Designation: E1773 – 10

# Standard Practice for Sealing Rigid Wall Tactical Shelters with Polysulfide Based Sealants[1]

This standard is issued under the fixed designation E1773; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the U.S. Department of Defense.*

## 1. Scope

1.1 This practice covers the procedures for sealing rigid wall tactical shelters. It outlines the techniques for the storage, mixing, handling, and application of polysulfide based sealants.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

2.1 *ASTM Standards:*[2]

D907 Terminology of Adhesives

E1749 Terminology Relating to Rigid Wall Relocatable Shelters

2.2 *Society of Automotive Engineers (SAE) Specification:*[3]

SAE-AMS-S-8802 Sealing Compound, Temperature-Resistant, Integral Fuel Tanka and Fuel Cell Cavities, High Adhesion

SAE-AMS-3819 Cleaning Cloths

## 3. Terminology

3.1 *Definitions*—See Terminology E1749 for definitions of general terms used in this practice.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *accelerator*—used by sealant formulators to denote an ingredient included in the formulation to accelerate the rate of cure. It is also used separately in a mixture to accelerate surface curing only of applied polysulfide sealant, that is, tack free time accelerator.

3.2.2 *adhesion*—The state in which two surfaces are held together by interphase forces. D907

3.2.3 *application time (sealants)*—the time available for sealant application after mixing or time available after thawing a premixed and frozen cartridge of sealant.

3.2.3.1 *Discussion*—Acceptability limits for Class B extrudable sealants are expressed in terms of the extrusion rate of a sealant from a 6 fl oz (180 mL) cartridge through a nozzle with a 0.125 in. (3.2 mm) diameter orifice, using air pressure of 90 ± 5 psi (620 ± 34 kPa) in a pneumatic sealant gun. The extrusion rate is expressed in grams per minute or on cc per minute. A minimum extrusion rate after the stated application time is given as the acceptable limit. Sealant applied after the application time is exceeded tends not to wet the surface well and thus not to form a good bond. This term should not be used interchangeably with work life.

3.2.4 *assembly time*—the amount of time available after a two-part sealant is mixed, before the faying surfaces, to which sealant is applied, shall be assembled and the sealant squeezed out.

3.2.4.1 *Discussion*—If the assembly time is exceeded, the cure will have progressed too far to permit most of the sealant to be squeezed out for the desired surface to surface contact. The term assembly time is used in reference to faying-surface sealants. Also called work life and open time.

3.2.5 *base compound*—the major component of a two-part curing sealant that contains the polysulfide polymer.

3.2.6 *bridging*—see Terminology E1749.

3.2.7 *cartridge*—a plastic container which contains an integral plunger.

3.2.7.1 *Discussion*—The cartridge is used to contain either a frozen quantity of premixed base compound and curing compound or simply the base compound in unmixed injection kits.

[1] This practice is under the jurisdiction of ASTM Committee E06 on Performance of Buildings and is the direct responsibility of Subcommittee E06.53 on Materials and Processes for Durable Rigidwall Relocatable Structures.

Current edition approved Nov. 1, 2010. Published December 2010. Originally approved in 1995. Last previous edition approved in 2005 as E1773 – 05. DOI: 10.1520/E1773-10.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, http://www.sae.org.

3.2.8 *cohesion strength (sealant)*—the internal forces holding a cured sealant together.

3.2.9 *contaminant*—any foreign substance that degrades the performance of the sealant.

3.2.10 *cure rate*—the rate at which a sealant polymerizes or crosslinks (that is, solidifies), a measure of which is the hardness of a sealant at a specified cure time.

3.2.11 *cure time (sealants)*—the time required for a sealant to polymerize and develop its full physical/mechanical properties.

3.2.11.1 *Discussion*—In practice, however, it is the time required to reach a designated hardness.

3.2.12 *curing compound*—the crosslinking agent for the base compound.

3.2.13 *hardness*—see **Shore A hardness** and **REX Hardness** in Terminology E1749.

3.2.14 *interference seal*—a seal produced between a given diameter mechanical fastener and a smaller diameter hole in a member into which it is inserted.

3.2.14.1 *Discussion*—An interference seal is also produced when a fastener shank is expanded by the installation process.

3.2.15 *primary seal*—a seal which, in combination with the structure and optional brush coat or secondary seal, forms a continuous, durable seal in the sealing plane and requires no additional seals.

3.2.16 *self-sealing fastener*—a fastener that provides a tight seal without the need for sealant materials or the use of a mechanical seal.

3.2.16.1 *Discussion*—An interference fit fastener is an example.

3.2.17 *tack free time*—the time required for a curing sealant to lose its surface tackiness to polyethylene.

3.2.17.1 *Discussion*—Refer to SAE-AMS-S-8802.

