DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

HIPIR LIQUID COOLING SYSTEM CLEANING STATION AKI-83005B

Headquarters, Department of the Army, Washington, D. C.
1 July 1986

REPORTING OF ERRORS

You can help improve this bulletin. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms), direct to: Commander, U.S. Army Missile Command, ATTN: AMSMI-LC-ME-PM, Redstone Arsenal, AL 35898-5238. A reply will be furnished to you.

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WARNING
DANGEROUS CHEMICALS

are used in the operation of this equipment

DEATH

may result if personnel fail to observe safety precautions

The following is a list of chemicals used in the operation or maintenance of the equipment in this bulletin, including proper care and handling procedures and corrective actions (fire and first aid procedures).

Hazards	Preventive Actions	First Aid
	Flammable; avoid open flames and sparks, Extinguish fires with $C0_2$ or dry chemical extinguisher.	
Coolant (6850-00-078-4459/ 5959151)	Avoid contact with skin (use rubber gloves).	Wash with water.
	Avoid contact with eyes (use safety goggles).	Flush thoroughly with water.
If swallowed, coolant causes damage to the central nervous system and severe kidney damage.		Seek medical attention immediately.

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Hazards	Preventive Actions	First Aid
Not flammable	Use a ventilation device or a hood during preparation of chemical solutions.	Remove victim to fresh air and get medical attention.
Skin injury; irritation, pain	Wear protective clothing; gloves, apron.	Promptly remove soaked clothing and wash skin thoroughly with water.
Eyes; irritation, pain	Wear safety goggles.	Flush thoroughly with water. Get medical attention.
If swallowed, $K_2 5_2 0_7$ causes throat irritation, stomach pain		Rinse the mouth, drink a large amount of water and get medical attention.
Disposal	**Storage**	
Chemical spilled on floor must be flushed thoroughly with water. For the disposal, the chemical must be treated as a weak sulphuric acid (refer to National Regulations).	In a dry place. Keep away.	

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Ethylene Diamine Tetra Acid (EDTA)

Hazards	Preventive Actions	First Aid
Not flammable		
Inhalation can cause cough and throat irritation.	Use a ventilation device or a vent hood.	Remove victim to fresh air and get medical attention.
Skin injury; irritation, pain	Wear protective clothing (rubber gloves, apron).	Promptly remove soaked clothing and wash skin thoroughly with water.
Eyes; irritation, pain	Wear safety goggles.	Flush thoroughly with water. Get medical attention if necessary.
If swallowed, EDTA causes throat irritation.		Rinse the mouth, drink a lot of water and get medical attention.
Disposal	**Storage**	
Chemical spilled on floor must be flushed with a large amount of water (refer to National Regulations).	EDTA is a complex former, and should never be mixed with other solutions.	

Section I. GENERAL

1. Purpose and Scope. The purpose of this purging process is to eliminate excessive HIPIR downtime caused by contamination and leakage of the coolant system. This procedure informs and guides personnel responsible for direct and general support maintenance of Radar Set AN/MPQ-57, High-Powered Illuminator Radar (HIPIR). These instructions contain maintenance information beyond the scope of the tools, equipment or supplies normally available to using organizations. Information in this bulletin is supplemental to and used in conjunction with TM 9-1430-1533-12-1. This bulletin also contains general maintenance and unique removal, installation, repair, and purging operations peculiar to direct and general support. Maintenance test procedures for units of this equipment are covered in TM 9-1430-1533-34-1.

NOTE

MWO 9-1430-1533-50-3 (Replacement of Cooling Hoses) appendix A and MI-B0162R1 (Coolant Hoses "O" ring change) appendix B must be applied before the purging procedure is performed.

2. Reporting Equipment Improvement Recommendations (EIRs). If your equipment needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design. Tell us why the procedure is hard to perform. Put it on an SF 368 (Quality Deficiency Report). Mail it to the address stated in DA PAM 738-750. We will send you a reply.

3. Description.

DESCRIPTION OF THE CLEANING STATION

The Cleaning Station (fig. 1) contains five reservoirs (6.5 gals each), four heater elements (1.5 KW each for heating reservoirs Nos. 1, 2 and 3), a thermometer, and a 1.75 V 650 MA DC power supply. Additional items are: A pump (maximum pressure 100 PSI), a filter housing with elements, and a pressure indicator. The reservoirs are filled as follows:

No. 1 with a (ETHYLENE DIAMINE TETRA ACETIC ACID) Versene-Acid solution, No. 2 with an alkali-free soap solution, No. 3 with a pyrosulphate solution. No. 4 with distilled or demineralized water, and No. 5 with ethylene glycol.

4. General Instructions. None.

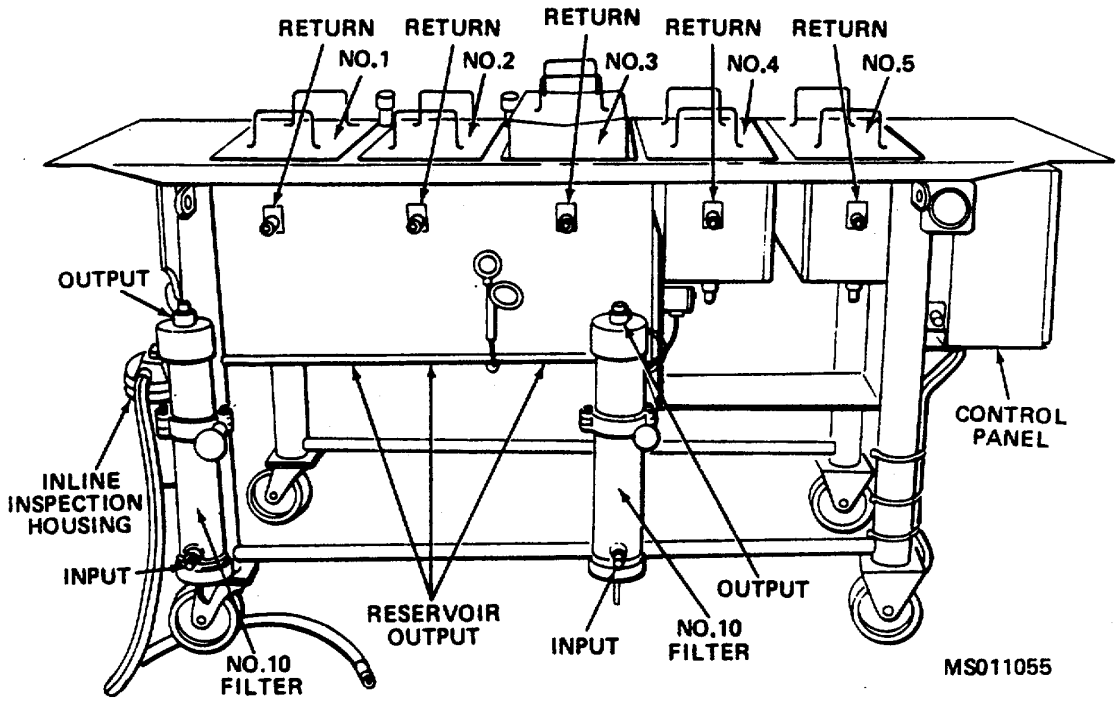

Figure 1. Cleaning station.

Section II. COOLANT CLEANING

5. Preparation of Cleaning Station.

a. Fill reservoir No. 1 to within two inches of the rim with hot (160°F) tapwater. Pour in two pounds of Versene-Acid and stir with a wooden paddle until powder dissolves. Place cover on reservoir.

b. Fill reservoir No. 2 to within two inches of the rim with hot (160°F) tapwater. Pour in three ounces of concentrated liquid soap (alkali-free) and stir for a few seconds. Place cover on reservoir.

c. Fill reservoir No. 3 to within two inches of the rim with hot (160°F) tapwater. Pour in two pounds of pyrosulphate and stir with a wooden paddle until powder dissolves. Place cover on reservoir.

d. Fill reservoir No. 4 to within two inches of the rim with distillated or demineralized water. Place cover on reservoir.

e. Fill reservoir No. 5 to within two inches of the rim with Ethylene Glycol. Place cover on reservoir.

f. Set the main power switch and the control current switch to ON.

g. Set the heater control switch to position I & II (fig. 2).

h. Adjust thermostat to 160°F.

6. Preparation for Cleaning the HIPIR Cooling System.

CAUTION

In performing the following purging procedure, the pump may be operated without the required lubrication provided by the coolant; as a result, the life of the pump is affected. Therefore, it is important that operation of the pump not exceed the time noted in the procedure:

NOTE

To achieve maximum results, it is necessary, when performing this cleaning procedure on the HIPIR for the first time, to clean the coolant fluid reservoir (1, figure 5) and the heat exchange (2, figure 5) separately.

