UNCLASSIFIED

AD NUMBER

AD867353

NEW LIMITATION CHANGE

TO

Approved for public release, distribution unlimited

FROM

Distribution authorized to U.S. Gov't. agencies and their contractors; Administrative/Operational Use; JUL 1969. Other requests shall be referred to U.S. Army Test and Evaluation Command, Attn: AMSTE-TS, Aberdeen Proving Ground, MD 21005.

AUTHORITY

USATEC ltr, 14 Dec 1970

THIS PAGE IS UNCLASSIFIED

This document has been approved for public release and sale; its distribution is unlimited. Reproduction in whole or in part is permitted for any purpose of the United States Government. Requests for additional copies may be made only by agencies of the United States Government.

U.S. Army Test & Evaluation Command
Attn: AMSTE-TS
APG, Md. 21005

12 July 1969

Materiel Test Procedure 10-2-051
General Equipment Test Activity

AD 867353

U. S. ARMY TEST AND EVALUATION COMMAND
COMMODITY ENGINEERING TEST PROCEDURE

FIRE EXTINGUISHERS

1. OBJECTIVE

This document provides test methods and techniques necessary to determine the technical performance and safety characteristics of fire extinguishers and their associated tools and equipment as described in the Qualitative Materiel Requirements (QMR's), Small Development Requirements (SDR's), Technical Characteristics (TC's) and to determine the item's suitability for service tests.

2. BACKGROUND

There exists a need for portable fire extinguishers to be used by Army personnel for extinguishing the following four classes of fires, any one of which may be encountered in the field, or at bases:

Class of Fire	Description
A	Paper, wood, cloth, etc., where quenching by water, a water solution, a general purpose dry chemical or a foam is effective.
B	Burning liquids (gasoline, oils, paints, cooking fats, etc.) where smothering action is required
C	Fires in live electrical equipment (motors, switches, appliances, etc.) where a non-conducting extinguishing agent is required.
D	Fires in combustible metals such as magnesium, sodium and potassium. Extinguishing agent is a coarse powder which seals the burning surface and smothers the fire.

The extinguishing agents most suitable for extinguishing the four classes of fire described above are as follows:

Extinguishing Agent	Class of Fire
Plain Water	A
Water solution (anti-freeze)	A
Water solution (soda-acid)	A
Water solution (loaded steam)	A, B
Foam	A, B

DDC
APR 13 1970
A

Reproduced by the
CLEARINGHOUSE
for Federal Scientific & Technical
Information Springfield Va. 22151

54

WHITE SECTION
BUFF SECTION
AVAILABILITY CODES
AVAIL. and/or SPECIAL

Multipurpose dry chemical	A,B,C
Carbon dioxide (with metal horn extinguishers)	B
Carbon dioxide (with non-metallic horn extinguishers)	B,C
Bromotrifluoromethane	B,C
Dry chemical	B,C
Monobromotrifluoromethane (CF3BR)	B,C
Coarse powder (composition depends upon the particular metal involved in the fire)	D

3. REQUIRED EQUIPMENT

One or more of the following items and/or facilities may be required to obtain data during the various evaluations:

a. Measuring tape, ruler, caliper, flashlight.
b. Camera, film, flash bulbs.
c. Suitable scales for weighing from fractions of an ounce to several hundred pounds avoirdupois.
d. Liquid measuring containers for weighing from liquid ounces to 50 gallons.
e. Marking ink, and cloth tags.
f. Heavy rubber gloves, heavy rubberized apron, safety goggles.
g. Calibration facility for checking pressure gage accuracy.
h. Pressure gages, including remote-reading types.
i. Waterproof containers for measuring volume of foam discharge.
j. Clean running water, water hose, and floor drain.
k. Stop watch reading in seconds and minutes.
l. Clean work bench.
m. Dry cabinet or other storage space for "recharges" for each type of extinguisher being tested.
n. Environmental test chamber.
o. Short length of half-inch pipe or a dowel, wrenches.
p. Pressurized air tank, service air line, and air hose.
q. Variable frequency vibration test stand.
r. Clean metal mixing tanks for preparing liquid solutions, fine wire mesh strainer, and metal funnel.
s. Vaseline and lubricating oil.
t. Spare extinguisher gaskets.
u. Scrubbing brush.
v. Well-ventilated room when recharging vaporizing liquid or CO_2 extinguishers.

w. Refrigerant leak detector.

x. Hand-pump-operated hydrostatic pressure test equipment, protective cage, and suitable drying equipment, for testing all cylinders or containers except those which will contain carbon dioxide or inert-gases under pressure. This equipment shall meet the requirements of paragraphs 4110 through 4135 of booklet No. 10A, 1967 edition, National Fire Protection Association.

y. Electric-pump-driven hydrostatic pressure test equipment, protective tank, burette and pressure gage for testing liquified gas extinguisher cylinders, and cylinders used for inert gas storage. This equipment shall meet the requirements of Pamphlet C-1, Second edition, "Methods for Hydrostatic Testing of Compressed, Gas Cylinders," the Compressed Gas Association, Inc., 500 West Fifth Avenue, New York, N. Y. 10036.

z. Suitable drying equipment when making hydrostatic tests on dry chemical, dry powder (Class D fire hazard extinguishers), liquified gas (carbon dioxide and Bromotrifluoromethane) and vaporizing liquid types of fire extinguishers, and for drying hose assemblies which are hydrostatically tested separately.

aa. Special fittings (procured from the manufacturer) when making hydrostatic tests on pressurized vaporizing liquid types of extinguishers of the dual chamber design, or on nozzles, discharge valves, safety pressure relief devices and pressure regulators, as required.

bb. Master pressure gage for use in checking the accuracy of pressure gages.

cc. A suitable firing range, and a gun which will fire a 50 caliber, armor-piercing type projectile, when making a gun fire test.

dd. Thermostatically-controlled oven.

ee. Sieve shaker with standard 140, 200, and 325 mesh sieves.

ff. Remotely-controlled device for opening and closing the discharge nozzles.

gg. Remotely-controlled device for alternately inverting a chemical foam type extinguisher and returning it to the upright position.

hh. Chemical analysis facility for performing chemical analyses on extinguishing agents and pressure-generating expellant chemicals, including analytical balance and dessicator jars.

4. REFERENCES

A. Government Specifications covering hand-pump-operated, hand and back-pack type water solution extinguishers.

1. O-E-940, Extinguisher, Fire, Water (Hand, Portable, Pump-Tank-Type).
2. MIL-E-212C, Extinguishers, Fire, Water, Back-pack, 5-Gallon.

B. Government Specifications covering water solution, expellant-gas-operated, extinguishers.

1. O-E-942a, Extinguishers, Fire, Water (2 1/2 Gallon Stored-Pressure).
2. O-E-945a, Extinguisher, Fire, Water (2 1/2 Gallon Cartridge-Operated).

3. MIL-E-52120, Extinguishers, Fire, Water-Type.

C. Government Specifications covering soda-acid extinguishers.

1. 0-E-930a, Extinguishers, Fire, Soda-Acid: On Wheels.

D. Government Specifications covering foam extinguishers.

1. 0-E-920a, Extinguishers, Fire Foam: On wheels.
2. 0-E-925a, Extinguishers, Fire, Foam, (2 1/2 Gallon).

E. Government Specifications covering carbon dioxide extinguishers.

1. 0-E-910a, Extinguishers, Fire, Carbon-Dioxide (Hand and Wheeled Types).
2. MIL-E-52215, Extinguishers, Fire, Carbon Dioxide, 10-pound capacity (Nonshatterable Cylinder, Fixed-Type, with 1-inch Flood Valve).
3. MIL-E-5627B, Extinguisher, Fire, carbon dioxide, portable.

F. Government Specifications covering dry chemical extinguishers.

1. 0-E-915b, Extinguishers, Fire, Dry-Chemical, (portable).
2. MIL-E-22345, Extinguisher, Fire, Dry Chemical: Wheeled, 150-pound capacity.
3. MIL-E-73906A, Extinguisher, Fire, Twinned Unit ("Light Water"-Dry Chemical) Skid mounted, 800 pound capacity.
4. MIL-E-23925, Extinguisher, Fire, "Twinned" Unit, "Light Water", Potassium-Bicarbonate, Spherical, Platform Mounted, 50-Gallon and 400-Pound (Respectively) Capacity.
5. MIL-E-24091A, Extinguisher, Fire, Portable, Potassium Bicarbonate, Dry Chemical, Cartridge, Type.

G. Government Specifications covering vaporizing liquid extinguishers.

1. MIL-E-7351A, Extinguisher, Fire, Bromochloromethane, Portable, Type D-1.
2. MIL-E-7589A, Extinguisher, Fire, Vaporizing Liquid, Type D-2, Bromochloromethane, Portable.
3. MIL-E-26243C, Extinguisher, Fire, Vaporizing Liquid, FE-1/M and FE-2/M.
4. MIL-E-52031A, Extinguisher, Fire, Vaporizing Liquid, CF_3BR; 2 3/4 pound with Bracket.

H. Government Specifications covering extinguishers for use on combustible metals.

1. MIL-E-22103, Extinguisher, Fire, "TMB", Portable.

I. Government Specifications covering extinguishing agents and pressuring gases, chemicals and cartridges.

1. BB-C-101, Carbon Dioxide (CO_2): Technical and U.S.P.
2. O-C-230, Charge, Fire Extinguishers, Foam.
3. O C-240, Charge, Fire Extinguisher, Anti-freeze and Charge, Fire Extinguisher, Soda-Acid.
4. BB-C-00310, Chlorofluero Hydrocarbons (of the Methane and Ethane Series).
5. JAN-C-344, Charges, Fire Extinguisher (Water).
6. BB-N-411, Nitrogen, Technical.
7. MIL-B-4394, Bromochloromethane, Technical.
8. MIL-B-12218, Monobromotrifluoromethane (Liquidfied).
9. MIL-F-22287, Fire Extinguishing Agent, Potassium Dry Chemical.
10. MIL-F-23555, Fire Extinguishing Agent, Multi Purpose, Phosphate Dry Chemical.
11. MIL-F-23905, Fire Extinguishing Agent, "Light Water" Liquid Concentrate (Six Percent).
12. MIL-C-24224, Cartridge, Gas Pressure, for Pressurizing Dry Chemical Fire Extinguishers.
13. MIL-A-24226, Applicator for Dry Chemical Powder Portable Fire Extinguisher.

J. Other Government Specifications and Laboratory Reports.

1. U-T-81, Tags, Shipping and Stock.
2. MIL-STD-105, Sampling Procedures and Table for Inspection by Attributes.
3. MIL-P-116E, Preservation, Methods of.
4. CCC-T-191, Textile Test Methods.
5. MIL-STD-810, Environmental Test Methods.
6. MIL-STD-1186, Cushioning, Anchoring, Bracing, Blocking, and Waterproofing with Appropriate Test Methods.
7. MIL-E-5272, Environmental Testing, Aeronautical and Associated Equipment (General Specification for).
8. MIL-M-008090, Mobility, Towed Aerospace Ground Equipment, General Requirements for.
9. Naval Research Laboratory Report, No. 1076. An Improved Vacuum Pneumatic System for Filling Large Dry Chemical Fire Extinguishers.
10. Naval Research Laboratory Report No. 4933, 10 July 1957. The Use of "TMB" for Extinguishment of Metal Fires.

K. Government Drawings

1. AN 6045, Extinguisher Assembly-Fire, Carbon Dioxide, Portable.
2. AN 6046, Bracket, Mounting, Extinguisher, Fire.
3. MS 26545, Cylinders, Compressed Gas, Non-shatterable.
4. MS 26562, (AER), Fire Extinguisher, "TMB" Portable.
5. MS 39082, Extinguisher, Fire, Water, Back-Pack, Pump Tube; Hand, 5 Gallon (See MIL-E-212).
6. MS 39084, Extinguisher, Fire, Water, Pump Type, Hand, 4 Gallon, Conical, Demountable and Nestable (See O-E-940).

7. MS 51336, Lunette-Coupler, Drawbar, Ring.
8. 53D6944, (Air Force) Bracket, Fire Extinguisher D-2, Portable, Bromochloromethane.

L. Code of Federal Regulations.

1. 49 CFR 71-90, Interstate Commerce Commission (ICC) Rules and Regulations for the Transportation of Explosives and Other Dangerous Articles.

