CRAY C90™ Series PMI/PMP Manual

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Record of Revision

Each time this manual is updated with a change packet, a change to part of a text page is indicated by a change bar in the margin directly opposite the change. A change bar in the footer of a text page indicates that most, if not all, of the text is new. A change bar in the footer of a page composed primarily of a table and/or figure may indicate that a change was made to that table/figure or, it could indicate that the entire table/figure is new. Change packets are assigned a numerical designator, which is indicated in the publication number on each page of the change packet.

Each time this manual is fully revised and reprinted, all change packets to the previous version are incorporated into the new version, and the new version is assigned an alphabetical revision level, which is indicated in the publication number on each page of the manual. A revised manual does not usually contain change bars.

REVISION	DESCRIPTION
	December 1992. Original printing.
A	January 1994. This revision includes new procedures for checking the new dewpoint monitors, inspecting and tightening the power hardware, checking the module voltage drops on CRAY C916 mainframes, and cleaning the MWS-E and OWS-E peripheral trays. It changes the recommended frequency intervals for several procedures and includes a list of parts or tools necessary for each procedure in a new format.

PREFACE

The *CRAY C90 Series PMI/PMP Manual* is written for Cray Research, Inc. field engineers and support personnel.

These procedures are written to assist you in maintaining CRAY C90 water-cooled system components. Each PMP contains step-by-step instructions for inspecting, cleaning, adjusting, or testing components.

The time required to complete a procedure may vary, depending on the system configuration or other site variables.

CONTENTS

FIGURES

TABLES

1 SAFETY GUIDELINES AND POWER-UP PROCEDURE

When you perform preventive maintenance or emergency maintenance, always observe all safety precautions, electrostatic discharge (ESD) prevention guidelines, and Cray Research, Inc. (CRI) lockout and tagout procedures.

Dangers, Warnings, Cautions

Hazard statements alert maintenance personnel of dangers they may encounter while servicing CRI equipment. The following list describes the hazard statement signal words.

- Danger – Indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury.
- Warning – Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.
- Caution – Indicates a potentially hazardous situation that, if not avoided, may result in minor or moderate injury, equipment damage, or data corruption.

Electrostatic Discharge Prevention

The purpose of this subsection is to familiarize you with the equipment and procedures necessary to prevent electrostatic discharge from damaging mainframes, peripheral assemblies, and electrical components. For more information regarding the control of ESD, refer to *Static Discharge Prevention in Cray Computer Rooms*, Engineering specification number 02258000-A2.

ESD Control Equipment

Wear the following ESD-protective gear when working on CRI computer systems and electrical components.

ESD Wrist Straps

Wear an approved wrist strap when servicing or handling ESD-sensitive devices. If possible, connect the wrist strap cord directly to earth ground to provide a discharge path to earth ground. Otherwise, connect the wrist strap cord to a special ground mat cord using a wrist strap plug to ensure that an effective path exists to earth ground.

ESD Smocks

Wear an approved static-dissipative smock when servicing or handling an ESD-sensitive device. Fasten all of the snaps on the front of the smock and wear it as the outermost layer of clothing. Snap the sleeve cuffs for a snug fit at the wrists. You must have a portion of the smock sleeves in direct contact with the skin of your arms. Skin contact is essential for a dissipative path to earth ground through your wrist strap. Tuck hair that exceeds shoulder length inside the back of the smock.

ESD Shoes

Wear approved static-dissipative shoes or approved dissipative heel straps on both shoes when servicing or handling an ESD-sensitive device. When sensitive equipment is exposed to static discharge, ESD shoes provide a backup to the wrist straps and grounding cords and help prevent an excessive charge from building up on you when you are in contact with conductive flooring. Use dissipative footwear in addition to, not as an alternative to, a wrist strap.

Maintaining ESD Equipment

ESD equipment must be clean for proper operation. Soil buildup on static-dissipative equipment greatly decreases the desired dissipative flow of static charges to ground.

ESD Wrist Strap Care

Wash elastic wrist straps in warm soapy water, rinse with hot water, and allow to air-dry. The wrist straps may also be inserted into the pockets of the ESD smock and washed with it. Periodically check the wrist strap cord with an ohmmeter to ensure that it is not defective.

ESD Smock Care

Wash ESD smocks as you do normal clothing. Manufacturers recommend washing them in warm water, rinsing with cool water, and drying using the permanent press cycle. Do not use chlorine bleach. Replace the smock after 50 to 75 washings or if the smock is torn.

ESD Shoe Care

Clean and polish ESD shoe uppers. Clean the bottom of the ESD shoes periodically with either soap and water or denatured alcohol.

Cray Research, Inc. Lockout and Tagout Guidelines

All CRI employees are required to follow CRI lockout/tagout procedures when servicing equipment. The lockout and tagout procedures ensure that all potentially hazardous energy is locked out and isolated before anyone services the equipment. The lockout and tagout procedures help protect employees from injury caused by an unexpected startup or release of stored energy. These procedures are also required by the federal Occupational Safety and Health Act (OSHA).

You must attach a lockout/tagout card to the isolation device for the energy source before servicing the equipment. You must also lock the isolation device for the energy source with a padlock while the equipment is being serviced.

You must isolate and lock both electrical energy sources and mechanical energy sources, such as hydraulics and pneumatics, pressurized water, steam, and refrigerants. Normally, electrical and mechanical energy systems have devices such as disconnects and valves that enable you to isolate the energy source. When pressurized lines are part of the energy system, you need to bleed off the pressure in the system before you begin servicing the equipment.

You must use the following CRI lockout and tagout procedures for any equipment before starting to service it:

- Lock and tag all equipment that uses or produces electrical energy, including motors and generators.
- Use the valves on hydraulic equipment to isolate the hydraulic lines from the components you are servicing. After isolating the equipment energy source, bleed off pressure in the lines.

- Use the valves on pneumatic equipment to isolate the pneumatic lines from the components you are servicing. After isolating the equipment energy source, bleed off pressure in the lines.

- Use the valves on equipment with pressurized water or steam lines to isolate them from the components you are servicing. After isolating the equipment energy source, bleed off pressure in the lines.

- Use the valves on refrigeration equipment to isolate the refrigeration lines from the components you are servicing. After isolating the equipment energy source, bleed off pressure in the lines.

You must also isolate and lock out equipment containing any type of device that can store mechanical energy, such as flywheels and springs.

CRI equipment normally includes the following types of energy isolation equipment:

- Electrical disconnects
- Breakers and breaker boxes
- Stop/start controls
- Equipment with built-in energy isolation features
- Equipment with valves on pressurized lines

The Logistics department stocks the following parts needed to secure the energy isolation equipment on CRI equipment:

- Lockout/tagout card, part number 01670500
- Small padlock, part number 01673600
- Large padlock, part number 01673601

Use the following guidelines to satisfy CRI lockout and tagout requirements and OSHA regulations. These guidelines are taken from the CRI Health, Safety, and Environment department's lockout and tagout procedures.

A training video that shows how to isolate energy sources safely when you service or repair CRI equipment is also available. Contact the CRI Health, Safety, and Environment department to get more information about lockout and tagout procedures.

WARNING

Do not remove padlocks or lockout/tagout cards attached by other personnel. Unexpected restoration of an energy source could result in death or serious injury to maintenance personnel. Padlocks and lockout/tagout cards may be removed only by the person identified on the lockout/tagout card.

1. Give advance notice to CRI and customer personnel prior to beginning any service work that requires you to power off CRI equipment.

2. Identify all energy sources and the isolation devices (breakers, valves, etc.) for the equipment you plan to service or repair.

   When an activity requires more than one person, both people must attach lockout and tagout equipment, or a crew leader may do so.

3. Power down the equipment on which you intend to perform maintenance using the normal power-down procedure to remove the energy source.

4. Attach lockout/tagout cards, CRI part number 01670500, to the isolation devices of all energy sources powering the equipment. This includes the electrical disconnect box, breaker panel, and isolation valves on pressurized lines.

5. Fill in the information on the back side of the lockout/tagout cards.

6. Attach small or large CRI padlocks, CRI part number 01673600 or 01673601, to lock the energy isolation control devices.

7. Make sure that no one is working with the equipment you have isolated.

8. Try activating the energy source for the equipment using the normal power-on procedure to ensure that the device will not operate.

9. Place the power controls for the equipment on which you are working in the power-off position. If you are isolating a pressurized component, shut off the isolation valve or other type of isolation device.

10. When isolating an electrical energy source, test the circuit with a current/voltage meter to ensure that no electrical energy is being supplied to the circuit.

11. Perform the required service or repair activity.

12. After completing the service activity, advise CRI and customer personnel that you are going to restore power to the equipment.

13. Check the area around the equipment to ensure that no one is working with the equipment before you unlock any energy isolating devices.

14. Remove only your padlocks and lockout/tagout cards. Do not remove padlocks or lockout/tagout cards that someone else attached to the energy isolating devices.

15. Verify that all padlocks and lockout/tagout cards have been removed and that no one is working with the powered-off equipment.

16. Power up the equipment.

CRAY C90 Power-up Procedure

1. Turn on the mainframe circuit breaker on the wall breaker switch.

2. Power up the system by pressing the START button on the WACS display panel on the back of the mainframe.

NOTE: For normal power-down, press the STOP button on the WACS display panel. This allows you to restart the system by pressing the START button. For a complete power-down, you must also turn off the mainframe circuit breaker on the wall breaker switch.

2 PREVENTIVE MAINTENANCE OVERVIEW

This manual contains the preventive maintenance indexes and procedures (PMI/PMPs) for the standard equipment in CRAY C90 water-cooled computer systems, referred to throughout this manual as CRAY C90 computer systems. It contains PMIs and PMPs for the following standard equipment:

- Mainframe
- Heat exchanger unit (HEU)
- Maintenance workstation model E (MWS-E)
- Operator workstation model E (OWS-E)
- Motor-generator set (MGS)
- Refrigeration condensing unit (RCU)
- Front-end interface (FEI)
- Disk storage unit (DSU)

Customer agreements or site variables may require that PMI/PMP guidelines be tailored to meet specific needs of the customer. The engineer-in-charge (EIC) should set up a fixed preventive maintenance schedule based on the requirements described in this section under "Preventive Maintenance Scheduling."

Preventive Maintenance Scheduling

The average time required for preventive maintenance (PM) on the CRAY C90 computer system is shown in Table 2-1. For optimum system use, the EIC should arrange with the customer for PM time on an as-needed basis.

Table 2-1. CRAY C90 Computer System PM Hours per Month

Months since System Installation	1 – 2 mos.	3 – 4 mos.	5 – 6 mos.
PM Hours per Month	8 – 10 hrs.	5 hrs.	2 – 3 hrs.

The PM notify utility configured with the maintenance activities contained in this manual is available as part of release ME-C1.0. This utility is capable of sending you E-mail to notify you of scheduled maintenance activities. You are not required to use the PM notify utility, although it can be helpful in scheduling maintenance.

CRAY C90 System PMI Description

The CRAY C90 system PMI is shown in Table 2-2. The system PMI contains a column labeled “PMP Number” and columns that list each system component. The “PMP Number” column lists the alphanumeric characters that represent the PMPs. The alphabetic character indicates the recommended frequency for performing the procedure. W means weekly, M means monthly, Q means quarterly, S means semiannually, and A means annually.

CRAY C90 Component PMI Description

The PMI for each component of the system is provided at the beginning of each section of this manual. Each component PMI table contains five columns labeled “PMP Number,” “Time Required,” “Dedicated Time Required,” “Procedure,” and “Page.”

The “PMP Number” column contains alphanumeric characters that represent the PMPs. The alphabetic character indicates the recommended frequency for performing the procedure. D means daily, W means weekly, M means monthly, Q means quarterly, S means semiannually, and A means annually.

The “Time Required” column indicates the approximate time required to complete the PMP, if no problems occur. CRAY C90 computer systems vary, depending on the number and types of equipment in the configuration. Therefore, you must multiply the PM time required for one unit by the number of similar units in the configuration.

The “Dedicated Time Required” column indicates whether the procedure requires dedicated system time. When dedicated system time is required, you must perform the procedure during scheduled preventive maintenance (PM) time.

The “Procedure” column describes the actual PMP activity.

The “Page” column lists the page number of the manual on which the procedure begins.

PMP Format

The standard PMP format shows the title of the procedure at the top of the page, and the procedure number in the upper outside corner of the page.

“PMP Number” is the number of the PMP that is listed in the PMI and located in the upper outside corner of the page.

“Equipment” is the name of the equipment or system component on which you perform the PMP.

“Tools” lists any tools that are required to perform the PMP.

“Time” is the estimated time it should take to complete the PMP if there are no problems. All values in the “Time” column are in increments of 0.1 hour to simplify PM planning.

“Procedure” lists the ordered steps to be performed.

Table 2-2. CRAY C90 Water-cooled System PMI

PMP Number	Mainframe/HEU	MWS/OWS	MGS	RCU	FEI	DSU		
						DS-40/41/42	DD-60	DD-61/62 and RD-62
D1						Reviewing the error logs	Reviewing the error logs	Reviewing the error logs
W1	Cleaning and checking the computer system area		Inspecting the MGS and control cabinet	Completing weekly refrigeration check-off sheets		Recording refrigeration readings		
W2	Checking WACS indicators, sensors, and scanners		Inspecting the MG room					
M1	Checking the dielectric-coolant level	Cleaning and inspecting the MWS-E, OWS-E, displays, and printers			Cleaning and inspecting the FEI			Checking and cleaning the filter
Q1				Cleaning the RCU	Checking FEI voltage and ripple	Cleaning and inspecting the subsystems	Replacing and cleaning the filter	Cleaning the external surfaces
Q2				Checking for refrigerant leaks			Cleaning the external surfaces	
S1	Testing the power-supply temperature sensors	Cleaning the MWS-E and OWS-E peripheral trays	Bringing the standby MGS online					
S2	Inspecting the HEU pump							
S3	Cleaning and testing the smoke detectors							
S4	Cleaning and calibrating the dewpoint monitors							
A1	Infrared scanning the mainframe	Verifying MWS-E operation	Infrared scanning the MGS	Checking suction-line and liquid-line filters	Infrared scanning the FEI hardware			
A2	Cleaning and inspecting the HEU		Lubricating the MGS shaft bearings	Checking RCU electrical connections	Tightening and inspecting the FEI power-supply hardware			
A3	Verifying mainframe voltage and clock margins				Cleaning the FEI filters			
A4	Checking the module voltage drops							
A5	Checking the system voltage and ripple measurements							
A6	Inspecting and tightening the power hardware							

3 MAINFRAME AND HEAT EXCHANGER UNIT PMI/PMP

Table 3-1. Mainframe and Heat Exchanger Unit PMI

PMP Number	Time Required (in Hours)	Dedicated Time Required	Procedure	Page
W1	0.5	No	Cleaning and checking the computer system area	3-3
W2	0.5	No	Checking WACS indicators, sensors, and scanners	3-5
M1	0.1	No	Checking the dielectric-coolant level	3-9
S1	0.5	Yes	Testing the power-supply temperature sensors	3-11
S2	0.2	Yes	Inspecting the heat exchanger unit pump	3-15
S3	1.0	Yes	Cleaning and testing the smoke detectors	3-17
S4	0.5	Yes	Cleaning and calibrating the dewpoint monitors	3-23
A1	0.5	Yes	Infrared scanning the mainframe	3-29
A2	0.5	Yes	Cleaning and inspecting the heat exchanger unit	3-31
A3	3.0	Yes	Verifying mainframe voltage and clock margins	3-35
A4	0.2	Yes	Checking the module voltage drops	3-39
A5	0.5	Yes	Checking the system voltage and ripple measurements	3-43
A6	1.0	Yes	Inspecting and tightening the power hardware	3-45

CLEANING AND CHECKING THE COMPUTER SYSTEM AREA

W1

PMP Number: W1
Equipment: CRAY C90 Computer Room
Tools: ESD-safe vacuum cleaner
Time: 0.5 hour
Procedure:

1. Work with the customer to ensure that all CRI equipment surfaces and the computer system area are kept clean.

2. Be sure to remove all CRI tools and parts from the computer room.

3. Inspect the system panels for nicks or chipped paint. Repair any nicked or chipped paint areas using touch-up paint. Touch-up paint may be ordered from the Logistics department in Chippewa Falls, Wisconsin.