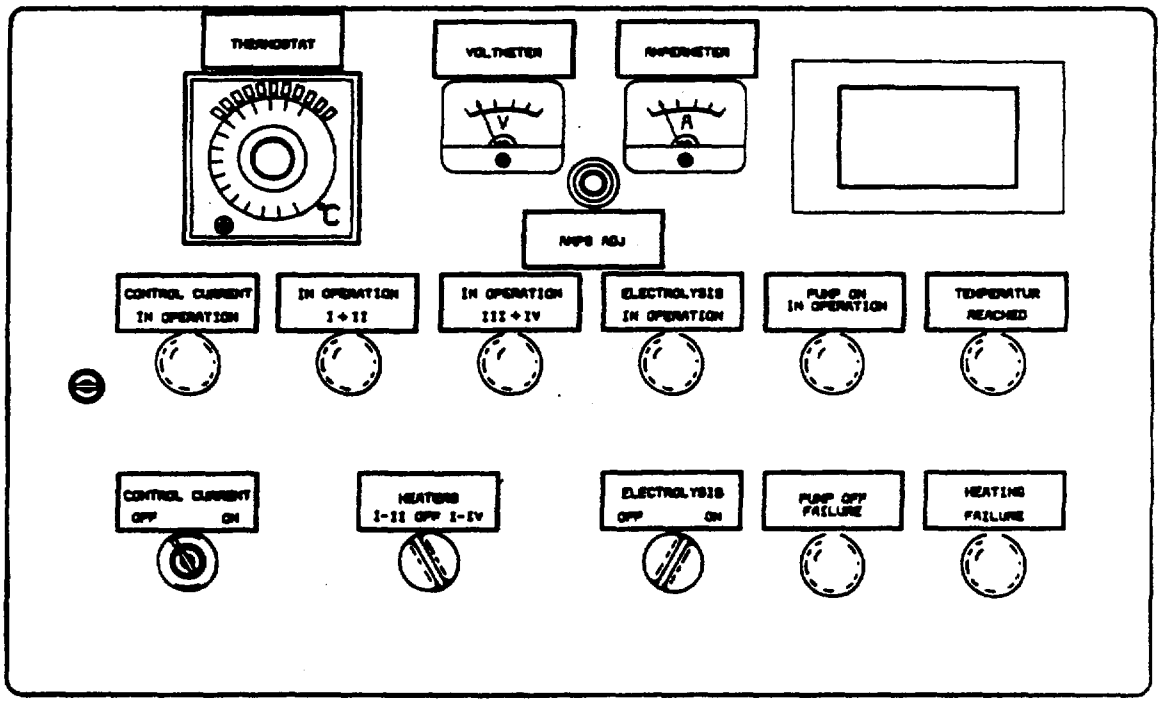

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Figure 2. Cleaning unit controls.

a. Deenergize the HIPIR and disconnect to power cable.

b. Drain the entire HIPIR glycol cooling system.

* *c.* Refill the cooling system with tapwater, distilled or demineralized water.

* *d.* Run the HIPIR glycol pump for TWO MINUTES.

* *e.* Drain the system again.

f. Remove the glycol heater coolant Fluid Tank (1, figure 3).

g. Remove the heat exchanger and dummy load (2 and 6, figure 3) may be purged in place.

h. Remove the Modulator Oscillator Amplifier Group (R.F. Pallet), (3, figure 4), Flow Rate Detector (4, figure 3) High Voltage Power Supplies A1 and A4 (3, figure 3).

i. Ensure that the liquid cooler filter assembly is cleaned as directed in TM 9-1430-1533-12-1.

CAUTION

Collect any coolant that drains from coolant line fittings as soon as possible after disconnecting. Dispose of the coolant in accordance with local safety regulations.

7. Coolant Fluid Tank (figure 4).

a. Remove the heater elements from the tank and flush the tank and elements (1, 2, figure 4) with tapwater. Manually clean heater elements and coolant tank with soap solution and nylon brush. Remount the heater elements.

b. Remove the tank pressure relief valve and plug the opening.

c. Plug the glycol pump connection and the remaining opening (figure 4, upper left side of the tank).

d. Mount the male-adapter tightly to the glycol inlet-port.

e. Install the #10 filter into the filter housing (figure 5).

f. Connect the pump-pressure line to the lower (pressure) connection of filter housing (figure 6).

g. Connect the return line of the coolant fluid tank to the upper (PRESS) connection of reservoir No. 2 (cleaning station, (figure 6).

h. Connect the lower (RETURN) connection of reservoir No. 2 (figure 7) to the pump.

WARNING

Failure to perform step (*i*) will result in breaking the VISUAL INSPECTION GLASS during pump-operation.

i. Turn the PUMP-PRESSURE REGULATOR fully counter clockwise (figure 8).

j. Switch on the pump and let it run for 5 minutes. Stop the pump and press the air-relief-valve-button to empty the tank (figure 7).

k. Disconnect the pressure-and-return line from the station and connect them respectively to the tapwater input and drain connection. Flush the coolant fluid tank with water until no evidence of soap is visible.

l. Reconnect the return line of the coolant fluid tank to the upper connection of reservoir No. 1 (Versene-Acid) solution and the lower connection of reservoir No. 1 to the pump (figure 1). Start the auxiliary pump and let it run for 60 minutes.

m. Stop the pump and press the air relief valve button to empty the tank (fig. 1).

n. Flush the tank with water. Disconnect the pressure and return line from the station and connect them respectively to the tapwater input connection and drain. Flush the coolant fluid tank with water until no evidence of Versene-Acid solution is visible.

o. Remove all plugs and connections and install the pressure relief valve (fig. 1). Reinstall the reservoir tank.

8. Liquid Coolant Tank Unit (Figure 4).

NOTE

Steps *a* and *b* below can be performed during the Versene-Acid cleaning cycle of the coolant fluid tank.

a. Remove the thermostat from the heat exchanger and replace it with the applicable dummy (figure 9). This simulates an extended thermostat.

* It is not necessary to perform the steps when purging the HIPIR for the first time.

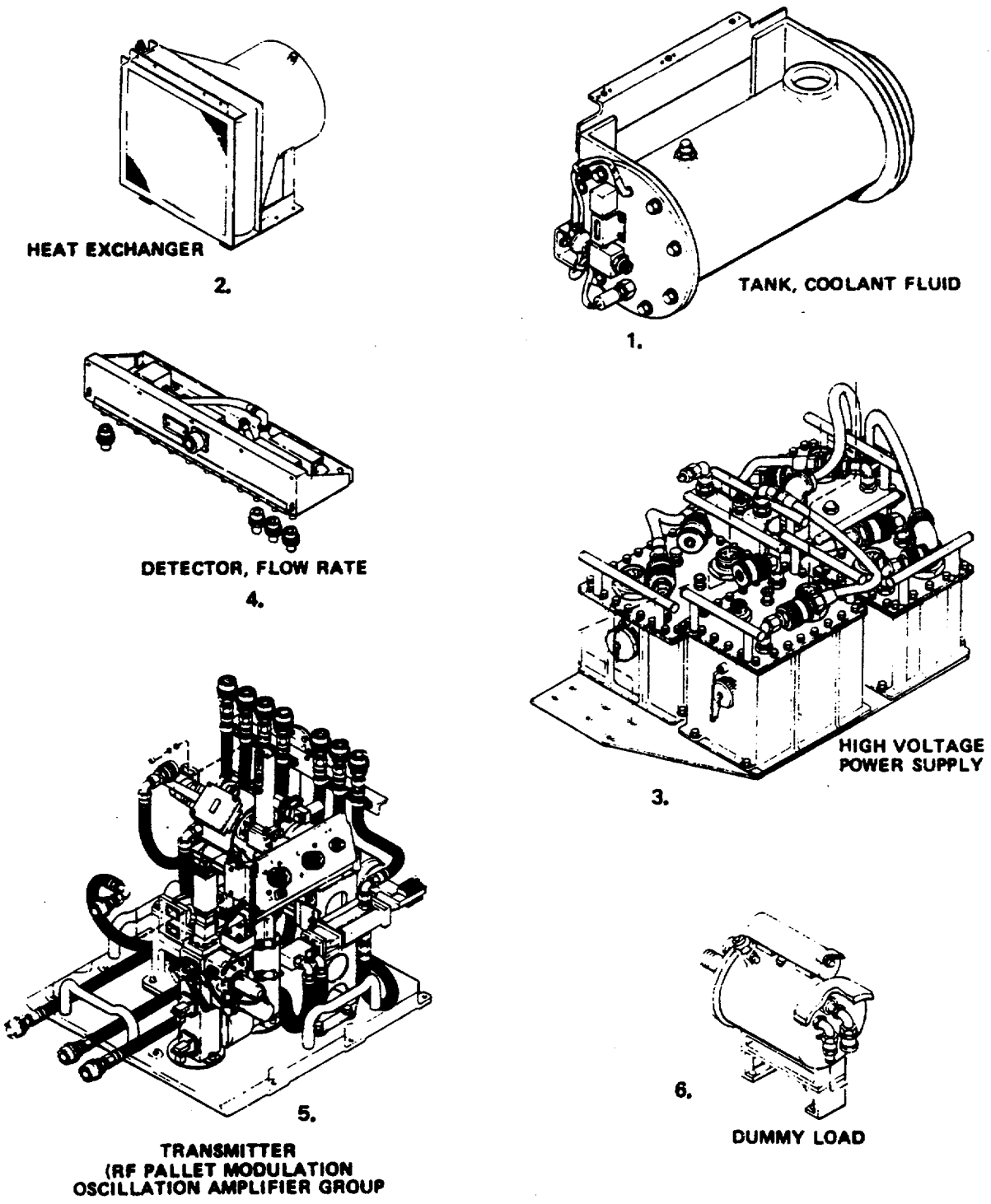

Figure 3. Coolant system components illustrated (coolant tank, heat exchanger, flow rate, detector, H.V.P.S., XMTR, dummy load).