3.2.18 *tooled fillet*—a fillet formed by working an applied bead of sealant to a feathered edge using a shaped tool.

3.2.18.1 *Discussion*—The goal is to ensure good surface contact at the feathered edges, to eliminate voids, trapped air and re-entrant edges, and to produce a contour of the correct thickness and shape over the area being sealed.

3.2.19 *two-component sealant injection kit*—a kit designed for the mixing and application of a two-part sealant. The kit consists of a plastic (usually polyethylene) cartridge filled with base compound, a hollow dasher rod containing curing compound, and a plunger. The dasher rod extends into one end of the cartridge; at the end of the dasher rod inside the cartridge, a multi-armed agitator is attached. The plunger caps the other end of the cartridge.

3.2.19.1 *Discussion*—To use, a ram rod is inserted into the dasher rod and the curing compound is forced into the base compound. The dasher rod is then pulled back and forth at a specified rate with periodic rotation to add to the efficiency of the agitator. When the sealant is mixed thoroughly, the dasher rod is unscrewed from the agitator and removed. A nozzle is screwed onto the cartridge and the unit inserted into a sealant gun. Sealant is dispensed as the plunger is pushed further into the cartridge.

3.2.20 *wet installed fasteners*—fasteners that are coated on the shank and under the head with a curing-type sealant to provide a corrosion barrier and a secondary seal.

## 4. Significance and Use

4.1 This recommended practice is intended to provide information on the storage, mixing, handling, and application of polysulfide based sealants. Tooling and equipment requirements for the satisfactory application of the sealants to joints in tactical shelters are also provided.

## 5. Hazards

5.1 *Materials*—The precautions outlined in the manufacturers' material safety data sheets (MSDS) for the materials being used shall become a part of this practice.

5.2 *Work Place:*

5.2.1 All lights and other electrical equipment used for the sealant application within an enclosed shelter shall be explosion proof. Extension cords shall be long enough to make electrical connections outside the shelter.

5.2.2 When use of compressed air is required, proper safety equipment shall be provided and used.

## 6. Storage

6.1 *Premixed and Frozen Sealant*—Sealants that are supplied premixed and frozen shall be stored in a cold box or a room maintained at −40 ± 5°F (−40 ± 2.8°C) or within ±5°C (2.8°F) of the manufacturer's recommended storage temperature.

6.2 *Two-Component Sealant Kits*—Two-component sealants supplied as either injection kits or bulk sealant kits shall be stored in areas maintained at a temperature not to exceed 80°F (27°C).



## 7. Labeling

7.1 Sealant containers shall have attached labels which clearly identify the product, manufacturer, matched base and curing compounds (if applicable), batch and lot numbers, date of manufacture, recommended mix ratio (if applicable), and expiration date under specified storage conditions.

## 8. Material Handling

8.1 *Premixed and Frozen*—Sealants are supplied premixed and frozen, used prior to the manufacturer's expiration date on the label, and shall be ready for immediate use following thawing of the contents. With the addition of a nozzle, the material is dispensed directly from the cartridge.

8.2 *Two-Component Sealant Injection Kits*—Sealants supplied in this form shall be mixed according to the manufacturer's instructions and used before the expiration date provided on the label and within the application time determined for that sealant.

8.3 *Bulk Sealant*—Two-part sealants are supplied in a wide range of kit sizes from ½ pt to 50-gal drums plus 5-gal pail of curing compound. In every case there is a small percentage of extra curing compound included, ranging from 2 to 10 % to compensate for losses in the transfer of the curing compound.

Although kit sizes are generally quoted in terms of volume, the base and curing compound are matched on basis of weight ratio. Both weight and volume ratio are usually included on the label.

8.3.1 *Mixing:*

8.3.1.1 *Hand Mixing*—Kits under 5 gal are packaged such that the base compound container will permit the addition and mixing of the curing compound. Mix the entire kit at one time and use all the curing compound. By mixing and using the entire kit at once, the user is assured that the correct amounts have been used and the resultant sealant properties will be those expected. Some of the pitfalls of attempting to use partial kits include: (*1*) the possible use of incorrect ratio; (*2*) incorrect weighing; (*3*) failure to thoroughly stir the curing compound in the container before removing the desired quantity; (*4*) incomplete transfer of base or curing compound, or both; and (*5*) compromising the remaining material by failure to supply an inert atmosphere or failure to set the can lid completely.