4. Clean the side panels of the cabinets using an ESD-safe vacuum cleaner.

5. Verify that the computer room environment is maintained within the following ranges:

   - Temperature: 60 °F to 80 °F (16 °C to 27 °C) maximum temperature change is 10 °F (5.5 °C), at a rate of change not exceeding 3 °F (1.6 °C) per hour.

   - Humidity: 35% to 65% relative humidity (noncondensing) maximum rate of change is 5% relative humidity per hour.

   - Dewpoint: 55 °F (13 °C) maximum.

   NOTE: The customer is responsible for ensuring one fresh air change per hour in the computer room.

W1

6. Notify the customer and technical support personnel if the temperature, humidity, and/or dewpoint readings deviate from these ranges, so that they may be corrected.

CHECKING WACS INDICATORS, SENSORS, AND SCANNERS

W2

PMP Number: W2
Equipment: CRAY C90 Mainframe
Tools: Logbook of standard operating parameters for your site
Time: 0.5 hour
Procedure:

Checking Voltages and Temperatures Using the WACS Display Panel

Do not adjust potentiometers or variacs during normal customer operations without the customer's approval. A defective potentiometer or variac could cause the system to power down or cause an unscheduled interrupt.

1. Check the 400-Hz input voltage using the CRAY C90 WACS display panel.

   a. Press the screen switch repeatedly until the MG SET screen display appears.

   b. Read the voltage at each phase and compare these voltages with the standard operating parameters for your site.

   c. If necessary, adjust the system voltage to the normal operating value using the MG Adjust potentiometer located on the WACS panel.

2. Check the power supply voltages using the WACS display panel.

   a. Press the screen switch repeatedly until the POWER SUPPLIES screen display appears.

   b. Read the voltages for each power supply and compare these voltages with the standard operating parameters for your site.

   c. If necessary, adjust the incorrect voltage at the appropriate variac.

3. Check the system temperatures using the WACS display panel.

   a. Press the screen switch repeatedly until the MODULE TEMPS screen display appears.

   b. Read the temperatures for each module and compare these temperatures with the normal readings for your site.

   c. Press the screen switch once to show the POWER SUPPLIES screen display.

   d. Read the temperatures for each power supply and compare these temperatures with the normal readings for your site.

   e. Discuss any abnormal readings with the customer and, if necessary, with a technical support engineer to determine whether emergency maintenance is necessary or the problem can be deferred until PM time.

Comparing Dewpoint Monitor Output Using the WACS Display Panel

Take primary and backup dewpoint monitor temperature readings in rapid succession because dewpoint varies with changes in computer room temperature during air treatment cycles.

On the CRAY C90 mainframe, scanner A and scanner B both provide dewpoint readings for the primary and backup dewpoint monitors. Either can be used as the only enabled scanner if the other is faulty.

Perform the following steps to check the primary and backup dewpoint monitor values using both scanner A and scanner B:

1. Press the screen switch repeatedly until the SYSTEM screen display appears.

2. Press the scanner switch once to show the dewpoint temperature on the A PRIMARY dewpoint monitor. Record this value.

3. Press the scanner switch once to show the dewpoint temperature on the A BACKUP dewpoint monitor.

4. The difference between the primary dewpoint monitor temperature and the backup dewpoint monitor temperature should not exceed 2 °F (1.1 °C). If the difference is greater than this, refer to the cleaning and calibrating dewpoint monitors procedure in this section for information on correcting the problem.

5. Press the scanner switch once to show the dewpoint temperature on the B PRIMARY dewpoint monitor. Record this value.

6. Press the scanner switch once to show the dewpoint temperature on the B BACKUP dewpoint monitor.

7. The difference between the primary dewpoint monitor temperature and the backup dewpoint monitor temperature should not exceed 2 °F (1.1 °C). If the difference is greater than this, refer to the cleaning and calibrating dewpoint monitors procedure in this section for information on correcting the problem.

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CHECKING THE DIELECTRIC-COOLANT LEVEL

M1

PMP Number: M1
Equipment: Heat Exchanger Unit
Tools: Dielectric-coolant, if necessary
Time: 0.1 hour
Procedure:

1. Locate the controller display panel on the front panel of the HEU-C90.

2. Press the CHANNEL ADVANCE switch repeatedly until the value monitored by channel 1 (reservoir level) is displayed.

   This value should be between 10 and 35 (indicating the percentage of the reservoir that is filled) when the computer system is powered on and between 65 and 88 when the system is powered off.

   NOTE: Regardless of whether the computer system is powered on or off, if the dielectric-coolant level in the reservoir drops below the low limit or exceeds the high limit mentioned above, the HEU-C90 controller displays a warning or fault signal on its display panel. In addition, if the level drops below 10 percent when the computer system is powered on, a fault signal is sent to the WACS display panel.

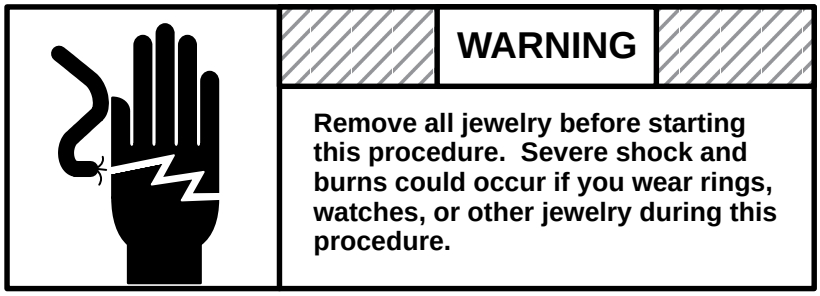
3. If necessary, add dielectric coolant.

TESTING THE POWER-SUPPLY TEMPERATURE SENSORS

S1

PMP Number: S1
Equipment: CRAY C90 Mainframe
Tools:
- Two persons
- Screwdriver
- Heat gun

Time: 0.5 hour
Procedure:



Test only one pair of temperature sensors every 6 months. Use one primary sensor and one backup sensor when performing this procedure.

NOTE: Two people are required to perform this procedure.

1. Power down the mainframe.
2. Open the mainframe side access doors on both sides of the mainframe power supplies.
3. Locate the primary and backup temperature sensors on the power bus of any power supply. Refer to Figure 3-1 and Figure 3-2.
4. Select the corresponding temperature sensor readout on the WACS display panel, using the screen and scanner switches.
5. Loosen the temperature sensor mounting screws so that the temperature sensors do not come in contact with the power bus.

S1

NOTE: If the temperature sensors come in contact with the power bus, the mass of the bus bar functions as a heat sink, and it is difficult to achieve the proper temperature on the sensor in order to perform the following steps.

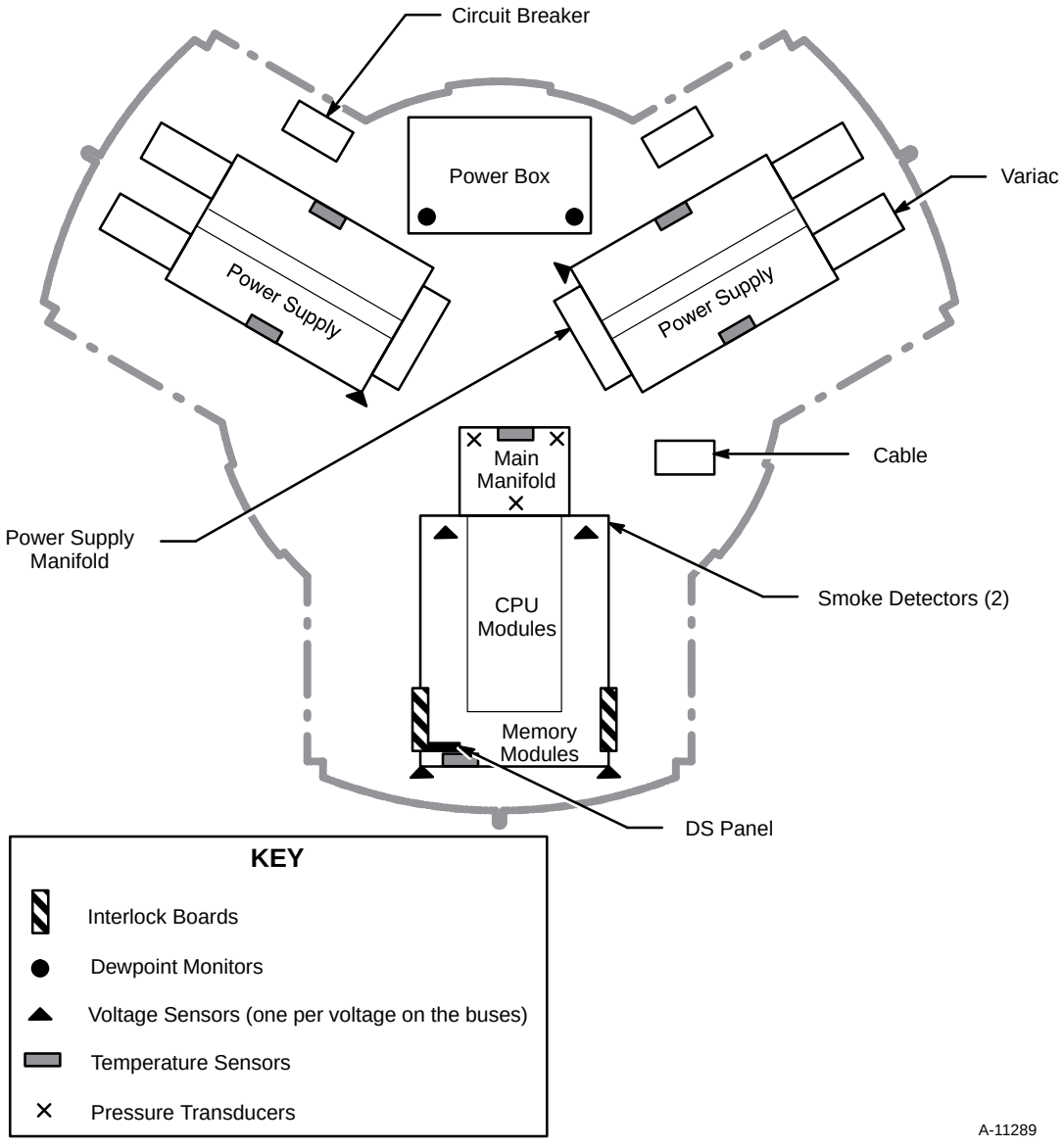


Figure 3-1. Sensor Locations

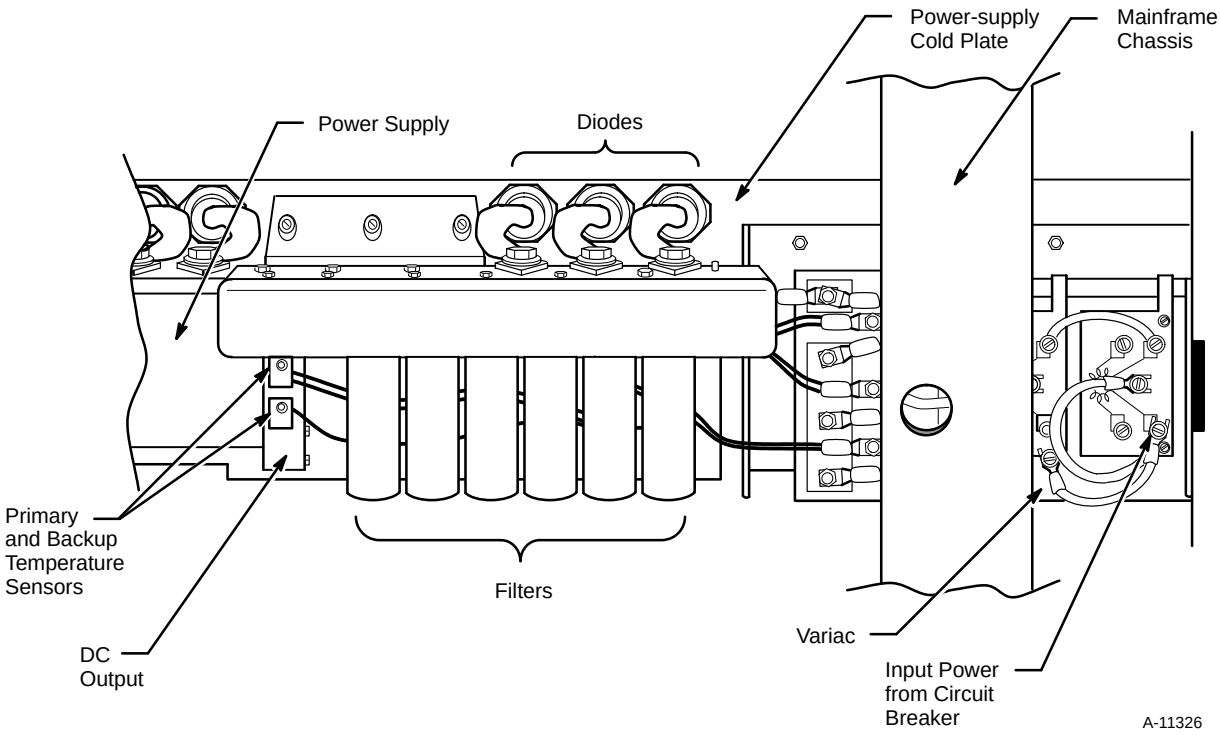


Figure 3-2. Mainframe Linear Power Supply and Interconnections

6. Increase the temperature of the sensors at the power-supply bus bar by blowing hot air over the sensors with a heat gun.

   As the temperature rises, the display should show the increasing values. When the temperature reaches 210 °F, the warning horn should sound. There is no fault condition reported for the power supply sensor. Do not apply any more heat to the sensor; allow the sensor to cool.

   NOTE: The power-supply temperature sensors do not report low-temperature conditions and need not be checked.

S1

7. Replace any defective sensors.

   NOTE: The WACS system boards may also need to be changed; if so, schedule repair time with the customer.

8. Tighten the temperature sensor mounting screws.

9. Close the mainframe side access doors.

10. Power up the mainframe.

INSPECTING THE HEAT EXCHANGER UNIT PUMP

S2

PMP Number: S2
Equipment: CRAY C90 Heat Exchanger Unit
Tools: None
Time: 0.2 hour
Procedure:

1. Remove the HEU panels.
2. Inspect the HEU pump assemblies for excessive vibration and unusual noises such as vibration noise or high-pitched squeals caused by a defective pump.
3. If possible, immediately correct any problems found during the pump inspection; if the repair requires more time, schedule maintenance time to correct the problem.
4. Replace the HEU panels.
5. Repeat this procedure for each HEU pump.

