GM13 Test Methods, Test Properties, and Testing Frequency for High-Density Polyethylene (HDPE) Smooth and Textured Geomembranes- Testing Equipment

Description

1 Scope

1.1 This specification covers high density polyethylene (HDPE) geomembranes with a formulated sheet density of 0.940 g/ml, or higher, in the thickness range of 0.75 mm (30 mils) to 3.0 mm (120 mils). Both smooth and textured geomembrane surfaces are included.

1.2 This specification sets forth a set of minimum, physical, mechanical and chemical properties that must be met, or exceeded by the geomembrane being manufactured. In a few cases a range is specified.

1.3 In the context of quality systems and management, this specification represents manufacturing quality control (MQC).

Note 1: Manufacturing quality control represents those actions taken by a manufacturer to ensure that the product represents the stated objective and properties set forth in this specification.

1.4 This standard specification is intended to ensure good quality and performance of HDPE geomembranes in general applications, but is possibly not adequate for the complete specification in a specific situation. Additional tests, or more restrictive values for test indicated, may be necessary under conditions of a particular application.

Note 2: For information on installation techniques, users of this standard are referred to the geosynthetics literature, which is abundant on the subject.

2 Referenced Documents

2.1 ASTM Standards

D 792 Specific Gravity (Relative Density) and Density of Plastics by Displacement

D 1004 Test Method for Initial Tear Resistance of Plastics Film and Sheeting

D 1238 Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer

D 1505 Test Method for Density of Plastics by the Density-Gradient Technique

D 1603 Test Method for Carbon Black in Olefin Plastics

D 4218 Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique

D 4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products

D 5199 Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes

D 5397 Procedure to Perform a Single Point Notched Constant Tensile Load – (SP-NCTL) Test: Appendix

D 5596 Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics

D 5721 Practice for Air-Oven Aging of Polyolefin Geomembranes

D 5885 Test method for Oxidative Induction Time of Polyolefin Geosynthetics by High-Pressure Differential Scanning Calorimetry D 5994 Test Method for Measuring the Core Thickness of Textured Geomembranes D 6370 Standard Test Method for Rubber-Compositional Analysis by Thermogravimetry (TGA) D 6693 Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes

D 7238 Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Fluorescent UV Condensation Apparatus

D 7466 Test Method for Measuring the Asperity Height of Textured Geomembranes D 8117 Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by Differential Scanning Calorimetry

4 Material Classification and Formulation

4.1 This specification covers high density polyethylene geomembranes with a formulated sheet density of 0.940 g/ml, or higher. Density can be measured by ASTM D1505 or ASTM D792. If the latter, Method B is recommended.

4.2 The polyethylene resin from which the geomembrane is made will generally be in the density range of 0.932 g/ml or higher, and have a melt index value per ASTM D1238 of less than 1.0 g/10 min.4.3 The resin shall be virgin material with no more than 10% rework. If rework is used, it must be a similar HDPE as the parent material.

4.4 No post consumer resin (PCR) of any type shall be added to the formulation.

5 Physical, Mechanical and Chemical Property Requirements

5.1 The geomembrane shall conform to the test property requirements prescribed in Tables 1 and 2. Table 1 is for smooth HDPE geomembranes and Table 2 is for single and double sided textured HDPE geomembranes. Each of the tables are given in English and SI (metric) units. The conversion from English to SI (metric) is soft.

Note 3: The tensile strength properties in this specification were originally based on ASTM D 638 which uses a laboratory testing temperature of 23C \pm 2C. Since ASTM Committee D35 on Geosynthetics adopted ASTM D 6693 (in place of D 638), this GRI Specification followed accordingly. The difference is that D 6693 uses a testing temperature of 21C \pm 2C. The numeric values of strength and elongation were not changed in this specification. If a dispute arises in this regard, the original temperature of 23C \pm 2C should be utilized for testing purposes.

