

**TECHNICAL MANUAL**  
**OPERATOR'S AND UNIT MAINTENANCE MANUAL**  
**(INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST)**  
**FOR**  
**PORTABLE STILL, 1.8 LITERS/HOUR**

This technical manual is an authentication of the manufacturer's commercial literature and does not conform with the format and the content requirements normally associated with Army technical manuals. This technical manual does, however, contain all essential information required to operate and maintain the equipment.

**Approved for public release; distribution is unlimited.**

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**SUPPLEMENTARY INTRODUCTORY MATERIAL**

1-1. Maintenance Forms and Records.

Department of the Army forms and procedures used for equipment maintenance will be those described by DA Pam 738-750, The Army Maintenance Management System.

1-2. Reporting Errors and Recommending Improvements.

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letters, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual, directly to: Commander, U.S. Army Troop Support Command, ATTN: AMSTR-MMTS, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798. A reply will be furnished to you.

1-3. Destruction of Army Material to Prevent Enemy Use.

Refer to TM 750-2443 for instructions covering the destruction of Army Material to prevent enemy use.

1-4. Administrative Storage of Equipment.

a. Placement of equipment in administrative storage should be for short periods of time when a shortage of maintenance effort exists. Items should be in mission readiness within 24 hours or within the time factors as determined by the directing authority. During the storage period appropriate maintenance records will be kept.

b. Before placing equipment in administrative storage, current preventive maintenance checks and services should be completed. Shortcomings and deficiencies should be corrected, and all modification work orders (MWO's) should be applied.

c. Storage site selection. Inside storage is preferred for items selected for administrative storage. If inside storage is not available, trucks, vans, conex containers and other containers may be used.

**Instruction Manual**

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**Barnstead Company**

**1.8 LITERS/HOUR  
PORTABLE STILL,  
CAT. NO. A1007**

Subsidiary of Sybron Corporation  
160 Wells Avenue Newton, MA 02159  
617-969-8400/800-446-6060  
Telex 443-01 11 /FAX 964-9533

November 1983

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## 60003

### DESCRIPTION

**GENERAL.** The Barnstead Electrically Heated Portable Still provides high quality distilled water at the rate of 1.8 liters/hour. The still is designed to use approximately 14.4 liters of cooling water and feedwater combined for each 1.8 liters of distilled water produced. Two electrically powered, immersion-type heaters are used to give complete heat transfer and maximum heating efficiency.

### TECHNICAL CHARACTERISTICS

Distillate Capacity	1.8 liters/hour.
Maximum Water Pressure	90 psig.
Minimum Water Pressure	40 psig.
Plumbing Connections	
Water Inlet	1/4 NPT1*
Waste	1/4 NPT1.
Electrical Requirements	**
Overall Dimensions	
Width	20 1/2 in.
Depth	9 1/2 in.
Height	19 3/8 in.
Shipping Weight	65 lbs.

\*A hose nipple is provided for a 1/2" hose connection if a permanent connection is not desired.

\*\*The still is rated at 1300-watts and operates on 115 or 230-volts AC or DC. The still will draw 12-amperes of current at 115-volts and 6-amperes of current at 230-volts. The still is wired for 115-volts at the factory, but *may* be converted to 230-volts in the field by replacing the plug and reconnecting the heating elements as shown in the wiring diagram in this instruction.

### INSTALLATION

**UNPACKING.** Unpack the still carefully to prevent damage. Ensure that all parts are removed from the container before discarding the packing materials.

**SITING.** Move the still evaporator to the operating location and install the evaporator so that it is level and plumb.