CLEANING AND TESTING THE SMOKE DETECTORS

S3

PMP Number: S3
Equipment: CRAY C90 Mainframe
Tools:
- ESD-safe vaccuum cleaner
- 0.1-in. (0.25-cm) maximum diameter tool

Time: 1.0 hour
Procedure:

Before You Begin Cleaning and Testing the Smoke Detectors

Clean and test all smoke detectors before powering up the mainframe. The primary smoke detector is located on the Y-side of the chassis. The backup smoke detector is located on the Z-side of the chassis. Refer to Figure 3-1. The following subsections describe the cleaning and testing procedures. Repeat these procedures for each cabinet in the system configuration.

Cleaning the Smoke Detectors

1. Power off the mainframe at the WACS panel.
2. Open the side service panels on the module chassis.
3. Remove the smoke detector cover by turning it counterclockwise. Refer to Figure 3-3.
4. Remove the screen by pulling it straight out.
5. Use an ESD-safe vacuum cleaner or compressed air to remove dust from the smoke detector screen and vaned chamber piece.
6. Reinstall the screen by lining up the arrow on top with the test module socket on the detector and pushing it tightly onto the base.
7. Reinstall the smoke detector cover by turning it clockwise until it clicks into place.
8. Close the side service panels on the module chassis.

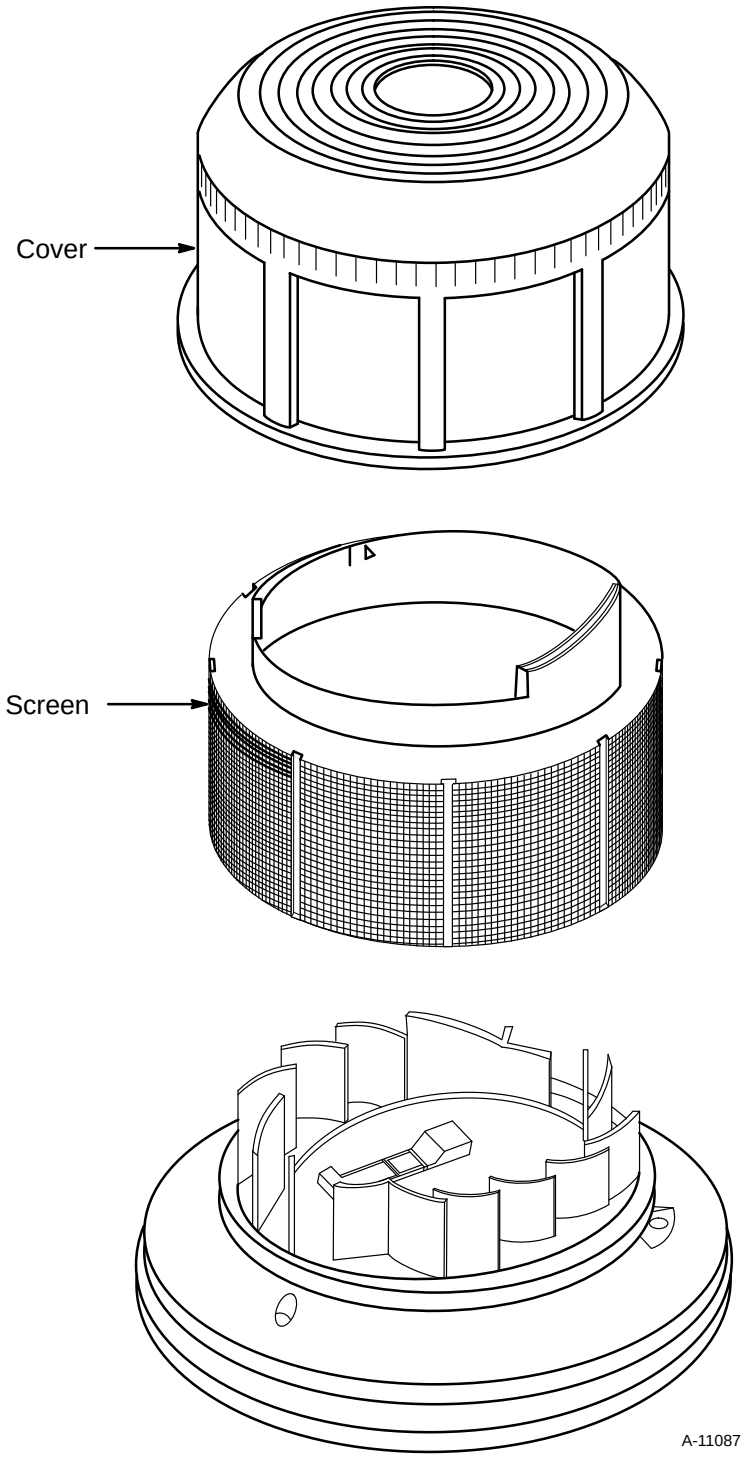


Figure 3-3. Model 2412 Smoke Detector

Testing the Smoke Detectors

Clean all smoke detectors before testing them.

Before testing the smoke detector, check to see whether the LED is flashing. If it does not flash, there is no power to the detector (check the wiring). If the smoke detector is defective, replace it.

1. Make sure that power is applied to the smoke detectors.

2. Push and hold the recessed test switch with a 0.1-in. (0.25-cm) maximum diameter tool. The recessed switch is located on the detector housing as shown in Figure 3-4. The LED should illuminate within 5 seconds, and the 500-ampere main breaker on the mainframe should trip off.

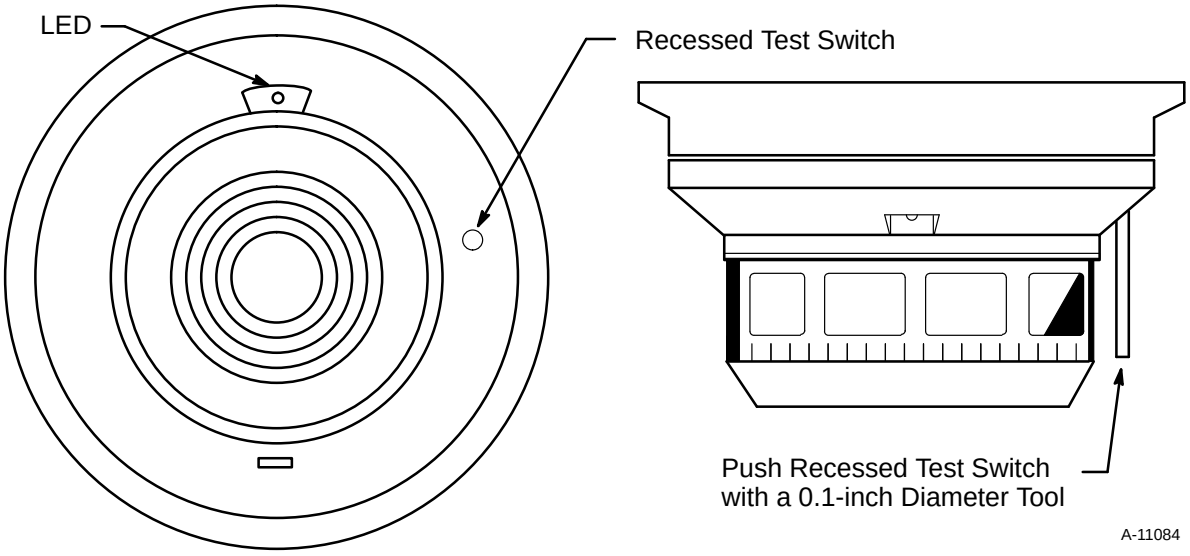


Figure 3-4. Bottom and Side Views of Smoke Detector

3. Wait 30 seconds for the smoke detector capacitor to discharge, and turn on the main breaker.

4. Remove the smoke detector cover.

5. Insert the NO ALARM end of the test card fully into the test slot and slide it clockwise until it stops. Refer to Figure 3-5. No alarm should sound after 20 seconds. If the alarm sounds after 20 seconds, replace the defective smoke detector.

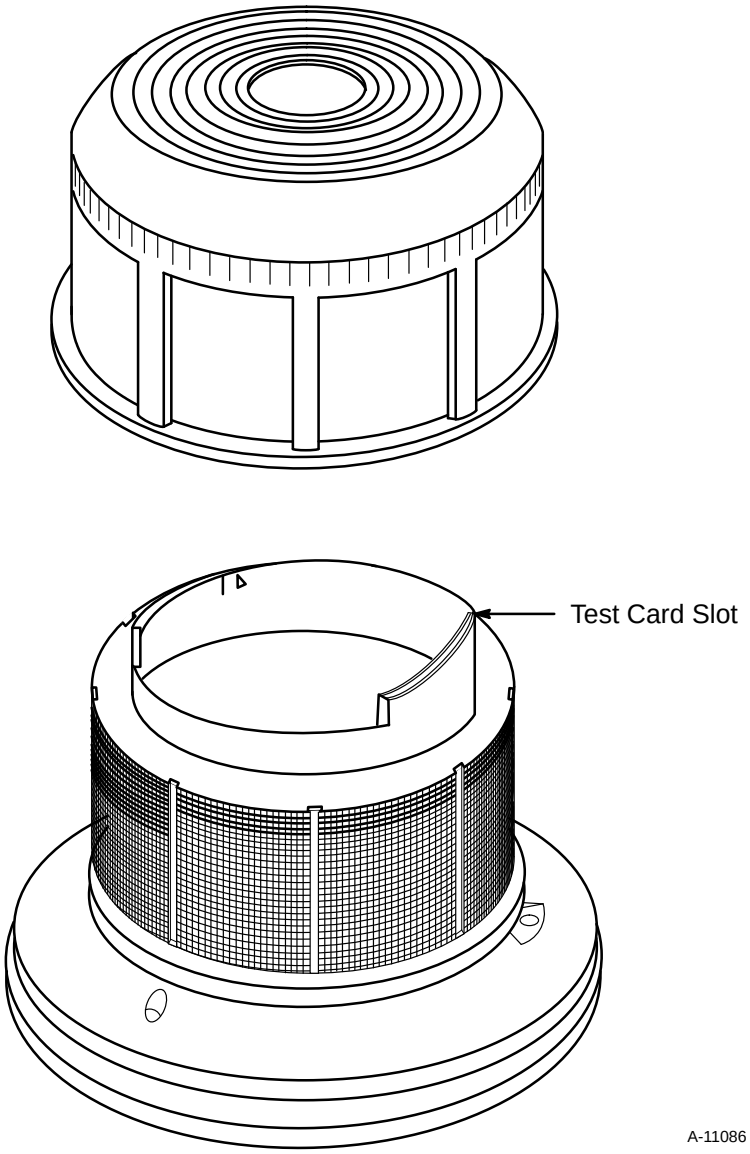


Figure 3-5. Test Card Slot Location

6. Turn the test card counterclockwise and pull it out of the test slot.

7. Insert the ALARM end of the test card fully into the test slot. The LED should illuminate within 30 seconds, indicating an alarm condition exists, and the 500-ampere main breaker should trip off. If this breaker does not trip, check the smoke detector and the WACS for the source of the problem. If the LED fails to illuminate, check the power and the wiring to the smoke detector.

8. Remove the test card by sliding it counterclockwise and then pulling it out of the test slot.

9. Wait 30 seconds for the smoke detector capacitor to discharge before turning on the main breaker switch.

CLEANING AND CALIBRATING THE DEWPOINT MONITORS

S4

PMP Number: S4

Equipment: Dewpoint Monitors

Tools:
- Screwdriver
- Cotton swab
- Cleaning kit, CRI part number 01605600

Time: 0.5 hour

Procedure:

In CRAY C98 and CRAY C94 systems, the dewpoint monitors are mounted in the Y- and Z-sides of the chassis. In CRAY C916 systems with a standalone IOS/SSD-E (700 series) cabinet, these dewpoint monitors are mounted in the Y-side of the IOS/SSD-E cabinet. The top dewpoint monitor is the primary monitor and the bottom dewpoint monitor is the backup monitor.

NOTE: In the original CRAY C916 systems, the dewpoint monitors may be located inside of the WACS cabinet.

Two styles of dewpoint monitors are used in CRAY C90 systems: the original blue dewpoint monitor and the new black dewpoint monitor. The new dewpoint monitor is a self-cleaning, self-calibrating, and self-adjusting dewpoint monitor.

Original Blue Dewpoint Monitors

Mirror cleaning and a concurrent optical bias adjustment are critically important periodic maintenance functions that should be performed semiannually, or whenever the temperature readings of the two dewpoint monitors vary by 2 °F or more. Adjustment of the optical bias determines the thickness of the dew layer at which the system reaches its control point. The dewpoint sensor is designed to monitor a thin dew layer. Proper adjustment of the bias is essential because the dewpoint sensor will not function properly when an excessively thick dew layer exists.

1. Power off the mainframe by pressing the STOP button on the WACS panel.

2. Open the WACS panel door to expose the backup and primary dewpoint monitors.

3. Remove the screws that hold the monitor box cover in place.

4. With the monitor box cover removed, determine whether the switch (SW-1) is a 2-position or 3-position switch. Refer to Figure 3-6 for an illustration of 2-position and 3-position switches.

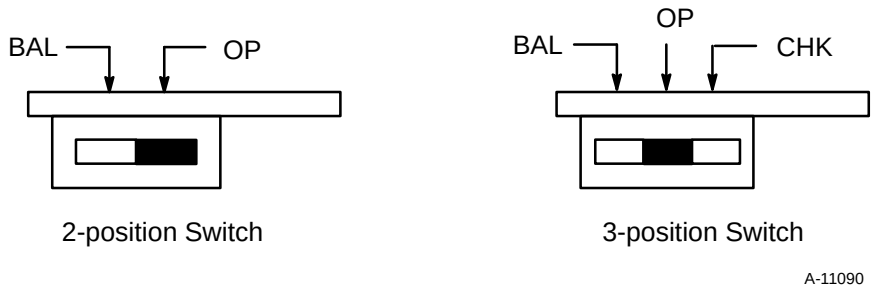


Figure 3-6. Dewpoint Monitor Switches

Switch SW-1 is located at the opposite end of the box from the fan as shown in Figure 3-7. If switch SW-1 is a 2-position switch, proceed to Step 9. If switch SW-1 is a 3-position switch, proceed to Step 5.

5. Slide switch SW-1 to the check (CHK) position and then wait 2 minutes.

6. Return switch SW-1 to the operate (OP) position. If the red LED is illuminated, no service is required; proceed to Step 13. If the red LED is not illuminated, proceed to Step 7.

7. Power off the thermoelectric cooler by sliding switch SW-1 to the balance (BAL) position.

8. Remove the dewpoint sensor from the monitor box to gain access to the filter and mirror. Refer to Figure 3-8 for an illustration of the dewpoint sensor.

9. Remove the silver- or black-colored sensor shield and replace the filter.

10. Clean the mirror in the measurement cavity using a cotton swab and the blue cleaning solution provided in the cleaning kit. The cleaning kit, which includes replacement filters, is CRI part number 01605600. Remove any excess solution with a clean, dry cotton swab.

11. Inspect the two O-rings on the sensor tube for any damage and replace them if necessary. Replace the sensor shield on the tube. This will block any light from entering into the measurement cavity when calibrating the dewpoint monitor.