Note 4: There are several tests often included in other HDPE specifications which are omitted from this standard because they are outdated, irrelevant or generate information that is not necessary to evaluate on a routine MQC basis. The following tests have been purposely omitted:

- Volatile Loss Water Absorption
- Dimensional Stability
 Ozone Resistance
- Coeff. of Linear Expansion Modulus of Elasticity
- Resistance to Soil Burial Hydrostatic Resistance
- Low Temperature Impact
 Tensile Impact
- ESCR Test (D 1693) Field Seam Strength
- Wide Width Tensile Multi-Axial Burst
- Water Vapor Transmission Various Toxicity Tests

Note 5: There are several tests which are included in this standard (that are not customarily required in other HDPE specifications) because they are relevant and important in the context of current



manufacturing processes. The following tests have been purposely added:

- Oven Aging
- Oxidative Induction Time
- Ultraviolet Resistance
- Asperity Height of Textured Sheet (see Note 6)

Note 6: The minimum average value of asperity height does not represent an expected value of interface shear strength. Shear strength associated with geomembranes is both site-specific and productspecific and should be determined by direct shear testing using ASTM D5321/ASTM D6243 as prescribed. This testing should be included in the particular site's CQA conformance testing protocol for the geosynthetic materials involved, or formally waived by the Design Engineer, with concurrence from the Owner prior to the deployment of the geosynthetic materials.

Note 7: There are other tests in this standard, focused on a particular property, which are updated to current standards. The following are in this category:

Thickness of Textured Sheet

- Puncture Resistance
- Stress Crack Resistance
- AKINA Carbon Black Dispersion (In the viewing and subsequent quantitative interpretation of ASTM D 5596 only near spherical agglomerates shall be included in the assessment).

5.2 The values listed in the tables of this specification are to be interpreted according to the designated test method. In this respect they are neither minimum average roll values (MARV) nor maximum average roll values (MaxARV).

5.3 The properties of the HDPE geomembrane shall be tested at the minimum frequencies shown in Tables 1 and 2. If the specific manufacturer's quality control guide is more stringent and is certified accordingly, it must be followed in like manner.

Note 8: This specification is focused on manufacturing quality control (MQC). Conformance testing and manufacturing quality assurance (MQA) testing are at the discretion of the purchaser and/or quality assurance engineer, respectively.

7 MQC Sampling

7.1 Sampling shall be in accordance with the specific test methods listed in Tables 1 and 2. If no sampling protocol is stipulated in the particular test method, then test specimens shall be taken evenly spaced across the entire roll width.

7.2 The number of tests shall be in accordance with the appropriate test methods listed in Tables 1 and 2.

7.3 The average of the test results should be calculated per the particular standard cited and compared to the minimum value listed in these tables, hence the values listed are the minimum average values and are designated as "min. ave."

8 MQC Retest and Rejection

8.1 If the results of any test do not conform to the requirements of this specification, retesting to

determine conformance or rejection should be done in accordance with the manufacturing protocol as set forth in the manufacturer's quality manual.

9 Packaging and Marketing

9.1 The geomembrane shall be rolled onto a substantial core or core segments and held firm by dedicated straps/slings, or other suitable means. The rolls must be adequate for safe transportation to the point of delivery, unless otherwise specified in the contract or order.

ENGLISH UNITS

Dronantias	Test		Testing Engances						
Properties	Test	2.0	resting Frequency						
	Method	30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils	(minimum)
Thickness (min. ave.) - mils	D5199	nom.	nom.	nom.	nom.	nom.	nom.	nom.	per roll
 lowest individual of 10 values - % 		-10	-10	-10	-10	-10	-10	-10	
Formulated Density (min. ave.) - g/cc	D 1505/D 792	0.940	0.940	0.940	0.940	0.940	0.940	0.940	200,000 lb
Tensile Properties (1) (min. ave.)	D 6693								20,000 lb
 yield strength - lb/in. 	Type IV	63	84	105	126	168	210	252	
 break strength - lb/in. 		114	152	190	228	304	380	456	
 vield elongation - % 		12	12	12	12	12	12	12	
 break elongation - % 		700	700	700	700	700	700	700	
Tear Resistance (min. ave.) - lb	D 1004	21	28	35	42	56	70	84	45,000 lb
Puncture Resistance (min. ave.) - lb	D 4833	54	72	90	108	144	180	216	45,000 lb
Stress Crack Resistance (2) - hr.	D5397	500	500	500	500	500	500	500	per GRI-GM10
	(App.)								-
Carbon Black Content (range) - %	D 4218 (3)	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	20,000 lb
Carbon Black Dispersion	D 5596	note (4)	note (4)	note (4)	note (4)	note (4)	note (4)	note (4)	45,000 lb
Oxidative Induction Time (OIT) (min. ave.) (5)									200,000 lb
(a) Standard OIT - min.	D 8117	100	100	100	100	100	100	100	
— or —			K7 \					1	
(b) High Pressure OIT - min.	D 5885	400	400	400	400	400	400	400	
Oven Aging at 85°C (5), (6)	D 5721								
(a) Standard OIT (min. ave.) - % retained after 90 days	D 8117	55	55	55	55	55	55	55	per each
— or —								1	formulation
(b) High Pressure OIT (min. ave.) - % retained after 90 days	D 5885	80	80	80	80	80	80	80	
UV Resistance (7)	D 7238								
(a) Standard OIT (min. ave.)	D 8117	N.R. (8)	N.R. (8)	N.R. (8)	N.R. (8)	N.R. (8)	N.R. (8)	N.R. (8)	per each
— or —									formulation
(b) High Pressure OIT (min ave) - % retained after 1600 hrs (0)	D 5885	50	50	50	50	50	50	50	1

