

ENVIRONMENTAL PRODUCT DECLARATION for ECONYL® POLYMER



EPD®

**CPC347-PLASTICS IN PRIMARY FORMS
PCR2010:16 VERS. 3.01**

Program: The International EPD® System, www.environdec.com

Program operator: EPD International AB

This environmental product declaration is compliant with ISO 14025

Owner of the declaration:


Aquafil S.p.A., Via Linfano 9, 38062 Arco Italy

Publication date: 2013 - 12 - 17

Revision 5, 2020 - 05 - 07

Certification No.: S-P-00500

Valid until: 2025 - 05 - 07



COMPANY AND PRODUCT

Related information

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THE COMPANY

Aquafil Group history began in 1969, when the Bonazzi family built the first manufacturing plant in Arco (Trentino Alto Adige region, Italy). In 1970, the Group began the polymerization and production of polyamide 6 at this facility, which started Aquafil's market share acquisition in the BCF yarn sector (polyamide yarn for textile flooring). During the '80s, significant investments allowed a consolidation and diversification of the Group's activities. The most significant diversification of the Group's operation occurred in 1995 when the Aquafil Group finalized the first privatization of a public company in the newly born Republic of Slovenia. This acquisition allowed Aquafil to start its Nylon Textile Filament (NTF) product area.

Meanwhile, the Group continued to widen its product offering by opening several production plants in Europe and entering (with its "Polyamide products priority focus" always in mind) the Engineering Plastics business to supply engineering plastics to the automotive, electronics and construction industries. At the same time, the Group started its internationalization process with the creation of Aquafil USA, based in Cartersville, Georgia (USA).

Between 2000 and 2010, the Group expanded its presence in all three key markets where it was operating (carpet yarn, textile yarn and engineering plastics), gradually becoming a global leader in the manufacturing of Polyamide 6 fibers. In 2005, a manufacturing facility was established in Thailand for processing and marketing BCF products for the carpet industry in the Asian area. In 2009, a new manufacturing facility was built in China to assist in the ever-growing Asian market. In 2013, the Group sold the Engineering Plastics division to DOMO and acquired DOMO's BCF business Xentrys.

In 2007 the company started the development of a visionary project aligned with its manufacturing and market growth focus. Driven by a genuine concern for the environment, resources and investments were dedicated to the design and construction of the ECONYL® Regeneration Plant (the recycling of pre- and post-consumer Polyamide 6 waste material), which was launched in 2011. As of 2019, the Group operates 16 manufacturing plants worldwide with more than 2,900 employees, in eight countries (Italy, Slovenia, Croatia, Germany, United Kingdom, USA, Thailand and China) on three continents (Europe, North America and Asia).

IT OPERATES 2 DIFFERENT PRODUCT AREAS:

- **BCF** *Carpet yarn for the flooring market*
 - **NTF** *Special yarns for sportswear and fashion applications*
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In 2008, during the engineering and design phase of Aquafil's **ECONYL® Regeneration System**, a third operating unit was created - Energy & Recycling.

This Energy & Recycling operational unit is dedicated to the promotion of sustainability and environmental issues. It has a transverse nature in respect to the other product areas, providing solutions and innovative technologies in the area of energy, recycling and the promotion of the culture of sustainability both inside and outside of the Group.

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PROGRAM INFORMATION

PROGRAM OPERATOR

EPD international AB: Valhallavägen 81, SE-114 27 Stockholm Sweden;
E-mail: info@environdec.com

COMPARABILITY

EPDs within the same product category but from different programs may not be comparable.

OWNERSHIP

The EPD owner has the sole ownership, liability, and responsibility for this EPD.

VERIFICATION INFORMATION

CPC347- Plastics in primary forms

PCR2010:16 vers. 3.01

PRC review was conducted by: Technical Committee of the International EPD® System

Independent third-party verification of the declaration and data, according to ISO 14025:2010:

EPD process certification EPD verification

Third party verifier:

Bureau Veritas, accredited by SWEDAC

www.bureauveritas.com

Procedure for follow-up data during EPD validity involves third-party verifier:

YES NO

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PRODUCT INFORMATION

OWNER OF THE EPD

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DESCRIPTION OF THE PRODUCT

This EPD refers to a PA6 polymer of 100% recycled with post-consumer and post-industrial recycled (certified by independent third party DNV 18590-2008-PC-ITA-DNV), which is used in several sectors such as apparel, residential, automotive, fashion, sportswear, electrical, building construction and technical applications.