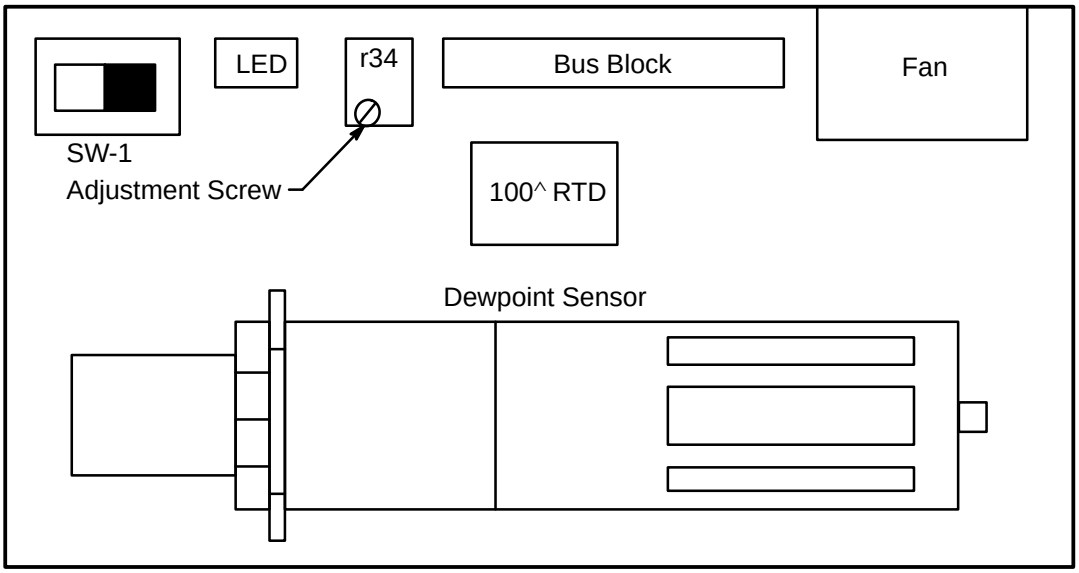


Figure 3-7. Dewpoint Monitor (Top View)

12. Adjust the mirror bias using the following procedure:

    a. Wait at least 2 minutes after disabling the slide switch SW-1 (refer to Figure 3-6) before you adjust potentiometer r34. This is to ensure that the moisture evaporates from the mirror properly.

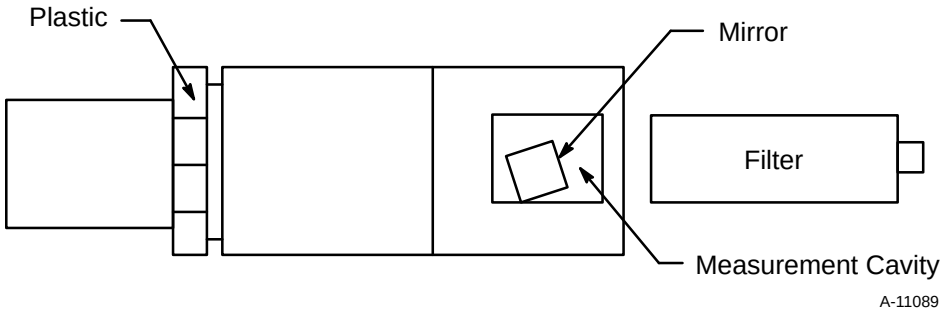


Figure 3-8. Dewpoint Sensor (Side View)

    b. Use a small screwdriver to turn the adjustment screw on potentiometer r34 (located next to switch SW-1) counterclockwise until the nearby red LED is no longer illuminated.

    c. Turn the adjustment screw on potentiometer r34 slowly clockwise until the same LED illuminates.

       NOTE: Stop turning the adjustment screw on the potentiometer r34 at the instant it illuminates to ensure an accurate bias adjustment.

    d. After the adjustments are made, return switch SW-1 to the OP position.

13. Reinstall the dewpoint sensor inside the monitor box.

14. Check to ensure that the dewpoint monitor is operating correctly.

15. If the dewpoint monitor is not operating correctly after you reconnect it, replace it using the procedure described in the *CRAY C916, CRAY C98, and CRAY C94 Repair Procedures Manual*, publication number CMM-0512-0A0. Make sure that the replacement monitor operates correctly.

16. Close the WACS panel door.

17. Power up the mainframe.

18. Repeat this procedure for the IOS-E and for the SSD-E (if one is included) in the system configuration.

    NOTE: A dewpoint calibration cable is required to perform this procedure while the system is powered up. This cable supplies power and proper grounding to the dewpoint monitor, while eliminating the signal path from the dewpoint monitor to the WACS system. Using the calibration cable could cause the system to shut down; therefore, it is recommended that the calibration cable not be used while customer software is running.

New Black Dewpoint Monitors

The new dewpoint monitors use an optical sensor much like the old dewpoint monitors. The new dewpoint monitors, however, balance automatically to compensate for dust contamination. The balance cycle runs automatically every 7 days or whenever the access door is opened and closed. The balance cycle should never take longer than 2.5 minutes. Automatic balancing reduces the need for preventive maintenance.

1. Power off the mainframe by pressing the STOP button on the WACS panel.

2. Open the WACS panel door to expose the primary and backup dewpoint monitors.

3. If the Valid Data LED is illuminated, no maintenance is required; proceed to Step 11.

4. If the Clean Mirror LED is illuminated, proceed to Step 6.

   NOTE: The Replace Sensor LED may also be illuminated. Cleaning the mirror should clear both LEDs.

5. If only the Replace Sensor LED is illuminated, replace the defective monitor using the procedure described in the *CRAY C916, CRAY C98, and CRAY C94 Repair Procedures Manual*, publication number CMM-0512-0A0. Make sure that the replacement monitor operates correctly.

6. Obtain the mirror cleaning solution (blue) and cotton swabs from the cleaning kit.

7. Squirt some of the cleaning solution onto a clean cotton swab.

8. Open the mirror access door on the front of the monitor.

9. Clean the mirror with the moistened cotton swab. If the mirror is very dirty, you may need to use more than one cotton swab.

10. Close the mirror access door. If the Valid Data LED does not illuminate after 2.5 minutes and the Replace Sensor LED remains illuminated, replace the dewpoint monitor using the procedure in Section 4, “Warning and Control System (WACS),” of the *CRAY C916, CRAY C98, and CRAY C94 Repair Procedures Manual*, publication number CMM-0512-0A0.

11. Close the WACS panel door.

12. Power up the mainframe.

INFRARED SCANNING THE MAINFRAME

A1

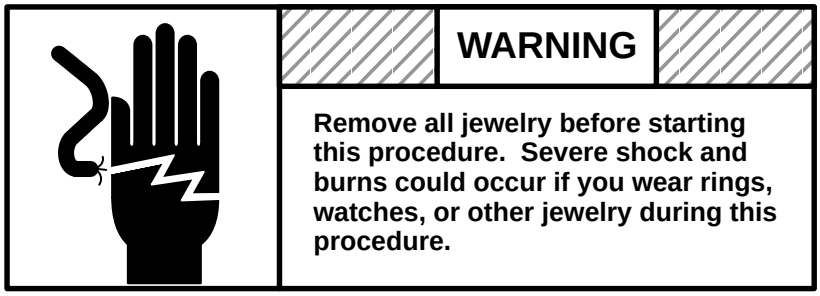
PMP Number: A1

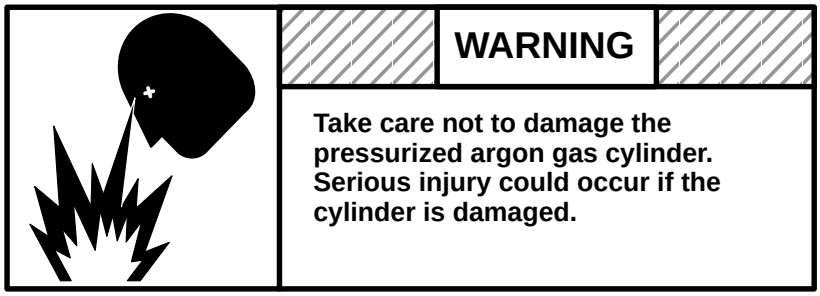
Equipment: CRAY C90 Mainframe

Tools:
- Infrared scanner
- System logbook
- Torque wrench, if necessary

Time: 0.5 hour

Procedure:





NOTE: If possible, perform infrared scans for all system equipment during the same PM session.

Before starting this procedure, review the infrared viewer operating instructions in the *Probeye Thermal Data Viewer Operation Manual*, which is included in the scanner shipping case.

A1

1. Power on the mainframe at least 2 hours before beginning the infrared scan.

2. Set up the infrared viewer using the procedure described in the operation manual mentioned previously.

3. Open the mainframe side access doors on both sides of the mainframe power supplies and the front door of the module chassis.

4. Scan all of the bolted connections between the horizontal and vertical voltage buses.

5. Record any hot spots in the system logbook.

   NOTE: Hot buses or bolts appear on the infrared viewer as a brighter shade of red in comparison to adjacent buses and bolts.

6. Scan all power supplies, terminal connections, and variacs.

7. Record all hot spot areas in the system logbook. Use similar components for comparison.

8. If you suspect a loose hardware connection is causing the hot spot, perform the following procedure.

   a. Power down the mainframe.

   b. Loosen, then torque the hardware according to specifications.

   c. Power up the mainframe.

   d. Scan the failing location again to ensure that the problem has been corrected.

9. Replace the mainframe access panels.

CLEANING AND INSPECTING THE HEAT EXCHANGER UNIT

A2

PMP Number: A2

Equipment: Heat Exchanger Unit

Tools:

- Pliers
- 1-gallon container
- Small amount of dielectric-coolant in pail, if necessary
- Soft-bristle brush, if necessary
- Vacuum cleaner

Time: 0.5 hour

Procedure:

1. Power down the system.
2. Remove the heat exchanger unit (HEU) panels.
3. Close the inlet and outlet valves to the HEU strainer assemblies. There are two strainer assemblies in the HEU-C90. Refer to Figure 3-9. When the butterfly valve levers are horizontal, the inlet or outlet valves are closed.
4. Loosen the QC clamps on the HEU strainer assembly, using a pair of pliers if necessary.
5. Remove the QC clamps and slowly withdraw each strainer from its housing. Use a 1-gallon container to catch any dielectric coolant that drains from the filter housings.
6. Inspect the strainers for dirt and metal particles; clean them if necessary. If metal particles are found, investigate the source of the metal particles. Clean the strainers by rinsing them with a small amount of dielectric-coolant in a pail. If necessary, brush away any dirt or particles on the strainers using a soft-bristle brush.
7. Carefully reinstall the strainers.
8. Replace the QC clamps and tighten them securely, using a pair of pliers if necessary.

A2

9. Open the inlet and outlet valves to the strainer assemblies. The butterfly valve levers are turned downward 90° to open the inlet and outlet valves to the strainer assemblies. (When the inlet and outlet butterfly valve levers are in line with the hose, the inlet and outlet valves are open.)

10. Inspect and clean the interior of the HEU. Use a vacuum cleaner to remove debris from the interior of the HEU.

11. Examine the fluid lines and refrigerant fittings for dielectric-coolant leaks.

12. Eliminate any dielectric-coolant leaks.

13. Replace the HEU panels and return the system to normal operation.

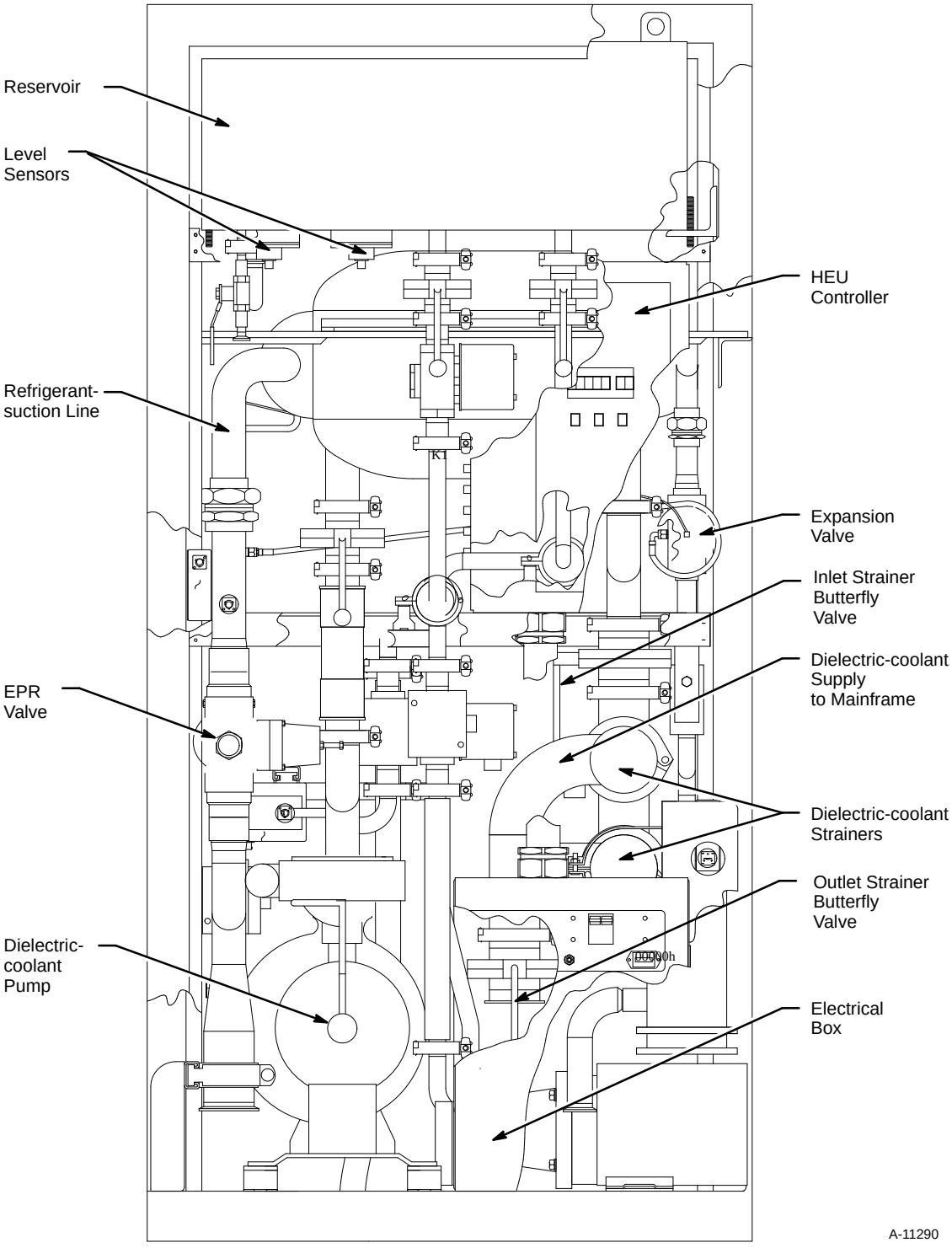


Figure 3-9. HEU-C90 (Front View)

VERIFYING MAINFRAME VOLTAGE AND CLOCK MARGINS

A3

PMP Number: A3

Equipment: CRAY C90 Mainframe

Tools:
- Voltmeter
- System logbook

Time: 3.0 hours

Procedure:

In this procedure, you will run a number of diagnostic tests on each CPU. If you perform any portion of this procedure while troubleshooting, consider that portion of the PMP complete for the year. Test each CPU under the clock and voltage margin conditions and log any failures in the system logbook. Schedule approximately 1 hour per CPU. More than one maintenance period may be required to test all CPUs.