Table 1(a) - High Density Polyethylene (HDPE) Geomembrane -Smooth

Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction. (1)Yield elongation is calculated using a gage length of 1.3 inches

Break clongation is calculated using a gage length of 2.0 in. The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing. (2)

(3)Other methods such as D 1603 (tube furnace) or D 6370 (TGA) are acceptable if an appropriate correlation to D 4218 (muffle furnace) can be established. Carbon black dispersion (only near spherical agglomerates) for 10 different views:

(4)

9 in Categories 1 or 2 and 1 in Category 3 The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane. (5)

It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response. The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C. (6)

(7)

In contained of the test about of 20 m. Or option of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples. UV resistance is based on percent retained value regardless of the original HP-OIT value. (8)

(9)

SI (METRIC) UNITS

Properties	Test	Test Value							Testing Frequency
	Method	0.75 mm	1.00 mm	1.25 mm	1.50 mm	2.00 mm	2.50 mm	3.00 mm	(minimum)
Thickness - (min. ave.) - mm	D5199	nom.	nom.	nom.	nom.	nom.	nom.	nom.	per roll
 lowest individual of 10 values - % 		-10	-10	-10	-10	-10	-10	-10	
Formulated Density (min. ave.) - g/cc	D 1505/D 792	0.940	0.940	0.940	0.940	0.940	0.940	0.940	90,000 kg
Tensile Properties (1) (min. ave.)	D 6693								9,000 kg
 yield strength - kN/m 	Type IV	11	15	18	22	29	37	44	
 break strength - kN/m 		20	27	33	40	53	67	80	
 yield elongation - % 		12	12	12	12	12	12	12	
 break elongation - % 		700	700	700	700	700	700	700	
Tear Resistance (min. ave.) - N	D 1004	93	125	156	187	249	311	374	20,000 kg
Puncture Resistance (min. ave.) - N	D 4833	240	320	400	480	640	800	960	20,000 kg
Stress Crack Resistance (2) - hr.	D 5397	500	500	500	500	500	500	500	per GRI GM-10
	(App.)								-
Carbon Black Content (range) - %	D 4218 (3)	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	9,000 kg
Carbon Black Dispersion	D 5596	note (4)	note (4)	note (4)	note (4)	note (4)	note (4)	note (4)	20,000 kg
Oxidative Induction Time (OIT) (min. ave.) (5)									90,000 kg
(a) Standard OIT - min.	D 8117	100	100	100	100	100	100	100	
— or —									
(b) High Pressure OIT - min.	D 5885	400	400	400	400	400	400	400	
Oven Aging at 85°C (5), (6)	D 5721								
(a) Standard OIT (min. ave.) - % retained after 90 days	D 8117	55	55	55	55	55	55	55	per each
— or —									formulation
(b) High Pressure OIT (min. ave.) - % retained after 90 days	D 5885	80	80	80	80	80	80	80	
UV Resistance (7)	D 7238								
(a) Standard OIT (min. ave.)	D 8117	N. R. (8)	N.R. (8)	N.R. (8)	N.R. (8)	N.R. (8)	N.R. (8)	N.R. (8)	per each
— or —									formulation
(b) High Pressure OIT (min. ave.) - % retained after 1600 hrs (9)	D 5885	50	50	50	50	50	50	50	

Table 1(b) - High Density Polyethylene (HPDE) Geomembrane - Smooth

 Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction Yield elongation is calculated using a gage length of 33 mm Break elongation is calculated using a gage length of 50 mm
 The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.
 Other methods such as D 1603 (tube furnace) or D 6370 (TGA) are acceptable if an appropriate correlation to D 4218 (muffle furnace) can be established.
 Carbon black dispersion (only near spherical agglomerates) for 10 different views: 9 in Categories 1 or 2 and 1 in Category 3
 The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
 It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.
 The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.
 Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.
 UV resistance is based on percent retained value regardless of the original HP-OIT value. (1) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction

Table 2(a) - High Density Polyethylene (HDPE) Geomembrane - Textured

Properties	Test Method	Test Value							Testing Frequency
		30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils	(minimum)
Thickness mils (min. ave.) - mils	D 5994	nom5%	nom5%	nom5%	nom5%	nom5%	nom5%	nom5%	per roll
 lowest individual for 8 out of 10 values - % 		-10	-10	-10	-10	-10	-10	-10	
 lowest individual for any of the 10 values - % 		-15	-15	-15	-15	-15	-15	-15	
Asperity Height mils (min. ave.) - mils	D 7466	16	16	16	16	16	16	16	every 2nd roll (1)
Formulated Density (min. ave.) - g/cc	D 1505/D 792	0.940	0.940	0.940	0.940	0.940	0.940	0.940	200,000 lb
Tensile Properties (min. ave.) (2)	D 6693								20,000 lb
 yield strength - lb/in. 	Type IV	63	84	105	126	168	210	252	
 break strength - lb/in. 		45	60	75	90	120	150	180	
 yield elongation - % 		12	12	12	12	12	12	12	
 break elongation - % 		100	100	100	100	100	100	100	
Tear Resistance (min. ave.) - lb	D 1004	21	28	35	42	56	70	84	45,000 lb
Puncture Resistance (min. ave.) - lb	D 4833	45	60	75	90	120	150	180	45,000 lb
Stress Crack Resistance (3) - hr.	D 5397	500	500	500	500	500	500	500	per GRI GM10
	(App.)								
Carbon Black Content (range) - %	D 4218 (4)	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	20,000 lb
Carbon Black Dispersion	D 5596	note (5)	note (5)	note (5)	note (5)	note (5)	note (5)	note (5)	45,000 lb
Oxidative Induction Time (OIT) (min. ave.) (6)									200,000 lb
(a) Standard OIT - min.	D 8117	100	100	100	100	100	100	100	
— or —		10.0	100	100	10.0				
(b) High Pressure OIT - min.	D 5885	400	400	400	400	400	400	400	
Oven Aging at 85°C (6), (7)	D 5721								
(a) Standard OIT (min. ave.) - % retained after 90 days	D 8117	55	55	55	55	55	55	55	per each
- or	D 5005	80	80	80	80	80	80	80	formulation
(b) High Pressure Off (min. ave.) - % retained after 90 days	D 5885	80	80	80	80	80	80	80	
(a) Standard OIT (min_ava)	D 7238	N.P. (0)	N.P. (0)	N. P. (0)	N. P. (0)	N.P. (0)	N.P. (0)	N.P. (0)	nor each
(a) Standard OTI (min. ave.)	108117	N.K. (9)	N.K. (9)	N.K. (9)	N.K. (9)	N.K. (9)	N.K. (9)	N.K. (9)	formulation
(b) High Pressure OIT (min. ave.) - % retained after 1600 hrs (10)	D 5885	50	50	50	50	50	50	50	formulation
L									

(b) High Pressure OIT (min. avc.) - % retained aiter 1000 ms (1.07)
(l) Alternate the measurement side for double sided textured sheet
(2) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction. Yield elongation is calculated using a gage length of 1.3 inches Break elongation is calculated using a gage length of 2.0 inches
(3) SP-NCTL per ASTM D5397 Appendix, is not appropriate for testing geomembranes with textured or irregular rough surfaces. Test should be conducted on smooth edges of the same formulation as being used for the textured sheet materials. The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MOC testing.
(4) Other methods such as D 1603 (tube furnace) or D 6370 (TGA) are acceptable if an appropriate correlation to D 4218 (muftle furnace) can be established.
(5) Carbon black dispersion (only near spherical agglomerates) for 10 different views: 9 in Categories 1 or 2 and 1 in Category 3
(6) The manufacturer has the option to select either on of the OTI methods listed to evaluate the antioxidant content in the geomembrane.
(7) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.
(8) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.
(9) Not recommended to menetative of the 514-OTI test produces an unrealistic result for some of the antioxidants in the UV exposed samples.
(10) UV resistance is based on percent retained value regardless of the orginal HP OTI value. of textured rolls or on smooth sheets made from