This declaration refers to two polymers

- **ECONYL®** polymers 2,4 viscosity; produced in AquafilSLO plant (Slovenia Ljubljana)
- **ECONYL®** polymers 2,7 viscosity; produced in Aquafil plant (Italy Arco and Slovenia Ljubljana)

IDENTIFICATION OF THE PRODUCT ACCORDING TO THE UN CPC SCHEME

347 – Plastics in primary forms.

PRODUCTION SITES INVOLVED IN EPD

- **AquafilSLO d.o.o. - Ljubljana** (Letališka cesta 15, 1000 Ljubljana, Slovenia) > *process E & F*
 - **AquafilSLO d.o.o. - Ajdovščina** (Tovarniška cesta 15, 5270 Ajdovščina, Slovenia) > *process I*
 - **Aquafil S.p.A.** (Via Linfano 9, 38062 Arco, Italy)
> *process A*
 - **Aquafil Carpet Recycling (ACR#1)** Phoenix (3555 W. Washington street, 85009 Phoenix, USA)
> *process S*
- **Production country:** Italy, Slovenia

ISO standard	AquafilSLO Ljubljana	AquafilSLO Ajdovščina	Aquafil S.p.A.	ACR#1 Phoenix
ISO 9001 : 2015	X	X	X	
ISO 14001 : 2015	X	X	X	
OHSAS 18001 : 2007	X	X	X	

PRODUCT CHARACTERISTICS

A. Product information on ECONYL® polymer 2,4 viscosity:

- Trade name: ECONYL® polymer 2,4 viscosity
- ISO code: PA6
- IUPAC name: poly (hexano-6-lactam)
- CAS number: 25038-54-4
- GHS classification: not dangerous

TECHNICAL SPECIFICATION	TEST METHOD	VALUE
Density	ISO 1183	1,14 g/cc
Melt flow rate	ISO 1133	59,1 cc/10'
Tensile strength at yield	ISO 527	78,48 MPa
Glass transition temperature for amorphous polymers	ISO 11357	226°C
Deflection temperature under load	ISO 75	180°C (0,45 MPa)

B. Product information on ECONYL® polymer 2,7 viscosity:

- Trade name: ECONYL® polymer 2,7 viscosity
- ISO code: PA6
- IUPAC name: poly (hexano-6-lactam)
- CAS number: 25038-54-4
- GHS classification: not dangerous

TECHNICAL SPECIFICATION	TEST METHOD	VALUE
Density	ISO 1183	1,14 g/cc
Melt flow rate	ISO 1133	33,6 cc/10'
Mechanical properties: Tensile	ISO 527	75,99 MPa
Glass transition temperature for amorphous polymers	ISO 11357	222°C
Deflection temperature under load	ISO 75	180°C (0,45 MPa)

GEOGRAPHICAL SCOPE OF THE EPD

Global.

DECLARED UNIT

Declared unit is 1 kg of granules delivered.

REFERENCE SERVICE LIFE

This EPD does not indicate RSL.