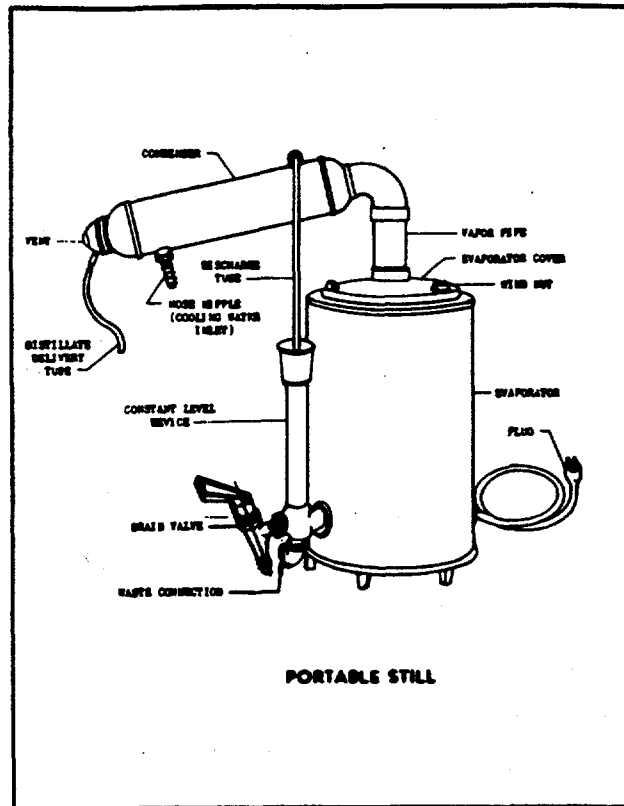
**PLUMBING CONNECTIONS.** Connect the water and waste service lines to the still. Ensure that the waste service line at the still is atmospherically vented and gravity flow. A shut-off valve and throttling valve should be installed in the water supply line, just before the still, if the still is to be permanently piped. If the still is not to be permanently piped, a hose may be connected between the inlet hose nipple connection and a water faucet. The water faucet may be used as a water throttling valve. The distillate delivery tubing should be connected to the point of distribution or storage.

**NOTE:** Ensure that the service piping is adequately supported. The still is not designed to support the service piping.

**ELECTRICAL CONNECTIONS.** The still may be connected electrically by connecting the cord to a 115-volt or 230-volt AC or DC, grounded electrical service. See the nameplate on the still evaporator for the electrical requirements.

**CAUTION:** THE HEATERS ARE IMMERSION-TYPE HEATERS, AND WILL BURN OUT IF OPERATED IN AIR. READ THE OPERATION SECTION BEFORE CONNECTING THE STILL TO THE ELECTRICAL SERVICE.

**WARNING:** A FIRE HAZARD MAY RESULT IF THE STILL IS USED WITH A FLAMMABLE LIQUID.



## PRINCIPLE OF OPERATION

**GENERAL.** The water to be purified enters the condenser at the water inlet. As the water flows around the outside of the condenser tubes, it becomes preheated almost to boiling. The preheated water leaves the condenser through the discharge tube and is fed into the constant level device. The constant level device maintains a constant water level in the evaporator. The excess hot water (which may be used elsewhere as plain hot water) flows to drain. In the evaporator the water is converted into steam which passes up through the vapor pipe to the condenser tubes where it is cooled to form distilled water.

By reducing the flow of water so that a little steam escapes through the condenser vent, high efficiency is assured, entrance of air becomes impossible, and any trace of gases cannot redissolve in the hot distillate but leaves with the wisp of steam. The vent also makes the system an open system so that no pressure can build up within the still.

## OPERATION

**INITIAL STARTUP.** The first time that the still is started, or after cleaning, operate the still as follows:

**NOTE:** During the procedures listed below, check all connections for leaks and tighten as required.

- A. Close the drain valve.

- B. Open the water shut-off valve.
- C. Open the water throttling valve about 1/2 turn.

D. When the water level in the evaporator reaches a sufficient level, as indicated by a steady overflow to waste, connect the still to the electrical service.

CAUTION: ENSURE THAT THE WATER LEVEL IN THE STILL EVAPORATOR IS ABOVE THE HEATING ELEMENTS BEFORE CONNECTING THE STILL TO THE ELECTRICAL SERVICE. THE HEATING ELEMENTS ARE THE IMMERSION TYPE AND WILL BURN OUT IF OPERATED IN AIR. THE WATER WILL BE AT A SAFE LEVEL WHEN WATER OVERFLOWS TO WASTE.

E. When the still begins to produce distilled water, adjust the water throttling valve until just a puff of steam issues from the condenser vent. Discard the first 2 hours of distillate production to allow the still to clean itself out.

### **NORMAL OPERATION**

**Starting.** Start the still as follows:

- A. Close the drain valve.
- B. Open the water shut-off valve.
- C. When water overflows to waste, connect the still to the electrical service.

CAUTION: ENSURE THAT THE WATER LEVEL IN THE STILL EVAPORATOR **IS** ABOVE THE HEATING ELEMENTS BEFORE CONNECTING THE STILL TO THE ELECTRICAL SERVICE. THE HEATING ELEMENTS ARE THE IMMERSION TYPE AND WILL BURN OUT IF OPERATED IN AIR. THE WATER WILL BE AT A SAFE LEVEL WHEN WATER OVERFLOWS TO WASTE.