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Properties	Test Method	Test Value							Testing
	inteniou	0.75 mm	1.00 mm	1.25 mm	1.50 mm	2.00 mm	2.50 mm	3.00 mm	(minimum)
Thickness (min. ave.) - mm	D 5994	nom5%	nom5%	nom5%	nom5%	nom5%	nom5%	nom5%	per roll
 lowest individual for 8 out of 10 values - % 		-10	-10	-10	-10	-10	-10	-10	
 lowest individual for any of the 10 values - % 		-15	-15	-15	-15	-15	-15	-15	
Asperity Height mils (min. ave.) - mm	D 7466	0.40	0.40	0.40	0.40	0.40	0.40	0.40	every 2 nd roll (1)
Formulated Density (min. ave.) - g/cc	D 1505/D 792	0.940	0.940	0.940	0.940	0.940	0.940	0.940	90,000 kg
Tensile Properties (min. ave.) (2)	D 6693								9,000 kg
 yield strength - kN/m 	Type IV	11	15	18	22	29	37	44	
 break strength - kN/m 		8	10	13	16	21	26	32	
 yield elongation - % 		12	12	12	12	12	12	12	
 break elongation - % 		100	100	100	100	100	100	100	
Tear Resistance (min. ave.) - N	D 1004	93	125	156	187	249	311	374	20,000 kg
Puncture Resistance (min. ave.) - N	D 4833	200	267	333	400	534	667	800	20,000 kg
Stress Crack Resistance (3) - hr.	D 5397	500	500	500	500	500	500	500	per GRI GM10
	(App.)								
Carbon Black Content (range) - %	D 4218 (4)	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	9,000 kg
Carbon Black Dispersion	D 5596	note (5)	note (5)	note (5)	note (5)	note (5)	note (5)	note (5)	20,000 kg
Oxidative Induction Time (OIT) (min. ave.) (6)									90,000 kg
(a) Standard OIT - min.	D 8117	100	100	100	100	100	100	100	
— or —									
(b) High Pressure OIT - min.	D 5885	400	400	400	400	400	400	400	
Oven Aging at 85°C (6), (7)	D 5721								
(a) Standard OIT (min. ave.) - % retained after 90 days	D 8117	55	55	55	55	55	55	55	per each
	D 6006	20	80	0.0	80	80		80	formulation
(b) High Pressure OIT (min. ave.) - % retained after 90 days	D 5885	80	80	80	80	80	80	80	
(v) Standard OFT (min_mus)	D 7238	N.B. (0)	N.B. (0)	N.B. (0)	N.D. (0)	N.D. (0)	N.B. (0)	N.B. (0)	a se se sh
(a) Standard OI1 (min. ave.)	1 8117	IN.K. (9)	N.K. (9)	IN.K. (9)	N.K. (9)	N.K. (9)	N.K. (9)	IN.K. (9)	formulation
(b) High Pressure OIT (min_ave) - % retained after 1600 hrs (10)	D 5885	50	50	50	50	50	50	50	Tornidation
(b) right ressure or (inn. ave.) - /o retained aner 1000 his (10)	D 2005	50	50	50		50		50	
	-								

Table 2(b) - High Density Polyethylene (HDPE) Geomembrane - Textured

Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction \hat{a}

(2) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction. Yield elongation is calculated using a gage length of 30 mm Break elongation is calculated using a gage length of 50 mm
(3) The SP-NCTL test is not appropriate for testing geomembranes with textured or irregular rough surfaces. Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation as being used for the textured sheet materials. The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.
(4) Other methods such as D 1603 (tube furnace) or D 6370 (TGA) are acceptable if an appropriate correlation to D 4218 (muffle furnace) can be established.
(5) Carbon black dispersion (only near spherical agglomerates) for 10 different views: 9 in Categories I or 2 and I in Category 3
(6) The manufacturer has the option to select either one of the OT methods listed to evaluate the antioxidant content in the geomembrane.
(7) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.
(8) The commended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.
(10) UV resistance is based on percent retained value regardless of the original HP-OIT value.

Universal Tensile Compression Tester (UTM)

ASTM D5748 Testing Equipment for Puncture Resistance of Stretch Wrap Film

Full Notch Creep Tester (FNCT, 2NCT)

High Pressure OIT Test for Geomembranes ASTM D 5885

High Pressure OIT Tester (HPOIT, HP OIT)

Differential Scanning Calorimeter (DSC, OIT)

Accelerated Aging UV Testing Chamber

Melt Flow Index Tester (MFI, MFR)

Carbon Black Content Test Furnace (CBC Tester)

ISO 18553 – Method for the Assessment of the Degree of Pigment or Carbon Black Dispersion in Polyolefin Pipes, Fittings and Compounds / Testing Equipment

PLASTIK MAKINA **Cutting Punch for Tensile Test Samples**

Hot Air Oven

Category

- 1. Equipment for Standards
- 2. Standards