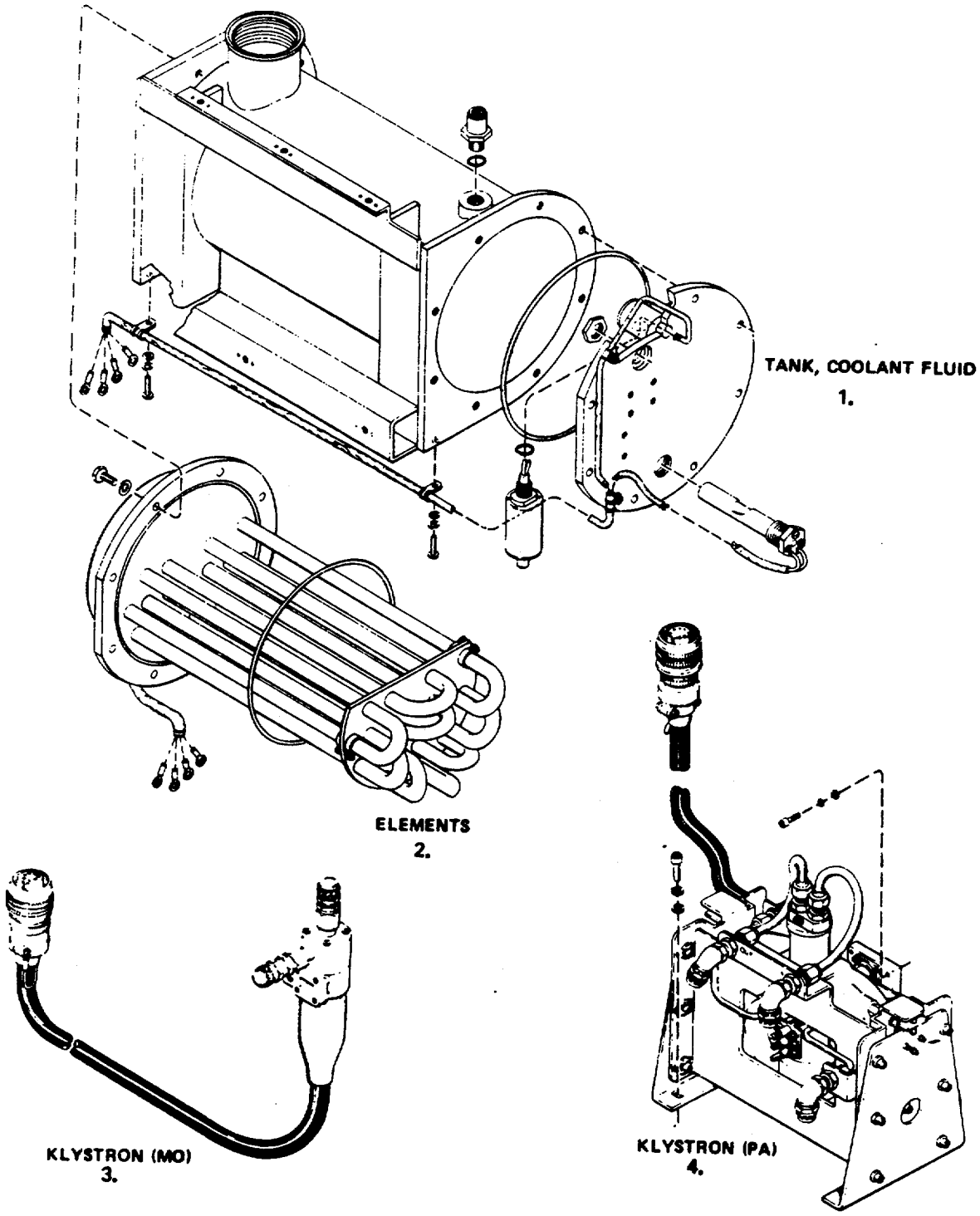

Figure 4. Cooling system components illustrated (coolant tank, klystron (MO), klystron (PA).

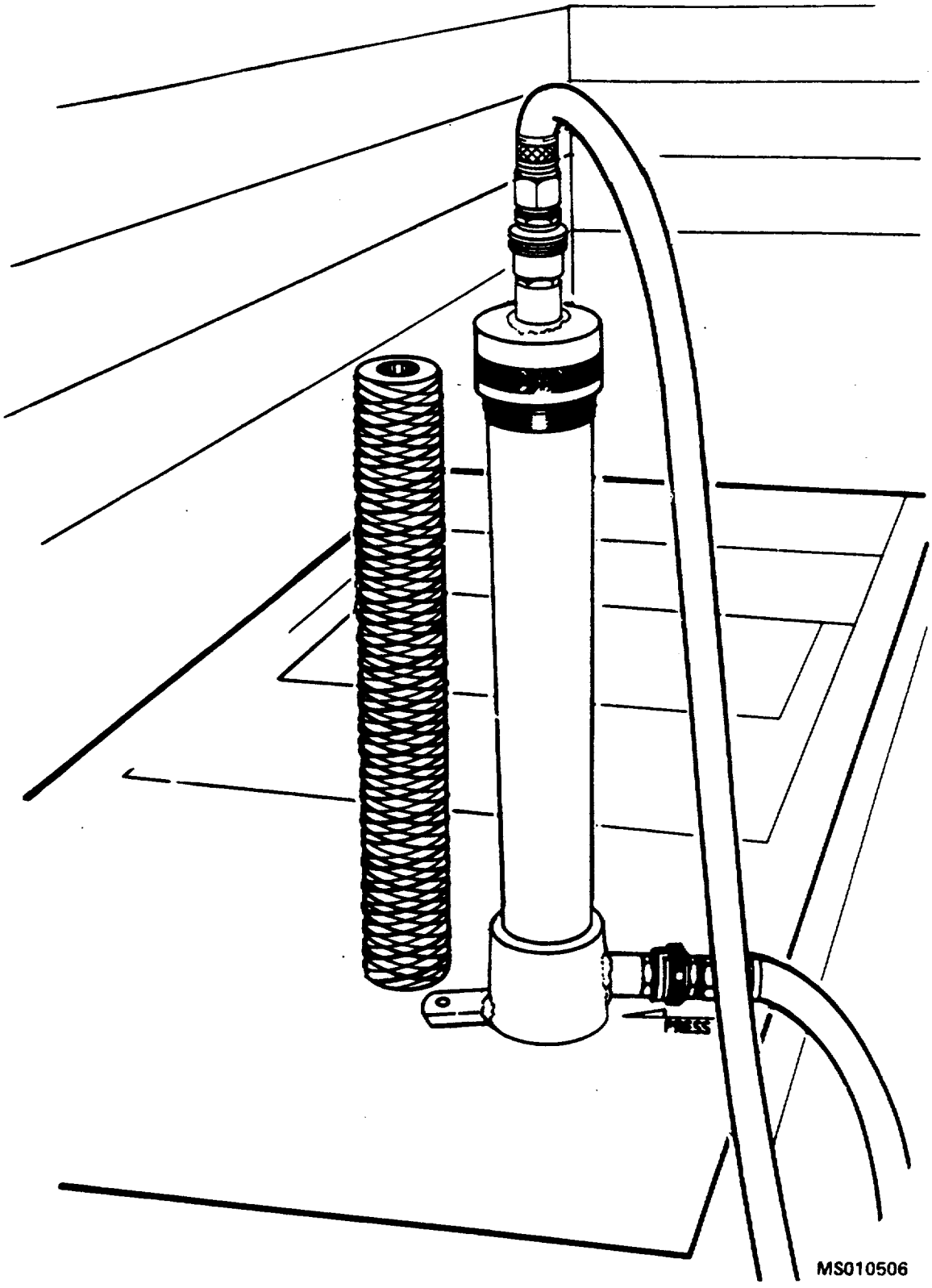

Figure 5. Number 10 filter and housing.

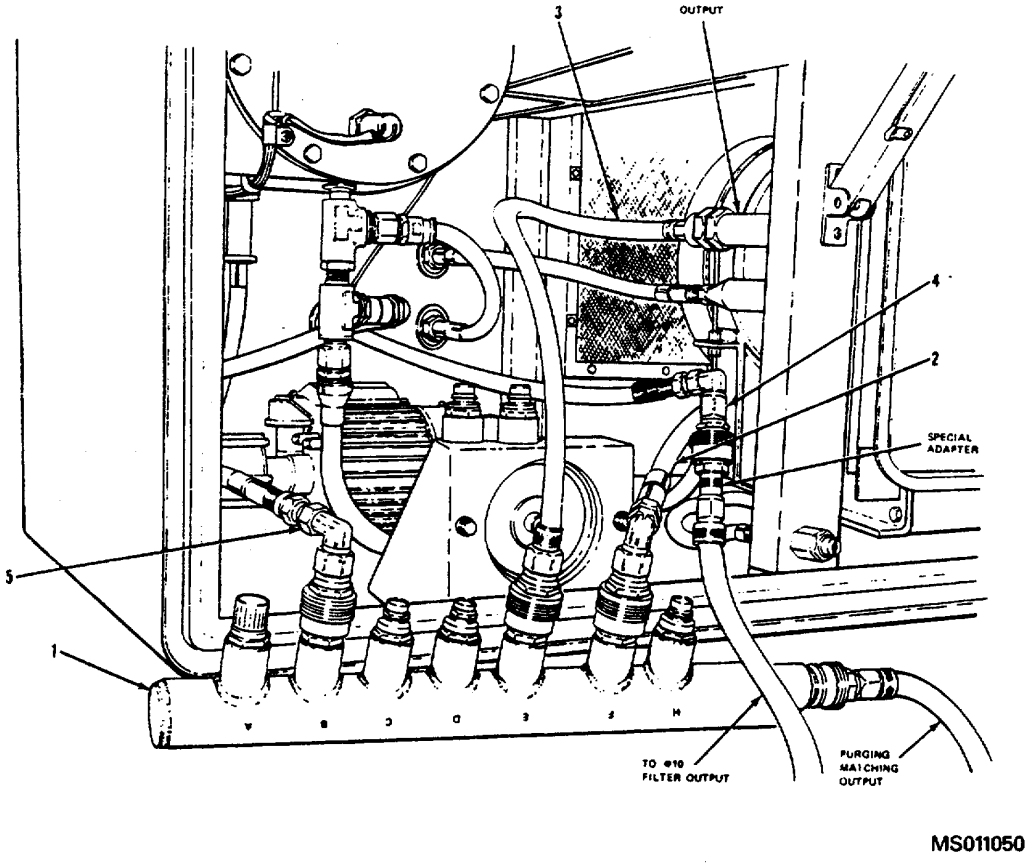

Figure 6. Liquid coolant unit.