M. Underwriters' Laboratories (UL), Inc. Standards and Tests.

1. UL 7, Soda-Acid Fire Extinguishers.
2. UL 8-1967, Foam Fire Extinguishers.
3. UL 154, Carbon Dioxide Hand Fire Extinguishers.
4. UL 299, Dry Chemical Hand Fire Extinguishers.
5. UL 626, 2 1/2 Gallon Stored-Pressure, Water-Type Fire Extinguisher.
6. UL 711, Classification, Rating, and Fire Testing of Class A, B, and C Fire Extinguishers and for Class D Extinguishers or Agents for use on Combustible Metals.
7. Bulletin of Research No. 23, Rain Tests of Electrical Equipment - Methods and Apparatus.

N. National Fire Protection Association.

1. NFPA No. 10, Installation of Portable Fire Extinguishers.
2. NFPA No. 10A, Maintenance and Use of Portable Fire Extinguishers.
3. NFPA No. 408, Aircraft Fire Extinguishers.

O. Compressed Gas Association, Inc.

1. C-1, Methods for Hydrostatic Testing of Compressed Gas Cylinders.
2. C-6, Standards for Visual Inspection of Compressed Gas Cylinders.

P. Department of the Army Publications.

1. Army Regulation AR 700-68, Safe Handling, Storing, Shipping, Use and Disposal of Compressed Gas Cylinders.
2. Technical Manual TM 5-687, Repairs and Utilities, Fire Protection Equipment and Appliances Inspection, Operations, and Preventive Maintenance.
3. Technical Bulletin TB5-4200-200-10, Hand Portable Fire Extinguishers Approved for Army Users.
4. USATECOM Regulation 385-6, Verification of Safety of Materiel During Testing.
5. USAMC Regulation 385-12, Verification of Safety of Materiel from Development through Testing and Supply Disposition.

6. USAMC Regulation 385-224, AMC Safety Manual.
7. USATECOM Regulation 700-1, Value Engineering.
8. USATECOM Regulation 705-4, Equipment Performance Report.
9. MTP 10-2-052, Hoses, Fire Extinguisher.
10. MTP 10-2-500, Physical Characteristics.
11. MTP 10-2-501, Operator Training and Familiarization.
12. MTP 10-2-503, Surface Transportability (General Supplies and Equipment).
13. MTP 10-2-505, Human Factors Evaluation.
14. MTP 10-2-507, Maintenance Evaluation.
15. MTP 10-2-508, Safety.

5. SCOPE

5.1 SUMMARY

This materiel test procedure describes the following engineering inspections and tests to be used in evaluating fire extinguishers:

a. Preparation for Test - A visual inspection of the as-received condition of the test item and its salient physical, handling and safety features, an evaluation of the as-received conditions of the extinguisher recharging materials and containers, a chemical analysis of the extinguisher recharging materials and operator training and familiarization procedures.

b. Hydrostatic Strength Test - An evaluation of the following test item components to determine whether they will pass the specified hydrostatic strength tests:

1) The extinguisher shell
2) The extinguisher shell cap, test bonnet or fitting
3) Refillable gas cartridge or cylinder
4) Discharge, or flood, valves
5) Pressure relief devices
6) Pressure regulator
7) Discharge nozzle

c. Components Test - An evaluation of the following test item components to determine their usage, safety and operability:

1) Check the calibration accuracy of the extinguisher pressure gage, and the hydrostatic test pressure gage.
2) Check of non-refillable carbon dioxide cartridge.

d. Gunfire Test - An evaluation of the non-shatterable type extinguisher shells to meet the specified gunfire test.

e. Hose Tests (other than hydraulic tests) - Evaluation to determine the following hose characteristics as applicable:

1) Volume swell and low temperature characteristics on bromochloromethane extinguishers.

2) Resistance to deterioration on trimethoxyboroxine extinguishers.
3) Flexibility on wheel-mounted, water-tank-type extinguishers
4) Packed hose characteristics on dry chemical extinguishers.

f. Packed Chamber Test (dry chemical extinguishers) - An evaluation to determine maximum pressure developed and the amount of dry chemical discharged under specified conditions.

g. Maximum Pressure Developed Test (chemical foam and soda-acid extinguishers) - An evaluation to determine the maximum pressure developed under specified conditions.

h. Performance Tests - An evaluation of the ability of the test item to meet the specified steady, and intermittent, fire extinguishing agent discharge characteristics, including discharge range and duration, under specified environmental conditions. On soda-acid extinguishers, the acidity of the discharge stream is also checked. The performance of the stopple when a loose-type stopple is used, is also checked.

i. Leakage Test - An evaluation of the ability of the test item to meet specified leakage requirements.

j. Vibration Tests - An evaluation to determine whether hand-carried type extinguishers can withstand exposure to specified vibration conditions.

k. Transportability - An evaluation to determine whether the test item is capable of withstanding the shock that may be encountered during normal handling and transporting conditions.

l. Safety - An evaluation to determine whether the test item contains any hazards.

m. Maintainability and Reliability Evaluation - That portion of the test which is concerned with the following: verification and appraisal of failures; determination and appraisal of maintenance characteristics and requirements; appraisal of design-for maintainability; appraisal of the maintenance test package; and, calculation of indicators which express the effects of the preceding aspects.

n. Human Factors Evaluation - An evaluation of the man-item relationship during operation and maintenance of the test item to include handling characteristics with gloves or arctic mittens and any operability design deficiencies.

o. Value Analysis - An evaluation to determine whether the test item contains any unnecessary, costly, or "nice-to-have" features which could be eliminated without affecting technical performance or safety.

5.2 LIMITATIONS

These procedures are limited to portable fire extinguishers of the following general types:

a. Hand type (hand-carried).
b. Back-pack type (back-carried).
c. Wheeled type (mounted on a manually-propelled wheeled carriage).
d. Skid (or platform) mounted type (for installation on a motor vehicle body).

The term "extinguisher" will be used hereinafter to apply to one of the above described types of portable fire extinguishers.

6. PROCEDURES

NOTE: During installation and operation, the operating techniques provided in the manufacturer's instruction manual, or draft technical manual, will be used. Any change or deviation from these instructions will be recorded in the test item logbook.

6.1 PREPARATION FOR TEST

6.1.1 Initial Inspection

Upon receipt of the test item at the test site, the test item shall be subject to the applicable portions of MTP 10-2-500 and the following procedures:

a. Visually inspect the test item package(s) and record the following:

1) Evidence of packaging damage or deterioration.
2) Identification markings, including:

a) Name of contractor
b) Number and date of contract
c) Date of manufacture
d) Other markings pertaining to the test item

b. Weigh and measure the individual package(s) of the test item and its accessories and record the following:

1) For each shipping package:

a) Contents
b) Weight
c) Length, width, and height
d) Cubage

2) For the entire test item:

a) Weight
b) Cubage

c. Unpack the test item, visually inspect it and record the following, when applicable:

1) Evidence of defects in:

a) Manufacturing
b) Materiel

c) Workmanship

2) Evidence of damage
3) Evidence of wear

NOTE: Make use of photographs, diagrams and narration to indicate the condition of the test item.

d. Record the presence of instruction plates, and their adequacy, including:

1) Identification, name and serial number
2) Caution instructions
3) Service instructions (operating, maintenance and recharging)

e. Record the presence of descriptive technical literature.

f. Inspect and record the condition of compressed gas cylinders (see Reference 4.0.2.).

g. Record the presence of visible seals to indicate that tampering with pressurized gas cartridges or cylinders, or extinguisher fill caps, will be readily noticed.

h. Record the means used to prevent inadvertent pressurization of the extinguisher.

i. Record the adequacy of guards or shields to protect pressurized carbon dioxide cartridges or cylinders.

j. Unpack the extinguisher recharging materials, visually inspect them, and record the following as applicable:

1) Evidence of defects in:

a) Manufacturing
b) Material
c) Workmanship

2) Evidence of damage.
3) Adequacy of recharging instructions appearing on, or in, each recharge package.

NOTE: 1. Not less than two complete recharges shall be furnished with each test item, except for the carbon dioxide used in recharging rechargeable carbon dioxide cartridges and cylinders and the nitrogen gas used as the expellant means in some extinguishers. In these cases, the carbon dioxide and nitrogen gas will be taken from suitable storage cylinders located at the test site.

2. When the test item is equipped with a non-refillable carbon dioxide cartridge, a minimum of two such cartridges is to be supplied with each test item.

6.1.2 Physical Characteristics

Determine and record the following physical characteristics of the extinguisher under test:

a. For individual test item components, as applicable:

1) Weight
2) Length
3) Overall diameter

b. Overall weight.
c. Overall length.
d. Overall diameter.
e. Diameter of inlet pipe.
f. Diameter of outlet pipe.
g. Diameter of pressure gage connections.
h. When a non-magnetic extinguisher is specified, the material shall be such that the magnetic permeability of the extinguisher assembly and mounting brackets shall be no more than 2.0. Materials shall be approved by the command or agency concerned.

6.1.3 Operator Training and Familiarization

Determine the data, subject to the applicable portions of MTP 10-2-501 and the following:

a. All members of the test team shall receive a review of safety precautions listed in the technical manuals, Army Regulation AR 700-68, or developed from previous test experience. The safety precautions shall, as a minimum, include the following:

1) Handling, storing, shipping, operation, and disposal of compressed gas cylinders used in the following types of extinguishers:

a) Water, vaporizing liquid, or dry chemical types employing air or nitrogen under pressure as the expellant.
b) Carbon dioxide types.
c) Those types containing a compressed gas cartridge which forces the extinguishant out when punctured.

2) Types of fires and suitable extinguishers to be used on each type.

b. Test personnel shall be instructed in the capabilities of the test item and in the objectives and procedures of the test.
c. The technical manuals shall be made available for study and their adequacy for training purposes shall be observed and recorded.
d. Record the amount of time and type of training and familiarization required for each member of the test team.
e. Record any unusual difficulty.

6.2 TEST CONDUCT

NOTE: All equipment failures shall be reported in accordance with USATECOM Regulation 705-4.

6.2.1 Hydrostatic Strength Test

NOTE:
1. In no case should air or gas be used for pressure testing, because violent rupturing, with extreme personal hazard or even death, will result in cases of failure.
2. Hydrostatic tests should be conducted prior to any other tests, and they shall also be conducted immediately after discovering any indication of mechanical injury, or when there is any indication of corrosion in vessels subjected to high internal pressures.
3. This test is not required on hand pump type water and/or antifreeze extinguishers, or on hand pump type vaporizing liquid extinguishers.
4. Proper hydrostatic testing requires that competent personnel do the work; that suitable testing equipment and facilities be provided, and that testers have a practical knowledge of pressure testing procedures and safeguards. When a fire brigade is available, personnel from the fire brigade shall perform these tests.
5. Extinguisher shells, cartridges, or cylinders which show leakage or permanent distortion in excess of specified limits, or which rupture, shall be removed from service.

6.2.1.1 Preparation for Testing

a. Ensure the availability of the following apparatus needed to conduct hydrostatic tests on all extinguishers except the liquified gas types, and gas cylinders on wheeled units:

1) Hydrostatic Test Pump with check valves and fittings, hand or power operated, capable of producing not less than twice the test pressure.
2) Flexible Connection with a fitting for attachment to the extinguisher nozzle or to a test bonnet or fitting, as applicable, and the test pump.
3) Substantial Protective Cage capable of completely surrounding the extinguisher under test and providing visual observation of the extinguisher.
4) Suitable Drying Equipment for use with all dry chemical, dry powder, liquified gas (carbon dioxide, and bromotrifluoromethane) and vaporizing liquid types of extinguishers.
5) Special Fittings for pressurized vaporizing liquid types of extinguishers of the dual chamber design.

NOTE: The manufacturer shall be consulted for such types.

b. Empty the extinguisher to be tested and remove most internal parts (except those in some dry chemical, dry powder and vaporizing liquid extinguishers).

NOTE: All dry chemical and dry powder types of extinguishers must have all traces of extinguishing materials removed from inside the shell before filling with water.

c. Remove the cartridge (and some cartridge receivers) from all dry chemical and dry powder extinguishers having externally-mounted gas cartridge for creating discharge pressure and insert a suitable plug into the shell opening at the point of removal.

d. Remove the discharge nozzle from wheeled extinguishers of the soda-acid, stored-pressure water, loaded stream, cartridge-operated or foam types.

