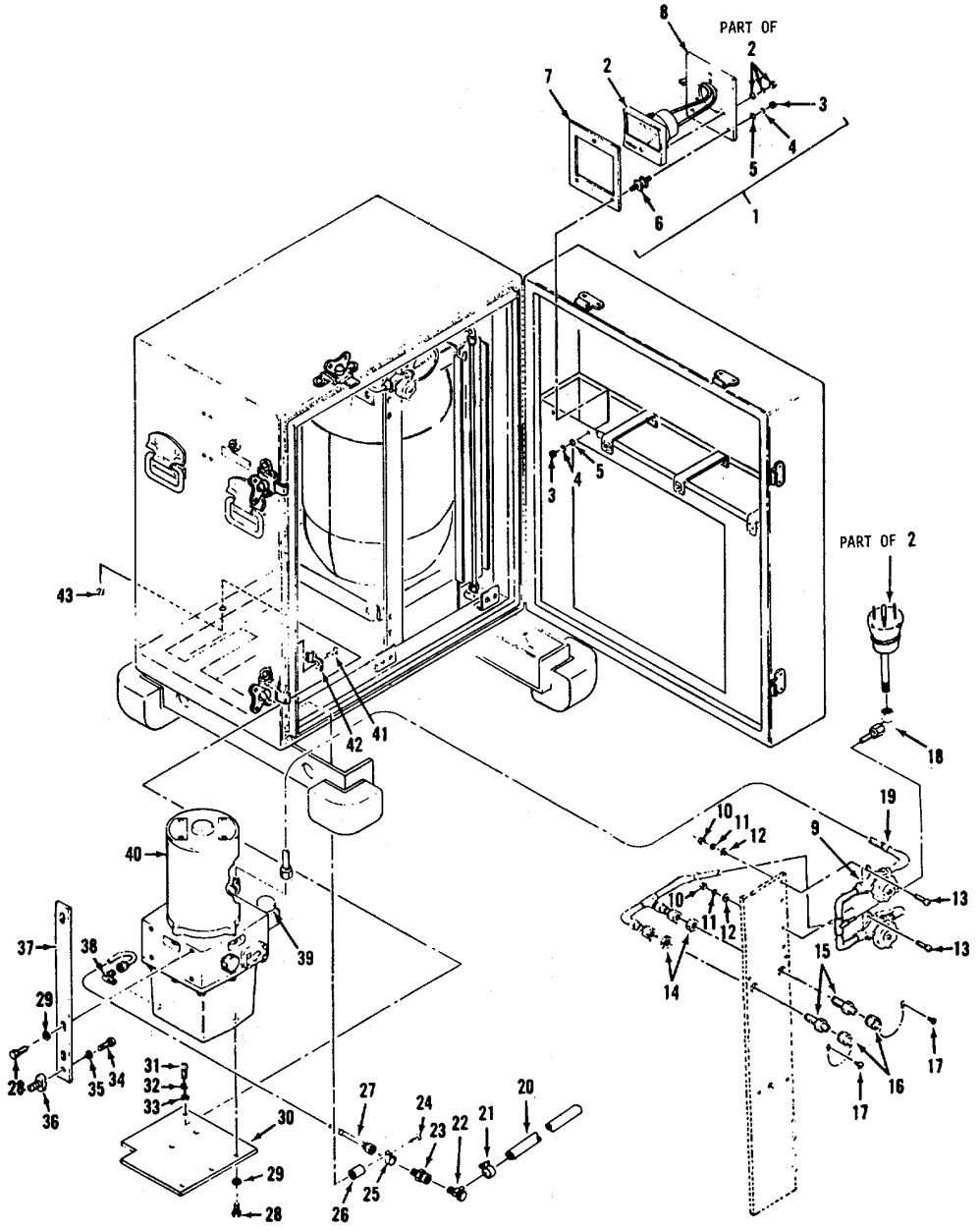


Figure 5-2. Service unit electrical schematic.



1. Vacuum gage assembly
2. Thermocouple gage control
3. Nut
4. Washer
5. Washer
6. Shock isolator
7. Panel
8. Bracket
9. Evacuation valve assembly
10. Nut
11. Washer
12. Washer
13. Screw
14. Nut
15. Union
16. Cap and chain
17. Screw
18. Elbow
19. Tape
20. Hose
21. Clamp
22. Drain valve
23. Reducer
24. Screw
25. Clamp
26. Spacer
27. Drain tube
28. Screw
29. Washer
30. Plate
31. Bolt
32. Washer
33. Washer
34. Screw
35. Washer
36. Nut
37. Bracket
38. Elbow
39. Pump, oil fill
40. Vacuum pump
41. Screw
42. Hose clip
43. Nut

TS5-4130-235-13/5-3

Figure 5-3. Vacuum system.