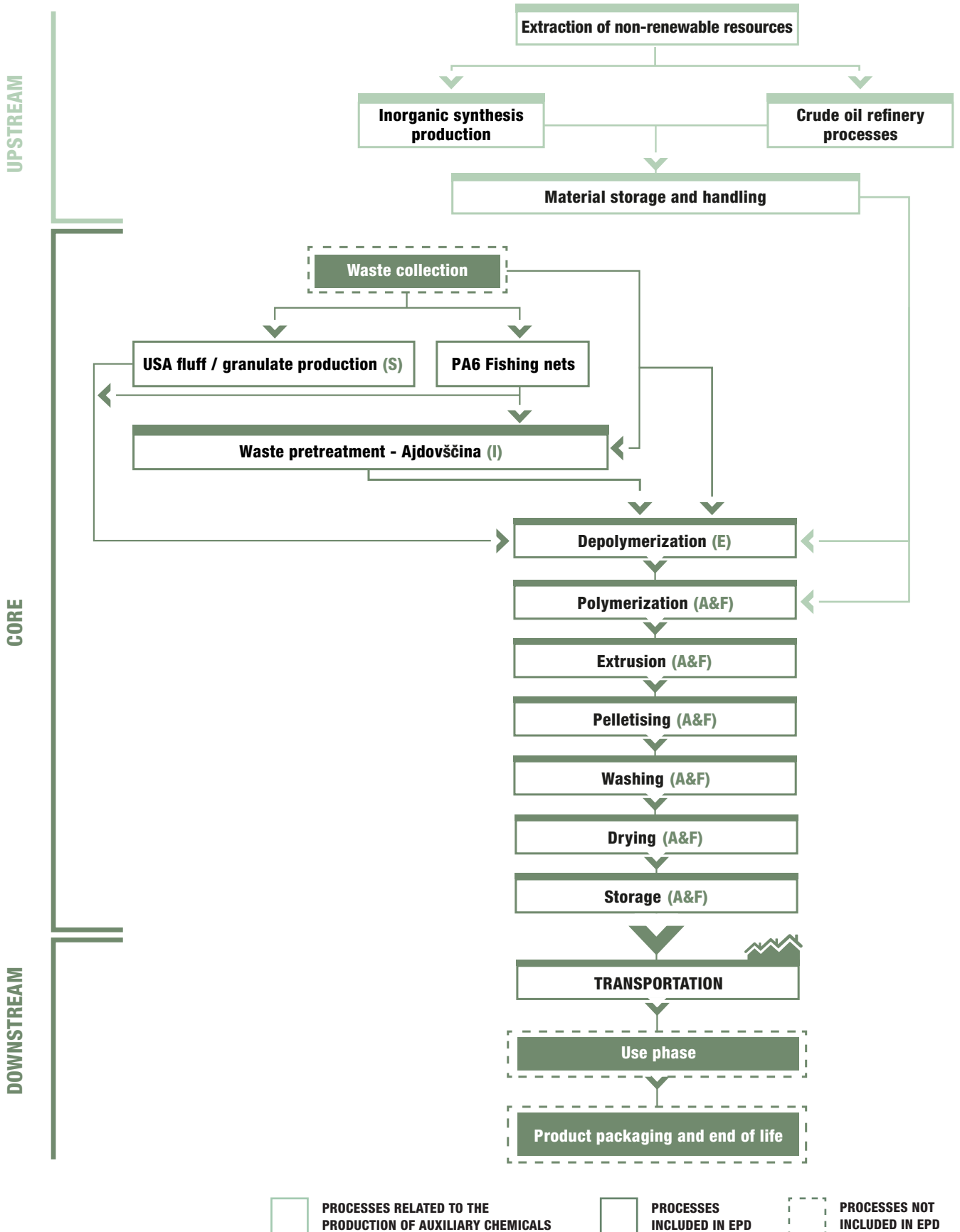
DATA COLLECTION

Life cycle assessment primary data of processes owned by Aquafil group were collected from period of January 2019 to December 2019.

BACKGROUND DATA AND METHOD

All the background data relevant for modelling were taken from Gabi database – service pack 40, (update 2020). CML2001, January 2016 assesment method is used.

SYSTEM BOUNDARIES



CONSIDERED LIFE CYCLE STAGES

Upstream processes include:

- **extraction of non-renewable resources**
- **additives and auxiliary's production**
- **all relevant transportation**

All energetic input flows (electricity, heating fuels, steam...) and water consumption to the upstream processes are considered. All emissions to air, water and soil and treatment of waste and wastewater generated are considered as well.

The Core Process analysis considers resources, as well as electricity and fuels, transportation of materials, emissions and waste that go into or are given off during the production of ECONYL® polymer.

Transportation of all input materials is included.

Core processes include:

- **transportation of all input materials;**
- **waste materials that are entering the pretreatment plant and are constituted of three main types of waste:**
 - A.** PA6 fishing nets collection;
 - B.** PA6 carpets, fluff or granules;
 - C.** Oligomers and other plastics waste generated by polymer industries.

Depending on the type and shape of waste, it can be cleaned, sorted, grinded, washed, granulated, and/or pelletized.

All waste material is characterized with the specific feedstock energy entering the system and the processes are described by means of energy use and emissions.

