DEPARTMENT OF THE ARMY
HEADQUARTERS, U.S. ARMY TEST AND EVALUATION COMMAND
314 LONGS CORNER ROAD
ABERDEEN PROVING GROUND MD 21005-5055

REPLY TO ATTENTION OF

AMSTE-TM-T (70) 27 Jan 99

MEMORANDUM FOR Administrator, Defense Technical Information Center,
ATTN: 8725 John J. Kingman Rd., STE 0944,
Fort Belvoir, VA 22060-6218

SUBJECT: Test Operations Procedure (TOP) 3-2-609 "Chemical Compatibility of Nonmetallic Materials used in Small Arms Systems", 12 Feb 99

1. Enclosed are DTIC Form 50 (Encl 1) and two copies of subject test operations procedure (Encl 2) for assignment of accession number.

2. This TOP supersedes TOP 3-2-609, AD No. A176600, 3 Feb 87.

3. The TECOM point of contact is Mr. Wolfgang H.R. Schmidt, AMSTE-TM-T, wschmid@tecl.apg.army.mil, DSN 298-1486.

FOR THE COMMANDER:

2 Encls

RICHARD S. COZBY
Acting Chief, Simulation & Technology Div
Directorate for Technical Mission

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Commander
U.S. Army Aberdeen Test Center
ATTN: STEAC-TC-I
AberdeenProving Ground, MD 21005-5059

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This TOP provides procedures for evaluating the chemical compatibility of nonmetallis materials used in small arms systems (weapons/ammunition) by conditioning them in various chemical solutions. Physical properties of the material to be tested are measured before and after conditioning to determine the degradation attributable to the chemical solution. The chemicals used for the test are mainly used in military training, maintenance, and combat environments.

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TEST OPERATIONS PROCEDURE

Test Operations Procedure (TOP) 3-2-609 12 February 1999
AD No.

CHEMICAL COMPATIBILITY OF NONMETALLIC MATERIALS USED IN SMALL ARMS SYSTEMS

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1. SCOPE. This TOP provides procedures for evaluating the chemical compatibility of nonmetallic materials used in small arms systems (weapons/ammunition) by conditioning them in various chemical solutions. Physical properties of the material to be tested are measured before and after conditioning to determine the degradation attributable to the chemical solution. The chemicals used for the test are mainly used in the life cycle of the item.

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2. FACILITIES AND INSTRUMENTATION.

2.1 Facilities.

Item	Requirements
Laboratory	A laboratory equipped with fume hood with exhaust fan.
Temperature chamber	To be able to condition materials to temperatures ranging from 71°C to 51°C, and relative humidity from 5% to 95% (ASTM D618-95[1*]).
Weighing room	Marble top table supported on a foundation (concrete) floor). The weigh room environment will be maintained at a constant temperature ($+21^0C \pm 2$ preferred) and required humidity.

2.2 Instrumentation.

Devices for Measuring:	Measurement Accuracy
Weighing balance	0.0001 gram of a sample (weight to 4 significant digits).
Dimensions of test items	Dimension measurements to 0.025 mm (0.001 in.).
Durometer Hardness Type D or Durometer Hardness Type A	Average of five measurements/sample when possible.
Other Instrumentation for Physical Measurement	As required.

* Superscript numbers/letters correspond with those in Appendix B, References.

3. REQUIRED TEST CONDITIONS.

a. Review the safety assessment report (provided in accordance with AR 385-16[2], AMC Suppl and TECOM Suppl 1) and all previous test reports of similar or related system.

b. Assemble information on the physical characteristics of the item (TOP 1-2-504[3]), requirement, and expected modes and areas of use.

c. Select chemical compatibility tests based on the purpose and characteristics of the system being tested. Tests conducted for this TOP may include any or all of the solutions noted in Table 1. Other solutions may be added if the environment in which the end item is used requires it. The choice of chemical solution and conditioning times should be made with consideration given to realistic operational conditions.

d. Systematically observe and analyze the test system throughout all phases of chemical compatibility testing to identify and investigate any actual or potential hazards to personnel and equipment and degradation of performance that may result from operation and maintenance of the system by representative users.

