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13. ABSTRACT

Describes a method for evaluation of field heating and cooking equipment operational and functional performance characteristics. Identifies supporting tests, facilities, and equipment required. Provides procedures for adjustment, control accuracy, heat distribution, and efficiency. Not applicable to space heaters, field mess equipment, and test at climatic test sites.

4

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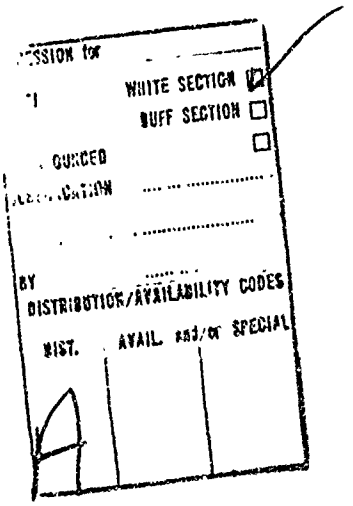

U.S. ARMY TEST AND EVALUATION COMMAND
SYSTEM ENGINEERING TEST OPERATIONS PROCEDURES

AMSTE-RP-702-109
*Test Operations Procedure 10-2-036 1 May 1972

FIELD HEATING AND COOKING EQUIPMENT

		Paragraph	Page
Section I.	GENERAL		
	Purpose and Scope	1	1
	Background	2	1
	Equipment and Facilities	3	2
II.	TEST PROCEDURES		
	Supporting Tests	4	2
III.	SUPPLEMENTARY INSTRUCTIONS		
	Characteristics and Accuracy of Controls and Adjustments	5	4
	Heating Distribution	6	5
	Efficiency	7	5
APPENDIX.	REFERENCES		7

SECTION I
GENERAL

1. Purpose and Scope. This TOP describes test procedures for evaluating the operational and performance characteristics of field heating and cooking equipment. Equipment covered includes: solid fuel tablets, one and two burner gasoline stoves, five man cooking kit, small detachment field cooking outfit, immersion heater, and liquid fuel fired field range and accessory outfit. Excluded are space heaters and field mess equipment. From the tests listed in Section II, the test director can select those that will satisfy the requirements for the particular test item and the particular test type (i.e., engineering test, initial production test, etc.). This document provides for simulated environmental testing but does not include service testing or environmental testing at climatic test sites.

2. Background. To feed a modern Army and provide needed nutrition is a task requiring high quality food and exacting standards for the equipment used in its preparation. To support an Army at a large installation is task enough, but when the Army moves to the field, the heating and cooking equipment required for food preparation under field conditions must

*This TOP supercedes MTPs 10-2-036 (24 Oct 1969), 10-2-037 (28 Oct 69) and 10-2-040 (19 Dec 67), including all changes.

be even more carefully designed to ensure efficient operation, ease of cleaning to meet field sanitation conditions and minimum size and weight for a high degree of portability. Safety of operation must also be given more than the usual amount of consideration due to the inherent dangers that exist in small, portable, liquid fuel burning stoves. Field heating and cooking equipment may take the form of a solid chemical tablet for heating water or an individual meal, a one or two burner gasoline stove, a cook kit for five men, a small detachment field cooking outfit or a liquid fuel fired field range and accessory outfit for a platoon that may be employed in multiple thereof to prepare hot food for larger units.

3. Equipment and facilities. In addition to the equipment and facilities defined in the documents listed in Section II, a standard calorimeter is required to perform the procedures defined by paragraph 7.

SECTION II
TEST PROCEDURES

4. Supporting tests. Common Engineering MTPs/TOPs, Military Standards, the tests defined in Section III, and other published documents to be considered in formulating a test plan are as follows:

TEST SUBJECT TITLE	PUBLICATION NO.
a. Pre-operational Inspection	10-3-500
(1) Operator Training and Familiarization	10-2-501
(2) Photographic Coverage	10-3-519
b. Physical Characteristics	10-2-500
(1) Plastic Indicator Knobs	MIL-S-10736F Para 4.4.1
(2) Valve and Orifice Hardness	FED-STD-151B Method 243
c. Safety	10-2-508
d. Performance Tests	
(1) Leakage	MIL-C-1588D
(a) Field Cooking outfit	Para 4.4.1
(b) Single burner stove - tank	Paras 4.4.2;
- complete stove	4.4.4

TEST SUBJECT TITLE	PUBLICATION NO.
(c) Field range fire unit	MIL-B-40098D
-tank assy.	Para 4.4.1
-double tank assy.	Para 4.4.3
-burner unit	Para 4.4.4
-generator	Para 4.4.5
(d) Two burner stove	MIL-S-40608C Para 4.4.2
(2) Ignition and Flame Characteristics	
(a) Small detachment cooking outfit	MIL-C-1588D Para 4.4.3
(b) Single burner stove	MIL-S-10736F Para 4.4.5
(c) Field range fire unit	MIL-B-40098D Para 4.4.7
(d) Two burner stove	MIL-S-40608C Para 4.4.3
(3) Controls and Adjustments (Refer to para 5)	
(4) Heat Distribution	
(a) Stoves and griddles (Refer to para 6)	
(b) Stove/Range Ovens	MIL-B-12570C Para 4.4.5
(5) Efficiency (Refer to para 7)	
(6) Solid Fuel Packet	MIL-F-10805C Amend. -1 Paras 4.3.2; 4.4
(7) Immersion Heaters	MIL-H-1597B Para 4.4
e. Environmental Testing	
(1) Altitude	MIL-STD-810B Method 500
(2) Temperature	Method 501
(3) Sunshine	4-2-826
(4) Rain	2-2-815
(5) Humidity	4-2-820
(6) Fungus	4-2-818
(7) Salt Fog	MIL-STD-810B Method 509
(8) Dust Test	Method 510
(9) Vibration	4-2-804
(10) Rough Handling	4-2-602