NOTE: The complete remaining assembly (including the hose) shall be tested.

e. Remove the hose (complete with couplings, but without the discharge nozzle) from all wheeled dry chemical and dry powder extinguishers and test it separately.

f. Remove the head assembly on all wheeled stored pressure dry chemical extinguishers and replace it with a suitable test bonnet.

g. Leave the discharge or flood valve on the extinguisher shell but remove the safety pressure relief device (usually a frangible disc) and plug up the hold occupied by this device.

h. Remove the following, when used, and insert a suitable plug into the shell opening at the point of removal:

1) Pressure indicating gage
2) Pressure relief device
3) Pressure regulator

i. Attach the hose of the hydrostatic test pump with a flexible connection to the discharge nozzle, hose assembly, test bonnet, or test fittings.

NOTE:
1. In the case of wheeled dry chemical and dry powder extinguishers, procedures and fittings must be those recommended by the manufacturer.
2. The extinguisher must now be placed in the protective cage before applying the test procedures.

6.2.1.2 Extinguisher Shell Test

NOTE:
1. This test is not applicable to carbon dioxide extinguishers and refillable gas cartridges or cylinders (See 6.2.1.4).
2. Unless otherwise specified, the test pressure shall be the original factory test pressure, as noted on the extinguisher nameplate.
3. Unless otherwise specified, the pressure shall be applied

at a rate of rise to reach the test pressure in approximately 1 minute, and the test pressure shall be held for 1 minute, after which it shall be released.

a. Turn on the water supply, and fill the extinguisher shell to the top of its threaded collar, except that:

1) When the extinguisher is to be tested with its cap in place, tighten the cap slowly, while the water supply remains open. When all of the entrapped air within the shell has been bled off, and after water emerges from the shell, tighten the cap fully.
2) When the extinguisher is to be tested with a special test bonnet or fitting, the bonnet or fitting should be tightened fully while the water supply remains open. When all of the entrapped air within the shell has been bled off, and after water emerges, close the vent tightly.

b. After the extinguisher shell has been completely filled with water, with no entrapped air, apply pressure at a rate of rise to reach the specified test pressure in approximately 1 minute, and maintain this test pressure and note and record any distortion or leakage of the extinguisher shell.

c. Release the pressure on the extinguisher shell and record if the shell returns to its original outside dimensions, or whether the shell remains distorted.

d. Siphon, or otherwise remove, all of the water in the extinguisher shell.

NOTE: All dry chemical, dry powder, liquified gas, and vaporizing liquid extinguishers must have all traces of water and moisture removed. A heated air stream is recommended with its temperature not exceeding 150 degrees fahrenheit.

6.2.1.3. Discharge or Flood Valve Test

During the conduct of 6.2.1.2. observe and record whether the valve shows any leakage during the test or any distortion after the test.

6.2.1.4 Extinguisher Hose Assemblies Tests

a. Conduct this test on hose assemblies (hose and couplings excluding nozzles), placed inside the protective cage, separate from the hydrostatic testing of the extinguisher shells under the following conditions:

1) When specified in the applicable developmental criteria.
2) When the extinguisher hose is equipped with a shut-off valve at the outlet end of the hose.

b. Determine the effects of hydrostatic pressure on the hose assemblies as follows:

NOTE: All traces of dry chemical or dry powder must be removed from the hose assembly before testing.

1) Turn on the water supply and fill the hose assembly completely.
2) Apply pressure at a rate of rise to reach the test pressure within 1 minute.

NOTE: Unless otherwise specified, the test pressure applied to hose assemblies shall be as follows:

1. 300 psi (except carbon dioxide extinguisher hose)
2. 1250 psi for carbon dioxide extinguisher hose

3) Maintain the test pressure for another full minute and record the occurrence of any of the following:

a) Distortion
b) Leakage
c) Pressure drop

4) Release the pressure on the hose assembly, and empty the hose assembly completely of water.
5) Repeat step b.1 through b.4 for each hose assembly under the following conditions, when specified:

a) Test the hose assembly at ambient temperature after having exposed it to a specified high temperature for a specified length of time.
b) Test the hose assembly at ambient temperature after having exposed it to a specified low temperature for a specified length of time.

6) When specified, open and close the shut-off nozzle for the number of times specified, with the extinguisher expellant source inactivated by suitable means, such as having the extinguishing agent unpressurized, before applying the hydrostatic test to the hose assembly.

NOTE: Hose assemblies tested separately must be thoroughly dried internally. If heat is used to accelerate drying, the temperature must not exceed 150 degrees fahrenheit.

6.2.1.5 Carbon Dioxide Extinguisher Shell, and Refillable Compressed Gas Cartridge or Cylinder Test

NOTE: 1. Carbon dioxide extinguishers, nitrogen cylinders and other cylinders or cartridges used for storage of inert, compressed gases shall be hydrostatically tested in accordance with requirements of the U. S. Department of Transportation (formerly Interstate Commerce Commission), Shipping

Container Specifications 3A, 3AA or 3HT as specified. (Specification 3HT applies only to cylinders for use on aircraft.) See reference 4.0.1.

2. Before testing these extinguisher cylinders they should be visually inspected in conformity with the requirements of the Standard for Visual Inspection of Compressed Gas Cylinders (see reference 4.0.2).

6.2.1.5.1 Preparation for Test - Perform the following on an empty container prior to charging or recharging:

a. Visually examine the extinguisher and record the following:

1) Physical damage
2) Exterior corrosion

b. Lightly tap the extinguisher with a hammer and record the type of ring obtained.

NOTE: Those cylinders which have a dull or peculiar ring, when tapped with a suitably-sized hammer, should be carefully examined and, if necessary, valves removed and interior examined with a suitable light, and retested before charging.

6.2.1.5.2 Test Conduct - Perform the following:

a. Set-up the test apparatus as shown in Figure 1.

NOTE: 1. Figure 1 illustrates the water jacket, burette method for testing cylinders employing a power driven pump and a pressure connection to the cylinder installed inside the water jacket.

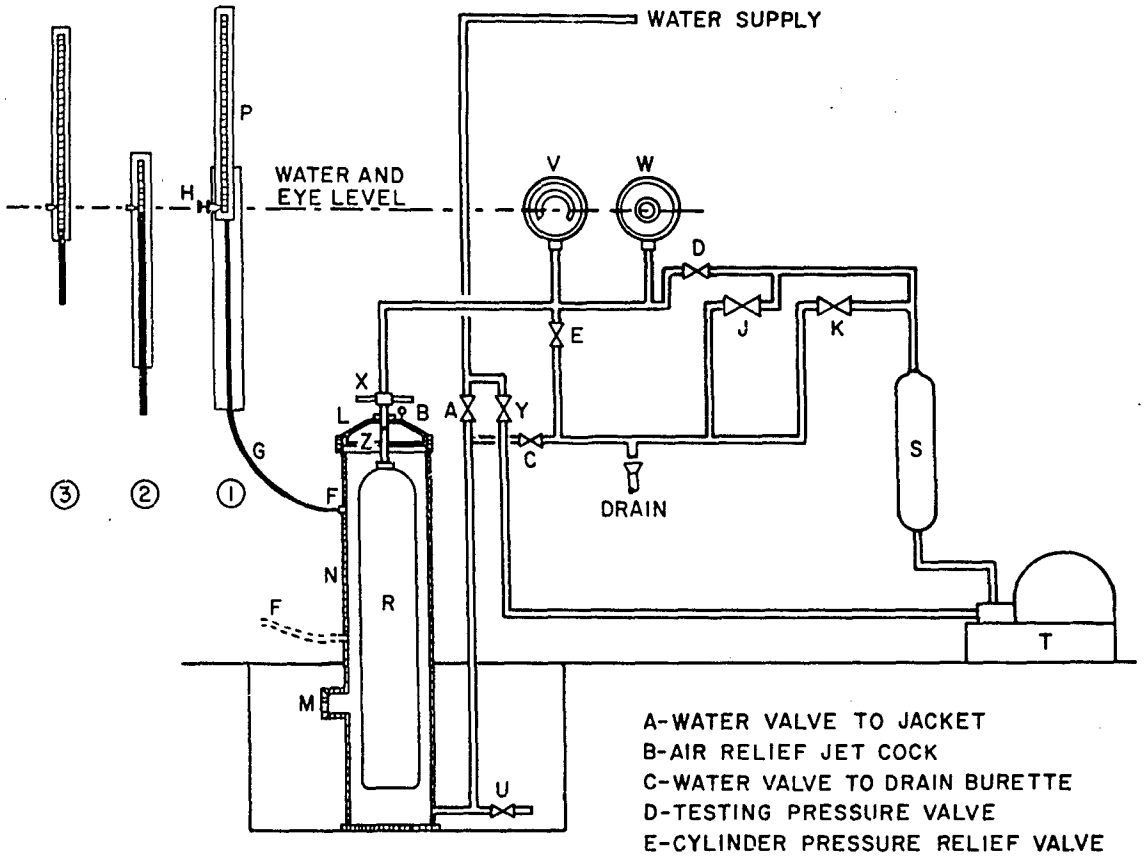
2. The test method illustrated in Figure 1 consists essentially of measuring the volume of water displaced from a water jacket enclosing the cylinder when pressure is applied to the interior of the cylinder, and the volume remaining upon release of the pressure. These volumes represent the total and permanent expansions of the cylinder, respectively. To measure them accurately, a movable burette calibrated in cubic centimeters is positioned to maintain the water level at a uniform height when taking readings.

b. Select the proper size burette for the cylinder to be tested and place in burette holder. Adjust rubber connection tight so it will not leak.

c. With burette in position (1) set zero adjuster (H) with zero of burette.

d. Select test nipple (Z) to fit valve inlet connection thread of cylinder and screw into the jacket head with pipe wrench; be sure it is <u>tight</u>.

e. Fill the cylinder to be tested with water. Clamp cylinder in vise and screw head and test nipple into the cylinder thread tight, using



A-WATER VALVE TO JACKET
B-AIR RELIEF JET COCK
C-WATER VALVE TO DRAIN BURETTE
D-TESTING PRESSURE VALVE
E-CYLINDER PRESSURE RELIEF VALVE
F-PIPE TO BURETTE LEVELER
G-FLEXIBLE RUBBER HOSE
H-ZERO ADJUSTER
J-PUMP RELIEF VALVE
K-SAFETY VALVE
L-WATER JACKET HEAD
M-WATER JACKET EXPLOSION PORT
N-WATER JACKET
P-LEVELING BURETTE
R-CYLINDER
S-PRESSURE RESERVOIR
T-HYDRAULIC PRESSURE PUMP
U-CLEAN-OUT VALVE
V-INDICATING GAUGE
W-RECORDING GAUGE (OPTIONAL)
X-DETACHABLE PRESSURE CONNECTION
Y-WATER VALVE TO PUMP
Z-TEST NIPPLE

Figure 1. Compressed Gas Cylinder Test Set-up.

NOTE: All readings of the water in the burette must be taken with the water at the same level when in position (1), (2), and (3) to eliminate errors due to compression of entrapped air in jacket if any is present. Water in the cylinder, jacket, hose and burette should be at approximately the same temperature during test to eliminate errors in burette readings caused by expansion or contraction. When jacket is installed some distance from the burette leveler, and pipe (f) is used, install pipe (f) sloping upward and free from pockets which will entrap air; bends are preferable to pipe fittings. Flexible hose (g) should be heavy-wall hose, and installed so that the bending action when placed in positions (1), (2), and (3) will not change the interior volume. Install so that it will operate on long, easy curve. It is necessary to wash jacket occasionally. Keep it free of dirt and organic matter. Valve (J) is to relieve pressure on the pump when valve (D) is closed. It is obvious that valves (D) and (J) cannot both be left closed and pump running. By releasing the pressure through valve (J); pump can be left running continuously when testing cylinders--if desired. Relief valve (K) is only intended to relieve pressure on pump if valve (J) is left closed, when valve (D) is closed. It is not intended to operate continuously. Keep long full threads of test nipple, in jack head, in good condition. Nipple can be cut off and rethreaded when worn.