4. TEST PROCEDURES. Test the nonmetallic materials which comprise various small arms and ammunition in the configuration and condition in which they are to be deployed and operated by the field army.

4.1 Initial Inspection.

a. Carefully inspect the test item and visually examine all major components for conformance with specifications and/or design drawing. Record any deviation from the specification.

b. The following table lists chemicals that weapons/arms and their parts (metallic or nonmetallic) may be exposed during its life cycle. Other chemicals may be added or subtracted depending on the test item and its use.

TABLE 1. CONDITIONING CHEMICALS

1. Cleaning compound, solvent	MIL-L-372B Bore cleaner
2. Dry cleaning solvent	P-D-680, type I or equivalent (naphtha solvent)
3. Engine oil	MIL-L-2104
4. Lubricant, semi-fluid, automatic weapons	MIL-L-46000B (LSA)
5. Lubricating oil, general purpose	VV-L-800 (PL-S)
6. Lubricant, cleaner, and preservative	MIL-L-63460A (CLP)
7. Gasoline, commercial, or combat	ASTM D 910
8. Turbine fuel (JP-8)	MIL-T-83133
9. Fuel oil diesel (DL-2)	ASTM D 975 Grade Low Sulfur No. 2
10. Insect repellent	0-I-503E
11. Dexron III	Transmission fluid
12. Antifreeze, ethylene glycol	MIL-A-46153
13. Carbon-removing compound	P-C-111B, type II
14. Water	Water (distilled)
15. Simulated sea water or 5% Sodium chloride	ASTM D1141
16. Decontaminating agent DS2	MIL-D-50030
17. Decontaminating agent STB	MIL-D-12468
18. Lubricating oil, weapons	MIL-L-14107 (LAW)
19. Hydraulic fluid, petroleum base	MIL-H-5606
20. Hydraulic fluid, fire-resistant	MIL-H-46170

c. Record the following for the weapon/ammunition to be tested:

(1) Nomenclature, model, serial numbers, lot numbers, and other pertinent data.

(2) Manufacturer.

(3) Accessories and tools supplies.

(4) Any material discrepancies.

4.2 Chemical Compatibility Test of Nonmetallic Materials in Small Arms Weapons (40-mm and smaller).

4.2.1 Method.

a. Prepare each of the nonmetallic (plastic) samples (depending upon the sample population) for chemical compatibility test as a standard tensile property specimen in accordance with ASTM D 638-93[4], or thin sheeting in accordance with ASTM D 882-95[5]. Determine the tensile strength of the plastic by testing a portion of the samples in accordance with ASTM D 638, and follow procedures in paragraph c. In case standard tensile property specimens cannot be prepared, prepare samples as follows, and measure hardness as specified in paragraph 4.2.1b.

(1) Use test specimens at least 2.5 cm square and as thick as the component if cut from a component part or material sample.

(2) Smooth cut edges of specimens by sharp cutting, machining, or by finishing with No. (O) or finer sandpaper or emery cloth.

b. To measure hardness, place the specimen on a hard, horizontal surface; hold the durometer in a vertical position with the point of the indentor at least 12 mm (0.5 in.) from any edge of the specimen, unless identical results can be obtained when measurements are made with the indentor at a lesser distance. Apply the presser foot to the specimen as rapidly as possible without shock, keeping the foot parallel to the surface of the specimen. Apply just sufficient pressure to obtain firm contact between presser foot and specimen (see ASTM D 2240-95[6]).

(1) Unless otherwise specified, read the scale within 1 second after the presser foot is in firm contact with the specimen. If the durometer has a maximum indicator, the maximum reading is taken. After a time interval is specified, hold the presser foot in contact with the specimen without change in position or pressure and read the scale after the period specified.

(2) Measure hardness at three different positions on the specimen at least 6 mm (0.25 in.) apart and determine the median value or the arithmetic mean.