- **ECONYL® plant operation;**
 - A.** washing (when necessary);
 - B.** depolymerization (where specific mix of waste is transformed back into secondary raw material – caprolactam);
 - C.** purification of caprolactam.
- **polymer production;**
 - A.** polymerization;
 - B.** extrusion;
 - C.** pelletizing;
 - D.** washing;
 - E.** drying.

- **storage and packing of polymer.**

All energetic input flows (electricity, heating fuels, steam...) and water consumption to the upstream processes are considered. All emissions to air, water and soil and treatment of waste and wastewater generated are considered as well.

Downstream processes include transportation to average retailer / distribution platform:

- **300 km by truck.**

Use phase and end of life of product are not included.

CUT OFF CRITERIA

In general, Life Cycle Inventory data for a minimum of 99% of total inflows (mass and energy) to the upstream and core module is included.

All energy inflows are considered in the study.

Primary packaging material was considered:

- **polymerization process: tank truck.**

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CONTENT DECLARATION

MATERIAL	% OF MATERIAL BY WEIGHT	OF WHICH RECYCLED %	CAS NUMBER
Polyamide 6	100	100	25038-54-4

ECONYL® polymers do not contain any materials / substances hazardous to health and the environment (carcinogenic, mutagenic or toxic to reproduction, allergic, PBT, vPvB) or substances of very high concern (SVHC), according to Regulation (EC) No 1907/2006 and Regulation (EC) No 1272/2008.

ECONYL® polymers are produced out of 100 % recycled PA6 polymer, with post-consumer and post-industrial recycled content certified by independent third party DNV 18590-2008-PC-ITA-DNV.

5 ENVIRONMENTAL PERFORMANCE

All the data are given for an average ECONYL® polymer, which is constituted of 47% by mass of ECONYL® polymer produced in AquafilSLO - Ljubljana and 53% by mass of ECONYL® polymer produced in Aquafil Arco and is representing the production ratio of 2019.

POTENTIAL ENVIRONMENTAL IMPACTS

IMPACT CATEGORIES		UPSTREAM	CORE	DOWNSTREAM	TOTAL
GWP biogenic*	kg CO ₂ eq	-7,72E-04	9,69E-03	-1,00E-04	8,82E-03
GWP fossil*	kg CO ₂ eq	0,15	0,77	0,02	0,94
GWP Land use*	kg CO ₂ eq	1,65E-04	2,15E-03	1,59E-04	2,48E-03
GWP total*	kg CO ₂ eq	0,14	0,78	0,02	0,95
Acidification Potentials	kg SO ₂ eq	1,18E-03	6,11E-03	8,77E-05	7,37E-03
Photochemical Ozone Creation P.	kg C ₂ H ₂ eq	6,96E-05	4,79E-04	8,14E-06	5,57E-04
Eutrophication Potentials	kg PO ₄ eq	5,78E-05	1,62E-03	2,16E-05	1,70E-03
Abiotic Depletion Potential - elements	kg Sb eq	2,07E-07	2,13E-07	1,62E-09	4,21E-07
Abiotic Depletion Potential - fossil fuel	MJ net calorific value	3,09	7,50	0,26	10,85
Water scarcity potential	m ³ eq	0,73	0,42	1,76E-04	1,15

Totals may not match, because of rounded data

USE OF RESOURCES

PARAMETER		UNIT	UPSTREAM	CORE	DOWNSTREAM	TOTAL
Primary energy resources - renewable	Use as energy carrier	MJ, net calorific value	0,19	16,54	0,01	16,74
	Use as raw materials	MJ, net calorific value	0	0	0	0
	TOTAL	MJ, net calorific value	0,19	16,54	0,01	16,74
Primary energy resources - non renewable	Use as energy carrier	MJ, net calorific value	3,20	7,57	0,26	11,04
	Use as raw materials	MJ, net calorific value	0	34,20	0	34,20
	TOTAL	MJ, net calorific value	3,20	41,77	0,26	45,24

PARAMETER	UNIT	UPSTREAM	CORE	DOWNSTREAM	TOTAL
Secondary material	kg	0	1,53	0	1,53
Renewable secondary fuels	MJ, net calorific value	0	0	0	0
Non-renewable secondary fuels	MJ, net calorific value	0	0	0	0

PARAMETER	UNIT	UPSTREAM	CORE	DOWNSTREAM	TOTAL
Net use of fresh water	m ³	0,02	0,01	1,71E-05	0,03
Agricultural land use for renewable material production	m ²	0	0	0	0