NOTE: If the still is operated continuously, it should be stopped and drained once every 4-hours. Draining the still at frequent intervals will help to inhibit the formation of scale in the evaporator.

**Stopping.** Stop the still as follows:

- A. Disconnect the still from the electrical service.
- B. Close the water shut-off valve.
- C. Open the drain valve to allow the still evaporator to drain completely while its contents are hot.

**CAUTION:** ALWAYS DISCONNECT THE STILL FROM THE ELECTRICAL SERVICE BEFORE SHUTTING OFF THE WATER SUPPLY.

NOTE: Do not change the setting of the water throttling valve.

### **CLEANING**

**CLEANING METHODS.** Cleaning requirements fall into two classes: scale removal and biological cleaning. Scale removal may be accomplished chemically or mechanically. biological cleaning is accomplished with a formaldehyde solution. For best results all solutions and water should be heated. The various methods of cleaning are as follows:

**Soft Scale Removal.** Soft scale may be removed with a stiff bristle brush. After cleaning all scale particles should be flushed out with water.

**Hard Scale Removal.** Hard scale can be removed by using a 10 percent solution of inhibited HCl. This acid solution is available commercially or can be prepared using 20 parts water and 6 parts 30 percent HCl. Flush the part thoroughly after using the acid solution. A 5 percent Sodium Bicarbonate Solution can be used to remove any acid left on the part.

WARNING: AVOID SPLASHING ANY ACID SOLUTION. WEAR PROTECTIVE CLOTHING AND AN EYE SHIELD WHEN HANDLING CHEMICALS.

CAUTION: WHEN USING THE ACID SOLUTION, DO NOT ALLOW THE ACID TO REMAIN IN CONTACT WITH THE PART FOR MORE THAN 20-MINUTES. UNDER NO CIRCUMSTANCES SHOULD ANY ACID CLEANER BE ALLOWED TO COME IN CONTACT WITH TINNED SURFACES (SUCH AS, THE DISTILLED WATER SIDE OF THE CONDENSER OR THE DISTILLED WATER TRANSMISSION TUBING).

NOTE: If inhibited HCl is not available, a 10-percent solution of sulfamic or acetic acid may be used as a substitute. Exposure time to this acid is 2 to 3-hours. Sulfamic and acetic acids have an advantage over HCl; they will not corrode the metal parts being cleaned.

**Organic Scale and Sludge Removal.** If the scale has a dark brown or black color, it may be formed from organic impurities present in the feedwater. This type of scale may be removed with a strong detergent solution. The detergent solution should be allowed to be in contact with the scale or sludge for 24-hours. Rinse off the parts with water after cleaning.

**Silica Scale Removal.** Silica scale is usually clear and shiny and hard to detect visually. It is very hard and cannot be removed with an acid solution. Silica scale formation can be reduced by controlling the quality of the feedwater by routing it through a mixed-bed deionizer. It is best removed with a blunt instrument.

**Biological Cleaning.** Biological cleaning is used on the parts that come in contact with the distillate (such as, the distilled water side of the condenser or distilled water transmission tubing) to remove biological contamination tubing may be biologically cleaned by immersing the parts in a 1-percent solution by weight of formaldehyde overnight. Formaldehyde is available in 37-percent concentrations. After the required amount of exposure to the formaldehyde solution, the still may be started and the distillate output may be used to rinse any remaining formaldehyde solution to waste.

WARNING: AVOID SPLASHING THE FORMALDEHYDE SOLUTION ON OPEN CUTS.

NOTE: If formaldehyde is not available, Isopropyl alcohol is a satisfactory substitute.

DISASSEMBLY FOR CLEANING. The frequency of cleaning will depend upon the purity of the water being used. The still should be inspected at frequent intervals until cleaning intervals are determined. Disassemble, inspect, and clean the still as follows:

- A. Stop the still.
- B. Remove the condenser from the still. Inspect the cooling water side of the condenser for scale and clean as required.
- C. Disassemble the evaporator until the interior of the evaporator is visible. Inspect the interior of the evaporator for scale. Remove as much scale as possible manually.



