INTERNATIONAL

Designation: ~~D7474 – 12~~ D7474 – 17

Standard Practice for Determining Residual Stresses in Extruded or Molded Sulfone Plastic (SP) Parts by Immersion in Various Chemical Reagents[1]

This standard is issued under the fixed designation D7474; 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.

1. Scope*

1.1 This practice covers the evaluation of residual stresses in extruded profile or molded SP parts. The presence and relative magnitude of residual stresses are indicated by the crazing of the specimen part upon immersion in one or more of a series of chemical reagents. The specified chemical reagents were previously calibrated by use of Environmental Stress Cracking (ESC) techniques to cause crazing in sulfone plastics (SP) at specified stress levels.

1.2 This practice applies only to unfilled injection molding and extrusion grade materials of high molecular weight as indicated by the following melt flow rates: PSU 9 g/10 min, max., PESU 30 g/10 m, max, and PPSU 25 g/10 min, max. Lower molecular weight (higher melt flow) materials will craze at lower stress levels than indicated in Tables 1-3. (See Specification D6394 for melt flow rate conditions.)

1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

NOTE 1—There is no known ISO equivalent for this standard.

1.4 *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~~ safety, health and ~~health~~environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D543 Practices for Evaluating the Resistance of Plastics to Chemical Reagents
D618 Practice for Conditioning Plastics for Testing
D883 Terminology Relating to Plastics
D4000 Classification System for Specifying Plastic Materials
D6394 Specification for Sulfone Plastics (SP)

2.2 *ISO Standard:*[3]

ISO 22088–3 Plastics—Determination of Resistance to Environmental Stress Cracking (ESC)—Part 3: Bent Strip Method

3. Terminology

3.1 *Definitions*—For definitions of technical terms pertaining to plastics used in this practice, see Terminology D883.

4. Summary of Practice

4.1 The practice involves the exposure of finished plastic parts to a specified series of chemical reagents which are known to produce cracking or crazing of Sulfone Plastic (SP) materials at specific stress levels, under otherwise constant conditions including a fixed time of one minute. Thus, the exposure of finished parts to one or more chemical reagents under no load

[1] This practice is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.15 on Thermoplastic Materials.

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[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 American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

***A Summary of Changes section appears at the end of this standard**

TABLE 1 Liquid Reagents for Residual Stress Test for PSU

Mixture	Mixture Composition		Critical Stress, MPa (psi)
	% by volume Ethanol	% by volume Ethyl Acetate	
1	50	50	15.2 (2200)
2	43	57	12.1 (1750)
3	37	63	9.0 (1300)
4	25	75	5.5 (800)

TABLE 2 Liquid Reagents for Residual Stress Test for PESU

Mixture	Mixture Composition		Critical Stress, MPa (psi)
	% by volume Ethanol	% by volume MEK	
1	50	50	17.9 (2600)
2	40	60	10.3 (1500)
3	20	80	6.9 (1000)
4	0	100	5.9 (850)

TABLE 3 Liquid Reagents for Residual Stress Test for PPSU

Mixture	Mixture Composition		Critical Stress, MPa (psi)
	% by volume Ethanol	% by volume MEK	
1	50	50	22.8 (3300)
2	25	75	13.8 (2000)
3	10	90	9.0 (1300)
4	0	100	8.0 (1150)

conditions allows the quantification of the residual stress levels in the finished parts. Since the evaluation is based on the subjective criteria of presence or absence of crazing, this practice only yields an approximate indication of the level of residual stresses in the parts. This practice estimates the relative magnitude of residual stresses in parts produced from the series of sulfone plastics, namely polysulfone (PSU), polyethersulfone (PESU), and polyphenylsulfone (PPSU) materials.

5. Significance and Use

5.1 Thermoplastic moldings contain residual stresses due to differential cooling rates through the thickness of the molding. Changes in residual stress have been found to occur with time after molding due to stress relaxation. Many part performance parameters as well as part failures are affected by the level of residual stress present in a part. Residual stresses cause shrinkage, warpage, and a decrease in environmental stress crack resistance. This practice estimates the relative magnitude of residual stresses in parts produced from the series of sulfone plastics (SP), namely polysulfone (PSU), polyethersulfone (PESU), and polyphenylsulfone (PPSU) materials.

5.2 No direct correlation has been established between the results of the determination of residual stresses by this practice and part performance properties. For this reason, this practice is not recommended as a substitute for other tests, nor is it intended for use in purchasing specifications for parts. Despite this limitation, this practice does yield information of value in indicating the presence of residual stresses and the relative quality of plastic parts.

5.3 Residual stresses cannot be easily calculated, hence it is important to have an experimental method, such as this practice, to estimate residual stresses.

5.4 This practice is useful for extruders and molders who wish to evaluate residual stresses in SP parts. This can be accomplished by visual examination after immersion in one or more chemical reagents to evaluate whether or not cracking occurs. Stresses will relax after molding or extrusion. Accordingly, both immersion in the test medium and visual examination must be made at identical times and conditions after processing, if comparing parts. It is important to note the differences in part history. Thus, this technique ~~may be used~~ is suitable as an indication for quality of plastic processing.

5.5 The practice is useful primarily for indicating residual stresses near the surface.

6. Apparatus

6.1 *Container*, of sufficient size to ensure complete immersion of specimen(s).

6.2 *Cotton swaps*, patches or similar means to apply reagent to a localized area if immersion is impractical.

7. Reagents

7.1 Ethanol, or Ethyl Alcohol, denatured,

7.2 Ethyl acetate (EA),

7.3 Methyl Ethyl Ketone (MEK), and