Figure 1., continued

jacket head as wrench.

f. Place cylinder in jacket by hoist and clamp head tight.

g. Open valve (A) until water comes out of jet cock (B). Close (B). Fill hose and burette to zero or above. Close (A).

h. Adjust water level in burette to zero by opening valve (C) with burette in position (1), with valves (E) and (J) open, (D) closed.

i. Check for leaks. If water falls below zero in burette, jacket or piping is leaking. If water rises in burette, valve (A) is leaking.

j. Close valves (E) and (J).

k. Open (D) and pump to approximately 75% of the specified test pressure (not over 90%). Close valve (D) and open valve (J). Check for leaks indicated by drop in pressure on gage. Pressure leaks inside of jacket are indicated by water rising in burette.

NOTE: Unless otherwise specified, the test pressure shall be the original factory test pressure as noted on the extinguisher, or gas cartridge or cylinder nameplate.

l. If free of leaks, close valve (J), open valve (D) and pump to the specified test pressure. Close valve (D); open valve (J).

m. Lower burette to position (2) with water in burette level with zero mark on zero adjuster (H). Hold pressure in cylinder for 30 seconds or as much longer as necessary to assure complete expansion of the cylinder.

n. Record the total expansion reading in cc.

o. Release pressure on cylinder by opening valve (E).

p. Raise burette to position (3) with water in burette level with zero mark on zero adjuster (H).

q. Record the permanent expansion reading in cc.

6.2.1.6 Safety Pressure Relief Device Test

a. Mount the device onto a suitable hydraulic test fixture, and apply the hydraulic test pressure using the applicable hydraulic test apparatus described under paragraph 6.2.1.1.a.

b. Record whether the device opens up or, when it is a frangible disc, whether it ruptures when the specified test pressure is applied. If the device fails this test, it shall be rejected.

6.2.1.7 Pressure Regulator Test

a. Mount the regulator onto a suitable hydraulic test fixture, and apply the specified hydraulic test pressure using the applicable hydraulic test apparatus described under paragraph 6.2.1.1.a.

b. Record whether the pressure setting meets specified requirements when the specified test pressure is applied.

6.2.1.8 Discharge Nozzle Test

a. Mount the nozzle onto a suitable hydraulic test fixture, and apply the specified hydraulic pressure, using the applicable hydraulic test apparatus described under paragraph 6.2.1.1.a.

b. Note and record whether the nozzle displays any leaks when the specified test pressure is applied.

6.2.2 Component Tests

a. Unless otherwise specified, the error in pressure indication of the extinguisher pressure gage, either in the "up" direction, or in the "down" direction at the indicated charging pressure, and at both ends of the operable range, shall not exceed 4 percent of the indicated charging pressure. The accuracy shall be checked against a standard pressure gage which is connected to the same pressure source as that applied to the pressure gage under test. The calibration accuracy shall be checked before any extinguisher performance tests are made.

b. The calibration of the pressure gages used during hydraulic pressure tests shall be checked against a standard pressure gage before any hydraulic tests are begun after the initial installation of the hydraulic test equipment is completed. This calibration check shall be repeated at the end of each month of accumulated testing time, except that this calibration check shall always be made at calendar intervals not exceeding one year.

c. Non-refillable carbon dioxide cartridges which are not under the jurisdiction of the Interstate Commerce Commission (ICC) (See item L - 1 under "4. REFERENCES") because of their small size and capacity, shall be certified by the extinguisher manufacturer as having been so designed and constructed that the rupture pressure is not less than 6,000 psi. These cartridges shall be provided with a safety relief appropriate for the cartridge used. This safety relief shall function at a pressure of not less than 2650 psi and not higher than five-thirds of the service pressure of the cartridge. The extinguisher manufacturer shall certify that the safety relief has been designed and tested to meet the following requirements:—

The safety relief is to be mounted in a test fixture and submitted to a bursting test in which the test pressure is to be raised rapidly to 85 percent of the upper level of the rated bursting pressure, held there for at least 30 seconds, and thereafter raised at a rate not in excess of 100 psi per minute until the safety relief functions.

d. Non-refillable carbon dioxide cartridges which come under the jurisdiction of the ICC because of their size and capacity, shall be certified by the extinguisher manufacturer as having been constructed, tested, marked, and charged in accordance with the applicable shipping container specifications of the ICC. The cartridge is also to be provided with a safety relief device as required by the ICC regulations that apply.

6.2.3 Gunfire Tests

NOTE: 1. This test is to be made on those extinguisher cylinders which are specified to be non-shatterable.
2. Ensure that no personnel is closer than 50 yards from the cylinder during the test.

a. Select at least 2 cylinders from the lot of cylinders to be evaluated.

NOTE: This lot of cylinders shall be made from the same melt of steel, and have the same heat treatment, and shall have been accepted

as meeting the requirements of the ICC Specification 3A or 3AA (or 3HT for cylinders for inside use on aircraft). (See Reference 4L.1).

b. Fit the cylinders under test with a valve and remote-indicating pressure gage assembly, so arranged as to permit the internal pressure to be measured when the valve is opened.

c. Charge the cylinder with air to the specified service pressure.

d. While under the specified service pressure, hit the cylinder with a 50-caliber, armor piercing-type projectile fired at service velocity at a range of 50 yards. Entry of the projectiles shall be into the side of the cylinder at any angle.

e. The test on one cylinder shall be performed with a straight (not tumbled) projectile.

f. The test on the second cylinder shall be performed with a tumbled projectile.

g. Record the following for each cylinder:

1) Any damage to the cylinder other than the perforations where the projectile enters and leaves the cylinder.
2) Any opening greater than 6 inches where the projectile enters and leaves the cylinder.
3) Any fragmentation occurring other than that of the primary aperture caused by the projectile.

h. This test shall be recorded as a failure if any of the conditions under 1, 2 or 3 of step g occur.

6.2.4 Hose Tests (other than hydrostatic tests)

Perform the following tests, as specified:

a. On Bromochloromethane extinguishers, test for volume swell and low temperature exposure effects as follows:

1) Volume Swell. Obtain a section of inner liner or tube stock by removing the exterior covering and all wrappings from a bromochloromethane hose sample. Immerse this specimen of inner liner in water and note its displacement. Then immerse it in bromochloromethane for a period of 24 hours at the specified temperature. After this exposure time, immerse the specimen again in water and note its displacement.
2) Low Temperature. Expose a 12-inch specimen of the hose to the specified low temperature for not less than 72 hours. Remove the hose from the cold chamber and bend it over a mandrel which is 10 times the outside diameter of the hose, and note and record any signs of cracking inside or outside.

b. On "TMB" Extinguishers, test the rubber stock hose for resistance to deterioration by trimethoxyboroxine as specified in the applicable Naval

Research Laboratory Report (See item J-10 under "4. REFERENCES") and note and record the results of the test.

c. On wheel-mounted, water-tank-type extinguishers, test for hose flexibility as follows:

1) Coil the entire hose length into a circle not more than 1 foot in diameter and place it in a cold chamber at -50°F for not less than 3 hours, with the discharge nozzle closed.
2) At the end of the cold exposure period, uncoil the hose just before removing it from the cold chamber.
3) After removing the uncoiled hose from the cold chamber, note, and record any evidence of cracks and check marks resulting from the cold flexure.

d. On dry chemical extinguishers, perform the following packed hose test:

1) Using an extinguisher charged to its exact rated capacity of dry chemical and expellant gas, operate it for a short time to expel a small quantity of the chemical.
2) Open the gas chamber charging valve and completely relieve the gas pressure. Perform this operation in such a manner as to disturb the chemical in the chamber, and in the extinguisher hose, as little as possible.
3) Repressurize the gas chamber in the normal manner to its specified initial operating pressure.
4) Open the discharge nozzle until a small quantity of chemical is discharged, and note and record the difference in time between the opening of the nozzle and the start of discharge of the dry chemical. This time difference shall not exceed 5 seconds.

6.2.5 Packed Chamber Test (Dry Chemical Extinguishers Only)

a. Charge the chamber with the maximum amount of dry chemical that can be introduced by jarring and packing.

b. Charge the chamber with the maximum allowable amount of expellant gas or with the expellant gas at the maximum allowable pressure, whichever is specified.

c. Weigh the unit and record its weight.

d. Install the unit inside an environmental test chamber and expose it to an ambient temperature of 120°F (49°C) for at least 24 hours.

e. Remove the unit from the environmental test chamber.

f. As soon as possible after removal from the environmental test chamber, record the maximum gage pressure, and operate the unit until it stops discharging chemical.

g. Weigh and record the weight of the unit after it stops discharging chemical.

6.2.6 Maximum Pressure Developed Tests

NOTE: 1. These tests shall be conducted using an extinguisher having minimum shell volume for its rated capacity. If desired, the minimum shell volume may be attained by inserting a section of wood into the container with the charge, the wood section to be sized so as to reduce the volume of the container, as measured, to the minimum volume specified.

2. The pressure gage used during these tests shall be of the remote-reading type. It shall be designed for easy reading of pressures to at least 200 psi more than the anticipated maximum pressures to be developed. It shall be connected to the container, using a drilled and tapped hole in the cap.

3. A remotely-controlled device shall be used for opening and closing the discharge nozzle. When testing chemical foam type extinguishers, a similar device shall be used for alternately inverting the extinguisher and returning it to the upright position.

a. Measure and record the volume of the extinguisher shell as it will be used during testing.

b. Perform the following tests on chemical foam and soda-acid extinguishers:

6.2.6.1 Free Discharge Test (Chemical foam and Soda-acid extinguishers)

a. Charge the extinguisher with the normal specified quantities of soda-acid, and water, or chemical charge, as applicable.

b. Install the unit in an environmental test chamber, and subject it to an ambient temperature of 70°F (21.1°C) until the temperature of the water solution (in soda-acid extinguishers, or the chemical charge in foam extinguishers), reaches 70°F, and then remove the unit from the test chamber.

c. As soon as possible after removing the unit from the test chamber, open the discharge nozzle fully by remote control, and record the maximum pressure developed within the extinguisher. This pressure shall not exceed 100 psi.

6.2.6.2 Closed Nozzle Test (Soda-Acid Extinguishers)

a. Charge the extinguisher with the maximum allowable specified quantities of soda, acid and water.

b. Install the unit in an environmental test chamber, and subject it to an ambient temperature of 120°F (49°C) until the temperature of the water reaches 120°F, and then remove the unit from the test chamber.

c. As soon as possible after removing the unit from the test chamber, operate the extinguisher by remote control in the usual manner, but keep the discharge nozzle tightly closed. Record the maximum pressure developed within the extinguisher. This pressure shall not exceed 300 psi.

6.2.6.3 Closed Nozzle Test (Chemical Foam Extinguisher)

a. Charge the extinguisher with the maximum quantities of chemical

charge allowed by the tolerances for packaging them.

b. Install the unit in an environmental test chamber, and subject it to the maximum allowable specified temperature (100°F or 120°F), until the teperature of the chemical charge reaches 100°F, or 120°F, as specified, and then remove the unit from the test chamber.

c. As soon as possible after removing the unit from the test chamber, operate the extinguisher by remote control in the usual manner, but keep the discharge nozzle tightly closed. Record the pressure developed within the extinguisher at intervals of 10 seconds for the first 5 minutes of operation, and at intervals of 30 seconds thereafter, until the maximum pressure has developed. At the end of this period, agitate the extinguisher by remote control for 3 minutes, by alternately inverting it and returning it to the upright position. This action is to be followed by a rest period of 3 minutes. Repeat this procedure until the maximum pressures developed remain stationary, and then starts to recede. Record all maximum pressures and the times at which they occur.

6.2.7 Performance Tests

6.2.7.1 Preparation for Test

a. Safety Precautions

1) Except when testing water or water-solution extinguishers (anti-freeze and loaded-stream types), all performance tests should be conducted out-of-doors to the greatest extent practicable. When performance tests must be conducted indoors, the enclosed space shall be as large as possible. This space shall be very well ventilated, in order to avoid the toxic effects which may be caused by breathing the vapors or gases liberated or produced as thermal decomposition of the extinguishing agent, or, in the case of carbon dioxide extinguishers, the loss of consciousness due to oxygen deficiency.