- D. Disassemble the drain line and clean as required. Ensure that the drain line is clear (including the drain opening in the evaporator) before using a cleaner. Reassemble the drain line.
- E. Soft scale may be removed as described under "Soft Scale Removal." Silica scale may be removed as described under "Silica Scale Removal." To remove hard scale or organic scale, fill the evaporator with acid cleaner (see "Hard Scale Removal").
- F. Inspect the constant level device and drain line and clean as required.
- G. Reassemble the still. Assembly is essentially the reverse of disassembly.
- H. Connect the water, waste and distillate lines.
- I. Start the still as described under INITIAL STARTUP.
- J. Lower the water flowrate with the water throttling valve until steam spouts out of the condenser vent at least 12-inches. Operate in this manner for 30 to 60 minutes to sterilize and clean out the still.

**CAUTION:** VENTILATE THE ROOM DURING THIS OPERATION.

- K. Readjust the still as described in INITIAL STARTUP.

## **TROUBLESHOOTING**

**GENERAL.** This section contains troubleshooting, testing and repair instructions. A troubleshooting chart is included to help the repair man find the difficulty quickly.

## **TESTS FOR CONDENSER LEAKS**

**Visual Test for Leaks.** A simple test for condenser leaks may be performed as follows:

- A. Disconnect the still from the electrical service.
- B. Let the water flow through the condenser until the condenser is cold.
- C. Note whether there is a flow, even in drop quantities, from the distillate outlet. If there is a continuous flow, it is possible that there is a leak from the cooling water side to the distillate side. If this is the case, the condenser (must be replaced).

**NOTE:** The condenser cannot be repaired and must be replaced as a unit.

**Pressure Test for Leaks.** If a more positive test is required, proceed as follows:

- A. Remove the condenser from the still.
- B. Remove the water discharge tubing. Plug the discharge connection on the condenser with a plug or stopper.
- C. Attach a hose to the water inlet connection on the condenser and apply about 5-psi of air pressure to the condenser.

- D. Submerge the entire condenser in a tank of water.
- E. If any air bubbles come from the condenser, replacement is necessary.

**NOTE:** The condenser cannot be repaired and must be replaced as a unit.

**CONDENSER TEST FOR SCALE.** Test the condenser for scale as follows:

- A. Adjust the water throttling valve so that just a puff of steam issues from the condenser vent.
  - 1. In extreme cases of scale, steam will always blow from the condenser vent, even when the water throttling valve is completely open.
  - 2. Ensure that a minimum water pressure of 40-psi is maintained. A drop in water pressure will cause steam to blow from the condenser because of inadequate cooling.
- B. Place a hand on the water discharge tubing and note the temperature.
  - 1. If the discharge pipe is very hot (from 150° to 200°F), probably very little scale is present.
  - 2. If the discharge pipe is cool enough to hold, the condenser may be scaled.
- C. Remove the condenser if the discharge pipe is cool enough to hold. Inspect the interior of the condenser for scale. If scale is present, pour the acid cleaning solution (see "Hard Scale Removal") into the condenser through one of the water connections.

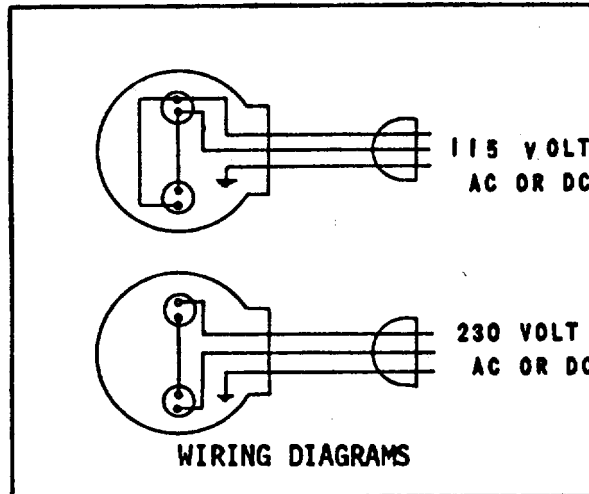
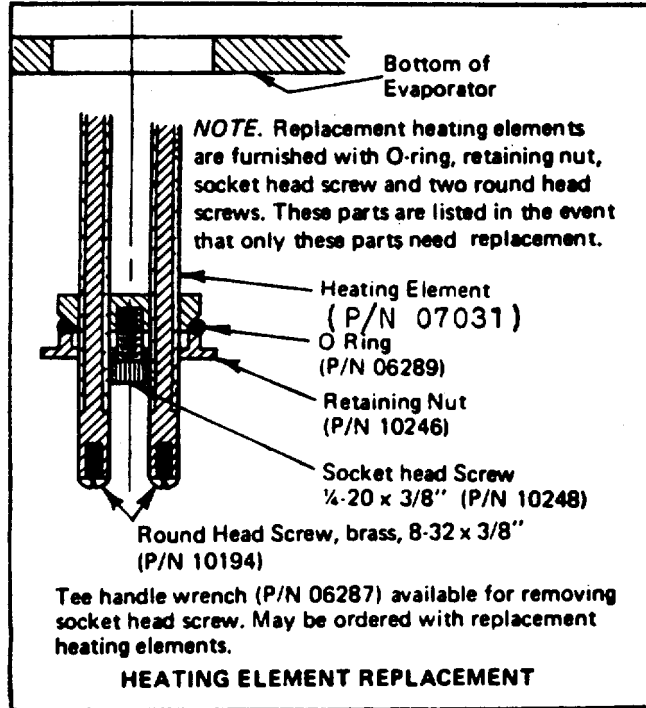
**WARNING: DO NOT ADD THE ACID CLEANING SOLUTION RAPIDLY BECAUSE IF ANY BICARBONATE SCALE IS PRESENT, GAS WILL BE RELEASED IN CONSIDERABLE AMOUNTS.**