(3) For further information and unique sample specimens, consult Appendix A.

c. Measure lengths of all major axes of test specimens and weigh all test specimens before immersing them. Record other appropriate pre-exposure physical measurements, i.e., color, gloss, etc. where applicable.

d. Place the specimens in the appropriate containers for the chemical solutions (table 1) being used. Allow the specimens to be conditioned in the solution for at least 8 hours in the standard laboratory atmosphere, depending on the chemical and test item. Total conditioning time will depend on the operational requirements, solutions used, and other judgmental factors. Normally, maximum time should not exceed 168 hours. It is recommended that the test items be visually observed after the first hour for any deterioration. If no change is observed (softening of test item or material leaching into chemical), place the item back into the chemical for the duration of the test. If there is visual deterioration of the item, stop the test for that item in that particular chemical and proceed to paragraph 4.2.1e.

e. After conditioning for the specified time period, remove each specimen individually from the solution. Wash and immediately weigh the specimen in a weighing boat, if necessary. Remeasure specimen dimensions and hardness and look for changes in surface texture.

(1) With running water, wash specimens removed from acid, alkali, or other aqueous solutions; wipe them dry with a cloth or tissue, and weigh them immediately.

(2) Hygroscopic (moisture-absorbing) solutions such as concentrated sulfuric acid may remain absorbed on the surface of the specimen even after rinsing. Immediate special handling is required to avoid moisture pickup before and during weighing.

(3) Specimens removed from nonvolatile, nonwater-soluble organic liquids should be washed with a nonaggressive, but volatile solvent such as ligroin before wiping dry.

(4) Specimens removed from volatile solvents such as acetone, alcohol, etc., need no rinsing before wiping dry.

g. Complete all post exposure measurements for comparison with pre-exposure measurements.

4.2.2 Data Required. Record the following for each nonmetallic sample tested:

a. Type of nonmetallic material tested.

b. Type of chemical(s) in which item was conditioned.

c. Sources from which the material is obtained.

d. Number of samples tested.

e. Weight and tensile strength or hardness, as appropriate.

f. Evidence of loss of gloss, developed texture, decomposition, discoloration, swelling, clouding, tackiness, rubberiness, bubbling, cracking and solubility, etc.

g. Conditioning time (hours).

h. Air temperature and relative humidity.

4.3 Chemical Compatibility Test of Nonmetallic Materials in Small Arms Ammunition.

4.3.1 Method.

a. Inspect the ammunition samples to determine physical and dimensional characteristics.

b. Condition (immerse/coat) a sample of cartridges/components in each of the appropriate chemical solutions listed in Table 1 for at least 8 hours.

c. Remove and naturally drain sample for an additional 8 hours. Store all cartridges in an upright position for draining.

d. Inspect cartridges for serviceability, including cracks, splits, and ruptures.

e. If required, remotely fire each test cartridge and a like number of dry cartridges (for comparison) as follows:

(1) For semiautomatic (rifle or pistol) test firing, load the weapon with 10 rounds and fire remotely in the semiautomatic mode as rapidly as possible.

(2) For automatic (machinegun) test firing, load the weapon with 50 rounds and fire remotely.

(3) Measure the instrumental velocity (per the requirements of the particular cartridge/ weapon combination) of each round and the cyclic rate of fire for machineguns.

(4) Inspect the spent cartridge cases for cracks, splits, or ruptures.

4.3.2 Data Required. Record the following for each ammunition sample:

a. Type of projectile (inert, specific type of ammunition).

b. Type of load (single, clip, belt-fed).

c. Mode of firing (single, automatic, semiautomatic).

d. Damage to the test cartridge or component and any safety hazards observed.

e. Evidence of case splits/ruptures or projectile and case separation.

f. Result of observation concerning cartridge function, instrumental velocity and weapon function.

4.4 Chemical Compatibility Test of Nonmetallic Materials In Ancillary Equipment (Except Ammunition and Weapons).

4.4.1 Method.

a. Prepare coupons/samples of the nonmetallic material to be subjected to testing in accordance with the method in paragraph 4.2 or with other applicable ASTM standards such as:

D 471, D 543, D 638, and D 882

b. Measure one or more material properties (tensile strength, hardness, weight, dimensions, etc.) in accordance with the ASTM requirements.