Sites have the option to perform portions of the voltage and clock margin procedure on a more frequent basis than specified in this procedure. The designated frequency for performing this procedure is the minimum recommended; it may be adjusted by the engineer-in-charge to satisfy the specific needs of a site.

Sites also have the option to run additional diagnostics during scheduled PM times if necessary.

1. Ensure that the power supply voltages and clock frequencies are at normal operating margins by observing the WACS indications on the MWS-E display and the WACS panel.

2. Verify the power supply voltages by using a voltmeter on the power supply voltage bus.

3. Set the individual power-supply voltages to the required margins by adjusting the remote MG potentiometer.

4. Verify the clock margins by using a frequency counter connected to the clock testpoint on any CPU module.

5. Monitor a –4.5 V power supply while adjusting the voltage margin to ensure that a voltage level between –5.05 V and –4.55 V is maintained.

6. Set the desired clock speed by changing the clock select switches located behind the module access door (deadstart panel). Table 3-2 lists the switch settings for the various clock speeds.

Table 3-2. Clock Select Switch Settings

Clock Speed	Switch Settings
Fast	1 0
Normal	0 1
Slow	0 0
Ext	1 1

Use the following dual-margin test conditions when verifying voltage and clock margins:

- High voltage/fast clock
- Low voltage/fast clock
- High voltage/slow clock
- Low voltage/slow clock

NOTE: Run each diagnostic test described in Steps 7 through 11 as a multiprocessor test when possible.

7. Run CPAVE in each CPU until the diagnostic reports a pass count of 1. Log any failures in the system logbook.

   The CPU running CPAVE must be the master CPU for this test. You should also run HSB concurrently if the HISP channel is connected to the IOS-E.

8. Run CSEM until the diagnostic reports a pass count of 2.

9. Run CEJT until the diagnostic reports a pass count of 10.

10. Run the RUN system using TL3 in all CPUs simultaneously for 10 minutes. Ensure that CSR3 and CFPT are included in TL3. Use an autoload of 45 seconds (AL 45).

11. Run five passes of an IOS/SSD-E interface diagnostic test if the CPU you are testing has an IOS and/or SSD-E connected to it.

12. Log any failures in the system logbook.

13. Troubleshoot and correct any failures.

14. Repeat this procedure for each margin condition.

15. Return the power supply voltages and clock frequency to normal operating conditions.

CHECKING THE MODULE VOLTAGE DROPS

A4

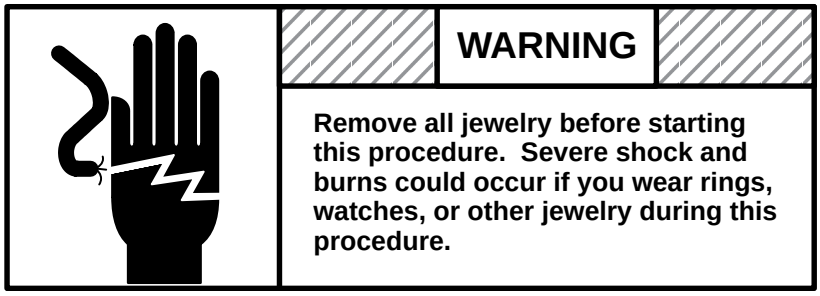
PMP Number: A4

Equipment: CRAY C90 Mainframe

Tools:
- Voltmeter
- System logbook
- For CRAY C916 mainframe, a 1-meter nonconducting rod and 1-meter test lead

Time: 0.2 hour

Procedure:



1. Power up the mainframe and wait 10 minutes before you measure module voltage ground drops.

2. Verify that normal voltage margins are set at the following levels:

   - –2.0 V power supplies are set to –2.05 V ±0.005
   - –3.4 V power supplies are set to –3.45 V ±0.005
   - –4.5 V power supplies are set to –4.55 V ±0.005 for memory
   - –4.5 V power supplies are set to –4.85 V ±0.005 for CPU
   - –5.2 V power supplies are set to –5.25 V ±0.005

3. Open the front access door on the mainframe.

4. Measure the ground voltage drop between the chassis and each module by using the following procedure:

   a. Connect the negative test lead of the digital voltmeter to the chassis ground.

   b. Connect the positive test lead of the digital voltmeter to the center of the cold plate on the module.

   c. Record any voltage drop exceeding 20 mV in the system logbook. Any module that has a voltage drop exceeding 30 mV must be returned for repair.

   NOTE: Corrective action for readings exceeding 20 mV is not possible in the field. If you are returning the module to a repair center, note this excessive voltage drop as an additional repair item.

5. Measure the voltage ground drop between the power supply and each module by using the following procedure:.

   a. Connect the negative test lead of the digital voltmeter to the ground plate of the power supply. Use the face of the aluminum frame on which the variac is mounted for the ground.

   b. Tape the 1-meter positive test lead of the digital voltmeter to one end of the nonconducting rod. Holding the rod by the other end, carefully manuever the voltmeter probe until it touches the alignment hole on the cold plate of one of the modules being powered by that supply. Table 3-3 and Table 3-4 list the module slots powered by each power supply and the voltage furnished to those slots.

   Investigate any readings exceeding 100 mV.

6. Close the front access door.

Table 3-3. Power-supply Voltage Distribution (S/N 4001 – 4003)

Power Supply	Module Slots	Voltage	Power Supply	Module Slots	Voltage
1z	1 – 8	–3.3	1y	1 – 4	–4.5
2z	10 – 13	–3.3	2y	1 – 3	–5.2
3z	1 – 4	–2.0	3y	5 – 8	–4.5
4z	10 – 13	–2.0	4y	4 – 6	–5.2
5z	5 – 8	–2.0	5y	10 – 13	–4.8
6z	14 – 17	–2.0	6y	7 – 8	–5.2
7z	14 – 17	–3.3	7y	14 – 17	–4.8
8z	18 – 21	–2.0	8y	18 – 21	–4.5
9z	27 – 30	–2.0	9y	22 – 26	–4.8
10z	14 – 17	–2.0	10y	27 – 29	–5.2
11z	31 – 34	–2.0	11y	27 – 30	–4.5
12z	18 – 21	–3.3	12y	30 – 32	–5.2
13z	27 – 34	–3.3	13y	31 – 34	–4.5
14z	22 – 26	–3.3	14y	33 – 34	–5.2

A4

Table 3-4. Power-supply Voltage Distribution (S/N 4004 and up)

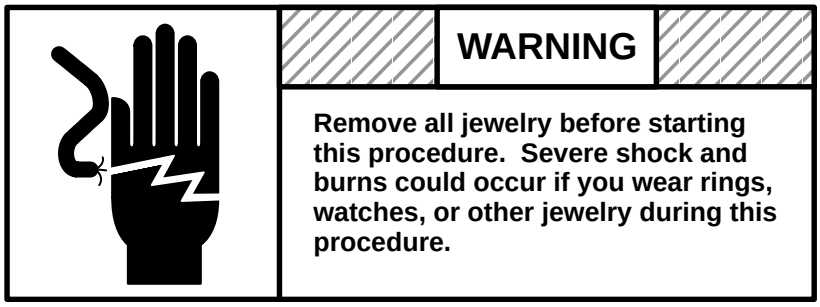
Power Supply	Module Slots	Voltage	Power Supply	Module Slots	Voltage
1z	1 – 8	–3.3	1y	1 – 4	–4.5
2z	9 – 12	–3.3	2y	1 – 3	–5.2
3z	1 – 4	–2.0	3y	5 – 8	–4.5
4z	9 – 12	–2.0	4y	4 – 6	–5.2
5z	5 – 8	–2.0	5y	9 – 12	–4.8
6z	13 – 16	–2.0	6y	7 – 8	–5.2
7z	13 – 16	–3.3	7y	13 – 16	–4.8
8z	18 – 21	–2.0	8y	18 – 21	–4.8
9z	27 – 30	–2.0	9y	22 – 26	–4.8
10z	22 – 26	–2.0	10y	27 – 29	–5.2
11z	31 – 34	–2.0	11y	27 – 30	–4.5
12z	18 – 21	–3.3	12y	30 – 32	–5.2
13z	27 – 34	–3.3	13y	31 – 34	–4.5
14z	22 – 26	–3.3	14y	33 – 34	–5.2

CHECKING THE SYSTEM VOLTAGE AND RIPPLE MEASUREMENTS

A5

PMP Number: A5
Equipment: CRAY C90 Mainframe
Tools:
- Oscilloscope
- Isolation power plug

Time: 0.5 hour
Procedure:



1. Master clear the mainframe and IOS-E.

2. Check the DC voltages as indicated by the WACS on the MWS-E display to make sure they are at the following operating values:

   - –2.0 V power supplies are at –2.06 V
   - –4.5 V power supplies are at –4.50 V
   - –5.2 V power supplies are at –5.20 V
   - +5.0 V power supplies are at 5.00 V
   - +6.0 V power supplies are at 6.00 V

3. Open the access doors on both sides of the mainframe.

4. Set the oscilloscope settings at 20 mV/div vertical and 200 μs sweep rate horizontal. Use a Tektronix 2465 (x1) probe with as short a lead as safety permits and connect its ground lead to the frame ground.

   NOTE: Use an isolation power plug for added safety and accuracy of measurements.

A5

5. Locate the two cables behind the WACS panel. Plug the breakout box. Using the Y/Z breakout box, check each of the 14 power supplies indicated in NO TAG or Table 3-4. Do the Y-side first and then the Z-side. The ripple must not exceed 70 mV on any power supply.

   Causes of excessive ripple can include, but are not limited to:

   - A defective power supply
   - Loose voltage or ground connections
   - Defective capacitor assembly

6. If you detect excessive ripple, power down the mainframe and check for any loose DC connections. If all of the connections appear normal, replace the power supply.

INSPECTING AND TIGHTENING THE POWER HARDWARE

A6

PMP Number: A6

Equipment: CRAY C90 mainframe

Tools:
- Socket wrench set
- ESD-safe vacuum cleaner
- Lockout tag

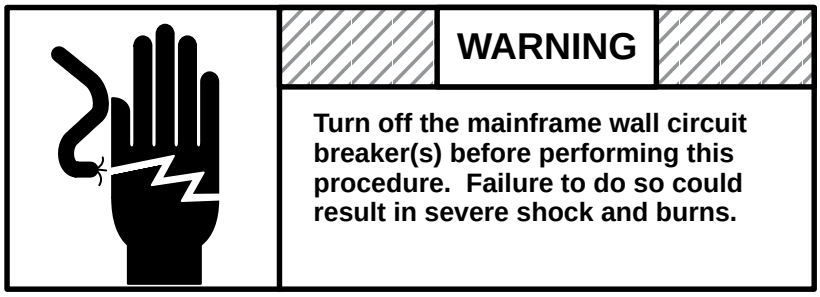
Time: 1.0 hour

Procedure:

NOTE: Perform procedure A1, Infrared Scanning the Mainframe, before performing this procedure.

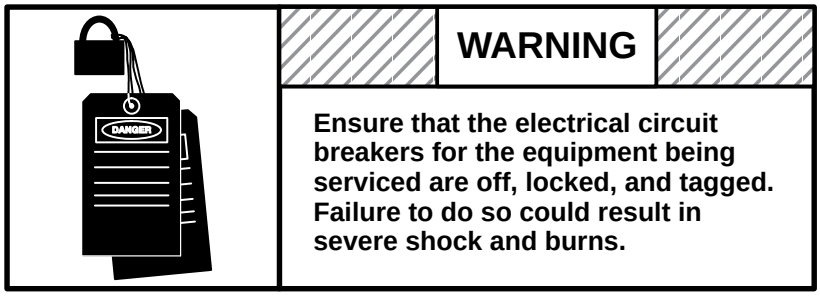
1. Power down the mainframe.

2. Turn off the mainframe wall circuit breaker(s).



WARNING

Turn off the mainframe wall circuit breaker(s) before performing this procedure. Failure to do so could result in severe shock and burns.



WARNING

Ensure that the electrical circuit breakers for the equipment being serviced are off, locked, and tagged. Failure to do so could result in severe shock and burns.

A6

3. Open the mainframe side access doors on both sides of the mainframe power supplies.

4. Clean the terminal blocks using an ESD-safe vacuum cleaner.

5. Make sure that none of the voltage bus bolts, circuit breaker connections, or transformer connections are loose or defective.

6. Inspect all of the power hardware
   - primary and secondary circuit breaker connections
   - primary power connections on the transformer
   - bus-bar lugs
   - power supply to plate connections
   - plate to bus-bar connections
   - DC connections to the bus
   - all other wire connections

7. Tighten any loose connections.

8. Close the access doors.

9. Power up the module cabinet.

10. Repeat this procedure for the IOS/SSD-E if one is included in the system configuration.

4 MAINTENANCE AND OPERATOR WORKSTATION PMI/PMP

Table 4-1. Maintenance and Operator Workstation PMI

PMP Number	Time Required (in Hours)	Dedicated Time Required	Procedure	Page
M1	0.5	No	Cleaning and inspecting the MWS-E, OWS-E, displays, and printers	4-3
S1	0.5	Yes	Cleaning the MWS-E and OWS-E peripheral trays	4-5
A1	0.5	Yes	Verifying MWS-E operation	4-7

CLEANING AND INSPECTING THE MWS-E, OWS-E, DISPLAYS, AND PRINTERS

M1

PMP Number: M1

Equipment: Maintenance Workstation (MWS) and Operator Workstation (OWS) Model E, Printers, and Display Terminals

Tools:

- Moistened cloth
- CRI-approved glass cleaner
- ESD-safe vacuum cleaner

Time: 0.5 hour

Procedure:

Use the following procedures to clean and inspect the cabinets, cables, and connectors for the following equipment:

- Maintenance and operator workstations model E (MWS-E and OWS-E)
- Printers and display terminals

1. Wipe the exterior surface of each cabinet, display, and printer with a moistened cloth. Use a mild cleaner to remove grime.
2. Clean the display screens with a CRI-approved glass cleaner, such as Windex, to remove fingerprints and dust.
3. Vacuum the keyboards to remove debris using an ESD-safe, computer room-grade vacuum cleaner.
4. Follow the printer vendor's cleaning procedure if the printer output quality is degraded.
5. Inspect the MWS-E, OWS-E, terminals, keyboards, modem, and printers to ensure that all cables and connectors are properly attached and there are no loose wires or improperly seated connector plugs. If any defective wiring or cables are found during the inspection, correct the problem immediately or schedule PM time to correct the problem.
6. Verify that all grounding cables and straps are properly connected.

CLEANING THE MWS-E AND OWS-E PERIPHERAL TRAYS

S1

PMP Number: S1

Equipment: Maintenance Workstation and Operator Workstation Model E

Tools:

- Screwdriver
- ESD-safe vacuum cleaner

Time: 0.5 hour

Procedure:

1. Power down the workstation.
2. Remove the front cover and bezel inserts as shown in Figure 4-1.
3. Remove the hard disk tray from the system.
4. Remove the four screws that secure the streaming cartridge tape drive and pull the drive forward to remove it from the system.
5. Remove all dust and debris from the tape and disk units and from the tray cavities in the workstation chassis with an ESD-safe vacuum.
6. Reinsert the peripheral trays and replace the four screws in the streaming cartridge tape drive tray.
7. Replace the front cover and bezel inserts.
8. Power up the workstation.