- D. Install the condenser on the still.

**HEATING ELEMENT TEST AND REPLACEMENT.** Whenever a heating element is suspected of not operating properly, test and, if necessary, replace the heating element as follows:

- A. Remove the bottom plate from the still evaporator. Disconnect the electrical leads and bus bars from the heating element terminals. Tag the leads to facilitate reassembly.
- B. To test each heating element for an open circuit, apply a current across the terminals. Use a test light in series with the applied current. If the test light does not light, the heating element is burned out. Mark the damaged heating elements.
- C. To test each heating element for a short circuit, connect one test lead to the boiler bottom and the other to each terminal (one at a time). If the heating element is short circuited, the test light will light. Mark all damaged heating elements.

- D. Remove the evaporator cover from the still and inspect the heating elements from the inside of the evaporator. Warped or split elements should be replaced.
- E. To remove an Inoperative or damaged heater, loosen the screw under the heater and push out the heater. If the heater is badly scaled, remove the retaining nut and rock the heater back and forth (from inside the evaporator) to break the scale.
- F. Install a new heater in place of the old heater. Tighten the screw only enough to hold the heater in place. This will allow you to rotate the heater when installing the bus bars.
- G. Install the bus bars and wiring between heater terminals. Retighten the heater retaining screws to eliminate the possibility of leakage.
- H. Add water to the evaporator and ensure that none of the heating elements are leaking.
- I. Reassemble the still and connect the still to the electrical service.