NOTE 1—In all cases it is of paramount importance that the batch of base be catalyzed only with the batch of curing compound to which it was matched. (Batch number of batch of matched base and curing compound should be given on each label.) Hand mix thoroughly by folding the material over itself. Frequently scrape down the walls of the container to ensure complete mixing. Avoid whipping the material as this will incorporate air into the mixture and result in void formation. High mixing speeds may also cause excessive heat which will advance the cure of the sealant, shortening the application and assembly time. If the storage area temperature is greatly different from normal (standard) temperature, the kits should be preconditioned to standard temperature [77°F (25°C)]; also, local humidity shall be on the order of 55 % RH if data sheet performance is expected. If the surface to which the sealant is to be applied is decidedly different from 77°F (25°C), the cure rate will vary accordingly. For example, a SAE-AMS-S-8802 B-2 system at 50 % RH will have a work life of 3 h at 60°F (16°C), 2 h at 80°F (27°C), but only 1 h at 100°F (37.8°C). While if the temperature is held at 80°F (27°C), the work life will be 3 h at 35 % RH, 2 h at 50 % RH, and at 65 % RH the work life is only 1 h.

8.3.1.2 *Machine Mixing*—Meter/mix machines are used when large quantities of mixed sealant are required. Separate pumps force base compound and curing compound through a metering system which measures the proper ratio of the components. The two streams are then fed into a mixing head where a uniform mixture is produced. The sealant is then usually dispensed into low density polyethylene cartridges ranging in size from 2.5 to 12 oz (74–355 mL) for immediate use or quick frozen (see 8.5) for future use. The mixed sealant should exhibit no visible streaks or evidence of entrapped air (bubbles or voids) during the dispensing operation. When using meter mix machines the following steps should be made a part of the standard operating procedure:

*(a)* Stir the 5-gal pail of catalyst thoroughly with a mechanical agitator, being careful not to whip air into the curing compound or excessively heat the material.

*(b)* Scrape down the walls of the pail.

*(c)* If the curing compound sits for 48 h after stirring, stir again.

*(d)* Start with clean lines and an empty meter/mix machine or purge the lines and machine with at least 2 gal of base and the equivalent catalyst.

*(e)* Calibrate a variable ratio machine frequently. (At the start of each shift or the change of containers, or both).

*(f)* If a static mix head is used, clean it if the flow rate decreases substantially. Purging of the static mix head is essential if the material has set for one quarter of the application life.

*(g)* Air pressure to the meter mix equipment should be of sufficient volume as well as pressure.

*(h) Quality Control*—A visual inspection should be conducted to ensure that no streaks or excessive air is incorporated into the mixed material.

8.4 *Freezing*—Once the base compound and curing compound are mixed, the application time will decrease rapidly. Therefore, unless mixed sealants are to be used immediately, they should be quick frozen [−40°F (−40°C) or below]. This can be accomplished by placing the filled cartridges in a cold bath of methanol and dry ice for at least 30 min [−100°F (−73.3°C)]. Another approved method of quick freezing is to place the freshly filled tube of sealant into a liquid nitrogen chamber for approximately 2 min. Place the frozen tubes in a cold box or room at −40°F (−40°C) or below at the manufacturer's recommended storage temperature.. Frozen tubes of polysulfide sealants should not be kept for more than 1 month, or at the manufacturer's prescribed shelf life, whichever is longer..

8.5 *Thawing*—Frozen cartridges of mixed sealant may be thawed by three methods:

*(a)* Normal temperature air, 8.5.1,

*(b)* Enclosed heating bath, 8.5.2, and

*(c)* Microwave oven, 8.5.3.

In all methods of thawing, less application life per tube will be available than in freshly mixed material. It is estimated that approximately 25 % of the work life is lost by freezing and thawing.

8.5.1 *Normal Temperature Air*—The frozen cartridges are placed on a bench or table and allowed to warm at normal temperature. The rate of warm up is variable depending upon the size of cartridge, temperature of the room and that of the cartridge, the closeness of one tube to the next, and whether it is standing vertically or lying horizontally. Normal temperature thaw usually takes approximately 30 min for a 6 oz tube.

8.5.2 *Enclosed Heating Baths*—The cartridges are inserted in metal sleeves in a water bath at 120°F (49°C) for 10 min. The metal sleeves are made to fit snugly to the cartridge providing good heat transfer and a dry condition. The sealant at the core of the cartridge should reach 65°F (18°C) before application is started.

8.5.3 *Microwave Oven*—A carousel microwave oven, 600 watts, with automated interrupt defrost cycle of 20 s heat, 20 s soak will thaw a 6 oz cartridge in approximately 2 min. This method is fairly reproducible if the same number and size of cartridge are used each time. The oven wattage, heat/soak cycle is directly related to the time required. The carousel feature is used to produce uniform radiation and to avoid hot spots.

8.6 *Surface Preparation*—Sealant adhesion is crucial for achieving a functional seal. Absence of a good bond or a partial failure of the bond can result in lack of the formation of a seal to isolate the environment. It is recognized that many sealing requirements encountered do not involve "virgin surfaces" but