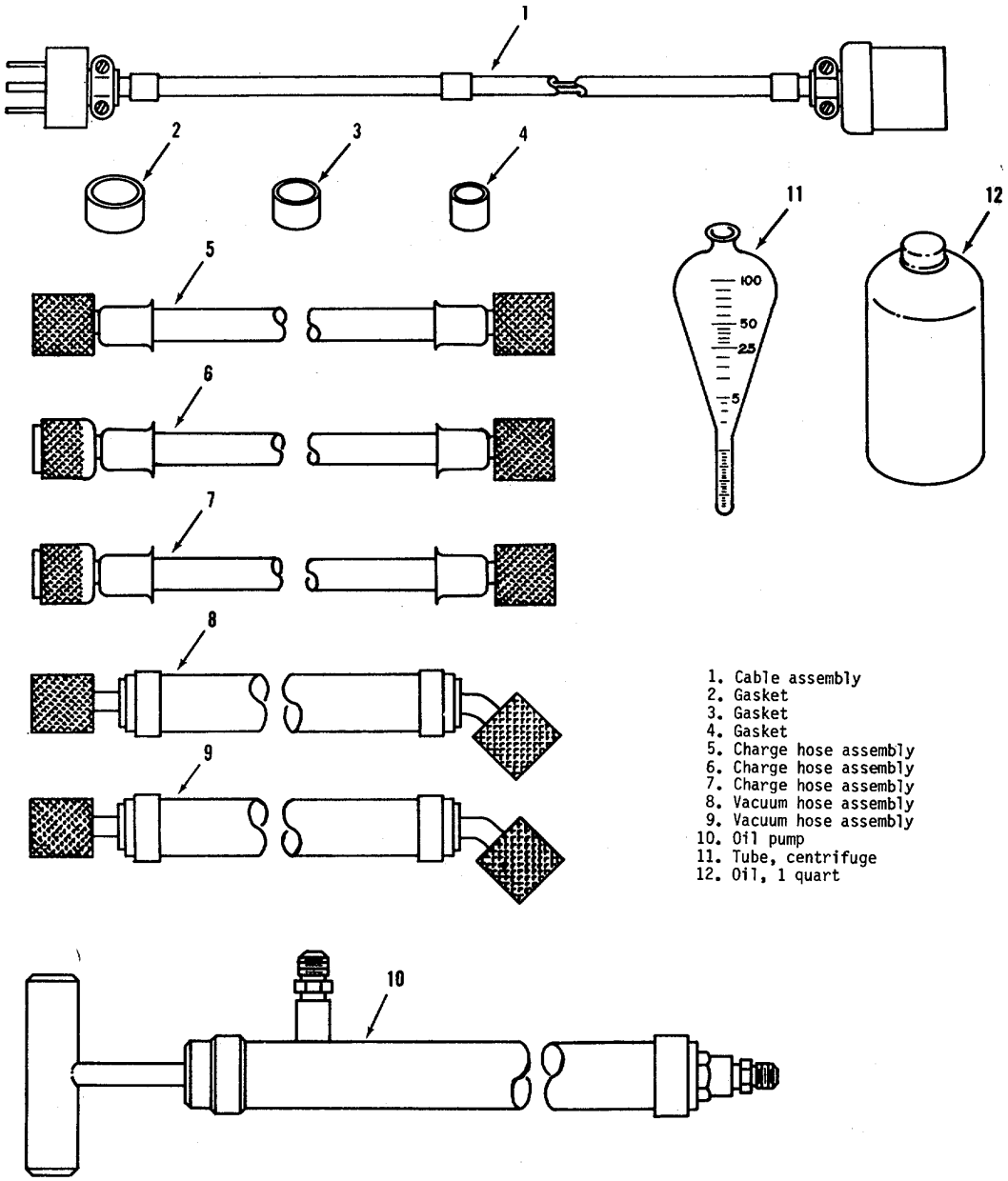


Figure 5-4. Refrigeration service unit accessories.

(2) Disconnect tube assemblies from vacuum pump (40) and from unions (15).

(3) Remove nuts (10), washers (11, 12) and screws (13), then remove evacuation valve assembly (9) from control panel.

c. Installation.