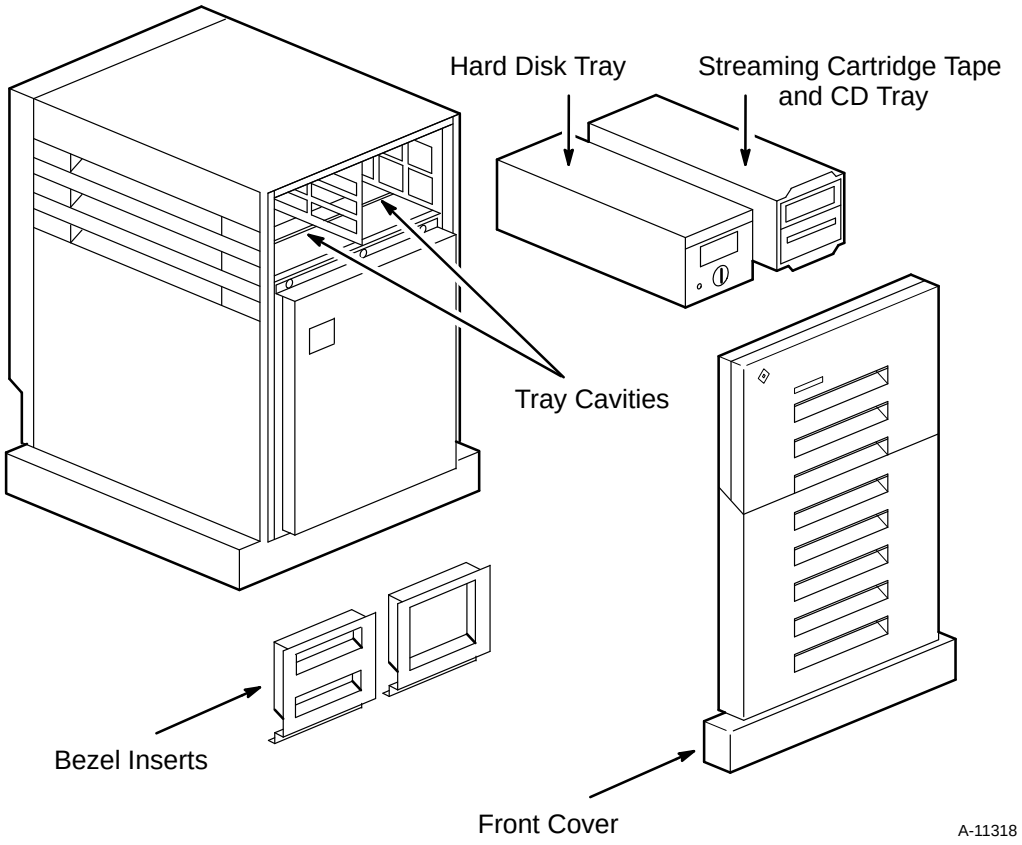


Figure 4-1. Peripheral Tray Cleaning

VERIFYING MWS-E OPERATION A1

PMP Number: A1
Equipment: Maintenance Workstation Model E
Tools: None
Time: 0.5 hour
Procedure:

NOTE: If an equivalent set of procedures was performed during troubleshooting in the previous 6 months, consider this PMP complete.

1. Ensure that the maintenance workstation (MWS-E) is connected to channel pair 24/25 of the IOP MUX.
2. Verify correct MWS-E operation while running your choice of IOS-E and/or CPU diagnostics.
3. Disconnect the IOS-E from mainframe channel pair 20/21.
4. Connect the MWS-E to channel pair 20/21 of the mainframe.
5. Verify correct MWS-E operation while running your choice of mainframe diagnostics.
6. Disconnect the MWS-E from channel pair 20/21 of the mainframe after successfully running diagnostics from the MWS-E.
7. Document any problems in the system logbook and schedule maintenance time if necessary.

5 MOTOR-GENERATOR SET PMI/PMP

Table 5-1. Motor-generator Set PMI

PMP Number	Time Required (in Hours)	Dedicated Time Required	Procedure	Page
W1	0.1	No	Inspecting the motor-generator set and control cabinet	5-3
W2	0.1	No	Inspecting the motor-generator room	5-5
S1	0.3	Yes	Bringing the standby motor-generator set online	5-7
A1	0.2	Yes	Infrared scanning the motor-generator set	5-9
A2	0.2	Yes	Lubricating the motor-generator set shaft bearings	5-11

INSPECTING THE MOTOR-GENERATOR SET AND CONTROL CABINET

W1

PMP Number: W1

Equipment: Motor-generator Set

Tools:

- Clean cloth
- Vacuum cleaner

Time: 0.1 hour

Procedure:

1. Inspect the pilot bulbs on the control cabinet of the motor-generator set (MGS) and replace all burned-out bulbs.

2. Wipe dirt from the exterior painted surfaces of the MGS and control panel assembly with a clean cloth.

3. Clean all ventilating ports with a vacuum cleaner.

INSPECTING THE MOTOR-GENERATOR ROOM

W2

PMP Number: W2
Equipment: Motor-generator Set
Tools: None
Time: 0.1 hour
Procedure:

NOTE: Perform this procedure only if the MGS is located outside the computer room.

1. Make sure that the motor-generator room is kept clean.
2. Ensure that the room does not contain stored articles and that proper ventilation or cooling is available.
3. Notify the customer facility maintenance personnel if the room needs to be cleaned.

BRINGING THE STANDBY MOTOR-GENERATOR SET ONLINE

S1

PMP Number: S1
Equipment: Motor-generator Set
Tools: Voltmeter
Time: 0.3 hour
Procedure:

A CRAY C90 computer system has either one 333 kVA MGS and an optional standby 333 kVA MGS or two 167 kVA MGSs and an optional standby 167 kVA MGS.

NOTE: Lubricate the shaft bearings of 167 kVA (150 kW) MGSs at least once every 2,000 to 2,300 hours of operation. If you are bringing a 167 kVA MGS online or putting it in standby mode, lubricate the shaft bearing using the procedures in the MGS instruction manual and the information on the bearing lubrication plate located on the MGS. The 333kVa MGS does not require lubrication.

1. Bring the standby MGS online for system use. The previously running MGS now becomes the standby unit.

2. Observe any unusual vibration and listen for any unusual noise in the MGS.

3. Observe control devices and meters for correct operation.

4. Use a voltmeter to measure the voltage coming into the voltage meter.

5. Compare this measurement to the MGS cabinet voltage meter reading.

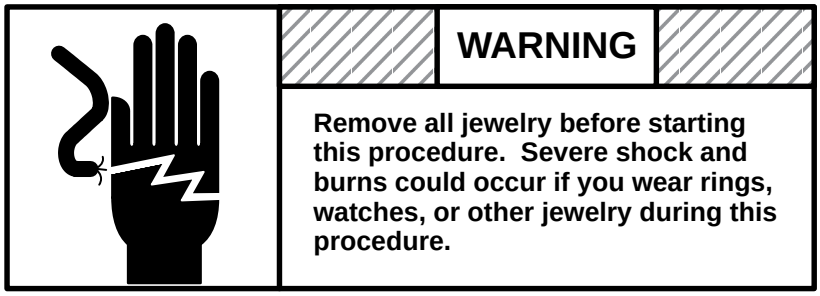
6. Calibrate the cabinet meter to ensure that its reading is identical to the input voltage reading.

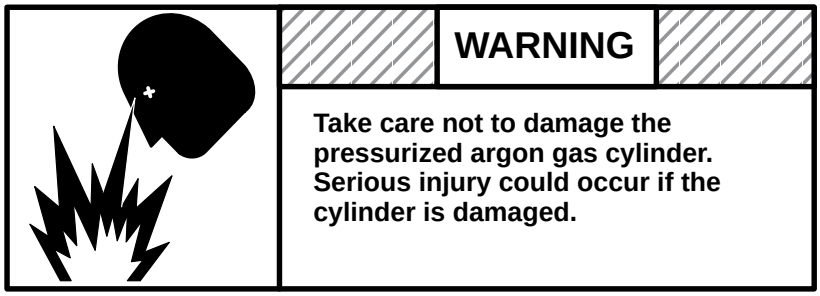
INFRARED SCANNING THE MOTOR-GENERATOR SET

A1

PMP Number: A1
Equipment: Motor-generator Set
Tools:
- Infrared viewer
- System logbook
- Torque wrench, if necessary

Time: 0.2 hour
Procedure:





A CRAY C90 computer system has either one 333 kVA MGS and an optional standby 333 kVA MGS or two 167 kVA MGSs and an optional standby 167 kVA MGS.

NOTE: If possible, perform infrared scans of all equipment during the same PM session.

A1

1. Before starting this procedure, review the operating instructions in the *Probeye Thermal Data Viewer Operation Manual*, which is included in the scanner shipping case.

2. Power up the MGS at least 2 hours before beginning the infrared scan.

3. Set up the infrared viewer using the procedure in the operation manual.

4. Scan the power connections and buses with the infrared viewer to detect any hot buses or connector hardware.

   NOTE: Hot buses or connector hardware appear on the infrared viewer as a brighter shade of red in comparison to adjacent buses and hardware.

5. Record the location of hot spots in the system logbook.

6. Inspect the MGS wiring for cracked insulation and loose electrical terminals.

7. Inspect control equipment (switches, breakers, relays, etc.) for loose mounting hardware or accumulations of dust.

8. If you suspect a loose hardware connection is causing a problem detected during the infrared scan, perform the following procedure:

   a. Power off the MGS.

   b. Loosen the connector hardware.

   c. Torque the connector hardware.

   d. Replace defective wires and electrical terminals as required.

   e. Tighten and clean control equipment as required.

   f. Power on the MGS.

9. Repeat Steps 2 through 8 of this procedure for each MGS in the system.

LUBRICATING THE MOTOR-GENERATOR SET SHAFT BEARINGS

A2

PMP Number: A2
Equipment: Motor-generator Set
Tools: MGS lubricant
Time: 0.2 hour
Procedure:

A CRAY C90 computer system has either one 333 kVA MGS and an optional standby 333 kVA MGS or two 167 kVA MGSs and an optional standby 167 kVA MGS.

The 167 kVA (150 kW) motor-generator set contains grease shaft bearings and requires more frequent lubrication. Refer to the procedures in the MGS instruction manual, CRI specification number 01680400, and the information on the bearing lubrication plate located on the MGS for more information on lubricating 167 kVA motor-generator sets.

The 333 kVA (300 kW) motor-generator set contains oil-bath shaft bearings. Refer to the procedures in the MGS instruction manual for more information on lubricating 333 kVA motor-generator sets.

6 REFRIGERATION CONDENSING UNIT PMI/PMP

Table 6-1. Refrigeration Condensing Unit PMI

PMP Number	Time Required (in Hours)	Dedicated Time Required	Procedure	Page
W1	0.5	No	Completing weekly refrigeration system check-off sheets	6-3
Q1	0.1	No	Cleaning the refrigeration condensing unit	6-15
Q2	0.1	No	Checking for refrigerant leaks	6-17
A1	0.1	No	Checking suction-line and liquid-line filters	6-19
A2	0.2	Yes	Checking refrigeration condensing unit electrical connections	6-21

COMPLETING WEEKLY REFRIGERATION SYSTEM CHECK-OFF SHEETS

W1

PMP Number: W1

Equipment: Refrigeration Condensing Units

Tools:
- Weekly refrigeration system check-off sheets
- System logbook

Time: 0.5 hour

The following procedures describe the Weekly Refrigeration System Check-off Sheets, CRI part numbers Form1020 and Form1022. Refer to Figure 6-1 and Figure 6-2. Each site must complete these sheets, which are available from the Logistics department. The check-off sheets aid in monitoring the refrigeration system and alert field support personnel of potential refrigeration condensing unit (RCU) problems.

1. Before taking any measurements, allow the RCU to operate for a minimum of 30 minutes; when recording temperatures and pressures, allow the readings to stabilize for 1 minute.

2. Read the temperatures of the inlet and outlet water pipes for the RCU. The input/output temperature difference should be approximately 30 °F (17 °C).

3. If the input/output temperature difference varies significantly from this value, refer to the *CRAY C916, CRAY C98, and CRAY C94 Power Distribution and Refrigeration Manual*, publication number CMM-0506-0A0, for troubleshooting information.

4. Maintain a local history file of the weekly refrigeration system check-off sheets for trend analysis.

Site Serial Number

Enter the system serial number in the upper left corner of the refrigeration check-off sheet. No other number is required.

Site Name

Enter the name of your site.

W1

Date Checked

Enter the date the system is checked. For future references, the entire date (day/month/year) must be filled in each time the system is checked.

Chill H_20 Temp		Chill H_20 Press		G.P.M.
In	Out	In	Out	

Figure 6-1. Weekly Refrigeration System Check-off Sheet (CRI Part Number Form1022)

Weekly Refrigeration System Check-off Sheet

Site S/N _____

Site Name _____

Return Completed Copy on a Monthly Basis
to Regional Technical Support

Properties of Saturated Refrigerant Freon R-22

Temp.	Pressure	Temp.	Pressure
20	43	96	186
22	45	98	192
24	48	100	198
26	50	102	204
28	52	104	210
30	55	106	216
32	57	108	222
34	60	110	228
36	63	112	235
38	66	114	242
40	69	116	248
42	72	118	255

Discharge								Suction				Miscellaneous		
Date Checked Dy/Mo/Yr	Pressure Comp. #1	Comp. #2	Sat. Temp.	Liquid-line Temp.	Sub Cooling	Hot Gas Temp. Comp. #1	Comp. #2	Pressure	Sat. Temp.	Temp.	Super Heat	Oil Level #1	#2	LL Sight Glass	Initials
Nominal	190 – 225 PSI		97^0 – 110^0	See Instr.	15^0 – 20^0	170^0 – 215^0		45 – 70 PSI	See Instr.	50^0 – 60^0	15^0 – 20^0	1/4 – 1/2		Green	

Figure 6-2. Weekly Refrigeration System Check-off Sheet (CRI Part Number Form1020)

W1

Checking Discharge Pressure

1. Locate the RCU's TRC controller (refer to Figure 6-3).
2. Press the enter (ENT) key to activate the display.
3. Press the up arrow (↑) key to log on, and type your password.
4. Press the enter (ENT) key to display the main menu.
5. Press 4 to select the sensor control menu.
6. Press 1 to select the status.
7. Read the discharge pressure.
8. Press 0 twice to return to the main menu.

Determining Discharge Saturation Temperature

Determine the discharge saturation temperature by looking in the upper right corner of the refrigeration check-off sheet (refer to Figure 6-2). Use the discharge pressure to determine this value.

Determining Liquid-line Temperature

1. Locate the RCU's TRC controller (refer to Figure 6-3).
2. Press the enter (ENT) key to activate the display.
3. Press the up arrow (↑) key to log on, and type your password.
4. Press the enter (ENT) key to display the main menu.
5. Press 4 to select the sensor control menu.
6. Press 1 to select the status.
7. Press the down arrow (↓) key to read the liquid-line temperature from the display.
8. Press 0 twice to return to the main menu.