2) The extinguisher should be inspected and recharged immediately after each performance test. The following precautions must be observed:

a) Check the discharge nozzle, and make certain that it is not obstructed.

b) Use only those recharging materials which are specified on the extinguisher name-plate. The use of other recharging materials (this includes non-refillable gas cartridges or cylinders) may impair the efficiency, cause malfunction, or result in rupture of the extinguisher that could cause injury to the operator.

c) The pressure gage should be observed to see that the pointer indicates pressure in the operating range. Tap the gage gently to secure movement of the gage pointer as a check that the pointer is not stuck.

d) Do not recharge an extinguisher that shows obvious signs

of having developed a leak, or that it has been seriously damaged or impaired.

e) Place the extinguisher, for a period of not less than 12 hours (unless otherwise specified), in a room maintained at an ambient temperature of 70°F (21.1°C) before recharging it. The recharging shall be done at this same ambient temperature, using the exact amount of charging materials and charging pressures specified.

f) Always wear heavy rubber gloves, goggles and a heavy rubberized apron when recharging soda-acid extinguishers. The sulphuric acid could cause a serious burn.

b. Preconditioning ambient temperature

Unless otherwise specified, the fully-charged test item shall be placed in a controlled temperature test chamber for not less than 12 hours at the temperatures listed below:

Test	Test Chamber Temperature (±10%)
Nominal Temperature	70°F
High Temperature	120°F
Low Temperature*	-40°F
Storage Temperature	-80°F and + 155°F

After removal from the test chamber, the test item is to be taken to the performance test area and operated there with as little delay as possible.

c. Outdoor performance test area weather conditions

Unless otherwise specified the weather shall be fair and the temperature should preferably be at, or near, 70°F. There shall be no wind when testing the performance of those extinguishers which discharge a powder, foam, fog, gas or vapor extinguishing agent, and there shall be only a negligible wind when testing the performance of those extinguishers which discharge a liquid extinguishing agent.

d. Other preconditioning environmental conditions

When specified, the performance of the test item shall be checked immediately after it has been subjected to the following environmental conditions, as applicable:

1) Humidity
2) Salt Spray
3) Sand and Dust
4) Rain
5) Vibration

*In using CO_2 extinguishers in subzero temperatures, the valve must remain open at all times as a blockage of the discharge may occur if the extinguisher is operated intermittently unless a special low temperature change is added.

e. General Notes

1) The "gas Point" is defined as the time when the discharge changes from a liquid to a gas when testing the following types of extinguishers:

   a) Water-type (including antifreeze and loaded stream), using stored pressure or a gas cartridge as the expellant means.
   b) Soda-acid type.

2) On carbon dioxide type extinguishers, the "gas point" is defined as the time when the combined "snow" and gas discharge changes into a purely gaseous condition.
3) When testing soda-acid or chemical-foam type extinguishers equipped with a loose-type stopple, it shall be operated by slowly inverting it 180° from its normal upright position to its fully-inverted position, without impacting any part against any object.
4) When an out-of-doors performance testing site is used, choose a level open area away from construction and free of grass. The surface should preferably be hard clay, or, if available, cement or asphalt.
5) Wear gloves or arctic mittens when operating an extinguisher which has just been removed from a cold chamber.
6) Attach an identification tag to each extinguisher prior to the performance test, and record the serial number of the test item on it. If the extinguisher does not bear a serial number, assign a serial number to it.
7) The number of extinguishers of each type to be used during each test shall not be less than the following:

   a) Hand-type (Hand-carried) - 2 of each type.
   b) Back-pack type (back carried) - 2 of each type.
   c) Wheeled type (mounted on a manually-propelled wheeled carriage) - 1 of each type.
   d) Skid - (or platform) mounted type (for installation on a motor vehicle body) - 1 of each type.

8) Unless otherwise specified, the extinguisher assembly, during all performance tests, shall be in its normal operating position when it is discharging. This position shall be held throughout the specified discharge period.
9) Unless otherwise specified, the height of the extinguisher nozzle, discharge type, or horn, above the floor, or the ground, and its angle of elevation above the horizontal shall be as follows throughout the entire discharge period:

Type of Extinguisher	Approximate Position of discharge device (nozzle, horn or tube) Angle of elevation	Height above floor or ground
Water (including antifreeze and loaded stream)	45°	3 feet
Carbon dioxide	0°	3 feet
Soda-Acid	45°	3 feet
Dry Chemical	0°	3 feet
Bromochloromethane	0°	4 feet
Chemical foam	45°	3 feet
Dual "light-water" and dry chemical	0°	3 feet
Extinguisher for metal fires	0°	3 feet

10) The term "conditioned" will be used hereinafter to apply to the extinguisher immediately after it has been exposed to the specified ambient condition (temperature, humidity, salt spray, sand and dust, rain, or vibration, as applicable) for the specified exposure duration.

11) When testing bromochloromethane, and similar types of extinguishers which can discharge either a straight stream, or a fog, depending upon the nozzle setting, the effective range when discharging a fog shall be the most distant point at which a discharge of highly-atomized particles forms a pattern on a vertical wall conforming to the specified dimensions.

6.2.7.2 Procedures

NOTE: When salt spray, humidity, sand and dust, rain or vibration tests are specified, they shall be made after the applicable 70°F performance test described below has been made, unless otherwise specified.

6.2.7.2.1 Water Type Extinguishers (including anti-freeze and loaded stream), Using Stored Pressure or Gas Cartridge Expellant -

a. 70°F Performance

1) Weight the fully-charged extinguisher.
2) Condition at 70°F.
3) Discharge the extinguisher completely to the "gas point" and measure and record the following:

a) Time required to reach the specified range after starting discharge.
b) Time during which specified maximum range is maintained.

c) Time during which the specified shorter range is maintained after the maximum range time has elapsed.
d) Total discharge time to the "gas Point".

4) Weigh the fully-discharged extinguisher.

b. -40°F Performance (anti-freeze and loaded stream types only):

1) Weigh the fully-charged extinguisher
2) Condition at -40°F
3) Repeat step a under 6.2.7.2.1

c. + 120° Performance:

1) Weigh the fully-charged extinguisher
2) Condition at + 120°F
3) Perform step a under 6.2.7.2.1

6.2.7.2.2 Water Type, Back-Pack Extinguishers-

a. 125°F Performance:

1) Weigh the fully-charged extinguisher.
2) Condition at + 125°F.
3) Operate the handpump until the extinguisher is fully discharged and measure and record the following:

a) Time required to fully discharge
b) Maximum horizontal distance of the discharge stream
c) The weight of the fully-discharged extinguisher

b. -40°F Performance :

1) Charge the extinguisher with the specified amount of anti-freeze.
2) Weigh the fully-charged extinguisher.
3) Condition at -40°F.
4) Repeat steps a.3.a through a.3.c under paragraph 6.2.7.2.2.

6.2.7.2.3 Soda-Acid Type Extinguishers-

a. 70°F Performance :

1) Weigh the fully-charged extinguisher.
2) Condition at 70°F.
3) Discharge the extinguisher to the "gas point".
4) Take, and identify, 3 samples of the discharge stream, one at the start, one half-way through the discharge period, and one near the end of the discharge period.
5) Measure and record the following:

DISCHARGE DURATION TEST LIMITS

Extinguisher Size, Gallons	Discharge Duration, Seconds	
	Minimum	Maximum
1 1/4	25	35
1 1/2	25	50
2 1/2	45	65
17	125	180
33	175	255

DISCHARGE RANGE TEST LIMITS

Extinguisher Size Gallons	Minimum Discharge Distance, Feet	Minimum Time for Specified Minimum Discharge Distance To be Attained Following Opening of Stopple, Seconds	Minimum Time Minimum Discharge Distance is Maintained, Seconds
1 1/4	30	5	20
1 1/2	30	5	20
2 1/2	30	5	40
17	45	8	115
33	50	10	160

6) Weigh the fully-discharged extinguisher.
7) Analyze and record the acidity of the 3 samples taken under step 4.

6.2.7.2.4 Carbon Dioxide Extinguishers -

a. 70°F Performance:

1) Weigh the fully-charged extinguisher.
2) Condition at 70°F.
3) Discharge the extinguisher fully to the "gas point", as defined in paragraph 6.2.7.1(e) and perform the following:

a) Measure and record the discharge time
b) Weigh the fully-discharged extinguisher

b. -40°F Performance:

1) Weigh the fully-charged extinguisher.
2) Condition at -40°F.
3) Perform the operations described under step a. 3, paragraph 6.2.7.2.4.

c. Intermittent 70°F Operation:

1) Weigh the fully-charged extinguisher.
2) Condition at 70°F.
3) Open and close the discharge valve for the specified time intervals and repeat this cycle until the "gas point" is reached.
4) Weigh the fully-discharged extinguisher.

d. Intermittent 120°F Operation:

1) Weigh the fully-charged extinguisher.
2) Condition at 120°F.
3) Perform the operations described under steps c.3 and c.4, paragraph 6.2.7.2.4 and note the discharge valve performance.

6.2.7.2.5 Dry Chemical Extinguishers -

a. 70°F Performance:

1) Weigh the fully-charged extinguisher.
2) Condition at 70°F.
3) Discharge the dry chemical, for the specified period of time, into a suitably-sized box, and then direct the remainder of the discharge stream elsewhere until the first discharge "sputtering", or noticeable thinning of the dry chemical stream is observed.
4) Perform the following operations:

a) Measure the range for the bulk of the discharge (that portion which is discharged into the box).
b) Measure the range for the remainder of the discharge.
c) Weigh the dry chemical discharged into the box.
d) Weigh the discharged extinguisher.

b. Thirty-Day 120°F Performance:

1) Weigh the fully-charged extinguisher.
2) Condition at 120°F for 30 days.
3) Perform the operations described under steps a.3 and a.4, paragraph 6.2.7.2.5.

c. -40°F Performance:

1) Weigh the fully-charged extinguisher.
2) Condition at -40°F.
3) Perform the operations described under steps a.3 and a.4, paragraph 6.2.7.2.5.
4) Observe if any of the following conditions occur during the extinguisher discharge:

a) Freezing of nozzle
b) Substantial loss in hose flexibility

c) Difficulty in operating the nozzle.

d. Intermittent 70°F Operation :

1) Weigh the fully-charged extinguisher.
2) Condition at 70°F.
3) Open and close the discharge valve or nozzle for the specified time intervals, and repeat this cycle until discharge "sputtering" or noticeable thinning of the dry chemical stream is observed.
4) Perform the following:

a) Note the total number of ON-OFF cycles.
b) Measure the time interval between the time the discharge valve or nozzle is opened, and the time when the dry chemical starts to discharge.
c) Weigh the discharged extinguisher.

e. Intermittent -40°F operation :

1) Weigh the fully charged extinguisher.
2) Condition at -40°F.
3) Perform the operations described under steps d.3 and d.4 under paragraph 6.2.7.2.5.

6.2.7.2.6 Vaporizing Liquid (Including Bromochloromethane) Extinguishers-

a. 70°F Performance (Nozzle in Straight Stream Position):

1) Weigh the fully-charged extinguisher.
2) Condition at 70°F.
3) Discharge the extinguisher completely, and perform the following:

a) Measure the maximum horizontal distance of the steam range.
b) The time during which the stream range is not less than the specified range.
c) Weigh the fully-discharged extinguisher.

b. 70°F Performance (Nozzle in Fog Position):

1) Weigh the fully-charged extinguisher.
2) Condition at 70°F.
3) Discharge the extinguisher completely, and perform the following:

a) Measure the most distant range at which the specified fog pattern will appear on a vertical wall (See item e.11 under paragraph 6.2.7.1).
b) Weigh the fully-discharged extinguisher.

c. -40°F Performance (Nozzle in fog position):

1) Weigh the fully-charged extinguisher.
2) Condition at -40°F.
3) Perform the operations described under step b.3, under paragraph 6.2.7.2.6.

d. 120°F Performance (Nozzle in fog position):

1) Weigh the fully-charged extinguisher.
2) Condition at 120°F.
3) Perform the operations described under step b.3, under paragraph 6.2.7.2.6.

e. -40°F Performance (Nozzle in straight stream position):

1) Weigh the fully charged extinguisher.
2) Condition at -40°F.
3) Perform the operations described under step a.3, under paragraph 6.2.7.2.6.

f. 120°F Performance (Nozzle in straight stream position):

1) Weigh the fully-charged extinguisher.
2) Condition at 120°F.
3) Perform the operations described under step a.3, under paragraph 6.2.7.2.6.

6.2.7.2.7 Chemical Foam Extinguishers

a. 70°F Performance :

1) Weigh the fully-charged extinguisher.
2) Condition at 70°F.
3) Discharge the extinguisher completely, and collect the discharge foam into a waterproof container of suitable size. Typical dimensions are shown in the following table.