5. PRESENTATION OF DATA.

a. Tabulate all data, compare before and after results, and compare results with established criteria, if available.

b. Assemble and tabulate all results and safety information generated during the chemical compatibility tests. Assign the proper category of hazard for each hazard identified. Report hazard level (ref 8) and classification (deficiency, shortcoming, etc.) in accordance with AMC-R-70-13[7] and TECOM Supplement. Report the conditions incident to the observed hazard and describe any features that require further investigation, including any hazard that could occur or increase as a result of increased chemical exposure time. Describe (narratively) all safety hazards identified, and recommend action required to eliminate or avoid each potential hazard.

APPENDIX A. EXPLANATORY MATERIAL FOR MATERIAL HARDNESS MEASUREMENT

1. Test Specimen. The test specimen shall be at least 6 mm (0.25 in.) thick unless identical results can be obtained with a thinner specimen (Note 1). A specimen may be composed of thinner pieces to obtain the necessary thickness, but determinations made from such specimens may not agree with determinations made from one-piece specimens because the surfaces between plies may not be in complete contact. The lateral dimensions of the specimen shall be sufficient to permit measurements at least 12 mm (0.5 in.) from any edge unless identical results can be obtained when measurements are made at a lesser distance from an edge (Note 1). The surface of the specimen shall be flat over sufficient area to permit the presser foot to contact the specimen over an area having a radius of at react 6 mm (0.25 in.) from the indentor point. Rounded, uneven, or rough surfaces preclude a suitable hardness determination. If possible, test slabs representing the batch or lot of material used to construct the test item should be obtained from the manufacturer and used for conditioning and physical property testing.

Note 1 - The minimum requirement for the thickness of the specimen depends on the extent of penetration of the indentor into the specimen; i.e., thinner specimens may be used for materials having hardness values at the upper end of the scale. The minimum distance from edge, at which measurements may be made, decreases as the hardness increases. For materials having hardness values above 50 Type D durometer, the thickness of the specimen should be at least 3 mm (0.12 in.) and measurements should not be made closer than 6 mm (0.25 in.) to any edge.

2. Calibration. The spring can be calibrated by supporting the durometer in a vertical position and resting the point of the indentor on a small spacer at the center of one pan of a balance (see Figure 3 of ASTM D 2240) in order to prevent interference between presser foot and pan (Note 2). The spacer shall have a small cylindrical stem approximately 2.5 mm (0.1 in.) in height and 1.25 mm (0.05 in.) in diameter, and shall be slightly cupped on top to accommodate the indentor point. Balance the mass of the spacer by a tare on the opposite pan of the balance. Add weights to the opposite pan to balance the force on the indentor at various scale readings. The measured force shall equal the force calculated by either Eq 1 within +0.08 N (ASTM D2240) or Eq 2 within +0.44 N (ASTM D 2240).

Note 2 - Instruments specifically designed for calibration of durometers may be used. Zwick & Co., Control Equipment 7501, can be used for calibration as it is capable of measuring or applying a force on the point of the indentor within 0.004 N for a Type A durometer and within 0.02 N for a Type D durometer. Zwick Control Equipment 7501 with serial numbers higher than WA-20301 are satisfactory for this work. Instruments with lower serial numbers must be modified.

3. Conditioning. Tests shall be made at 23 °C ± 2° (73.4 °F +3.6°) if the temperature of test is not specified. When tests are made at other temperatures, it is recommended that they be made at one or more of the standard temperatures given in ASTM D 1349-87, Rubber-Standard Temperature for Testing or Procedure A of ASTM Methods D 618-95, Conditioning Plastics and Electrical Insulating Materials for Testing. The durometer and specimens shall be conditioned at the temperature of test for at least 1 hr before test for materials whose hardness does not depend on the relative humidity (Note 3). When hardness of materials depends on the relative humidity, the specimens shall be conditioned in accordance with Procedure A of ASTM D618 and tested at the same conditions.

Note 3 - When a durometer is moved from a chamber below room temperature to a higher temperature, the durometer shall be placed in a suitable desiccator or air-tight container immediately upon removal and allowed to remain there until the temperature of the durometer is above the dew point of the air in the new environment.