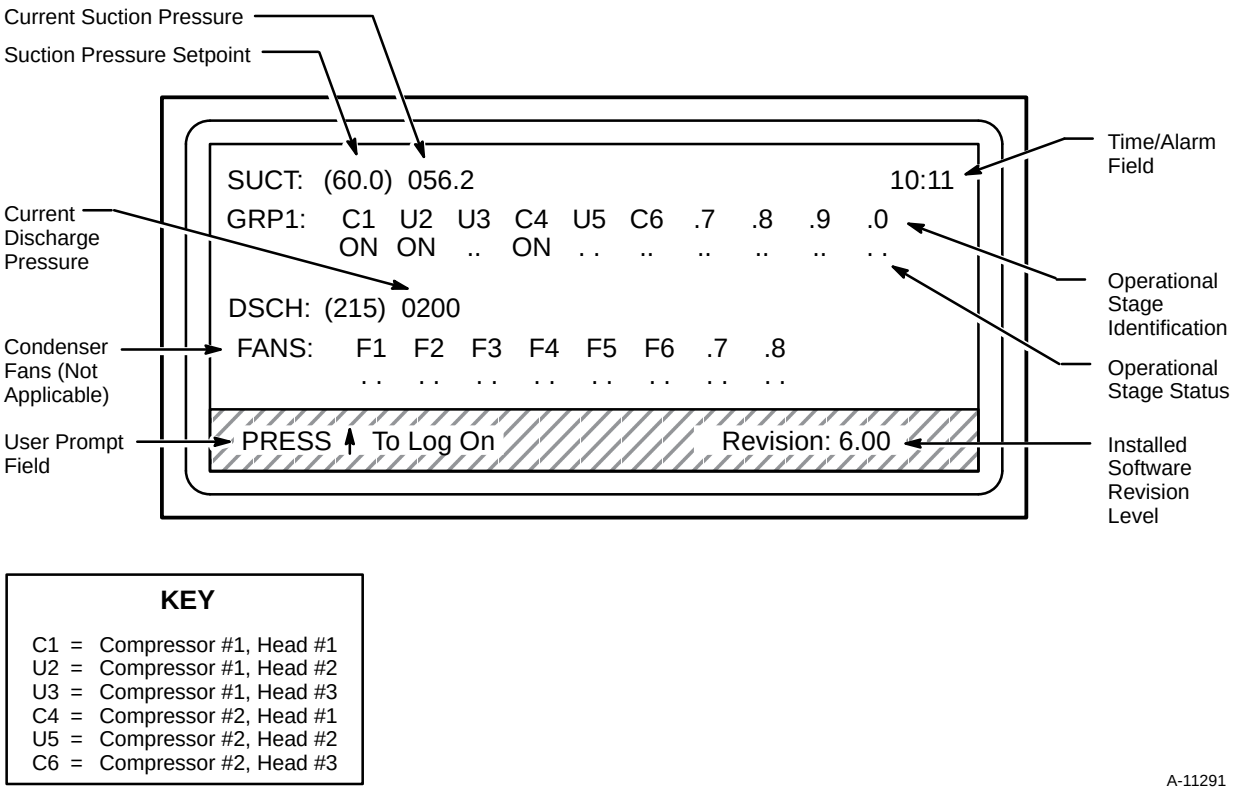


Figure 6-3. RCU-5A TRC Display Panel

Determining System Subcooling

1. Subtract the liquid-line temperature from the discharge saturation temperature to obtain the system-subcooling value. This value should remain constant. A decrease in the subcooling value on a continuing basis indicates a leak in the refrigeration system.

2. If necessary, use a Halogen detector to check the system for leaks. If necessary, replace the liquid-line filter.

W1

Determining Hot-gas Discharge Temperature

1. Locate the RCU's TRC controller (refer to Figure 6-3).
2. Press the enter (ENT) key to activate the display.
3. Press the up arrow (↑) key to log on, and type your password.
4. Press the enter (ENT) key to display the main menu.
5. Press 4 to select the sensor control menu.
6. Press 1 to select the status.
7. Read the discharge temperature for the compressor from the display.
8. Press 0 twice to return to the main menu.

Determining Suction Pressure

1. Locate the RCU's TRC controller (refer to Figure 6-3).
2. Press the enter (ENT) key to activate the display.
3. Press the up arrow (↑) key to log on, and type your password.
4. Press the enter (ENT) key to display the main menu.
5. Press 4 to select the sensor control menu.
6. Press 1 to select the status.
7. Read the suction pressure from the display.
8. Press 0 twice to return to the main menu.

Determining Suction Saturation Temperature

Determine the suction pressure by looking at the table in the upper right corner of the refrigeration check-off sheet (refer to Figure 6-2). Use the suction pressure to determine the suction saturation temperature value.

Determining Suction Temperature

1. Locate the RCU's TRC controller (refer to Figure 6-3).
2. Press the enter (ENT) key to activate the display.
3. Press the up arrow (↑) key to log on, and type your password.
4. Press the enter (ENT) key to display the main menu.
5. Press 4 to select the sensor control menu.
6. Press 1 to select the status.
7. Read the suction temperature from the display.
8. Press 0 twice to return to the main menu.

W1

Calculating System Superheat

Subtract the suction saturation temperature from the suction temperature to obtain the system-superheat value. The calculated superheat temperature should not be less than 15 °F (–9 °C) or more than 20 °F (–7 °C). If the system superheat is not within these limits, refer to the *CRAY C916, CRAY C98, and CRAY C94 Power Distribution and Refrigeration Manual*, publication number CMM-0506-0A0, for troubleshooting information.

Checking the Compressor Oil Level

Observe the compressor oil level through the oil sight glass (refer to Figure 6-4). The oil level in the sight glass should not be less than 1/4 or more than 1/2 full. If the oil level is not within these limits, refer to the *CRAY C916, CRAY C98, and CRAY C94 Power Distribution and Refrigeration Manual*, publication number CMM-0506-0A0, for troubleshooting information.

Checking the Liquid-line Sight Glass

1. Check the liquid-line sight glass for proper color and to ensure that it is free of bubbles (refer to Figure 6-5). If the dot in the center of the sight glass is green, the system is moisture free; a yellow dot indicates that there is too much moisture. If bubbles exist, the system requires additional refrigerant.

2. Use a Halogen detector to check the system for leaks.

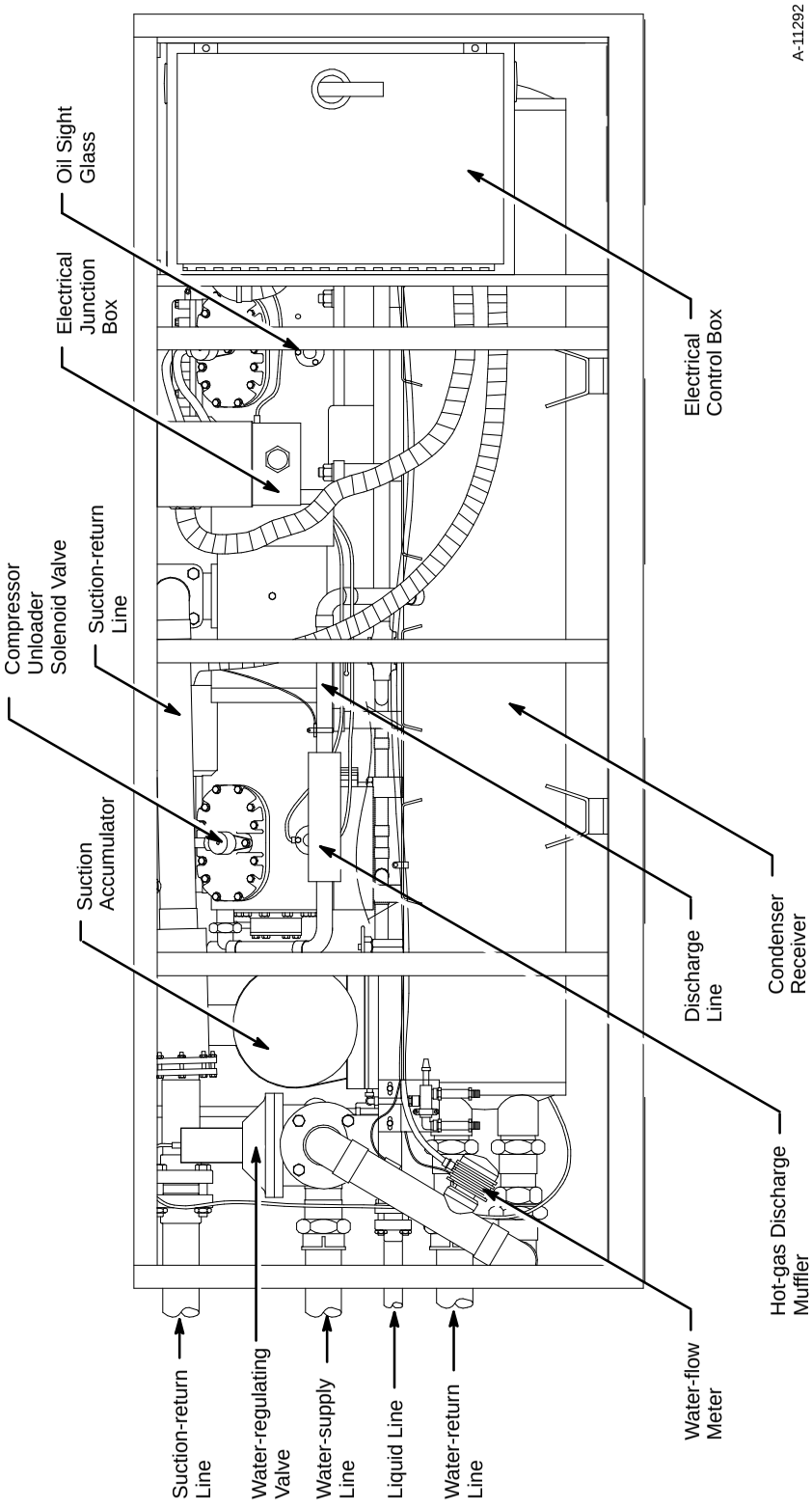


Figure 6-4. RCU-5A (Side View)

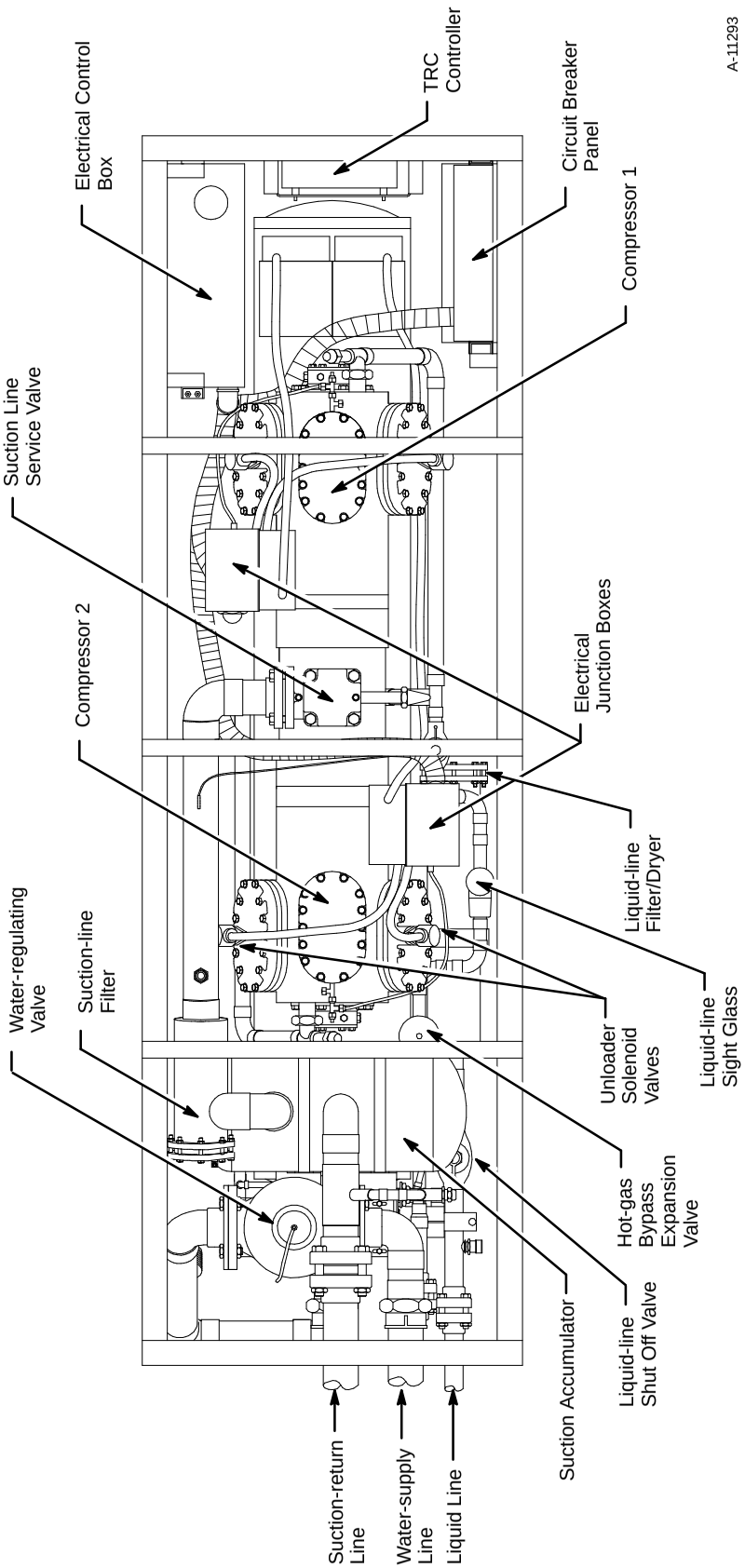


Figure 6-5. RCU-5A (Top View)

Checking Chilled Water Temperature

1. Locate the RCU's TRC controller (refer to Figure 6-3).
2. Press the enter (ENT) key to activate the display.
3. Press the up arrow (↑) key to log on, and type your password.
4. Press the enter (ENT) key to display the main menu.
5. Press 4 to select the sensor control menu.
6. Press 1 to select the status.
7. Press the down arrow (↓) key and read the water temperature from the display.
8. Press 0 twice to return to the main menu.

Checking Chilled Water Gallons per Minute (gpm)

1. Locate the RCU's TRC controller (refer to Figure 6-3).
2. Press the enter (ENT) key to activate the display.
3. Press the up arrow (↑) key to log on, and type your password.
4. Press the enter (ENT) key to display the main menu.
5. Press 4 to select the sensor control menu.
6. Press 1 to select the status.
7. Press the down arrow (↓) key and read the water gpm from the display.
8. Press 0 twice to return to the main menu.

W1

Submitting Weekly Refrigeration System Check-off Sheets

Each month, submit the Weekly Refrigeration System Check-off Sheets to Regional Technical Support (RTS). RTS notifies you if there are any inconsistent RCU values.

CLEANING THE REFRIGERATION CONDENSING UNIT

Q1

PMP Number: Q1

Equipment: Refrigeration Condensing Units

Tools:
- Soft-bristle brush
- Soft cloth

Time: 0.1 hour

Procedure:

Wipe dust from the refrigeration condensing unit and the operator's control panel using a soft-bristle brush and soft cloth.