DISCHARGE CAPACITY TEST

Extinguisher Size, Gallons	Minimum Volume Discharged, Gallons	Container Inside Dimensions, Inches
1 1/4, 1 1/2	9	15 1/4 diameter by 30 High
2 1/2	18	15 1/4 diameter by 30 High
5	35	24 diameter by 30 High
17	125	48 diameter or square by 30 High
33	250	60 diameter or square by 48 High

4) Perform the following:

a) Measure the discharge range and the discharge duration. Typical specified ranges and discharge times are shown in the following table:

DISCHARGE RANGE AND DURATION LIMITS

Extinguisher Size, Gallons	Bulk of Discharge Range, Feet	Bulk of Discharge Minimum Time, Seconds	Maximum Duration of Discharge, Seconds
1 1/4, 1 1/2	25+	20	50
2 1/2	25+	40	90
5	25+	40	120
17	30 to 55	60	200
33	30 to 60	120	400

b) Note the size of the bubbles in the foam collected.
c) Measure the volume of the foam collected:

(1) Immediately after discharge.
(2) 15 minutes after discharge, without disturbing the foam.

d) Weigh the fully-discharged extinguisher.

6.2.7.2.8 Twin "Light-Water" and Dry Chemical Extinguisher -

a. 70°F Performance:

1) Weigh the fully-charged combination "light-water" and dry chemical extinguisher.
2) Condition at 70°F.
3) Discharge the "light-water" extinguisher fully and perform the following:

a) Measure the rate of initial discharge in gpm.
b) Measure the minimum-maximum expansion of the foam and the foam drainage time.
c) Measure the nozzle ground pattern minimum-maximum reach and width.
d) Weigh the twin extinguisher assembly after the "Light-Water" has been fully discharged.

4) Discharge the dry chemical extinguisher fully, and perform the following:

a) Measure the initial rate of discharge in pounds per second.

b) The minimum-maximum reach of the powder stream.
c) Weigh the twin extinguisher assembly after the dry chemical powder has been fully discharged.

6.2.7.2.9 Metal Fire Extinguishers (Including "TMB) Extinguisher) -

a. 70°F Performance (Nozzle in straight stream position):

1) Weigh the fully-charged extinguisher
2) Discharge the extinguisher fully, and perform the following:

a) Measure the discharge range and the discharge duration
b) Weigh the fully-discharged extinguisher

b. 70°F Performance (Nozzle in Fan Stream Position) :

1) Weigh the fully-charged extinguisher
2) Condition at 70°F
3) Discharge the extinguisher fully, and perform the following:

a) Measure the discharge range and width, and the discharge duration.
b) Weigh the fully-discharged extinguisher.

6.2.7.2.10 Monobromotrifluoromethane Extinguishers -

a. 70°F Performance :

1) Weigh the fully-charged extinguisher
2) Condition at 70°F
3) Discharge the extinguisher completely:

a) Measure and record the discharge time
b) Weigh the fully-charged extinguisher

b. -40°F Performance:

1) Weigh the fully-charged extinguisher.
2) Condition at -40°F.
3) Perform operation described under item a.3, paragraph 6.2.7.2.10.

c. 120°F Performance:

1) Weigh the fully-charged extinguisher.
2) Condition at 120°F.
3) Perform operation described under item a.3, paragraph 6.2.7.2.10.

d. Intermittent 70°F operation (same as 6.2.7.2.10a)

e. Intermittent -40°F operation (same as 6.2.7.2.10b)
f. Intermittent 120°F operation (same as 6.2.7.2.10c)

6.2.8 Leakage Tests

NOTE: These tests are intended to uncover slow gas or air leaks which may not be found during specified hydrostatic pressure tests.

6.2.8.1 Stored Pressure, Water Type Extinguisher

a. Fully charge the extinguisher with the specified amount of water, or water-solution, as applicable. Pressurize it at room temperature to the specified charging pressure, and record the extinguisher pressure gage reading, and the room temperature.

b. Keep the fully-charged and pressurized extinguisher at room temperature for 7 days. At the end of this period, perform the following:

1) Make certain that the room temperature is the same as, or lower than, the room temperature which existed at the start of the test.
2) Record the pressure reading on the extinguisher pressure gage.

6.2.8.2 Carbon Dioxide Extinguisher

a. Remove the horn or the horn-and-hose assembly, as applicable, from the extinguisher, and fully charge the extinguisher to its specified filling weight. Submerge the extinguisher for not less than 4 hours under water or other suitable test liquid, maintained at a temperature between 90°F and 110°F.

b. Place transparent bell jars over the extinguisher valves in a manner to collect, and disclose the presence of escaping carbon dioxide gas. The 4 hour test period shall begin after all air bubbles appearing in the bell jars have been removed.

c. Examine the bell jars at the end of the above-described 4 hour period, and record the presence of any carbon dioxide gas in them.

6.2.8.3 Dry Chemical Extinguishers

a. Install the extinguisher in a room maintained at a constant temperature of about 70°F.

b. Fully charge the extinguisher with the specified amount of dry chemical and, on pressurized extinguishers, with the specified gas or air pressure.

c. Record the gas or air pressure reading on the extinguisher pressure gage.

d. Actuate the extinguisher to its operating condition in the normal manner, except that the dry-chemical flow control shut-off nozzle is to remain closed.

e. After a period of 1 hour after it has been actuated as described

under step d above, note and record the gas or air pressure on the extinguisher pressure gage.

f. Apply a positive pressure of 3 psi to the outlet side of the shut-off valve. The valve shall not show any leakage when tested with a suitable leak detector device.

6.2.8.4 Vaporizing Liquid Extinguishers (including Bromochloromethane)

a. Install the extinguisher in a room maintained at a constant temperature of about 70°F.

b. Fully charge the extinguisher to its specified stored-condition pressure.

c. Record the stored pressure reading on the extinguisher pressure gage.

d. 24 hours after charging as described under step b above, record the reading on the extinguisher pressure gage.

6.2.8.5 Gas Cartridges or Cylinders Used in Extinguishers as the Expellant Means

a. Submerge the charged device under water or other suitable test liquid, maintained at a temperature between 90°F and 110°F, for a period of not less than 4 hours.

b. Place a transparent bell jar over the device in a manner to collect and disclose the presence of escaping gas. The four hour test period shall begin after all air bubbles appearing in the bell jar have been removed.

c. At the end of the four hour test period, examine and record the presence of any gas in the bell jar.

6.2.9 Vibration Test

Unless otherwise specified, perform the following on each hand-portable extinguisher under test, (except back-pack extinguishers using rubberized fabric or similar materials to store the extinguishing agent) using a suitable vibration test stand.

NOTE: For these tests, amplitude is defined as the maximum displacement of sinusoidal motion from the position of rest, or one-half of the total table displacement. Resonance is defined as the maximum magnification of the applied vibration.

a. Mount the extinguisher in its own bracket, if one is provided. Otherwise, mount it in a standard mounting fixture, and secure it to the test fixture of the vibration test apparatus in a vertical position. The extinguisher shall be fully charged, except that, on dry chemical extinguishers, the powder chamber shall remain unpressurized.

b. Subject the extinguisher to the following variable frequency and endurance tests in each of three rectilinear orientation axes, horizontal, lateral, and vertical. Both variable frequency and endurance tests are to be completed in one plane of vibration before proceeding with the test in another plane.

1) Variable frequency test:

Vibrate the test item from 10 cycles per second to 60 cycles per second in discrete frequency intervals of 2 cycles per second, at the table displacement indicated in the Table V below. The vibration at each discrete frequency is to be maintained for 5 minutes.

2) Endurance test:

Vibrate the test item for a period of 2 hours at the frequency which produces maximum resonance, as determined in the variable frequency test. If no resonance is observed in the variable frequency test, vibrate it at a frequency of 60 cycles per second at the table displacement indicated in Table V.

TABLE V

AMPLITUDE OF VIBRATION

Frequency of Vibration, Cycles Per Second	Table Displacement, Plus or Minus, Inches	Amplitude, Plus, or Minus, Inches
10-19	0.060 ± 0.006	0.030 ± 0.006
20-30	0.040 ± 0.004	0.020 ± 0.004
40-60	0.020 ± 0.002	0.010 ± 0.002

c. Remove the extinguisher from the vibration test stand and subject it to the applicable performance tests under paragraph 6.2.6.

d. Subject carbon dioxide extinguishers to the leakage test described under paragraph 6.2.8.2.

6.2.10 Transportability

6.2.10.1 Preparation for Test

a. Pack and package the complete test item in conformity with MIL-P-116, unless otherwise specified.

NOTE: Use method 1 of MIL-P-116 for an overseas shipment package, and Method 111 for a domestic shipment package.

b. On wheeled, or skid, or platform mounted extinguishers, cushion, block or brace the test item in conformity with MIL-STD-1186 unless otherwise specified.

c. Have the test item in the fully-charged condition, or in the uncharged condition, whichever is specified in the procurement document.

6.2.10.2 Test Conduct

6.2.10.2.1 Eight-Corner Drop Test

NOTE: Perform this test only on packs not exceeding 200 pounds, and with no dimension greater than 60 inches, except that items having a net weight exceeding 100 pounds and which are secured to the base of the container, shall be tested per paragraph 6.2.10.2.2.

a. Drop the rectangular container once on each of the eight corners from a free-fall height of 30 inches.

b. Unpack the extinguisher and perform the following:

1) Visually inspect the packaged equipment for signs of damage.
2) Repeat the applicable performance test (6.2.7) and leakage test (6.2.8).
3) Record any failures.

6.2.10.2.2 Cornerwise, and Pendulum-Impact Test

NOTE: Perform this test only on packs exceeding 200 pounds, or having any dimension greater than 60 inches, or on items having a net weight exceeding 100 pounds which are secured to the base of the container.

a. Drop the container on each of 2 diagonally opposite corners of the bottom through the free-fall height shown in Table VI below. Follow this with step b.

TABLE VI

DROP TEST

Gross Weight of Container and Contents, pounds	Cornerwise Drop Test Height of Drop in Inches	Pendulum Impact Test Distance of Swing in Inches
Through 250	30	14
Over 250 thru 500	24	11
Over 500 thru 1000	18	8
Over 1000	12	5

b. Support the item with suitably sized ropes so that it can swing freely as a pendulum through the distance shown in Table VI. Cause the item to impact once on each of 2 opposite ends.

c. Unpack the extinguisher and perform the following:

1) Visually inspect the packaged equipment for signs of damage.
2) Repeat the applicable performance test (6.2.7) and leakage test (6.2.8).
3) Record any failures.

1) Variable frequency test:

Vibrate the test item from 10 cycles per second to 60 cycles per second in discrete frequency intervals of 2 cycles per second, at the table displacement indicated in the Table V below. The vibration at each discrete frequency is to be maintained for 5 minutes.

2) Endurance test:

Vibrate the test item for a period of 2 hours at the frequency which produces maximum resonance, as determined in the variable frequency test. If no resonance is observed in the variable frequency test, vibrate it at a frequency of 60 cycles per second at the table displacement indicated in Table V.

TABLE V

AMPLITUDE OF VIBRATION

Frequency of Vibration, Cycles Per Second	Table Displacement, Plus or Minus, Inches	Amplitude, Plus, or Minus, Inches
10-19	0.060 ± 0.006	0.030 ± 0.006
20-30	0.040 ± 0.004	0.020 ± 0.004
40-60	0.020 ± 0.002	0.010 ± 0.002

c. Remove the extinguisher from the vibration test stand and subject it to the applicable performance tests under paragraph 6.2.6.

d. Subject carbon dioxide extinguishers to the leakage test described under paragraph 6.2.8.2.

6.2.10 Transportability

6.2.10.1 Preparation for Test

a. Pack and package the complete test item in conformity with MIL-P-116, unless otherwise specified.

NOTE: Use method 1 of MIL-P-116 for an overseas shipment package, and Method 111 for a domestic shipment package.

b. On wheeled, or skid, or platform mounted extinguishers, cushion, block or brace the test item in conformity with MIL-STD-1186 unless otherwise specified.

c. Have the test item in the fully-charged condition, or in the uncharged condition, whichever is specified in the procurement document.