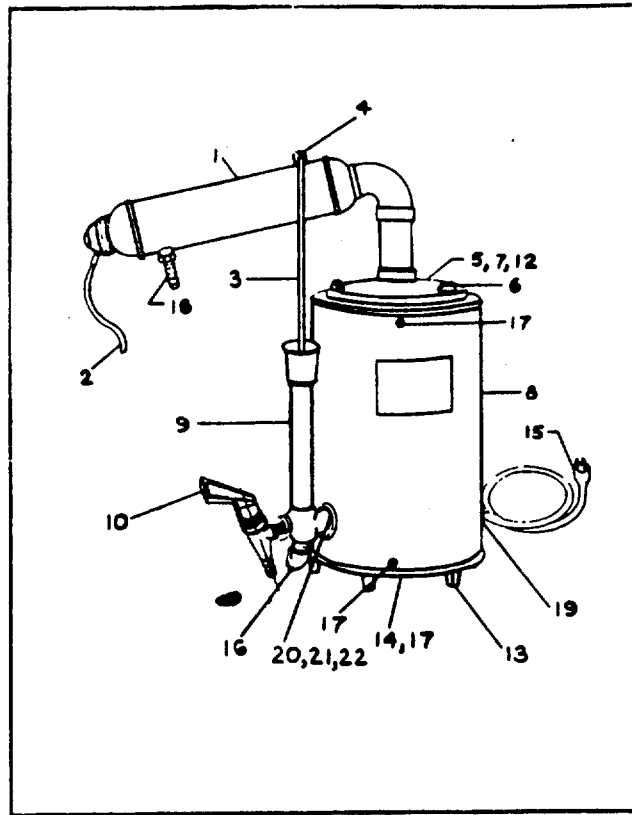


SYMPTOM	PROBABLE CAUSE	TEST AND REMEDY
DROP IN PURITY	-DIRTY STILL	Inspect evaporator for scale and clean as required.
	-VOLATILE IMPURITIES IN FEED WATER	Test distillate for CO <sub>2</sub> , NH <sub>3</sub> , etc. Reduce water flow rate to help eliminate volatiles from condenser.
PYROGENIC OR ORGANIC CONTAMINATION OF DISTILLATE	-DIRTY STILL	Inspect evaporator for excess scale and clean as required.
	-LEAK IN CONDENSER	Test condenser for leaks and replace if required.
	-BACTERIOLOGICAL GROWTH IN DISTILLED WATER	Inspect the suspected parts. Clean with formaldehyde if required. See "Biological Cleaning" under CLEANING METHODS.
DROP IN DISTILLATE CAPACITY	-EXCESS SCALE ON HEATING UNIT	Inspect and clean as required.
	-LOW VOLTAGE	Check voltage. If less than 5-percent of the rated voltage, notify electrician.
	-LEAK IN DRAIN VALVE	Ensure drain valve is closed and not leaking.
	-DAMAGED OR INOPERATIVE HEATERS	Check wiring, connections, etc. Test heaters and replace if necessary.
STEAM BLOWING FROM CONDENSER	-LOW WATER FLOW RATE	Readjust throttling valve.
	LOW WATER PRESSURE ,	Check water pressure. It should be at least 40-psi.
	-EXCESS SCALE IN CONDENSER	Inspect condenser for scale.
WATER BLOWING FROM CONDENSER	-CONUENSER LEAK	Test condenser for leaks. Repair or replace as required.
	-TRAPPED DISTILLATE LINE	Inspect distillate line for any restrictions or trapping.

## TROUBLESHOOTING CHART

## PARTS LIST

**GENERAL.** This section contains parts list information for the still. When ordering parts, ensure that the proper part number and quantity are specified. Also, provide the serial number of the still.



ELECTRICALLY HEATED PORTABLE STILL PARTS LIST

<u>INDEX NO.</u>	<u>DESCRIPTION</u>	<u>PART NO.</u>
	ELECTRICALLY HEATED PORTABLE STILL	A1007
1	CONDENSER	21058
2	DISTILLATE DELIVERY TUBE	21100
3	WATER DISCHARGE TUBE, 10-5/3"	21880
4	WATER DISCHARGE ELBOW	05219
5	STEAM COVER	21195
6	WING NUT, BRASS, #10-24 UNC	10047
7	GASKET, EVAPORATOR STEAM COVER	06271
8	EVAPORATOR	21252
9	OVERFLOW	21319
10	DRAIN FAUCET	02096
11	HEATING ELEMENT	*
12	DISH BAFFLE	21414
13	RING, STAND BASE	20251
14	BOTTOM PLATE	21894
15	CORD SET	16003
16	ELBOW, BRASS, 1/2 NPT X 1/4 NPT	05061**
17	SCREW, MACHINE, PHILLIPS HEAD, STAINLESS STEEL, #8-32 UNC X 1/4"	10098**
18	HOSE NIPPLE, BRASS, 1/2" x 1/4 NPT	05065**
19	STRAIN RELIEF, PLASTIC	15229
20	ELBOW, BRASS, 3/8 NPT x 90°	05043**
21	NIPPLE, BRASS, 3/8 NPT x 2"	05135**
22	NIPPLE, CLOSE, BRASS, 3/8 NPT	05073**

\*See the HEATING ELEMENT REPLACEMENT illustration in the TROUBLESHOOTING section of this instruction.

\*\*Standard hardware items-can be purchased locally.

**APPENDIX A  
REFERENCES**

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**A-1. PUBLICATIONS INDEX.**

The following index should be consulted frequently for latest changes or revisions of references given in this appendix and for new publications relating to material covered in this manual.

Index of Administrative Publications..... DA PAM 25-30

**A-2. FORMS AND RECORDS.**

Recommended Changes to Publications and Blank Forms..... DA Form 2028-2

Equipment Inspection and Maintenance Worksheet ..... DA Form 2404

Equipment Control Record ..... DA Form 2408-9

**A-3. TECHNICAL MANUALS**

The Army Maintenance Management System (TAMMS) ..... DA PAM 738-750

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

## APPENDIX B MAINTENANCE ALLOCATION CHART

### Section I. INTRODUCTION

#### B-1. General.

- a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance categories.
- b. The Maintenance Allocation Chart (MAC) in Section II designates overall authority and responsibility for the performance of maintenance functions on the identified end item or component. The application of the maintenance functions to the end item or component will be consistent with the capacities and capabilities of the designated maintenance categories.
- c. Section III lists the tools and test equipment (both special tools and common tool sets) required for each maintenance function as referenced from Section II.
- d. Section IV contains supplemental instructions and explanatory notes for a particular maintenance function.