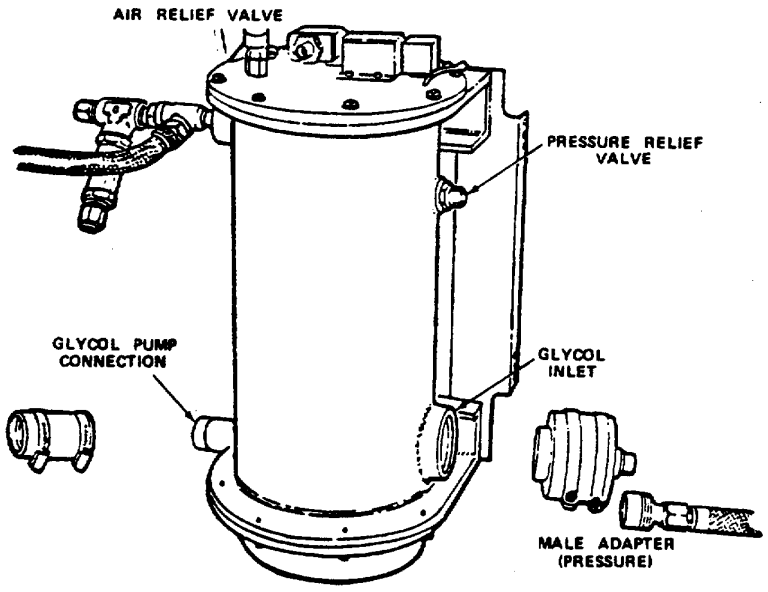

Figure 7. Coolant tank.

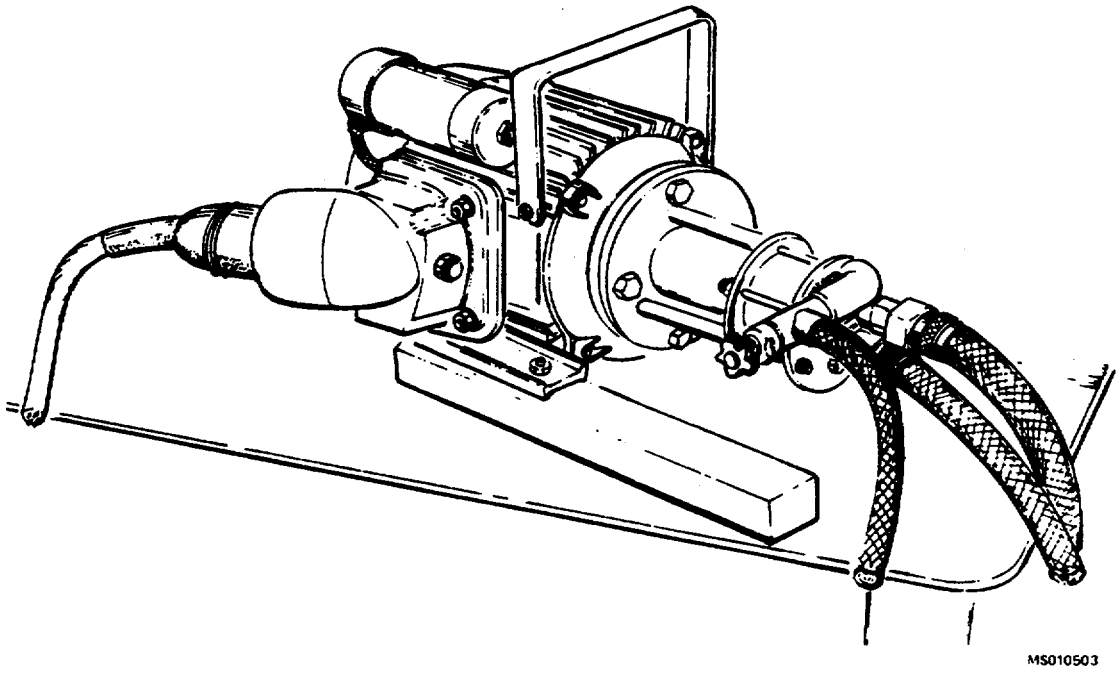

Figure 8. Pressure regulator.

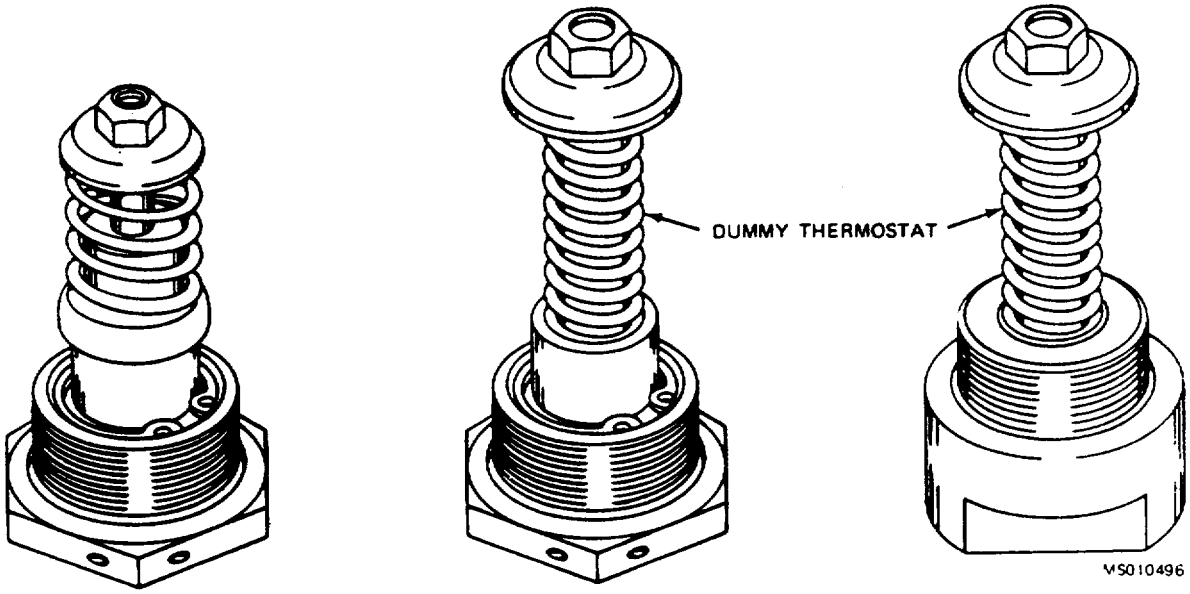

Figure 9. Dummy thermostat.

Plug the heat exchanger and flush it by connecting the radiator to a clear water source. Use a male connection hose as outlet to the drain. Flush until there is no visible evidence of loose dirt.

b. Check the thermostat by holding it in a 160°F solution (figure 9). The thermostat must extend approx. 1/4" within 90 seconds. If not, replace the thermostat.

c. Connect the heat exchanger to the upper connection of reservoir No. 2 (soap solution). The filter must be connected between the pressure line of the pump and the radiator (figure 5).

d. Turn the pump pressure regulator fully clock wise.

e. Start the pump and allow it to run for 20 minutes, then stop the pump.

f. Disconnect the pressure-and-return line from reservoir No. 2 and connect them to the clean water source and the drain. Flush until there is no visible evidence of soap.

g. Inspect the filter. Replace it if necessary (figure 3).

h. Connect the lines to reservoir No. 1 (Versene-Acid solution). The filter must be connected in the pressure line, between the pump and the heat exchanger (2, figure 5). Start the pump and allow it to run for 60 minutes.

i. Stop the pump and disconnect the pressure-and-return line from reservoir No. 1 and connect them to a clean water source and a drain. Flush until there is no evidence of Versene-Acid.

j. Install a clean #10 filter element in the filter housing.

k. Connect the pressure-and-return line to reservoir No. 3 (pyrosulphate solution).

l. Set control current switch to ON (figure 2) and with AMPS ADJ set rectifier current to 640 MA.

m. Start the pump.

n. Check the concentration of copper ions in the solution with Quantifix Test Paper and Color Comparator Chart at five minute intervals until the solution stabilizes.