CHECKING FOR REFRIGERANT LEAKS

Q2

PMP Number: Q2
Equipment: Refrigeration Condensing Units
Tools: Halogen detector
Time: 0.1 hour
Procedure:

1. Use a Halogen detector to scan the compressor, fittings, and valves for refrigerant leaks.

2. Visually inspect the compressor, fittings, and valves for refrigerant leaks.

CHECKING SUCTION-LINE AND LIQUID-LINE FILTERS

A1

PMP Number: A1
Equipment: Refrigeration Condensing Units
Tools: Temperature probe
Time: 0.1 hour
Procedure:

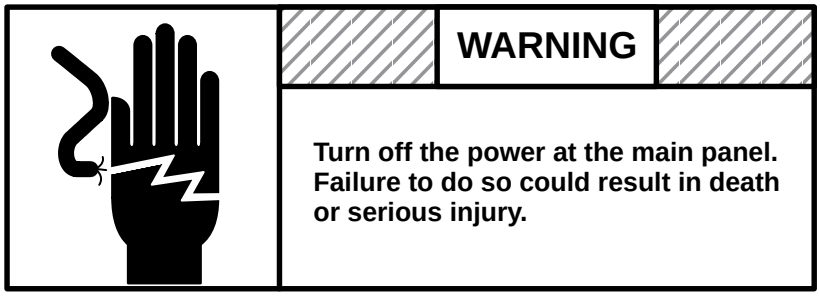
Using a temperature probe, check for a temperature difference between the suction- and liquid-line filters of the RCU. If the temperature difference between the input and output of either filter is greater than 3 °F (1.6 °C), the suction- or liquid-line filter may be clogged.

CHECKING REFRIGERATION CONDENSING UNIT ELECTRICAL CONNECTIONS

A2

PMP Number: A2
Equipment: Refrigeration Condensing Units
Tools: Lockout tag
Time: 0.2 hour
Procedure:

NOTE: For safety reasons, ensure that a second person is available to help perform this procedure.



1. Turn off all power at the wall breakers.

2. Attach a lockout tag to the breaker panel and follow the CRI lockout procedures provided in Section 1 of this manual.

3. Check all electrical connections on the RCUs. Ensure that all power connections (nuts, bolts, and screws) are tight.

7 FRONT-END INTERFACE PMI/PMP

Table 7-1. Front-end Interface PMI

PMP Number	Time Required (in Hours)	Dedicated Time Required	Procedure	Page
M1	0.1	No	Cleaning and inspecting the front-end interface	7-3
Q1	0.2	Yes	Checking the front-end interface voltage and ripple	7-5
A1	0.1	Yes	Infrared scanning the front-end interface hardware	7-7
A2	0.2	Yes	Tightening and inspecting the front-end interface power-supply hardware	7-9
A3	0.1	Yes	Cleaning the front-end interface filters	7-11

CLEANING AND INSPECTING THE FRONT-END INTERFACE

M1

PMP Number: M1

Equipment: Front-end Interface (FEI)

Tools:

- Moistened cloth
- Mild cleaning detergent

Time: 0.1 hour

Procedure:

1. Wipe off the exterior surfaces of the FEI cabinet with a moistened cloth.

2. Use a mild cleaning detergent to remove dirt from the cabinet surfaces.

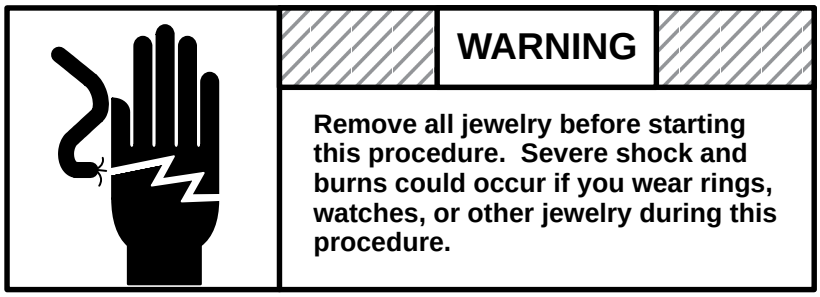
3. Inspect the air-intake vents to ensure that the cooling fans are operating and that nothing is blocking the airflow into the cabinet.

4. Repeat this procedure for each FEI in the computer system.

CHECKING THE FRONT-END INTERFACE VOLTAGE AND RIPPLE

Q1

PMP Number: Q1
Equipment: Front-end Interface (FEI)
Tools: Voltmeter
Time: 0.2 Hour
Procedure:



Use a digital voltmeter to measure power-supply voltages; use an oscilloscope to measure power-supply ripple.

1. Measure the voltage at the bus bars for the –5.2 V and –2.0 V power supplies. If the FEI has +5.0 V or +6.0 V power supplies, measure the voltage for these power supplies at their terminal blocks.

2. Record the voltage measurements.

3. Compare the measurements to the following acceptable operating voltage ranges:

- –5.2 V ± 0.02 V
- –2.0 V ± 0.01 V
- +5.0 V ± 0.02 V
- +6.0 V ± 0.02 V

4. Adjust the supply voltage if it is not within the acceptable operating range.

5. Measure and record the peak-to-peak ripple on each power supply of the front-end interface.

Q1

6. Compare the peak-to-peak measurements to previous measurements. If the ripple is greater than 150 mV on a power supply, investigate the cause, and make the necessary repairs.

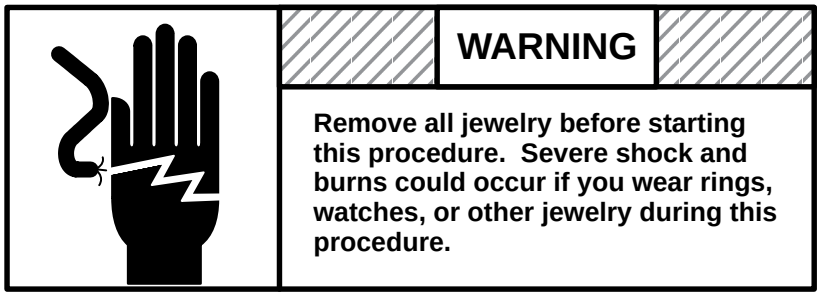
7. Repeat this procedure for each FEI in the computer system.

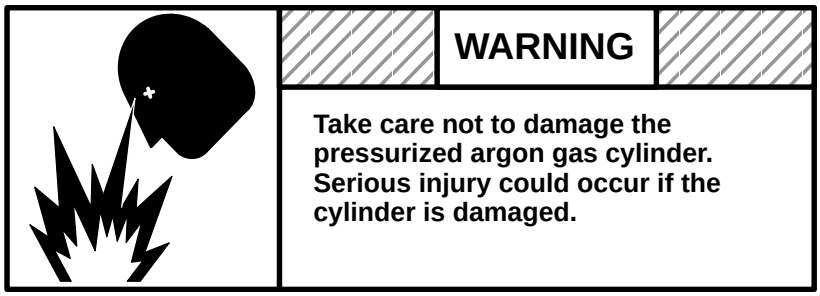
INFRARED SCANNING THE FRONT-END INTERFACE HARDWARE

A1

PMP Number: A1
Equipment: Front-end Interface
Tools:
- Infrared viewer
- System logbook

Time: 0.1 hour
Procedure:





NOTE: Perform the infrared scans for all equipment during the same PM session.

1. Power up the FEI at least 2 hours before starting the infrared scan.

2. Review the infrared viewer operating instructions in the *Probeye Thermal Data Viewer Operation Manual* included in the scanner shipping case.

A1

3. Set up the infrared viewer using the procedure described in the operation manual.

4. Remove the FEI access panels.

5. Scan all bus leads and terminal blocks for any hot components or hot connections.

6. Record the location of any hot spots in the system logbook.

7. Replace the FEI access panels.

8. Repeat Steps 1 through 7 of this procedure for each FEI in the system configuration.

9. Schedule maintenance time to correct any problems detected during the infrared scan.

TIGHTENING AND INSPECTING THE FRONT-END INTERFACE POWER-SUPPLY HARDWARE

A2

PMP Number: A2
Equipment: Front-end Interface
Tools: None
Time: 0.2 hour
Procedure:

1. Power off the front-end interface by unplugging it from the power outlet.

2. Inspect all power supply and power cable connections to ensure that there are no loose or defective connections.

3. Tighten any loose connections. Replace any defective connectors.

4. Power on the front-end interface by inserting the plug into the power outlet.

5. Repeat Steps 1 through 4 of this procedure for each FEI in the computer system.

CLEANING THE FRONT-END INTERFACE FILTERS

A3

PMP Number: A3

Equipment: Front-end Interface

Tools:

- Screwdriver
- Vacuum cleaner
- Soap and water

Time: 0.1 hour

Procedure:

1. Remove the screws from the top cover of the FEI cabinet.
2. Remove the top cover of the FEI cabinet.
3. Remove the two filters from the FEI cabinet.
4. Vacuum the filters to remove dust and debris.
5. Wash the filters with soap and water.
6. Allow the filters to air-dry.
7. Replace the filters after they have dried.
8. Replace the top cover.
9. Tighten the screws that hold the top cover.
10. Repeat Steps 1 through 9 of this procedure for each FEI cabinet in the computer system.

8 DISK STORAGE UNIT PMI/PMP

Several different models of disk storage units (DSUs) can be configured with CRAY C90 series computer systems. The following subsections describe the PMIs and PMPs for these DSUs.

Table 8-1. DS-40, DS-41, and DS-42 Disk Subsystems PMI

PMP Number	Time Required (in Hours)	Dedicated Time Required	Procedure	Page
D1	1.0	No	Reviewing the error logs	8-5
W1	0.5	No	Recording refrigeration readings	8-7
Q1	0.5	Yes	Cleaning and inspecting the subsystems	8-9

REVIEWING THE ERROR LOGS D1

PMP Number: D1
Equipment: DS-40, DS-41, or DS-42 Disk Subsystem
Tools: Disk subsystem error logs
Time: 1.0 hour
Procedure:

1.. Review the error logs of the disk subsystem.

2.. Analyze the controller and disk problems identified in the error logs for potential failures.

3.. Plan maintenance activity to correct any anticipated controller or disk failures.

4.. Maintain a file of printouts of disk subsystem failures for trend analysis.

RECORDING REFRIGERATION READINGS

W1

PMP Number: W1

Equipment: DS-40, DS-41, or DS-42 Disk Subsystem

Tools:

- DC-40/41 Refrigeration System Weekly Check-off Sheet
- Weekly Refrigeration System History File

Time: 0.5 hour

Procedure:

1.. Measure and record refrigeration readings on the DC-40/41 Refrigeration System Weekly Check-off Sheet, CRI part number Form1024. Refer to Figure 8-1. Form1024 is available from the Logistics department.

2.. Maintain a local history file of the weekly refrigeration system check-off sheets for trend analysis.

3.. Mail a copy of the weekly refrigeration check-off sheet to Regional Technical Support (RTS) once a month.

4.. Repeat this procedure for each DCC-2(A).

DC-40/41 Weekly Refrigeration System Check-off Sheet

Site Name _____

Site S/N _____

Cabinet S/N _____

Return completed copy on a monthly basis to Regional Technical Support

Properties of Saturated Refrigerant Freon R-22

Temp	Pressure
20	43
22	45
24	48
26	50
28	52
30	55
32	57
34	60
36	63
38	66
40	69
42	72

Temp	Pressure
96	186
98	192
100	198
102	204
104	210
106	216
108	222
110	228
112	235
114	242
116	248
118	255

Discharge						Suction				Miscellaneous					
Date Checked D/M/Y	Pressure	Sat Temp	Liquid-line Temp	Sub Cooling	Hot Gas Temp	Pressure	Sat Temp	Temp	Super Heat	Water Temp	Water Temp	ΔT	Oil Level	LL Sight Glass	Initials
Nominal	200 – 220 PSI	97° – 110°	See Inst.	10° – 15°	180° – 200°	50 – 70 PSI	See Inst.	50° – 70°	15° – 25°	In	Out		1/2	Green	

Figure 8-1. DC-40/41 Weekly Refrigeration System Check-off Sheet (CRI Part Number Form1024)

CLEANING AND INSPECTING THE SUBSYSTEMS

Q1

PMP Number: Q1

Equipment: DS-40, DS-41, or DS-42 Disk Subsystem

Tools:
- Spare filters
- CRI-approved vacuum cleaner

Time: 0.5 hour

Procedure:

1. Remove all of the subsystem access panels.

2. Remove the spindle filters.

   NOTE: Each DD-40 spindle in a DS-40 disk subsystem has a filter; DD-4R disk drives, DS-41 and DS-42 disk subsystems do not have filters.

3. Replace the filters with spare (new or cleaned) filters.

4. Inspect the drive cabinet and spindles to ensure there are no loose nuts, bolts, cables, wires, etc.

5. Replace the access panels.

6. If necessary, remove dust and debris from the used spindle filters using a CRI-approved vacuum cleaner. Discard any filter that cannot be cleaned.

Table 8-2. DD-60 Disk Drive PMI

PMP Number	Time Required (in Hours)	Dedicated Time Required	Procedure	Page
D1	0.1	No	Reviewing the error logs	8-13
Q1	0.1	No	Replacing and cleaning the filter	8-15
Q2	0.1	No	Cleaning the external surfaces	8-17

REVIEWING THE ERROR LOGS D1

PMP Number: D1
Equipment: DS-60 Disk Drive
Tools: Disk drive error logs
Time: 0.1 hour
Procedure:

1. Review the error logs of the disk drive.
2. Analyze the disk problems identified in the error logs for potential failures.
3. Plan maintenance activity to correct any anticipated disk failures.
4. Maintain a file of printouts of disk drive failures for trend analysis.

REPLACING AND CLEANING THE FILTER

Q1

PMP Number: Q1

Equipment: DS-60 Disk Drive

Tools:

- Spare filters
- CRI-approved vacuum cleaner

Time: 0.1 hour

Procedure:

1. Remove the filter cover from the front of the disk drive.
2. Remove the sponge filter.
3. Install a spare (new or cleaned) sponge filter in the normal operating position.
4. Replace the filter cover on the disk drive.
5. If necessary, remove dust from the replaced sponge filter using a CRI-approved vacuum cleaner. Discard the sponge filter if it cannot be cleaned.

CLEANING THE EXTERNAL SURFACES

Q2

PMP Number: Q2

Equipment: DS-60 Disk Drive

Tools:

- Clean, soft cloth
- High-quality cleaning detergent

Time: 0.1 hour

Procedure:

1. Wipe off the external surfaces of the disk drive cabinet with a clean, soft cloth.

2. Remove dust and grime with a high-quality commercial cleaning detergent.

Table 8-3. DD-61, DD-62, and RD-62 Disk Drives PMI

PMP Number	Time Required (in Hours)	Dedicated Time Required	Procedure	Page
D1	0.1	No	Reviewing the error logs	8-21
Q1	0.1	No	Cleaning the external surfaces	8-23

REVIEWING THE ERROR LOGS D1

PMP Number: D1
Equipment: DD-61, DD-62, or RD-62 Disk Drive
Tools: Disk drive error logs
Time: 0.1 hour
Procedure:

1. Review the error logs of the disk drive.
2. Analyze the disk problems identified in the error logs for potential failures.
3. Plan maintenance activity to correct any anticipated disk failures.
4. Maintain a file of printouts of disk drive failures for trend analysis.

CLEANING THE EXTERNAL SURFACES

Q1

PMP Number: Q1

Equipment: DD-61, DD-62, or RD-62 Disk Drive

Tools:
- Clean, soft cloth
- High-quality cleaning detergent

Time: 0.1 hour

1. Wipe off the external surfaces of the disk drive cabinet with a clean, soft cloth.

2. Remove dust and grime with a high-quality commercial cleaning detergent.