6.2.10.2 Test Conduct

6.2.10.2.1 Eight-Corner Drop Test

NOTE: Perform this test only on packs not exceeding 200 pounds, and with no dimension greater than 60 inches, except that items having a net weight exceeding 100 pounds and which are secured to the base of the container, shall be tested per paragraph 6.2.10.2.2.

a. Drop the rectangular container once on each of the eight corners from a free-fall height of 30 inches.

b. Unpack the extinguisher and perform the following:

1) Visually inspect the packaged equipment for signs of damage.
2) Repeat the applicable performance test (6.2.7) and leakage test (6.2.8).
3) Record any failures.

6.2.10.2.2 Cornerwise, and Pendulum-Impact Test

NOTE: Perform this test only on packs exceeding 200 pounds, or having any dimension greater than 60 inches, or on items having a net weight exceeding 100 pounds which are secured to the base of the container.

a. Drop the container on each of 2 diagonally opposite corners of the bottom through the free-fall height shown in Table VI below. Follow this with step b.

TABLE VI

DROP TEST

Gross Weight of Container and Contents, pounds	Cornerwise Drop Test Height of Drop in Inches	Pendulum Impact Test Distance of Swing in Inches
Through 250	30	14
Over 250 thru 500	24	11
Over 500 thru 1000	18	8
Over 1000	12	5

b. Support the item with suitably sized ropes so that it can swing freely as a pendulum through the distance shown in Table VI. Cause the item to impact once on each of 2 opposite ends.

c. Unpack the extinguisher and perform the following:

1) Visually inspect the packaged equipment for signs of damage.
2) Repeat the applicable performance test (6.2.7) and leakage test (6.2.8).
3) Record any failures.

6.2.11 Safety

a. Determine the safety of the test item as described in the applicable sections of MTP 10-2-508.

b. Record any safety hazards observed during the conduct of the test including the following:

1) Any sharp protrusions in the extinguisher assembly which could constitute a maintenance or operational hazard.
2) Lack of any mounting or control features which are needed to protect the operator during operation or maintenance.
3) Deviations from Safety Precautions of steps a.1 and a.2 of paragraph 6.2.7.1.
4) Inadequate ventilation in testing area.

6.2.12 Maintainability and Reliability Evaluation

Evaluate the maintenance-related factors of the test item as described in MTP 10-2-507 with emphasis on the following:

a. Organizational (O), Direct Support (F), and General Support (H) Maintenance requirements.
b. Operator through General Support Maintenance Literature.
c. Repair parts.
d. Tools.
e. Test and handling equipment.
f. Calibration and maintenance facilities.
g. Personnel skill requirements.
h. Maintainability.
i. Reliability.
j. Availability.

6.2.13 Human Factors Evaluation

This subtest is conducted to evaluate the man-item relationship during normal extinguisher use, and to compare the test item with a standard or control extinguisher as to operational characteristics. Comparisons between the characteristics of the test and standard extinguishers will be considered in determining the suitability of the extinguisher. Where test standards do not exist, suitability of the extinguisher will be based upon the observations and comments of the test supervisory personnel. Perform the following:

a. Throughout all testing, record the operator's comfort, ease and capability to operate the extinguisher, including those tests where the wearing of gloves or arctic mittens is specified.

b. Observe and record any difficulties in operating controls or in reading pressure gages. Determine and record the applicability, accuracy, practicability, and legibility of instruction plates and instructional materials.

c. Observe and record the relative ease in manipulating the extinguisher discharge hose.

6.2.14 Value Analysis

Determine whether the item has any nonfunctional, costly, or "nice-to-have" features as stated in USATECOM Regulation 700-1, as follows:

a. During operation and maintenance of the extinguisher, observations shall be made to determine whether the extinguisher incorporates any features that could be eliminated without compromising its performance, reliability, durability or safety.

b. During the conduct of the test, the users will be informally questioned regarding any features of the extinguisher that may be eliminated without decreasing the functional value of the extinguisher. All user comments regarding value analysis will be recorded in the daily log.

c. The test team members will study the extinguisher during use, and will comment separately in the daily log on elimination of unnecessary features, using their experience and background with respect to value analysis.

6.3 TEST DATA

NOTE: The test requirements of section 3 and 4 of the procurement specification shall be met.

6.3.1 Preparation for Test

6.3.1.1 Initial Inspection

Record the following:

a. Data collected as described in the applicable sections of MTP 10-2-508.

b. Evidence of packaging damage or deterioration.

c. Identification markings:

1) Name of contractor
2) Number and date of contract
3) Date of manufacture
4) Other pertinent markings

d. For each shipping package: (Including accessories and separately-packaged extinguisher charging materials).

1) Contents
2) Weight, in pounds
3) Overall dimensions, in feet and inches of:

a) Length
b) Width
c) Height

4) Cubage in ft^3

e. For the entire test item, after assembly:

1) Weight, in pounds
2) Cubage, in ft^3

f. Defects in:

1) Material
2) Construction
3) Workmanship

g. Evidence of damage.
h. Evidence of wear.
i. Presence of:

1) Identification plate, showing model or type, and serial number.
2) Caution instructions.
3) Service instructions (operating, maintenance and recharging).
4) Technical literature.
5) Visible seals to indicate any tampering with a pressurized gas cartridge or cylinder.
6) Means to prevent inadvertent pressurization of the extinguisher.

j. Adequacy of guards or shields to protect carbon dioxide cartridges or cylinders.
k. Results of inspection of compressed gas cylinders.
l. For recharge materials:

1) Defects in:

a) Manufacturing
b) Material
c) Workmanship

2) Evidence of damage.
3) Adequacy of recharging instructions appearing on or in each recharge package.

6.3.1.2 Physical Characteristics

Record the following:

a. Model or type, and serial number.
b. For individual test item components and complete-assembly test item:

1) Nomenclature
2) Weight in pounds
3) Length, height and width, feet and inches

4) Diameter of inlet pipe, in inches
5) Diameter of outlet pipe, in inches
6) Diameter of pressure gage connections, in inches

c. Magnetic permeability, when applicable.

6.3.1.3 Operator Training and Familiarization

Record the following for personnel performing tests:

a. Draft technical manuals made available for study, and the adequacy of manuals for training purposes.
b. Amount of time, and type of training or familiarization required for each member of the test team.
c. Difficulties encountered during training and familiarization.

6.3.2.1 Hydrostatic Strength Tests

Record the following for each test performed:

a. Rate of rise of applied hydrostatic pressure in psi/minute
b. Maximum hydrostatic pressure in psi
c. Duration of maximum applied pressure in minutes

6.3.2.1.1 Extinguisher Shell Test (Except Compressed Gas Shells)-

Record the following as applicable:

a. Leakage
b. Distortion under pressure
c. Distortion with pressure removed

6.3.2.1.2 Discharge or Flood Valve Tests -

Record valve leakage, if applicable

6.3.2.1.3 Extinguisher Hose Assemblies Tests -

Record the following, as applicable:

a. Test condition (normal temperature, post high temperature, post low temperature, post nozzle open-close).
b. For temperature extreme tests:

1) Temperature during exposure in °F
2) Exposure time in hours

c. Number of times the nozzle was turned ON-OFF.
d. For all tests, as applicable:

1) Distortion

2) Leakage
3) Pressure drop

6.3.2.1.4 Carbon Dioxide Extinguisher Shell, and Refillable Compressed Gas Cartridge or Cylinder Test -

Record the following:

a. For preparation for test:

1) Physical damage
2) Exterior corrosion
3) Results of the hammer test

b. For test conduct:

1) Test pressure in psi
2) Time pressure is applied in seconds
3) Total expansion (under pressure) of the cylinder in cc
4) Permanent expansion (pressure released) of the cylinder in cc

6.3.2.1.5 Safety Pressure Relief Device Test -

a. Pressure applied in psi
b. If device:

1) Opens at proper pressure per valves
2) Ruptures at proper pressure for fragile disc

6.3.2.1.6 Pressure Regulator Test -

Record the following:

a. Pressure applied in psi
b. Whether pressure setting meets requirements

6.3.2.1.7 Discharge Nozzle Test -

Record the following:

a. Pressure applied in psi
b. Evidence of leaks

6.3.2.2 <u>Component Tests</u>

Record the following:

a. Calibration accuracy of the extinguisher pressure gage.
b. Calibration accuracy of the pressure gage used during hydraulic pressure test, including the calibration date.
c. Presence of the extinguisher manufacturer's certification that

non-refillable carbon dioxide cartridges which are not under the jurisdiction of the Interstate Commerce Commission meet the specified requirements.

d. Presence of the extinguisher manufacturer's certification that non-refillable carbon dioxide cartridges which come under the jurisdiction of the Interstate Commerce Commission, meet the applicable ICC Shipping container specifications.

6.3.2.3 Gunfire Tests

Record the following for each extinguisher tested:

a. Projectile used, (straight, tumbled).

b. Any damage to the cylinder other than the performations where the projectile enters and leaves the cylinder.

c. Any opening greater than 6 inches where the projectile enters and leaves the cylinder.

d. Any fragmentation occurring other than that at the primary aperture caused by the projectile.

6.3.2.4 Hose Tests (Other than Hydrostatic Tests)

Record the following:

a. For Bromochloromethane Extinguishers:

1) For volume swell:

a) Displacement of specimen before immersion
b) Displacement of specimen after immersion

2) For low temperature:

a) Test temperature in °F.
b) Sign of cracking inside or outside the hose

b. On "TMB" Extinguishers, record the results of the test for resistance to deterioration by trimethoxyboroxine.

c. On wheel-mounted, water-tank, type extinguishers, record the results of the flexibility test.

d. On dry chemical extinguishers, record the results of the packed hose test.

6.3.2.5 Packed Chamber Test (Dry Chemical Extinguishers Only)

Record the following:

a. The weight of the fully-charged extinguisher.

b. The ambient temperature inside the environmental test chamber, and the duration of time that the extinguisher is exposed to this temperature.

c. The maximum extinguisher gage reading immediately after the extinguisher is removed from the test chamber.

d. The weight of the extinguisher after it has stopped discharging chemicals.

6.3.2.6 Maximum Pressure Developed Tests

6.3.2.6.1 Free Discharge Tests (Soda-Acid and Chemical Foan Extinguishers) -

Record the following for each extinguisher tested:

a. Extinguisher test volume in cc.
b. Weight, as applicable, in pounds of:

1) Soda, acid and water or water solution.
2) Chemical charge.

c. Temperature, just prior to removal from the test chamber, in °F of:

1) Water solution of soda acid extinguishers
2) Chemical charge of chemical foam extinguishers

d. Maximum pressure developed in the extinguisher in psi.

6.3.2.6.2 Closed Nozzle Test (Soda-Acid Type Extinguishers) -

Record the following for each extinguisher tested:

a. Extinguisher test volume in cc.
b. Weight of the soda, water and acid, or water solution in pounds.
c. Temperature of water, or water solution just prior to removal from the test chamber in °F.
d. Maximum pressure developed in the extinguisher in psi.

6.3.2.6.3 Closed Nozzle Test (Chemical Foam Type Extinguishers) -

Record the following for each extinguisher tested:

a. Extinguisher test volume in cc.
b. Weight of the chemical charge in ounces.
c. Temperature of the chemical charge just prior to removal from the test chamber in °F.
d. Pressure developed, during operation, within the extinguisher in psi at:

1) Each 10 seconds for first five minutes after start of operation.
2) Each 30 seconds thereafter until maximum pressure is developed.

e. For each agitation cycle:

1) Cycle number
2) Maximum pressure developed in psi
3) Time of maximum pressure in minutes and seconds

6.3.2.7 Performance Tests

Record the following prior to conducting any of the performance tests:

a. The reading of the extinguisher pressure gage.
b. The pre-conditioning ambient temperature, and the duration of exposure to this temperature.
c. When testing outdoors, the outdoor temperature, the intensity and direction of any wind, and the ambient humidity, sand and dust, salt spray, and rain, as applicable.
d. The height of the extinguisher nozzle, discharge tube or horn, above the floor or ground, and its angle of elevation above the horizontal.

6.3.2.7.1 Water Type Extinguishers (including antifreeze and loaded-stream) Using Stored Pressure or Gas Cartridge Expellant -

Record the following for each specified environmental condition:

a. Weight of the fully-charged extinguisher.
b. Weight of the fully-discharged extinguisher.
c. Time taken to discharge to the "gas point".
d. Time to reach specified range.
e. Time during which specified maximum range is maintained.
f. Time during which the specified shorter range is maintained after the maximum range time has elapsed.