(1) Position valves of evacuation valve assembly (9) on control panel and secure in place with screws (13), washers (12, 11) and nuts (10).

(2) Connect tube assemblies to vacuum pump (40) and to unions (15) on control panel.

(3) Lubricate threads of thermistor half with liquid sealer and install in elbow (18). Plug in remaining half of thermistor.

(4) Recheck for leakage in accordance with paragraph 5-4a.

5-5. Refrigerant Pressure Gages.

a. Inspection. Verify gages (9, 10, fig. 2-1) for defects and accuracy before replacement as follows:

(1) Inspect gages for broken glass, bent or missing pointers.

(2) Uncap unions CP2 and CP1 (17, 18) and connect certified gages covering the ranges of gages (9, 10) into a pressure line between unions (17, 18) and a pressure regulator. Calibrate in 20 psig intervals to 60 psig for gage (10) and 150 psig for gage (9).

(3) Gages must indicate within two percent of their respective certified gage.

b. Removal

(1) Disconnect tube assembly (29, fig.5-4) from gage (31) or (34), whichever is being replaced.

(2) Remove nuts (17), washers (18, 19), screws (21) and clamp (32) from gage (31) or (34).

(3) Remove elbow (33) from gage(s) to be replaced (31) or (34).

c. Installation.

(1) Lubricate threads of elbow with liquid sealer and install into new gage(s).

(2) Secure gage(s) to bracket (3) on control panel with clamp (32), screws (21), washers (18, 19) and nuts (17).

(3) Connect tube assembly (29) to elbow (33) on new gage(s) (31) or (34).

5-6. Vacuum Gage.

a. Inspection. Verify vacuum gage (7, fig. 2-1) for defects and accuracy before replacement as follows:

(1) Inspect gage for broken glass, bent or missing pointers.

(2) Close valves (12, 14) and open valve V3 (5).

(3) Uncap valve V3 (5) and connect a certified gage covering the range of gage (7) into a pressure line between valve V3 (5) and a pressure regulator. Calibrate gage (7) in 20 psig increments to 80 psig.

(4) Gage (7) must indicate' within two percent of certified gage.

b. Removal

(1) Disconnect tube assembly from connector (3, fig. 4-4) on back of gage (6).

(2) Remove nut (9), washers (7, 8), screw (4) and clamp (5), then remove gage (6).

(3) Remove connector (3) from back of gage (6).

c. Installation.

(1) Lubricate threads on back of new gage (6) with liquid sealer and thread connector (3) onto back of new gage.

(2) Secure gage with clamp (5), screw (4), washers (7, 8) and nut (9).

(3) Connect tube assembly to connector (3) on back of gage (6).

5-7. Filter Drier Replacement.

a. Removal

(1) Remove plastic shield (8, fig. 4-3) from in front of oil beaker by removing nuts (18), washers (14, 15) and screws (7).

(2) Disconnect valves (5, 9, fig. 4-6) from elbows (7), then remove oil beaker from enclosure.

(3) Remove nut (17, fig. 4-4), washer (18), screws (21) and clamp (22).

(4) Using a wrench on the hex nut at the base of the filter drier (23), unscrew the filter drier from its mounting.

b. Installation.

(1) Coat threads of' new filter drier with liquid sealer and thread into its mounting.

(2) Secure filter drier to its support bracket using clamp (22), screw (21), washer (18) and nut (17).

(3) Reinstall oil beaker in enclosure and connect

valves (5, 9, fig. 4-5) to elbows (7).

(4) Reinstall plastic shield (8, fig. 4-1) using screws (7), washers (14, 15) and nuts (18).

5-8. Refrigeration Vent Valve Assembly.

a. Removal.

(1) Disconnect tubes on refrigeration vent valve assembly (20, fig. 4-4) from connector (3) on back of gage (6) and from tee (1) in top of tank assembly (35).

(2) Remove nuts (17), washers (18, 19) and screws (21) from valve assembly (20) and remove valves assembly from panel.

b. Installation.

(1) Position new refrigeration vent valve assembly on panel and secure with screws (21), washers (18, 19) and nuts (17).

(2) Connect tubes on valve assembly to connector (3) on back of gage (6) and to tee (1) in top of tank assembly (35).

5-9. Refrigeration Plumbing Assembly.

a. Removal

(1) Remove plastic shield (8, fig. 4-3) from in front of oil beaker by removing nuts (18), washers (14, 15) and screws (7).

(2) Remove nuts (1, fig. 4-6), washers (2, 3) and screws (4) from valves (5) and (9), then remove assembled oil beaker and valves from enclosure.