TEST SUBJECT TITLE	PUBLICATION NO.
f. Surface Transportability (General Supplies and Equipment)	10-2-503
g. Human Factors Evaluation	10-2-505
h. Reliability Confidence Intervals and Sample Size	AMCP 702-3 3-1-002
i. Durability (Endurance Testing	10-2-502
j. Maintenance Evaluation	10-2-507
k. Value Analysis	USAMC SUPPL 1 to AR 11-26

SECTION III
SUPPLEMENTARY INSTRUCTIONS

5. Controls and Adjustments.

a. Objective. To determine the accuracy of operation of test item controls and adjustments.

b. Method. The test item is placed in an area free of air currents and external conditions that would affect the validity of this test. The fuel supply and metering valve controls (individual or combined) are turned on and the test item ignited. The controls are then adjusted for maximum output and the height of the flame and rate of fuel flow are determined. The controls are then adjusted for three-quarters, one-half, and one-quarter maximum output, and minimum output. Pertinent measurements at each setting are recorded.

c. Data Required.

(1) Nomenclature and type of test item.

(2) Flame heights and rate of fuel flow determined at maximum, three-quarters, one-half and one-quarter of maximum, and minimum outputs indicated by control settings.

d. Analytical Plan. The flame heights and rates of fuel flow are tabulated by control settings and the tabulations analyzed to determine control setting accuracy. The results of the analysis are compared to the requirements of the MN to determine conformance to specifications.

6. Heat Distribution.

a. Objective. To determine the heat distribution of the test item.

b. Method. (Applicable to stoves and field ranges.) The test item is prepared for testing by placing the specified type and size utensil for frying over the heat source. The utensil is instrumented by five remote reading temperature devices, one placed near each corner and one in the center. The test item is ignited and adjusted for a normal operating temperature. When the temperature is stablized, the five thermocouple indications are recorded simultaneously by location. The procedure is repeated for various indicated temperatures as required.

c. Required Data.

(1) Nomenclature and type of test item.

(2) Description of utensil used.

(3) Sketch of thermocouple locations.

(4) Tabulation of simultaneous readings by location, on utensil for each heat setting of burner unit.

d. Analytical Plan. An analysis is made of the difference in temperature between each point. The temperatures of the hottest and coldest of the five points are determined. This difference is compared with the requirements of the MN to determine conformance to specifications.

7. Efficiency.

a. Objective. To determine the operating efficiency of the test item.

b. Method. The test item is instrumented with an accurate fuel input measuring device and a calorimeter to record heat output. The burner is ignited and adjusted to stablized operation for maximum heat output. This condition is maintained for a period of one hour, during which time interval the quantity of fuel consumed and the heat output in BTU are accurately determined. This procedure is repeated for one-half maximum and minimum heat output settings. During the above procedures, the temperature of the flue gas is determined and a sample obtained for analysis.

c. Required Data.

(1) Nomenclature and type of test item.

(2) Type of fuel and published heating value in B.T.U.

(3) Fuel consumed during each test period (to the nearest tenth of a gallon).

(4) Heat output measured during each test period.

(5) Ambient temperature recorded for each test.

(6) Flue gas temperature and analysis during each test period.

d. Analytical Plan. The measured heat output during each test period is divided by the heating value of the fuel consumed and the result multiplied by 100 to obtain the efficiency of operation. The efficiencies of each test are averaged to obtain the average overall operating efficiency of the test item which, together with the CO_2 content of the flue gas is compared with the requirements of the MN to determine conformance to specifications.

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APPENDIX
REFERENCES

1. AR 7C-38, "Research, Development, Test, and Evaluation of Materiel for Extreme Climatic Conditions."

2. USAMC Supplement 1 to AR 11-26, "Value Engineering."

3. AMCP 702-3, "Quality Assurance - Reliability Handbook."

4. Federal Test Method Standard 151B, "Metals, Test Methods", including notice 1.

5. MIL-STDF810B, "Environmental Test Methods", including notices 1 thru 4.

6. MIL-C-1588D, "Cooking Outfit, Field, Small Detachment."

7. MIL-H-1597B, "Heater, Immersion, Liquid Fuel Fired, for Cans, Corrigated."

8. MIL-S-10736F, "Stove, Gasoline Burner, M1950, With or Without Case", including amendments 1 and 2.

9. MIL-F-10805C, "Fuel, Compressed, Trioxane, Ration Heating", including amendment 1.

10. MIL-B-12570C, "Bakery Oven, Trailer Mounted, M-533", including amendment 1.

11. MIL-B-00400[illegible]8D, "Burner Unit, Gasoline, Field Range Outfit, M2."

12. MIL-S-40608C, "Stove, Gasoline, 2-Burner."