6.3.2.7.2 Water Type Back-Pack Extinguishers -

Record the following at the applicable pre-conditioning temperatures:

a. Weight of fully-charged extinguishers
b. Weight of fully-discharged extinguishers
c. Time to fully discharge
d. Maximum horizontal distance of the discharge stream

6.3.2.7.3 Soda-Acid Type Extinguishers -

Record the following at the specified pre-conditioning temperatures:

a. Weight of fully-charged extinguisher
b. Weight of fully-discharged extinguisher
c. Time to reach the "gas point"
d. Discharge distances at specified times after opening of stopple
e. Time during which specified discharge distance is maintained
f. Degree of acidity of the discharge stream.

6.3.2.7.4 Carbon Dioxide Extinguishers -

Record the following at each of the specified pre-conditioning temperatures; for both continuous and intermittent operation:

a. Weight of fully-charged extinguisher
b. Weight of fully-discharged extinguisher
c. Time to reach "gas point"

6.3.2.7.5 Dry Chemical Extinguishers -

Record the following at each of the specified pre-conditioning temperatures, for both continuous and intermittent operation:

a. Weight of fully-charged extinguisher.
b. Weight of fully-discharged extinguisher.
c. The specified discharge time for the bulk of the dry chemical.
d. The range for the bulk of the discharge (that portion which is discharged into the box).
e. The range of the remainder of the discharge.
f. The weight of the dry chemical discharged into the box.
g. During the -40°F performance test, record the following:

1) Freezing of the nozzle
2) Any substantial loss in hose flexibility
3) Any difficulty in operating the nozzle

h. During the specified 70°F and -40°F intermittent performance tests, record the following:

1) The number of ON-OFF cycles of opening and closing of the nozzle until discharge "sputtering" or noticeable thinning of the dry chemical stream is observed.
2) The time interval between the time the discharge valve or nozzle is opened, and the time when the dry chemical starts to discharge.

6.3.2.7.6 Vaporizing Liquid (including Bromochloromethane) Extinguishers -

Record the following at each of the specified pre-conditioning temperatures:

a. The weight of the fully-charged extinguisher.
b. The weight of the fully-discharged extinguisher.
c. When the nozzle is in the straight stream position, record the following:

1) The maximum horizontal distance of the stream range.
2) The time during which the stream range is not less than the specified range.

d. When the nozzle is in the fog position, record the most distant range at which the specified fog pattern will appear on a vertical wall.

6.3.2.7.7 Chemical Foam Extinguishers

Record the following:

a. Weight of the fully-charged extinguisher
b. Weight of the fully-discharged extinguisher
c. The discharge range and discharge duration
d. The size of the foam bubbles collected
e. The volume of the foam collected:

1) Immediately after discharge
2) 15 minutes after discharge, without disturbing the foam

6.3.2.7.8 Twin "light-water" and Dry Chemical Extinguishers

Perform the following:

a. Weight of the fully-charged twin extinguisher.
b. Weight of the twin extinguisher after fully discharging the "Light-Water" extinguisher.
c. Weight of the twin extinguisher after having fully discharged both extinguishers.
d. When discharging the "Light-Water" extinguisher, record the following:

1) The rate of initial discharge in gpm.
2) The minimum-maximum expansion of the foam, and the foam drainage time.
3) The nozzle ground pattern minimum-maximum reach and width.

e. When discharging the dry chemical extinguisher, record the following:

1) The initial rate of discharge in pounds per second
2) The minimum-maximum reach of the powder stream

6.3.2.7.9 Metal Fire Extinguishers

Record the following:

a. Weight of the fully-charged extinguisher.
b. Weight of the fully-discharged extinguisher.
c. When the nozzle is in the straight stream position, record the discharge range and discharge duration.
d. When the nozzle is in the fan stream position, record the discharge range, discharge width, and discharge duration.

6.3.2.7.10 Bromotrifluoromethane

Record the following:

a. The weight of the fully-charged extinguisher
b. The weight of the fully-discharged extinguisher
c. Time to discharge contents of the cylinder

6.3.2.8 Leakage Tests

6.3.2.8.1 Stored Pressure, Water Type Extinguisher -

Record the following:

a. Date extinguisher was fully charged in day, month, year
b. Pressure gage reading:

1) Date of step a
2) Seven days after step a

c. Storage room temperature, in °F:

1) Date of step a
2) Seven days after step a

6.3.2.8.2 Carbon Dioxide Extinguisher -

Record the following:

a. Temperature of liquid immersion both in °F.
b. Time from immersion to removal of air bubbles in minutes
c. Presence of carbon dioxide in bell jars

6.3.2.8.3 Dry Chemical Extinguishers -

Record the following:

a. Test room temperature in °F.
b. Extinguisher pressure gage reading:

1) Prior to actuation
2) After one (1) hour of actuation

c. Evidence of leakage of the closed shut-off valve

6.3.2.8.4 Vaporizing Liquid Extinguishers (Including Bromochloromethane) -

Record the following:

a. Test room temperature in °F.
b. Extinguisher pressure gage reading:

1) At start of storage period
2) After twenty-four (24) hours of storage

6.3.2.8.5 Gas Cartridges or Cylinders Used as the Expellant Means -

Record the following:

a. Temperature of liquid immersion both in °F.
b. Time from immersion to removal of air bubbles in minutes
c. Presence of gas in bell jar

6.3.2.9 Vibration Tests

Record the following for each extinguisher tested:

a. Type extinguisher tested.
b. Performance data collected as described in the applicable section of paragraph 6.2.7.
c. Carbon dioxide leakage data collected as described in paragraph 6.2.7.2., when required.

6.3.2.10 Transportability

Record the following for each extinguisher tested:

a. Type extinguisher.
b. Extinguisher condition (fully-charged, uncharged).
c. Test performed (eight-corner drop, cornerwise and pendulum-impact).
d. Damage incurred.
e. Performance data collected as described in the applicable section of paragraph 6.2.7.
f. Leakage data collected as described in the applicable section of paragraph 6.2.8.

6.3.2.11 Safety

Record the following:

a. Data collected as described in the applicable section of MTP 10-2-508.
b. Safety hazards observed during testing including:

1) Presence of sharp protrusions.
2) Lack of any mounting or control features for protection during maintenance or operation.
3) Adequacy of ventilation in testing area.
4) Deviations from recommended safety precautions.

6.3.2.12 Maintainability and Reliability Evaluation

Record data collected as described in the applicable sections of

MTP 10-2-507.

6.3.2.13 Human Factors Evaluation

Record the following:

a. User's comfort, ease, capability to operate the extinguisher, and ease of operating controls under all ambient conditions including the use of gloves or arctic mittens.

b. Difficulties, such as excessive pressure, awkwardness or binding encountered in the operation of the controls.

c. Difficulties encountered in the operation of individual components of the extinguisher, including wheeled extinguisher lack of adequate mobility or maneuverability.

6.3.2.14 Value Analysis

Record whether the extinguisher incorporates any features that could be eliminated without compromising performance, reliability, durability or safety.

6.4 DATA REDUCTION AND PRESENTATION

6.4.1 General

Data obtained during the conduct of the tests shall be summarized, making use of charts, tabulations or graphs as appropriate. Test data for each item tested shall be obtained, summarized, and evaluated as required or as specified in the applicable MTP.

A preliminary report shall be submitted in accordance with USATECOM Regulation 385-6, based on the data collected related to safety.

6.4.2 Hydrostatic Strength Test on Carbon Dioxide Extinguisher Shells, and on Other Refillable Compressed Gas Cartridges or Cylinders

a. Using the test data obtained under paragraph 6.2.1.5, calculate the percent permanent expansion by dividing the permanent expansion by the total expansion and record. If the percent permanent expansion is over 10%, the cartridge or cylinder fails to meet ICC regulations:

EXAMPLE:

Total expansion	=	166.0 c.c
Permanent expansion	=	3.0 c.c
% Permanent expansion	=	3.0/166.0 = 1.8%

b. The elastic expansion is equal to the total expansion minus the permanent expansion. In the above example, the elastic expansion is (166.0 c.c. - 3.0 c.c) = 163.0 c.c.

6.4.3 Hose Tests

a. Calculate the percentage of volume swell by dividing the difference, in the displacement before and after immersion in bromochloromethane, by the original water displacement, and multiplying this difference by 100. The percent of swell should not exceed 60 percent.

b. Summarize the results of the other hose tests as applicable.

6.4.4 Packed-Chamber Test on Dry Chemical Extinguishers

Calculate the amount of dry chemical discharged by subtracting the weight of the fully-charged extinguisher from its weight after it is fully discharged.

6.4.5 Performance Tests

a. On all extinguishers, calculate the weight of the extinguishing agent discharged by subtracting the weight of the fully-charged extinguisher from its weight after it is fully discharged.

b. On dry chemical extinguishers, calculate the weight of the dry chemical discharged into the box by subtracting the weight of the empty box from its weight after the box has been filled with dry chemical to the extent specified.

c. On twin "Light-Water" and dry chemical extinguishers, calculate the rate of initial discharge by recording the extinguisher weight before the discharge is begun, and when 1/2 minute has elapsed from the time the discharge begins. Subtract the smaller weight from the larger weight to obtain the weight, in pounds, discharged in the first 1/2 minute. Multiply this weight by 2 to obtain the rate of initial discharge in pounds per minute. Convert this into gallons per minute by dividing the weight, in pounds per minute, by the specified weight of 1 gallon of "Light-Water".

d. To obtain the initial rate of discharge, in pounds per second, of the dry chemical, record the extinguisher weight before the dry chemical discharge is begun, and when 30 seconds have elapsed from the time the discharge begins. Subtract the smaller weight from the larger weight to obtain the weight, in pounds, discharged in the first 30 seconds. Divide this result by 30 to obtain pounds per second.

e. Prepare charts indicating the effect of various temperatures, adverse conditions, transportability tests and vibration tests on extinguisher performance.

6.4.6 Leakage Tests

Prepare charts to indicate the effect of vibration and shock on the extinguishing leakage.

6.4.7 Human Factors Evaluation

Tabulate all comments, difficulties, and other pertinent data indicating man-item relationships. Compare these data with data obtained from a standard fire extinguisher.

MTP 10-2-051
12 July 1969

UNCLASSIFIED
Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY *(Corporate author)* US Army Test and Evaluation Command (USATECOM) Aberdeen Proving Ground, Maryland 21005	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP ----------

3. REPORT TITLE

US Army Test and Evaluation Command Materiel Test Procedure 10-2-051, Commodity Engineering Test Procedure - "Fire Extinguishers."

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Final

5. AUTHOR(S) *(first name, middle initial, last name)*
---

6. REPORT DATE 12 July 1969	7a. TOTAL NO. OF PAGES 54	7b. NO. OF REFS 80
8a. CONTRACT OR GRANT NO. DA-18-001-AMC-1045(R) b. PROJECT NO. AMCR 310-6 c. d.	9a. ORIGINATOR'S REPORT NUMBER(S) MTP 10-2-051 9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)* ----------	

10. DISTRIBUTION STATEMENT
This document is subject to special export controls and each transmittal to foreign governments or foreign nationals,-WITH THE EXCEPTION OF AUSTRALIA, CANADA, AND UNITED KINGDOM,-may be made only with prior approval of HQ,USATECOM.

11. SUPPLEMENTARY NOTES ----------	12. SPONSORING MILITARY ACTIVITY Headquarters US Army Test and Evaluation Command Aberdeen Proving Ground, Maryland 21005

13. ABSTRACT

This Engineering Test Procedure report provides test methods and techniques necessary to determine ~~(a)~~ The technical and safety characteristics of fire extinguishers and their associated tools and equipment as described in the applicable qualitative Materiel Requirements (QMR), Small Development Requirements (SDR) and Technical Characteristics (TC) and ~~(b)~~ to determine the suitability of the items for army service tests.

DD FORM 1 NOV 65 1473 (PAGE 1)
S/N 0101-807-6811

UNCLASSIFIED
Security Classification

A-31408

MTP 10-2-051
12 July 1969

UNCLASSIFIED
Security Classification

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
Engineering Test						
Fire Extinguishers						
Test Procedure						
Test Methods and Techniques						

DD FORM 1 NOV 65 1473 (BACK)
S/N 0101-807-6821

UNCLASSIFIED
Security Classification

A-31409