4. Procedure. Place the specimen on a hard, horizontal surface. Hold the durometer in a vertical position with the point of the indentor at least 12 mm (0.5 in.) from any edge of the specimen, unless it is known that identical results are obtained when measurements are made with the indentor at a lesser distance. Apply the presser foot to the specimen as rapidly as possible without shock, keeping the foot parallel to the surface of the specimen. Apply just sufficient pressure to obtain firm contact between presser foot and specimen. (Note: Better reproducibility can be obtained by using either a durometer stand or a weight centered on the axis of the indentor or both to apply the presser foot to the specimen. Recommended weights are 1 kg for the Type A durometer and 5 kg for the Type D durometer.)

Unless otherwise specified, read the scale within 1 second after the presser foot is in firm contact with the specimen, unless the durometer has a maximum indicator, in which case the maximum reading is taken. If a reading after a time interval is specified, hold the presser foot in contact with the specimen without change in position or pressure and read the scale after the period specified. (Note: Durometers having only a maximum indicator cannot be used to obtain hardness values at various time intervals, nor in testing vinyl plastics which require the reading to be taken at 15-second intervals.)

Take five measurements of hardness at different positions on the specimen at least 6 mm (0.25 in.) apart and determine the arithmetic mean. (Note: It is recommended that measurements be made with the Type D durometer when values above 90 are obtained with the Type A durometer and that measurements be made with the Type A durometer when values less than 20 are obtained with the Type D durometer.)

5. Precautions. Safety precautions should be taken to avoid personal contact, to eliminate toxic vapors, and to guard against explosion hazards in accordance with the hazardous nature of the particular reagents being used.

6. Test Specimens. The type and dimensions of test specimens to be used depend upon the form of the material and the tests to be performed (Note 4). At least three specimens shall be used for each material being tested and for each reagent involved. The specimens shall be as follows:

a. Molding and Extrusion Materials. Specimens shall be molded to shape or cut from molded slabs as required below. The cut edges of specimens shall be made smooth by sharp cutting, machining, or by finishing with No. 0 or finer sandpaper or emery cloth. Molding shall conform to conditions recommended by the manufacturer of the material (Note 5). The shape and dimensions of specimens shall depend on the test to be performed and shall conform to the following:

(1) Weight and Dimension Changes. Standard specimens shall be in the form of disks 50.80 mm (2 in.) in diameter and 3.175 mm (0.125 in.) in thickness molded or cut from molded slabs. The nominal surface area of this standard disk is 45.60 cm (7.068 in.).

(2) Mechanical Property Changes. Standard tensile specimens shall be used according to the method of test prescribed in the appropriate specification for the material being tested, or by agreement among those concerned. When the determination of other mechanical properties is agreed upon by the seller and the purchaser, standard specimens prescribed in the appropriate standard methods of test shall be used.

b. Sheet Materials - Specimens from sheet materials shall be cut from a representative sample of the material (Note 6) in a manner depending on the tests to be performed and the thickness of the sheet as follows (see paragraph 6a regarding preparation of cut edges):

(1) Weight and Dimension Changes - Standard specimens shall be in the form of bars 76.20 mm (3 in.) long by 25.40 mm (1 in.) wide by the thickness of the material. The nominal surface area of the standard bar, having a thickness of 3.175 mm (0.125 in.) is 45.16 cm ($7.0\ in.^2$). Circular disk specimens 50.80 mm (2 in.) in diameter by the thickness of the material are permissible under mutual agreement between the seller and the purchaser. Permissible variations in thickness of both types of specimens are +0.18 mm (0.007 in.) for hot molded and +0.30 mm (0.012 in.) for cold molded or cast materials.

(2) Mechanical Property Changes - Standard machined, sheared, or cut tensile specimens shall be used according to the methods of test prescribed in the appropriate specifications of the material being tested, or by agreement among those concerned (see 6a(2)).

Note 4 - Specimen surface area greatly affects the weight change due to conditioning in chemical reagents. Thickness influences percentage dimension change as well as percentage change in mechanical properties. In addition, molded specimens may not agree with specimens cut from molded or otherwise formed sheet of a given material. Consequently, comparison of materials should be made only on the basis of results obtained from specimens of identical dimensions and like methods of specimen preparation.