NOTE

If, after the first 5 minutes the concentration of copper is 400 p.p.m. or more, immediately renew the pyrosulphate solution and repeat steps *(g)* thru *(r)*.

o. Stop the pump and set the rectifier current control switch to OFF. Disconnect the pressure and return line from reservoir No. 3. Disconnect the pump. Disconnect the filter housing.

p. Flush the heat exchanger with clear water as described in step *(g)* without the filter, until water is clear. This may be observed in the inline inspection housing.

q. Disconnect the heat exchanger pressure line from the tap.

NOTE

Perform step *r* thru *s* only if the liquid cooler unit is not to be installed in an HIPIR for immediate use.

r. Connect the return line of the pump to the lower connection of reservoir No. 5 (Ethylene Glycol).

s. Let the pump run, until Ethylene Glycol appears in the drain. Turn off the pump.

t. Connect the return line of the heat exchanger to the upper connection of reservoir No. 5. Let the pump run for 5 minutes in order to preserve the heat exchanger.

u. Switch off the pump and remove the lines. Drain the heat exchanger.

9. R.F. Pallet Flow Rate Detector, Power Supplies A1 thru A4, Dummy Load. Connect the R.F. Pallet, Power Supplies, Flow Rate Detector and Dummy Load to the manifold as shown in figure 10.

a. Connect the filter housing in the pressure line between the pump and the PRESS-manifold. The RETURN-manifold must be connected to the upper connection of reservoir No. 2 of the cleaning station. Connect the lower connection of reservoir No. 2 to the pump suction line.

b. Let the pump run for 10 minutes.

c. Remove the pressure-and-return line respectively from the upper connection of reservoir No. 2

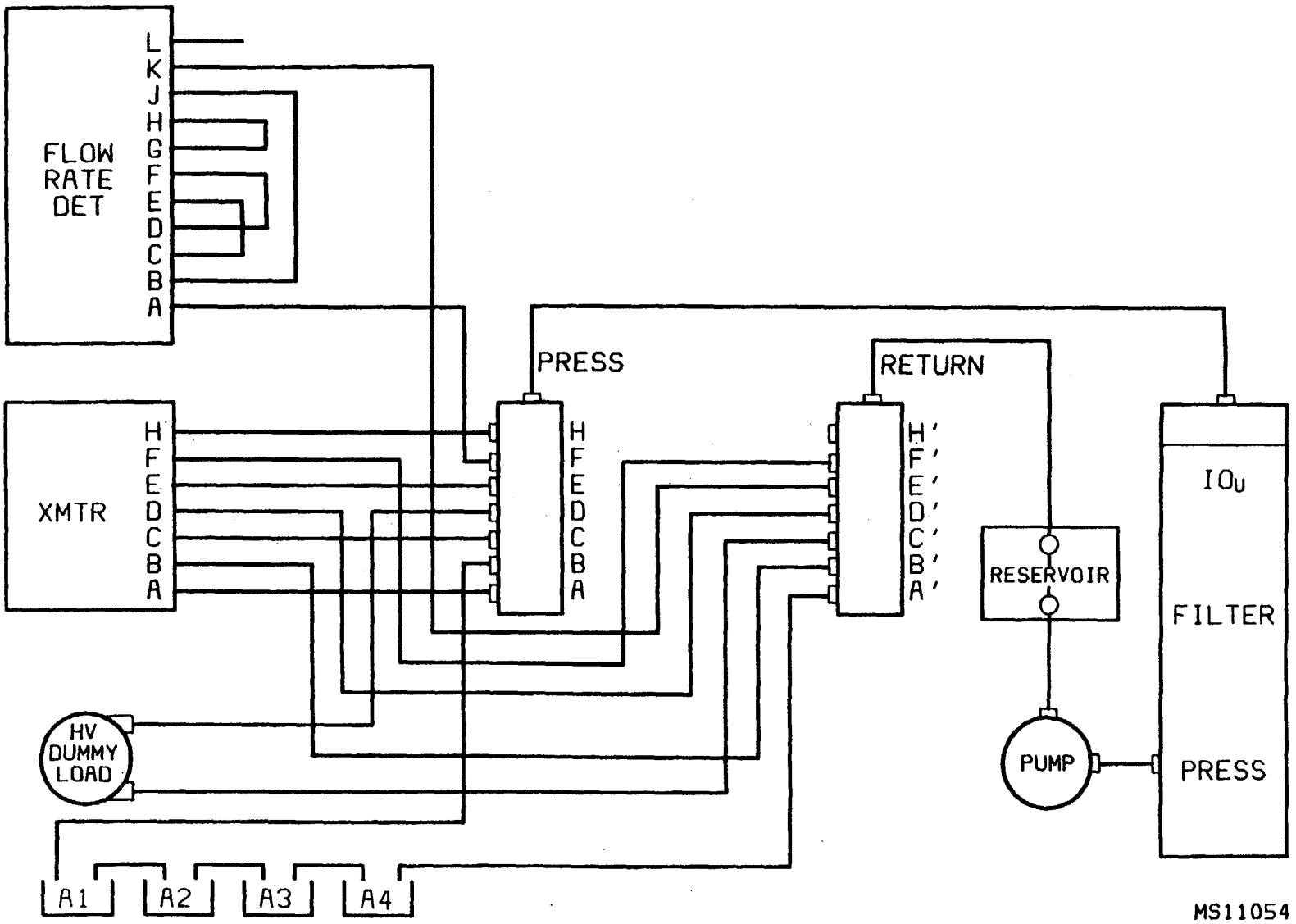

Figure 10. Cooling system hook-up flow rate detector XMTR, dummy load and power supplies A1 through A4.

and the top of the filter element and connect the lines to the drain and clear water source. Flush until there is no visible evidence of soap.

d. Remove the pressure-and-return lines and connect to the top of the filter housing and the upper connection of reservoir No. 1 (Versene-Acid solution). Let the pump run for 60 minutes.

e. Stop the pump and disconnect the pressure-and-return lines from the manifolds.

f. Remove the top connection from the transmitter isolator RF (connected to the H connector of the PRESS manifold). Carefully inspect the inside of the isolator. Use a flashlight. Only red copper should be visible. If there is still a black contamination, continue with step *(g)*. If not, proceed with step *(h).*

g. Reconnect all connections (figure 10). Follow instructions as described in step 8 substep *o* thru *p*. Stop the pump and switch off rectifier (figure 2).

h. Disconnect the line from the upper connections of reservoir No. 1. and connect this line with the single male connection hose to the drain.

i. Open the watertap and let the pump run until the water exiting the item in test is clear.

j. Stop the pump and turn off the watertap.

k. Connect the suction-line of the pump to the lower connection of reservoir No. 4 (distilled water) and reconnect return manifold line to the upper connection of reservoir No. 4.

l. Start the pump and allow it to run for 20 minutes, add distilled water as required to reservoir No. 4.

m. Stop the pump and remove all hoses.

n. Clean the hoses and the filter housing with water.

o. Switch off the heater power of the station and drain all reservoirs.

10. Waveguide Cleaning.

a. Record the inscriptions exactly as they appear on the waveguide. (figure 11).

b. Submerge the corroded waveguide completely into the Versene-Acid solution (160°F).

c. Connect the PRESS and RETURN line of reservoir No. 1 to the pump and let the pump run.

d. Inspect the waveguide every 5 minutes.

e. If there is still corrosion inside the waveguide after 60 minutes, repeat the procedure with pyrosulphate (160°F) until all contamination has disappeared.

f. Flush thoroughly with water.

g. Repeat flushing with distilled water.

h. Thoroughly dry waveguide.

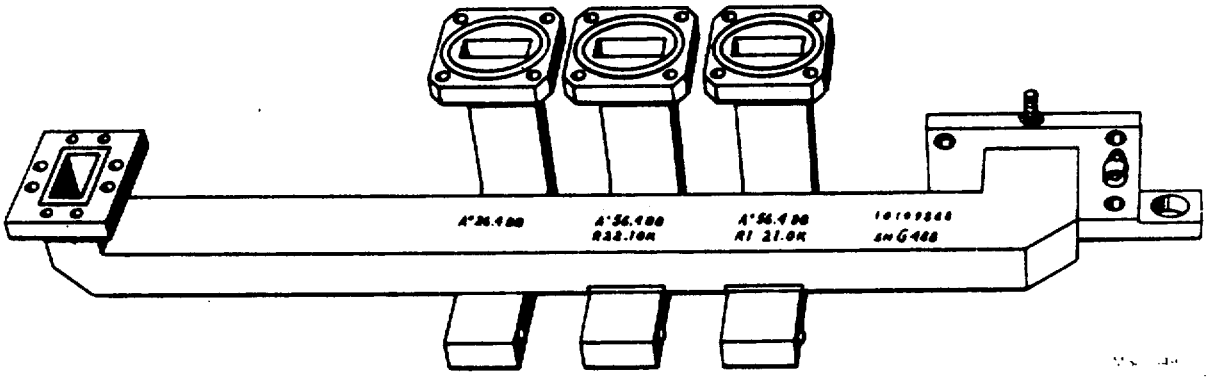

Figure 11. Waveguide.

