Designation: D6712 – 17

Standard Specification for Ultra-High-Molecular-Weight Polyethylene (UHMW-PE) Solid Plastic Shapes[1]

This standard is issued under the fixed designation D6712; 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.

INTRODUCTION

This specification is intended to be a means of defining Ultra-High-Molecular-Weight[2] Polyethylene (UHMW-PE) solid plastic shapes for commercial use.

1. Scope*

1.1 This specification covers requirements and test methods for the material and properties of solid plastic shapes manufactured from UHMW-PE.

1.2 The properties included in this specification are those required for the compositions covered and are derived from molded samples or fabricated from sheet, rod and profiles. Requirements necessary to identify particular characteristics important to specialized applications are described by using the classification system given in Section 4.

1.3 This specification allows for the use of recycled plastics (as defined in Guide D5033).

1.4 The values are stated in SI units and are to be regarded as the standard in all property tables. For reference purposes, English units are also included in Table S-UHMW-PE and Table A and are not necessarily exact equivalents.

1.5 The following precautionary caveat pertains only to the test method portions of this specification. *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 requirements prior to use.*

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

2. Referenced Documents

2.1 *ASTM Standards:*[3]

D618 Practice for Conditioning Plastics for Testing

D638 Test Method for Tensile Properties of Plastics

D883 Terminology Relating to Plastics

D1600 Terminology for Abbreviated Terms Relating to Plastics

D3892 Practice for Packaging/Packing of Plastics

D4000 Classification System for Specifying Plastic Materials

D4020 Specification for Ultra-High-Molecular-Weight Polyethylene Molding and Extrusion Materials

D5033 Guide for Development of ASTM Standards Relating to Recycling and Use of Recycled Plastics (Withdrawn 2007)[4]

2.2 *ISO Standard:*

ISO 11542-2 Ultra-High-Molecular Weight Polyethylene (PE-UHMW) Moulding Materials—Part 2: Preparation of Test Specimens and Determination of Properties

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of other technical terms pertaining to plastics used in this specification, see Terminology D883, D1600, or Guide D5033.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *additive, n*—any material added to the polymer such as processing aids, stabilizers, and colorants.

[1] This specification 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] Ultra High Molecular Weight refers to a polyethylene resin meeting the requirements of Specification D4020.

[3] 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.

[4] The last approved version of this historical standard is referenced on www.astm.org.

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

3.2.2 *recycled-plastic shape, n*—a product made from up to 100 % post-consumer material.

3.2.3 *regrind (plastic), n*—a product or scrap such as edge trim that have been reclaimed by shredding and granulating for use in-house.

3.2.4 *rod, n*—an extruded solid cylindrical shape with a minimum diameter of 1⁄16 in.

3.2.5 *sheet, n*—flat stock greater than 10 mils thickness.

3.2.6 *solid plastic shape, n*—a product of various geometries made up of UHMW-PE, such as sheet, rod, and so forth.

TABLE S-UHMW-PE Physical Property Requirements for Ultra High Molecular Weight Polyethylene Solid Plastic Shapes

Description	Type	Class	Description	Grade	Applicable Specification Callout	Description	Izod impact, Test Method for D4020, min, kJ/m^2 (ft-lbs/in.^{2})	Elongational Stress, Test Method for ISO 11542-2 (Annex 1), min, Mpa	Tensile Elongation, Test Method for D638, % at break, min
UHMW-PE	01	1	unfilled	1	ASTM D4020	General purpose	37 (18)	>0.20	200
				2	see Table A	Recycled	. . .	. . .	. . .
				0					
		0	as specified	1	see Table A	General purpose	. . .	. . .	. . .
				2	see Table A	Recycled	. . .	. . .	. . .
				0					
Other UHMW-PE	00	0	. . .	0	. . .	. . .	. . .	. . .	. . .

4. Classification and Material

4.1 Product shape and size as defined in the applicable purchase order.

4.2 This standard covers product as listed in Table S-UHMW-PE.

4.2.1 The type of a UHMW-PE product is categorized by grade and type depending on resin and additives present, as defined in Table S-UHMW-PE.

4.2.2 Every type of UHMW-PE solid plastic shape are categorized into one of two grades as follows:

4.2.2.1 *Grade l: General Purpose (Virgin) UHMW-PE*—UHMW-PE solid plastic shapes are made using only 100 % virgin UHMW polyethylene resin which meets the requirements of Specification D4020. Virgin product shall not contain materials of unknown origin or composition.

NOTE 2—If appropriate, the resin can contain additives, such as processing aids, stabilizers, and colorants.

4.2.2.2 *Grade 2: Recycled/Regrind UHMW-PE*—UHMW-PE solid plastic shapes are made using any amount up to 100 percent of recycled, or regrind UHMW-PE plastic, or both.

TABLE A Additional Requirements for UHMW-PE Solid Plastic Shapes

NOTE 1—The values listed in Table A are minimum values.

Designation Order Number	Property	0	1	9
1	Izod impact, Test Method for D4020, min KJ/m^2 (ft-lbs/in.^{2})	Unspecified	30 (14)	Specify value
2	Elongational stress, Test Method for ISO 11542-2 (Annex 1), min, MPa	Unspecified	>0.20	Specify value
3	Elongation at break, Test Method for D638, %, min	Unspecified	200	Specify value
4	To be determined	. . .	. . .	. . .