Note 5 - Molding conditions can affect the resistance of plastics to chemical reagents. Compression moldings should be prepared in a manner that will disperse external lubricants and result in complete fusion of the particles. Injection molding should be accomplished in a manner that results in a minimum of molecular orientation and thermal stresses or a controlled level of both depending upon the conditions being simulated.

Note 6 - For certain products, such as laminates, in which edge effects are pronounced, larger coupons may be exposed from which standard specimens can be cut after conditioning for determining the effects of reagents on mechanical properties. This may be allowed in provisions of material specifications by mutual agreement between the seller and the purchaser and should be reported as such.

7. Sampling.

a. For Procedure I, sample in accordance with the pertinent considerations outlined in ASTM D 1898-68 (1989), Sampling of Plastics.

b. For Procedure II, sample in accordance with the ASTM test methods for the specified properties to be determined.

8. Conditioning.

a. Conditioning. Condition the test specimens at 23 °C ±2° (73.4 °F +3.6°) and 50% +5% relative humidity for no less than 40 hours before test in accordance with Procedure A of ASTM D618 for those tests in which conditioning is required. In cases of disagreement, the tolerances shall be 1 °C (1.8 °F) and +2% relative humidity.

b. Test Conditions. Conduct tests in the Standard Laboratory Atmosphere of 23 °C ± 2° (73.4 °F ± 3.6°) and 50% ± 5% relative humidity, unless otherwise specified in the test methods or in this specification. In cases of disagreements, the tolerances shall be 1 °C (1.8 °F) and ±2% relative humidity.

9. Procedure for Weight and Dimension Changes (See Note 7).

a. Weigh each conditioned specimen separately and measure its thickness at the center and its length and width, or two diameters at right angles to each other, to the nearest 0.025 mm (0.002 in.). In the case of laminates, edge swelling is not uncommon under certain conditions. Consequently, it may be necessary to measure thickness both at the center and at the edges and report the percentage change separately for each position.

b. Place the specimens in appropriate containers for the reagents being used and allow the specimens to be totally immersed in fresh reagent for as many as 7 days in the standard laboratory atmosphere. Suspend the specimens to avoid any contact with the walls or bottom of the container. For specimens of thin sheeting or those having a lower density than the reagent, it may be necessary to attach small weights such as nichrome wire to prevent floating or curling. Several specimens of a given material may be immersed in the same container provided sufficient reagent is allowed for the total surface area exposed and the specimens do not touch each other. For specimens of nonextractable and relatively insoluble materials, the quantity of reagent shall be approximately 10 ml/in.^{2} of specimen surface area. For specimens that tend to dissolve or which involve extraction of plasticizers, the quantity of reagent shall be approximately 40 ml/in. of specimen surface area. When there is any doubt in these matters, use the higher solvent ratio. For tests at other than room temperatures, it is recommended that the test temperature be 50 °C , 70 °C, or other temperatures recommended in ASTM D 618. It is important that the reagent be at the elevated test temperature before the specimens are immersed. CAUTION: Containers should have small vent holes for pressure relief if solvents are to be heated above room temperature. Flammable vapors must be properly vented to preclude explosion.

c. Stir the reagents every 24 hours by moderate manual rotation of the containers or other suitable means (Note 4).

d. After 7 days or other agreed upon time period, individually remove each specimen from the reagent, dry and immediately weigh, and remeasure its dimensions. Wash with running water specimens removed from acid, alkali, or other aqueous solutions, wipe them dry with a cloth or tissue, and immediately weigh. Hygroscopic reagents such as concentrated sulfuric acid may remain absorbed on the surface of the specimen even after rinsing, requiring immediate special handling to avoid moisture pickup before and during weighing. Rinse specimens removed from nonvolatile, nonwater-soluble organic liquids with a nonaggressive, volatile solvent, such as ligroin, before wiping dry. Specimens removed from volatile solvents such as acetone, alcohol, etc., need no rinsing before wiping dry. Some specimens may become tacky due to dissolved material on the surface or solvent absorbed throughout the specimen. Take care in wiping such specimens not to disturb or contaminate the surface.

e. Observe the appearance of each specimen after exposure to chemical reagent. Observe and report appearance on the basis of examination for evidence of lose of gloss, developed texture, decomposition, discoloration, swelling, clouding, tackiness, rubberiness, crazing, bubbling, cracking, solubility, etc. See Definitions ASTM D 883-93, Plastics, for proper descriptive terminology. Report any change in color of the test solution, which might indicate leaching of material from the test specimens.