11. Final Rinse:

NOTE

Prior to this step, the Dummy Load COOLANT FLUID TANK, LIQUID COOLER UNIT, HIGH VOLTAGE POWER SUPPLY, AMPLIFIER-MODULATOR-OSCILLATOR GROUP, AND FLOW-RATE DETECTOR have been purged, except for the final distilled water and Glycol rinse.

a. Disconnect the output hose (2, figure 6) from the liquid cooler unit and install a quick disconnect P/N 10105417-1 to the hose and connect the hose to the purging manifold (1, figure 6).

b. Connect a jumper hose from the liquid cooler unit output (3, figure 6) to the purging manifold (1, figure 6).

c. Disconnect the output hose (5, figure 6) from the liquid cooler filter and connect it to the purging manifold (1, figure 6).

d. Disconnect the input hose (4, figure 6) from the liquid cooler filter assembly and connect the hose using special adapter (figure 6) to the secondary #10 filter output (figure 5).

e. Connect the #10 filter input (figure 6) to the pump pressure line.

f. Connect the pump return to the purging manifold and the distilled water reservoir #4 return (Top connection) and connect the pump input to the distilled water reservoir #4 output.

g. Turn on the pump for 30 minutes. Stop the pump and press the air release valve to empty the tank (figure 7). Drain the tank.

h. Disconnect the Pressure and Return line from the #4 reservoir and connect them respectively to Glycol reservoir #5 input and drain connection. Start the pump and let it run for 30 minutes.

i. Stop the pump, disconnect all external hoses and reconnect all internal hoses to the respective connections. Remove the coolant tank reservoir cover and insure that the reservoir is full.

12. Preparation for Cleaning the HIPIR Cooling System.

NOTE

Deenergize the HIPIR and disconnect the power cable.

a. Drain the entire HIPIR glycol cooling system.

b. Ensure that the liquid cooler filter assembly is cleaned as directed in TM 9-1430-1533-12-1.

CAUTION

Recover coolant that may drain from the coolant line fittings as soon as possible after disconnection. Dispose of the coolant in accordance with local safety regulations.

13. HIPIR Cooling System Cleaning.

a. Disconnect the output hose (2, figure 7) from the liquid cooler unit and install a quick disconnect P/N 10105417-1 to the hose and connect the hose to the purging manifold (1, figure 6).

b. Connect a jumper hose from the liquid cooler unit output (3, figure 7) to the purging manifold (1, figure 6).

c. Disconnect the output hose (5, figure 6) from the liquid cooler filter and connect it to the purging manifold, (1, figure 6).

d. Disconnect the input hose (4, figure 6) from the liquid cooler filter assembly and connect the hose using special adapter (P/N 10105425-1) to a tapwater source.

e. Connect a jumper hose from the manifold output (1, figure 6) to the inline-inspection housing. Turn on the tapwater source and allow it to run until clear water is observed in the inspection housing.

f. Disconnect the hose from the tapwater source and connect to the #10 filter output (figure 5). Connect the #10 filter input to the pump output and connect the pump input to reservoir #2 output (hot soapy water).

g. Disconnect the manifoldjumper hose from the in-line inspection housing.

h. Connect the pump return and reservoir #2 return ("T" connection) to the manifold.

i. Switch on the pump and allow to run for 15 minutes.

j. Stop off the pump and connect the station as instructed in steps *d* and *e.*

k. Start on the pump and allow it to run till clear water is observed in the inspection housing.

l. Stop off the pump, disconnect the tapwater connections and connect as instructed in steps *g* and *h* except connect the pump to reservoir #1 (EDTA).

m. Start on the pump and allow to run for 60 minutes.

n. Stop the pump and disconnect the hoses and reconnect as instructed in steps *d* and *e*. Turn on the water, (collect the first five gallons and dispose of in the contaminated container) and allow to run for fifteen minutes.

o. Stop the pump, disconnect the hoses. Install a clean #10 filter element in the filter housing.

p. Connect the pressure and return line to reservoir No. 3 (pyrosulphate solution).

q. Turn on the rectifier (figure 2) and adjust the current for 640 mA on the AMPEREMETER.

r. Start the pump.

s. Check the concentration of copper ions in the solution with Quantifix Test paper and color comparator chart at five minute intervals until the solution stabilizes.

NOTE

If, after the first 5 minutes the concentration of copper is 400 ppm or more, immediately renew the pyrosulphate solution and repeat steps *(q)* thru *(u)*.

t. Stop the pump and turn off the rectifier. Disconnect the pressure and return line from reservoir No. 3. Disconnect the pump. Disconnect the filter housing.

u. Flush the heat exchanger with clear water as directed in steps *d* and *e*.

v. Connect the pump and return to the purging manifold and the distilled water reservoir #4 (Top connection) and connect the pump input to the distilled water reservoir #4 output.

w. Turn on the pump and allow to run for 30 minutes. Stop the pump and press the air release valve to empty the tank (figure 7). Drain the tank.

x. Disconnect the pressure and return line from the #4 reservoir and connect them respectively to Glycol reservoir #5 input and drain connection. Start the pump and let it run for 30 minutes.

y. Stop the pump, disconnect all external hoses and reconnect all internal hoses to the respective connections. Remove the coolant tank reservoir cover and ensure that the reservoir is full.

14. Cleaning Station Flowcharts.

The following flowcharts (figures 12, 13) show the sequential procedure for cleaning the HIPIR liquid coolant system components using the AKI-83005B cleaning station.

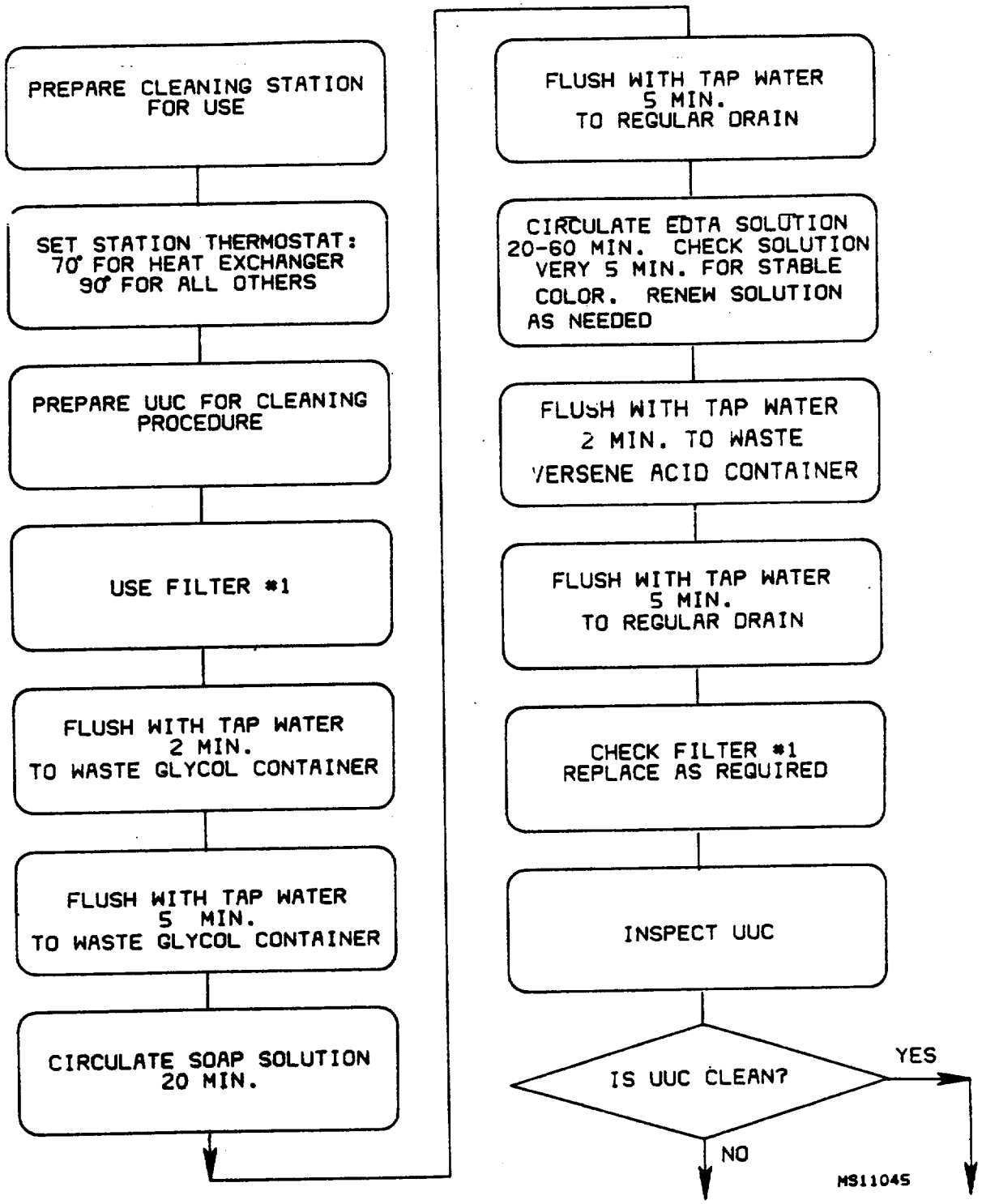

Figure 12. Cleaning station procedure flowchart for RF pallet, flow rate detector, high voltage power supply, high voltage dummy load and heat exchanger unit. (Sheet 1 of 2)