(3) Remove nut (17, fig. 4-4), washer (18), screw (21) and clamp (22).

(4) Disconnect tube assembly from elbow (16) in bottom of tank assembly (35).

(5) Remove nuts (17), washers (18, 19) and screws (21), then remove refrigeration plumbing assembly (24) from enclosure.

b. Installation.

(1) Position valves or the refrigeration plumbing assembly (24) on control panel and secure with screws (21), washers (18, 19) and nuts (17).

(2) Lubricate threads of elbow (16) with liquid sealer then connect tube assembly to elbow.

(3) Install clamp (22) around filter drier (23) and secure to bracket with screw (21), washer (18) and nut (17).

(4) Position oil beaker assembly in enclosure and secure with screws (4, fig. 4-6), washers (2, 3) and nuts (1).

(5) Install plastic shield on enclosure in front of oil beaker assembly and secure with screws (7, fig. 4-1), washers (14, 15) and nuts (18).

APPENDIX A
REFERENCES

A-1. Fire Protection.

TB 5-4200-200-10	Hand Portable Fire Extinguishers for Army Use

A-2. Lubrication.

C9100IL	Fuels, Lubrication, Oil and Waxes

A-3. Painting.

TM 9-213	Painting Instructions for Field Use

A-4. Cleaning.

C6800IL	Cleaning and Chemical Products

A-5. Maintenance.

TM 5-4130-235-23P	Organizational and Direct Support Maintenance Repair Parts and Special Tools List. Service Unit, Refrigeration System (MUST) (Amertech Corp. Model 1200-F-0001) NSN 4130-01-039-8124
TM 38-750	The Army Maintenance Management System (TAMMS)

A-6. Shipment and Storage.

TB 740-93-2	Preservation of USAMEC Mechanical Equipment for Shipment and Storage
TM 38-230-1	Preservation and Packing of Military Equipment
TM 740-90-1	Administrative Storage of Equipment

A-7. Destruction of Material to Prevent Enemy Use.

TM 750-244-3	Destruction of Material to Prevent Enemy Use.

APPENDIX B
MAINTENANCE ALLOCATION CHART

Section I. INTRODUCTION

B-1. General.

a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance levels.

b. The Maintenance Allocation Chart (MAC) in Section II designates overall responsibility for the performance of maintenance functions on the identified end item or component. The implementation of the maintenance functions upon the end item or component will be consistent with the assigned maintenance functions.

c. Section III lists the special tools and test equipment required for each maintenance function as referenced from Section II.

d. Section IV contains supplemental instructions on explanatory notes for a particular maintenance function.

B-2. Maintenance Functions.

a. Inspect. To determine the serviceability of an item by comparing its physical, mechanical and/or electrical characteristics with established standards through examination.

b. Test. To verify serviceability and detect incipient failure by measuring mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service. Operations required periodically to keep an item in proper operating condition, i.e., to clean (decontaminate), to preserve, to drain, to paint, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

d. Adjust. To maintain within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to be within specified parameters.

e. Align. To adjust specified variable elements of an item to bring about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipment used in precision measurement. Consists of comparison of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Install. The act of emplacing, seating, or fixing into position an item, part or module (component or assembly) in a manner to allow the proper functioning of an equipment or system.

h. Replace. The act of substituting a serviceable like type part, sub-assembly, or module (component or assembly) for an unserviceable counterpart.

i. Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, or replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, sub-assembly, module (component or assembly), end item or system.

j. Overhaul. That maintenance effort (service/ action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (i.e., DMWR) in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours/miles, etc.) considered in classifying Army equipment/components.

B-3. Column Entries Used in the MAC.

a. Column 1, Group Number. Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies, and modules with the next higher assembly.

b. Column 2, Component/Assembly. Column 2

contains the names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Functions. Column 3 lists the functions to be performed on the item listed in column 2. (For detailed explanation of these functions, see paragraph B-2.)

d. Column 4, Maintenance Level. Column 4 specifies, by the listing of a "work time" figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform the maintenance function at the indicated level of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance levels, appropriate "work time" figures will be shown for each level. The number of man-hours specified by the "work time" figure represents the average time required to restore an item (assembly, subassembly, component, module, end item or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time, and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. The symbol designations for the various maintenance levels are as follows:

C..... Operator or crew
O..... Organization maintenance
F..... Direct support maintenance
H..... General support maintenance
D..... Depot maintenance

e. Column 5, Tools and Equipment. Column 5 specifies, by code, those common tool sets (not individual tools) and special tools, test, and support equipment required to perform the designated function.

f. Column 6, Remarks. Column 6 lists information pertinent to the maintenance function being performed as indicated on the MAC, Section II.