Note 7 - For some materials, absorption of the reagent over the 7-day conditioning period is nearly balanced by the removal of soluble constituents from the plastic. This type of behavior may be revealed by comparing the initial conditioned weight of the specimen with its weight when dried for as many as 7 days at 23 °C and 50% relative humidity, after removal from the chemical reagent. A final weight lower than the initial weight may indicate removal of soluble constituents. However, only for particular combinations of reagent and test specimen can this weight difference be considered as due strictly to the removal of soluble constituents.

(Note: In making tests for shorter or longer than 7 days, it is recommended that the tests be run at 1- and 3-day increments. The containers should be stirred once each day during the first week, and once each week thereafter.)

10. Procedure for Mechanical Property Changes.

a. Immerse and handle the mechanical test specimens in accordance with instructions given under Section 9.

b. Determine the mechanical properties of identical nonimmersed and immersed specimens in accordance with the standard methods for tensile tests prescribed in the specifications for the materials being tested (Note 8). Make mechanical property tests on nonimmersed and immersed specimens prepared from the same sample or lot of material in the same manner, and run under identical conditions (Note 9). Test immersed specimens immediately after they are removed from the chemical reagent. When specimens are exposed to reagents at elevated temperature, unless they are to be tested at the elevated temperature, they shall be placed in another container of the reagent at the Standard Laboratory Temperature for approximately 1 hour to effect cooling before testing (Note 6).

Note 8 - While tensile tests are more generally applicable and preferred for assessing mechanical property changes due to the effects of chemical reagents, other mechanical properties may be more significant in special cases. For example, flexural properties of rigid materials, which are not appreciably softened by the reagents under study, may be extremely sensitive to surface attack such as crazing. Consequently, in the use of this method for establishing chemical resistance levels in material or product specifications, consideration should be given to the choice of mechanical properties that properly characterize the effects of exposure to chemical reagents.

Note 9 - To isolate the effects of certain chemical reagents on the mechanical properties of some plastics, it is necessary to test identical specimens that have been immersed in water. This is especially true of tests to determine the effects of aqueous solutions, where these may not differ greatly from the effects of immersion in water alone (see Appendix B). When tests are run with a variety of aqueous reagents, the effects due to water alone should be established for better comparison of results. Similar behavior may result when tests are run at elevated temperatures. Knowledge of the effects of temperature alone is required to properly assess the effects due to the chemical reagents.

APPENDIX B. REFERENCES

Required References

1. ASTM D618-95, Conditioning Plastics and Electrical Insulating Materials for Testing, 1995.

2. AR 385-16, System Safety Engineering and Management, 1 December 1980; AMC Suppl 1, 22 January 1982; TECOM Suppl 1, 11 June 1982; and APG Suppl 1, 5 January 1983.

3. TOP 1-2-504, Physical Characteristics, 31 October 1972.

4. ASTM D638M-93, Tensile Properties of Plastics, 1993.

5. ASTM D882-95, Tensile Properties of Thin Plastic Sheeting, 1995.

6. ASTM D2240-95, Rubber Property - Durometer Hardness, 1995.

7. AMC Regulation 70-13, Research, Development, and Acquisition, Test and Evaluation - Incidents Disclosed During Materiel Testing, 16 August 1982.

8. The standardization of one type of instrument is described by Lewis Larrick: "The Standardization of Durometers," Rubber Chemistry and Technology, RCTEA, Tol 13, 1940, page 969.

References for Information Only

a. MIL-STD-882A, System Safety Program Requirements, 28 June 1977.

b. ASTM D543-87, Resistance of Plastic to Chemicals Reagents, 1987.

c. Hubbard, L., Final Report, Prototype Qualification Test-Government (PQT-G) for Follow-On Test of Cartridge, 25 mm Dummy, XM 794, TECOM Project No. 1-MU-001-794-001, US Army Aberdeen Proving Ground, Report No. APG-MT-5650, April 1982.

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