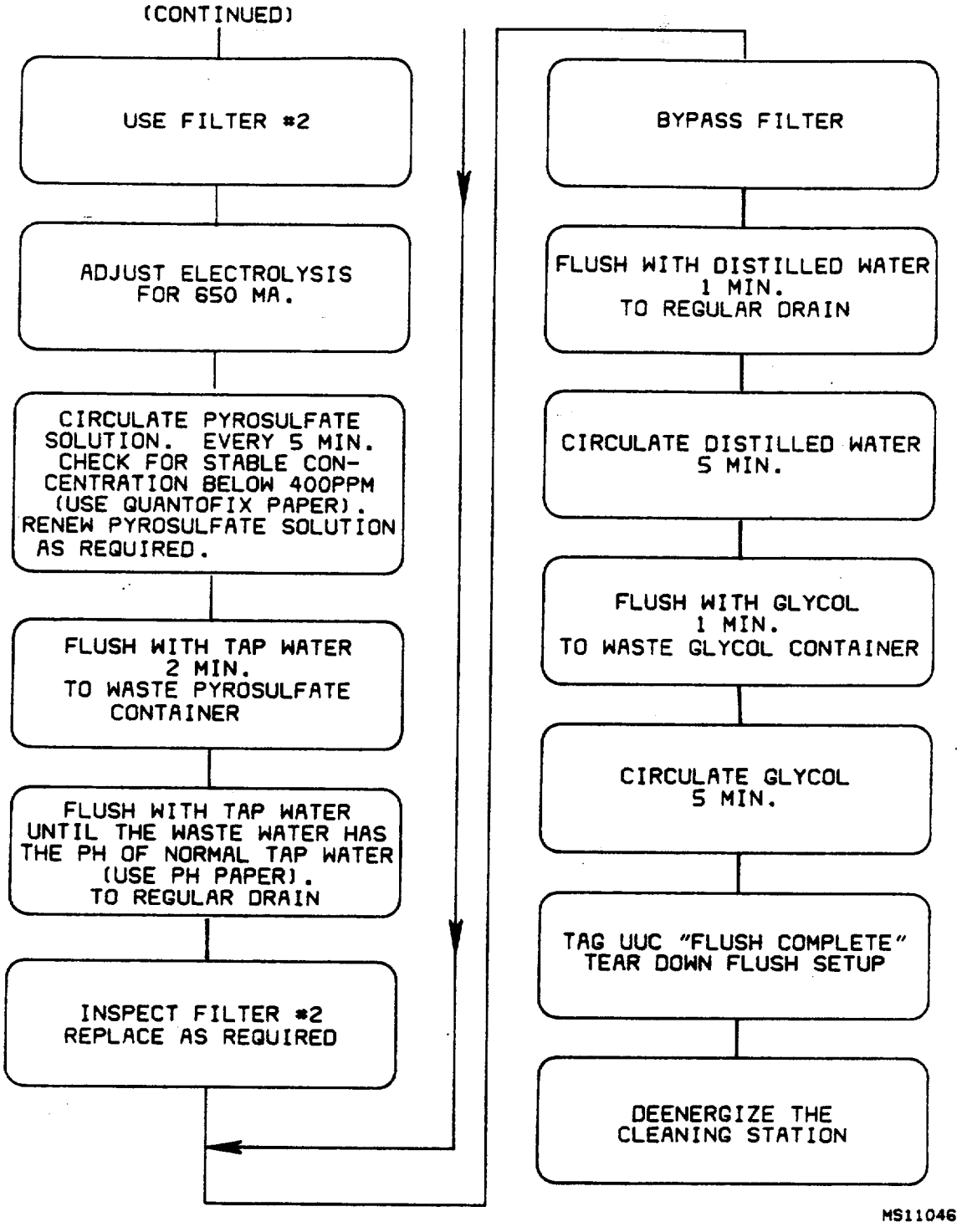

Figure 12. Cleaning station procedure flowchart for RF pallet, flow rate detector, high voltage power supply, high voltage dummy load and heat exchanger unit. (Sheet 2 of 2)

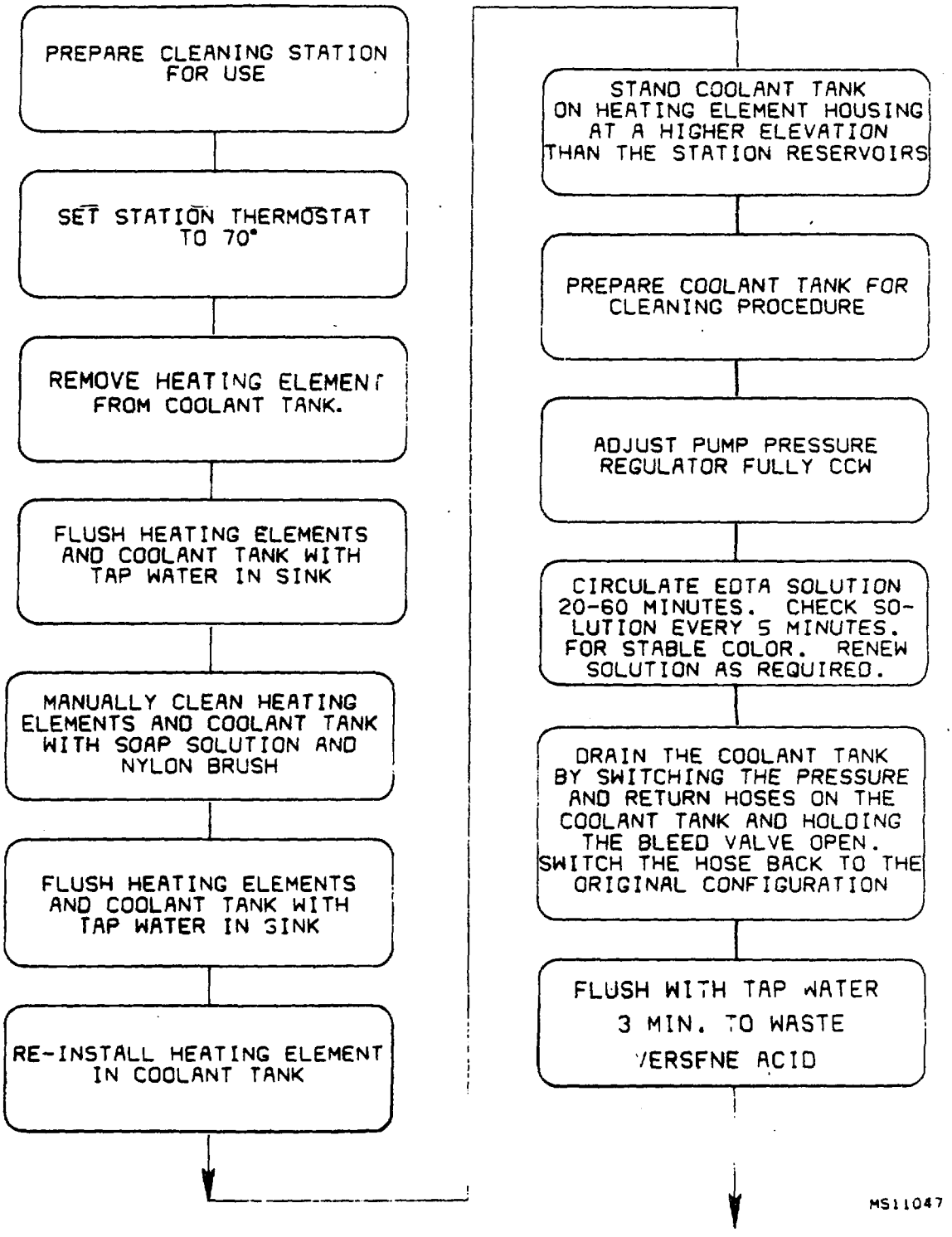

Figure 13. Cleaning station procedure flowchart for coolant tank and heating elements. (Sheet 1 of 3)