Section II. MAINTENANCE ALLOCATION CHART

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQPT	(6) REMARKS
01	Cover, Doors, and Panels	Inspect	0.3						
		Install		8.0					
		Replace			16.0				
02	Refrigeration Charge System	Inspect	0.5						
		Install			8.0				
		Replace			16.0				
03	Vacuum System	Inspect	0.5						
		Install			12.0				
		Replace			24.0				
04	Oil Charge System	Inspect	0.3						
		Install			0.5				
		Replace			1.0				
05	Electrical System	Inspect	0.5						
		Install			2.0				
		Replace			4.0				
06	Accessories	Inspect	0.5						
		Install			0.1				
		Replace			0.3				

APPENDIX C
COMPONENTS OF END ITEMS LIST

Section I. INTRODUCTION

C-1. Scope.

This appendix lists Integral Components of and Basic Issue Items (BII) for the Service Unit to help you inventory items required for safe and efficient operation.

C-2. General.

The components of end item list are divided into the following sections:

a. Section II, Integral Components of the End Item. These items, when assembled, comprise the Service Unit and must accompany it whenever it is transferred or turned in. These illustrations will help you identify these items.

b. Section III, Basic Issue items. These are minimum essential items required to place the Service Unit in operation, to operate it and to perform emergency repairs. Although shipped separately packed, they must accompany the Service Unit during operation and whenever it is transferred between accountable officers. The illustrations will assist you with hard-to-identify items. This manual is your authority to requisition replacement BII based on Table(s) of Organization and Equipment (TOE)/Modification Table of Organization and Equipment (MTOE) authorization of the end item.

C-3. Explanation of Columns.

a. Illustration. This column is divided as follows:

(1) Figure Number. Indicates the figure number of the illustration on which the item is shown (if applicable).

(2) Item Number. The number used to identify item called out in the illustration.

b. National Stock Number (NSN). Indicates the national stock number assigned to the end item which will be used for requisitioning.

c. Part Number (P/N). Indicates the primary number used by the manufacturer which controls the design and characteristics of the item by means of its engineering drawings, specifications, standards and inspection requirements to identify an item or range of items.

d. Description. Indicates the federal item name and, if required, a minimum description to identify the item.

e. Location. The physical location of each item listed is given in this column. The lists are designed to inventory all items in one area of the major item before moving on to an adjacent area.

f. Usable on Code. "USABLE ON" codes are included to help you identify which component items are used on the different models. Identification of the codes used in this list are:

Code	Used On

g. Quantity Required (Qty Reqd). This column lists the quantity of each item required for a complete major item.

h. Quantity. This column is left blank for use during inventory. Under the received column, list the quantity you actually receive on your major item. The date columns are for use when you inventory the major item at a later date, such as for shipment to another site.

Section II. INTEGRAL COMPONENTS OF END ITEM

(1) Illustration (a) Figure No.	(b) Item No.	(2) National Stock Number	(3) Part No. & FSCM	(4) Description	(5) Location	(6) Usable On Code	(7) Qty Reqd	(8) Quantity Rev'd	Date	Date	Date
2-2	1			Cable Assembly 1200-C-051 (51913)			1				
2-2	2			Gasket 4CH80 (11284)			10				
2-2	3			Gasket 4CH11 (11284)			10				
2-2	4			Gasket 4CH20.4 (11284)			10				
2-2	5			Hose, Charging 1200-C-0206-1 (51913)			1				
2-2	6			Hose, Charging 1200-C-0206-1			1				
2-2	7			Hose, Charging 1200-C-0207			1				
2-2	8			Hose, Vacuum 1200-C. 0208-1			1				
2-2	9			Hose, Vacuum 1200-C-0208-2 (61913)			1				
2-2	10			Pump, Oil 1200-C1 0126-1 (51913)			1				
2-2	11			Tube, Centrifuge 21119-001 (08474)			1				
2-2	12			Oil, Vacuum 1407L (64484)			1				

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The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 decagram = 10 grams = .35 ounce
1 hectogram = 10 decagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	*To*	*Multiply by*	*To change*	*To*	*Multiply by*
inches	centimeters	2.540	ounce-inches	Newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	Newton-meters	1.356	metric tons	short tons	1.102
pound-inches	Newton-meters	.11296			

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