Totals may not match, because of rounded data

WASTE PRODUCTION AND OUTPUT FLOWS

PARAMETER	UNIT	UPSTREAM	CORE	DOWNSTREAM	TOTAL
Hazardous waste disposed	kg	1,94E-06	2,05E-03	1,22E-08	2,05E-03
Non-hazardous waste disposed	kg	0,27	0,03	4,02E-05	0,30
Radioactive waste disposed	kg	3,59E-05	2,81E-05	3,25E-07	6,43E-05

PARAMETER	UNIT	UPSTREAM	CORE	DOWNSTREAM	TOTAL
Components for re-use	kg	0	0	0	0
Materials for recycling	kg	7,68E-08	0,16	0	0,16
Materials for energy recovery	kg	0	0	0	0
Exported energy, electricity	kg	0	0,55	0	0,55
Exported energy, thermal	Kg	0	0,99	0	0,99

Totals may not match, because of rounded data

OTHER ENVIRONMENTAL INDICATORS

GROSS ENERGY REQUIREMENT	UNIT	UPSTREAM	CORE	DOWNSTREAM	TOTAL
Non-renewable	MJ	3,46	42,48	0,28	46,22
Renewable	MJ	0,19	16,54	0,01	16,74
TOTAL	MJ	3,65	59,02	0,30	62,96

PARAMETER	UNIT	UPSTREAM	CORE	DOWNSTREAM	TOTAL
Energy content of product	MJ	0	34,2	0	34,2
% of bio-based	%	0	0	0	0

Totals may not match, because of rounded data

TECHNOLOGY APPLIED chemical depolymerization and subsequent purification step.

PERCENT OF RECOVERED PA6 FRACTION IN RESPECT OF THE TOTAL WASTE TREATED: 65% (this percentage includes the total weight input of post-consumer waste which consists also from other components as PA6, such as PP, backing of carpets...).

DESTINATIONS OF FRACTIONS NOT RECOVERED:

- plastics other than recovered PA6 and PP; recycled / WtE; EU
- metals; recycled; EU
- sludge; WtE; EU



ADDITIONAL INFORMATION

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ADDITIONAL INFORMATION

This chapter is intended to provide specific additional information about the ECONYL® Regeneration System as well as some comments of its environmental benefit.

In 2009 we set ourselves the challenge of collecting waste material all over the world and turning it into recycled polymers. It is possible to mention other environmental benefits, besides those appreciated from the impact categories investigated in the present study. In fact, part of virgin raw materials extraction and natural resources exploitation is prevented by the use of waste otherwise disposed of.

The European Commission has estimated that the EU discards 5.8 million tons of textiles and apparel every year, 75% of this is sent to landfill or incinerated, but the vast bulk is destined for landfill. The USA generates 12.7 million tons of textile waste; of this only 14.9% is recycled (US Environmental Protection Agency, 2009), which means more than 85% is waste, again largely being sent to landfill.

To put this number in context, in 2009 a total of 71.6 million tons of fiber was used around the world. This means that the EU and the USA in one year alone discarded 18.5 million tons is equal to 26% of annual global fiber usage.

Another aspect not directly emerging from the present study, which is worth a mention, is the contribution to the prevention of oceans pollution from the collection of fishing nets in their end-of-life.

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DIFFERENCES VERSUS PREVIOUS VERSION OF EPD

The main reason for GWP reduction compared to previous version of EPD is due to implementation of 100% biomass steam consumption in AquafilSLO d.o.o. Ljubljana plant.

References

> ISO 14025:2010

Environmental labels and declarations — Type III environmental declarations — Principles and procedures

> General Programme instructions 3.01

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> ISO 1183

Plastics — Methods for determining the density of non-cellular plastics — Part 1: Immersion method, liquid pycnometer method and titration method

> ISO 1133

Plastics — Determination of the melt mass-flow rate (MFR) and melt volume-flow rate (MVR) of thermoplastics — Part 1: Standard method

> ISO 527

Plastics — Determination of tensile properties — Part 1: General principles

> ISO 11357

Plastics — Differential scanning calorimetry (DSC) — Part 1: General principles

> ISO 75

Plastics — Determination of temperature of deflection under load — Part 1: General test method