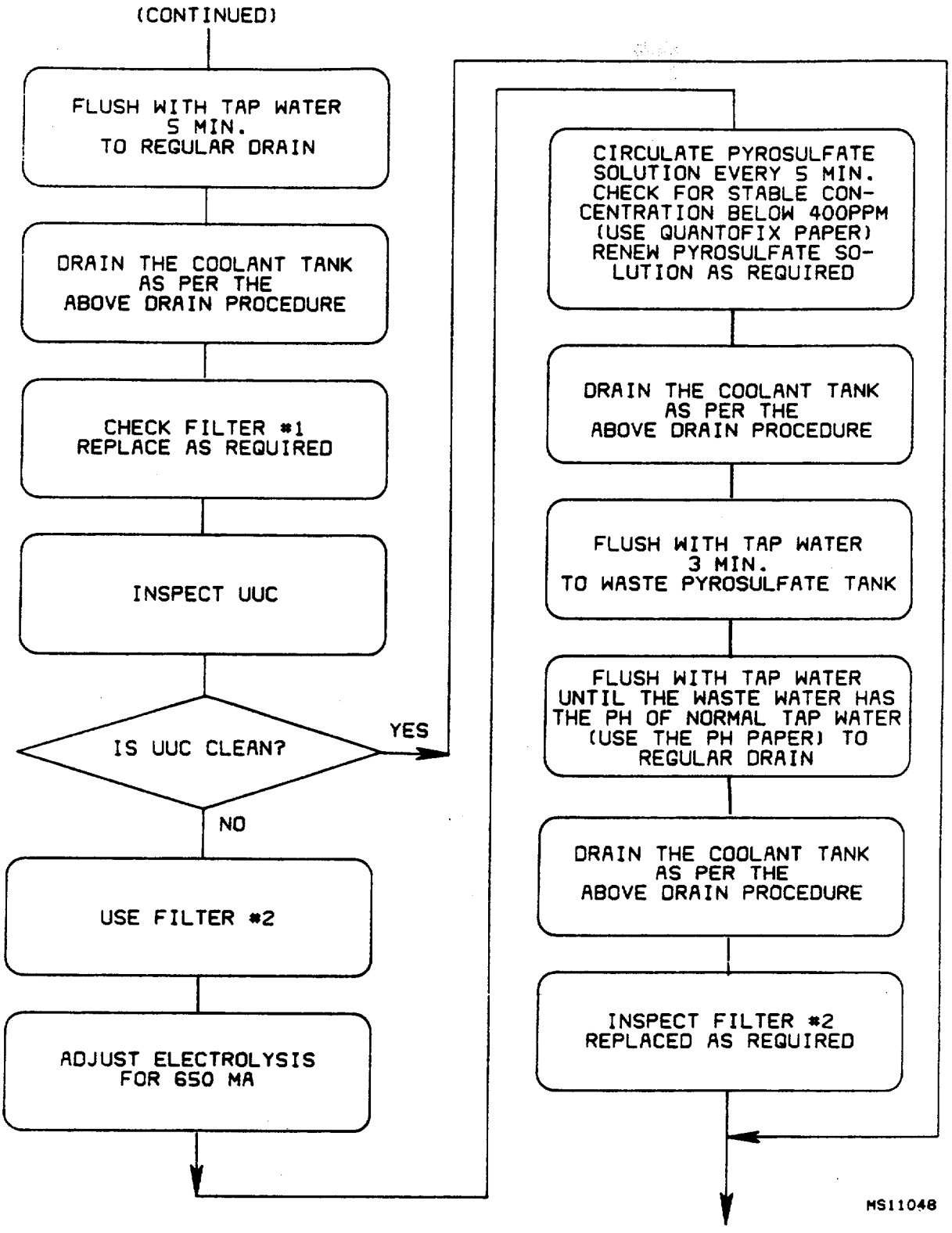

Figure 13. Cleaning station procedure flowchart for coolant tank and heating elements. (Sheet 2 of 3)

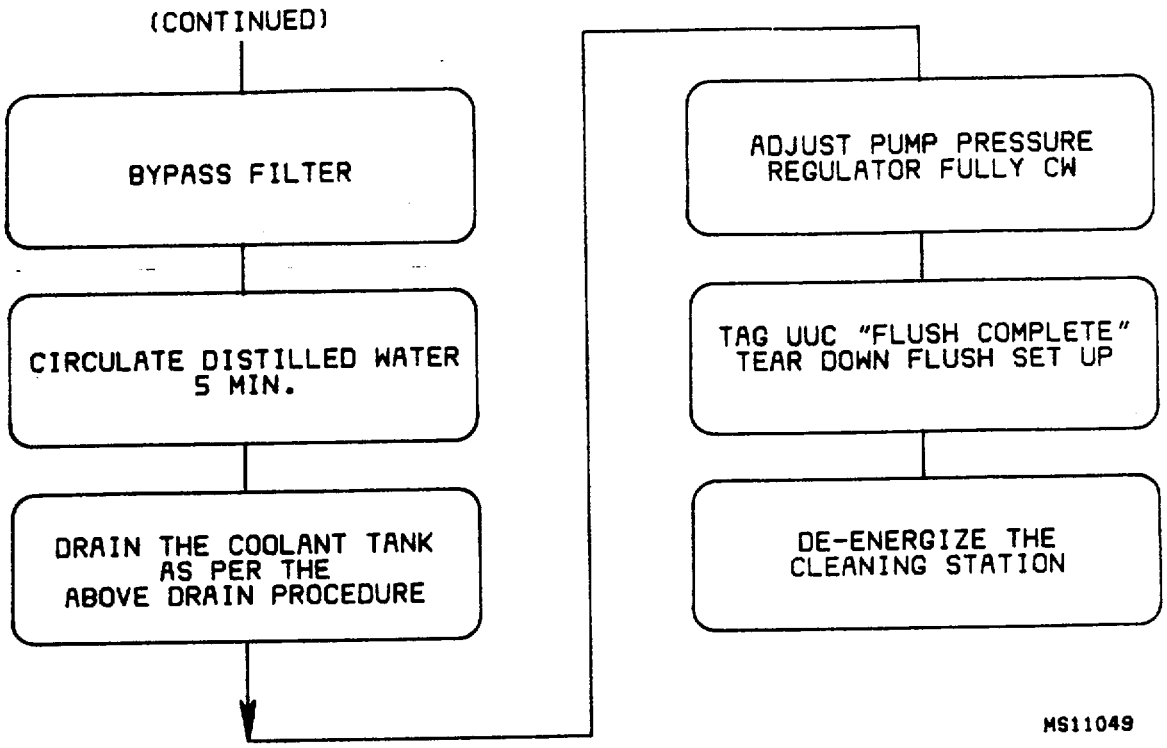

Figure 13. Cleaning station procedure flowchart for coolant tank and heating elements. (Sheet 3 of 3)

By Order of the Secretary of the Army:

JOHN A. WICKHAM, JR.
General, United States Army
Chief of Staff

Official:

R.L. DILWORTH
Brigadier General, United States Army
The Adjutant General

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PAGE NO.	PARA-GRAPH	FIGURE NO	TABLE NO.

IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

PRINTED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER	SIGN HERE:

DA FORM 1 JUL 79 2028-2

PREVIOUS EDITIONS ARE OBSOLETE.

P.S.—IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

THE METRIC SYSTEM AND EQUIVALENTS

'NEAR MEASURE

. Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches
1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches
1 Kilometer = 1000 Meters = 0.621 Miles

'VEIGHTS

Gram = 0.001 Kilograms = 1000 Milligrams = 0.035 Ounces
1 Kilogram = 1000 Grams = 2.2 lb.
1 Metric Ton = 1000 Kilograms = 1 Megagram = 1.1 Short Tons

LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces
1 Liter = 1000 Milliliters = 33.82 Fluid Ounces

SQUARE MEASURE

1 Sq. Centimeter = 100 Sq. Millimeters = 0.155 Sq. Inches
1 Sq. Meter = 10,000 Sq. Centimeters = 10.76 Sq. Feet
1 Sq. Kilometer = 1,000,000 Sq. Meters = 0.386 Sq. Miles

CUBIC MEASURE

1 Cu. Centimeter = 1000 Cu. Millimeters = 0.06 Cu. Inches
1 Cu. Meter = 1,000,000 Cu. Centimeters = 35.31 Cu. Feet

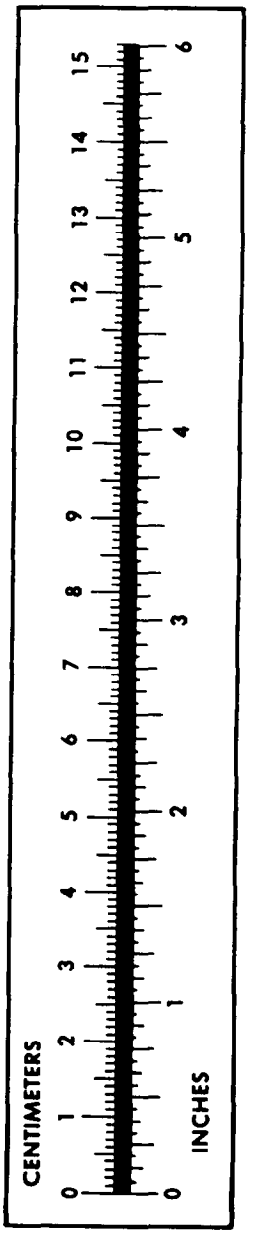
TEMPERATURE

5/9(°F - 32) = °C
212° Fahrenheit is evuivalent to 100° Celsius
90° Fahrenheit is equivalent to 32.2° Celsius
32° Fahrenheit is equivalent to 0° Celsius
9/5C° + 32 =°F

APPROXIMATE CONVERSION FACTORS

TO CHANGE	TO	MULTIPLY BY
Inches	Centimeters	2.540
Feet	Meters	0.305
Yards	Meters	0.914
Miles	Kilometers	1.609
Square Inches	Square Centimeters	6.451
Square Feet	Square Meters	0.093
Square Yards	Square Meters	0.836
Square Miles	Square Kilometers	2.590
Acres	Square Hectometers	0.405
Cubic Feet	Cubic Meters	0.028
Cubic Yards	Cubic Meters	0.765
Fluid Ounces	Milliliters	29.573
ıts	Liters	0.473
arts	Liters	0.946
allons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound-Feet	Newton-Meters	1.356
Pounds per Square Inch	Kilopascals	6.895
Miles per Gallon	Kilometers per Liter	0.425
Miles per Hour	Kilometers per Hour	1.609

TO CHANGE	TO	MULTIPLY BY
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Kilometers	Miles	0.621
Square Centimeters	Square Inches	0.155
Square Meters	Square Feet	10.764
Square Meters	Square Yards	1.196
Square Kilometers	Square Miles	0.386
Square Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters	Fluid Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
ers	Gallons	0.264
ms	Ounces	0.035
ograms	Pounds	2.205
Metric Tons	Short Tons	1.102
Newton-Meters	Pounds-Feet	0.738
Kilopascals	Pounds per Square Inch	0.145
lometers per Liter	Miles per Gallon	2.354
meters per Hour	Miles per Hour	0.621



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