4.3 *Property Tables:*

4.3.1 Table S-UHMW-PE is to be used to describe UHMW-PE solid plastic shapes.

4.3.2 To facilitate the incorporation of future UHMW-PE or special UHMW-PE formulations not covered by Table A, the "as specified" category (00) for grade is shown on the table with the basic properties to be obtained from Table S-UHMW-PE, as they apply.

4.4 *Callout Designation*—A one-line system shall be used to specify polyethylene materials covered by this specification.

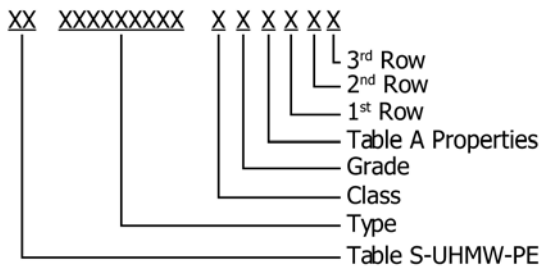

FIG. 1 Callout Designation Layout

4.4.1 The system uses pre-defined cells to refer to specific aspects of this specification as illustrated below in Examples 1–3:

4.4.2 *Example 1*—Product made from virgin Type UHMW-PE resin.

CELL CALLOUT: S-UHMW-PE0111

where:

S-UHMW-PE01 = product made from general purpose resin per Table S-UHMW-PE,
1 = unfilled class, and
1 = general purpose.

4.4.3 *Example 2*—Product made using virgin resin, or regrind/recycled UHMW-PE, or both, with an Izod impact 30 kJ/m^2 (14 ft-lb/m^2), minimum and elongation at break more than 200 %.

CELL CALLOUT: S-UHMW-PE0112A101

where:

S-UHMW-PE01 = product made from general purpose resin per Table S-UHMW-PE,
1 = unfilled class,

2	=	product made using virgin resin, or reprocessed/recycled UHMW-PE, or both, per Table S-UHMW-PE,
A	=	Table A properties,
1	=	Izod impact, 30 kJ/m^2 (14 ft-lb/in.^{2}), min,
0	=	unspecified, and
1	=	elongation at break, 200 %, min.

4.4.4 *Example 3*—Product made using virgin UHMW-PE resin and having an Izod impact strength of 105 kJ/m^2 (50) ft-lb/in.^{2}.

CELL CALLOUT: S-UHMW-PE0101A911PX105

where:

S-UHMW-PE01	=	product made from virgin resin per Table S-UHMW-PE,
0	=	as specified,
1	=	general purpose,
A	=	Table A properties,
9	=	specify value,
1	=	elongational stress ≥0.2 (MPa),
1	=	elongation at break, 200 %,
PX	=	D4020 suffix P, and
105	=	105 kJ/m^2 (50 ft-lb/in.^{2}) (for 9 above).

4.4.5 The three examples illustrate how a one-line, alpha-numeric sequence can identify the product composition, commercial parameters and physical characteristics of UHMW-PE sheet and rod product.

5. Physical Property Requirements

5.1 The data listed within this specification's tables are to be considered minimum values. If specific test data is required for a given production lot, it shall be specified at the time of order. All physical property data listed in Table S-UHMW-PE shall be provided by the supplier of the solid plastic shapes on demand. Physical property data for products not yet included in Table S-UHMW-PE is to be specified using Table A for UHMW-PE solid plastic shapes.

6. Dimensional Requirements

6.1 Products shall be supplied in the unfinished condition, unless otherwise specified at the time of order, sufficient to finish to the nominal dimension ordered.

7. Workmanship, Finish, and Appearance

7.1 *Appearance*—The color of products shall be as published by the manufacturer, within commercial tolerances. They shall be uniform in color throughout the thickness. If required, specific colors and color matching shall be agreed to by order.

NOTE 3—Physical properties may be affected by colors.

7.2 *Finish*—All products shall have a finish consistent with current manufacturing processes.

8. Sampling

8.1 Sampling shall be statistically adequate to satisfy the requirements of this standard.

9. Number of Tests

9.1 The criteria listed in these product tables and definitions are sufficient to establish conformity of the sheet to this specification. When the number of test specimens is not stated in the test method, a single determination is acceptable. If more than single determinations and separate portions of the same sample are made, the results shall be averaged. The final result shall conform to the requirements prescribed in this specification.

10. Test Conditions

10.1 *Conditioning of Specimens*—The specification values and dimensions are based on conditioning techniques outlined in Practice D618 Procedure A.

10.2 *Testing of Specimens*—The tests shall be conducted at the standard laboratory conditions at (23°C ± 2°C).

11. Test Methods

11.1 Elongation at break per Test Method D638, at the rate of 2.0 in./min ± 10 %.

11.2 Izod impact per Specification D4020, ¼-in. thick specimen.

11.3 Elongational stress per ISO 11542-2.

12. Certification

12.1 When requested at the time of order, the purchaser shall be furnished a certification that the lot is made from UHMW-PE plastic and meets the requirements of this standard.

13. Packing, Packaging and Marking

13.1 All packing, packaging, and marking provisions of Practice D3892 shall apply to this specification.

14. Ordering Information

14.1 All solid plastic shapes that are covered by this standard shall be ordered using the proper callout designation (see 4.4).

15. Keywords

15.1 recycled UHMW-PE; reprocessed UHMW-PE; sheet UHMW-PE

SUMMARY OF CHANGES

Committee D20 has identified the location of selected changes to this standard since the last issue (D6712 - 01(2009)) that may impact the use of this standard. (March 1, 2017)

(1) Removal of permissive language and minor editorial changes.