#### B-2. Maintenance Functions. Maintenance functions will be limited to and defined as follows:

- a. *Inspect.* To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination (e.g., by sight, *sound*, or feel).
- b. *Test.* To verify serviceability by measuring the mechanical, pneumatic, hydraulic, or electrical characteristics of an item and comparing those characteristics with prescribed standards.
- c. *Service.* Operations required periodically to keep an item in proper operating condition, i.e., to clean (includes decontaminate, when required), to preserve, to drain, to paint, or to replenish fuel, lubricants, chemical fluids, or gases.
- d. *Adjust.* To maintain or regulate, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to specified parameters.
- e. *Align.* To adjust specified variable elements of an item to bring about optimum or desired performance.
- f. *Calibrate.* To determine and cause corrections to be made or to be adjusted on instruments or test, measuring, and diagnostic equipments used in precision measurement. Consists of comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.
- g. *Remove/Install.* To remove and install the same item when required to perform service or other maintenance functions. Install may be the act of emplacing, seating, or fixing into position a spare, repair part, or module (component or assembly) in a manner to allow the proper functioning of an equipment or system.
- h. *Replace.* To remove an unserviceable item and install a serviceable counterpart in its place. "Replace" is authorized by the MAC and is shown as the third position code of the SMR code.

*i Repair.* The application of maintenance services<sup>1</sup>, including fault location/troubleshooting<sup>2</sup>, removal/installation, and disassembly/assembly procedures,<sup>3</sup> and maintenance actions<sup>4</sup> to identify troubles and restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

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

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

### B-3. Explanation Of Columns In The MAC, Section II.

*a. Column 1 Group Number.* Column 1 lists functional group code numbers, the purpose of which is to identify maintenance significant components, assemblies, subassemblies, and modules with the next higher assembly. End item group number shall be "00."

*b. Column 2. Component/Assembly.* Column 2 contains the names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

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

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

- 
- 1 *Services - inspect, test, service, adjust, align, calibrate, and/or replace.*
  - 2 *Fault locate & troubleshoot-the process of investigating and detecting the cause of equipment malfunctioning; the act of isolating a fault within a system or unit under test (UUT).*
  - 3 *Disassemble/assemble - encompasses the step-by-step taking apart (or breakdown) of a spare/functiona/group coded item to the level of its least componency identifies maintenance significant (ie., assigned an SMR code) for the category of maintenance under considerati6n.*
  - 4 *Actions - welding, grinding, riveting, straightening, facing, remachining, and/or resurfacing.*



- C.....Operator/Crew
- O.....Unit Maintenance
- F.....Direct Support Maintenance
- H.....General Support Maintenance
- D.....Depot Maintenance

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

f. Column 6. Remarks. This column shall, when applicable, contain a letter code, in alphabetic order, which shall be keyed to the remarks contained in section IV.

**B4. Explanation Of Columns In Tool And Test Equipment Requirements, Section III.**

a. Column 1. Reference Code. The tool and test equipment reference code correlates with a code used in the MAC, section 11, column 5.

b. Column 2. Maintenance Category. The lowest category of maintenance authorized to use the tool or test equipment.

c. Column 3. Nomenclature. Name or identification of the tool or test equipment.

d. Column 4. National Stock Number. The National stock number of the tool or test equipment.

e. Column 5. Tool Number. The manufacturer's part number.

**B-5. Explanation Of Columns In Remarks, Section IV.**

a. Column 1. Reference Code. The code recorded in column 6, Section II

b. Column 2. Remarks. This column lists information pertinent to the maintenance function being performed as indicated in the MAC, section II.

**Section II. MAINTENANCE ALLOCATION CHART**

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQUIP	(6) REMARKS
			UNIT		DS	GS	DEPOT		
			C	O	F	H	D		
01	Portable Still	Inspect	0.2					01	
		Test	0.5						
		Clean	1.0						
		Replace		0.3					
		Repair		0.5					

**Section III. TOOL AND TEST EQUIPMENT REQUIREMENTS  
FOR  
MAINTENANCE ALLOCATION CHART**

(1) TOOL/TEST EQUIP REF CODE	(2) MAINTENANCE CATEGORY	(3) NOMENCLATURE	(4) NSN	(5) TOOL NUMBER
01	C	Multimeter	662500-691-2453	
02	O	General Mechanics Tool Kit	5188-00-177-7033	

**Section IV. REMARKS**

**NOT APPLICABLE**

**APPENDIX C  
COMPONENTS OF END ITEM AND BASIC ISSUE ITEMS LISTS**

**Section I. INTRODUCTION**

**C-1. Scope.**

This appendix lists components of end item and basic issue items for the Portable Still to help you inventory items required for safe and efficient operation.

**C-2. General.**

The Components of End Item and Basic Issue Items Lists are divided into the following sections:

*a. Section II. Components of End Item.* This listing is for informational purposes only, and is not authority to requisition replacements. These items are part of the end item, but are removed and separately packaged for transportation or shipment. As part of the end item, these items must be with the end item whenever it is issued or transferred between property accounts. Illustrations are furnished to assist in identifying items.

*b. Section III. Basic Issue Items.* These are the minimum essential items required to place the Portable Still in operation, to operate it, and to perform emergency repairs. Although shipped separately packaged, BII must be with the shelter during operation and whenever it is transferred between property accounts. The illustrations will assist you with hard-to-identify items. This manual is your authority to request/requisition replacement BII, based on TOE/MTOE authorization of the end item.

**C-3. Explanation of Columns.**

The following provides an explanation of columns found in the tabular listings:

*a. Column (1) - Illustration Number (Illus Number).* This column indicates the number of the illustration in which the item is shown.

*b. Column (2)- National Stock Number.* Indicates the National stock number assigned to the item and will be used for requisitioning purposes.

*c. Column (3) - Description.* Indicates the Federal item name and, if required, a minimum description to identify and locate the item. The last line for each item indicates the CAGEC (in parentheses) followed by the part number.

*d. Column (4) - Unit of Measure (U/M).* Indicates the measure used in performing the actual operational/maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea, in, pr).

*e. Column (5) - Quantity required (QTY RQR).* Indicates the quantity of the item authorized to be used with/on the equipment.

**Section II. COMPONENTS OF END ITEM**

**NOT APPLICABLE**

**Section III. BASIC ISSUE ITEMS**

(1) Illus	(2) National Stock Number	(3) Description CAGEEC And Part Number	(4) Usable On Code U/M	(5) Qty
	4240-01-0552310	Safety Goggles	EA	1

**APPENDIX D**  
**ADDITIONAL AUTHORIZATION LIST**

**NOT APPLICABLE**

**D-1/(D-2 Blank)**

APPENDIX E

EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

Section I. INTRODUCTION

E-1 **Scope.** This listing is for informational purposes only and is not authority to requisition the listed items. These items are authorized to you by CTA 50-970, Expendable/Durable Items (except medical, class V, repair parts, and heraldic items).

E-2. **Explanation of Columns.**

a. Column (1) - Item Number. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material (e.g., Use cleaning compound, item 5, appendix C).

b. Column (2) - Level This column identifies the lowest level of maintenance that requires the listed item.

- C - Operator/Crew
- O - Unit Maintenance
- F - Direct Support Maintenance
- H - General Support Maintenance

c. Column (3) - National Stock Number. This is the National Stock Number assigned to the item; use it to request or requisition the item.

d. Column (4) - Description. Indicates the Federal item name, and, if required, a description to identify the item. The last line for each item indicates the Commercial and Government Entity Code (CAGEC) in parentheses followed by the part number.

e. Column (5) - Unit of Measure (UIM). Indicates the measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., EA, IN, PR). If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

Section II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

(1) Item Number	(2) level	(3) National Stock Number	(4) Description	(5)  U/M
	C	7920-00-018-7052	Bristle Brush	EA
	C	6810-00-543-7415	Denatured Alcohol	CN
	C	8415-00-222-8074	Apron, Disposable	BX
	C	7930-01-312-6387	Detergent, General	BX

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# The Metric System and Equivalents

## Linear Measure

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

## Weights

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

## Liquid Measure

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

## Square Measure

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

## Cubic Measure

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

## Approximate Conversion Factors

To change	To	Multiply by	To change	To	Multiply by
inches	centimeters	2.540	ounce-inches	newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29.573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	newton-meters	1.356	metric tons	short tons	1.102
pound-inches	newton-meters	.11296			

## Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C
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