Annex D Material plasticizer-free polyamide (PA-U) for the manufacture of high-pressure pipes and fittings for gas supply

(Edition: 2025-06)

D 1 Testing and certification specifications (see also section D 2)

DIN EN ISO 16486-1	Plastics piping systems for the supply of gaseous fuels - Unplasticized polyamide (PA-U) piping systems with fusion jointing and mechanical jointing - Part 1: General
DIN EN ISO 16486-2	Plastics piping systems for the supply of gaseous fuels - Unplasticized polyamide (PA-U) piping systems with fusion jointing and mechanical jointing - Part 2: Pipes
DIN EN ISO 16486-3	Plastics piping systems for the supply of gaseous fuels - Unplasticized polyamide (PA-U) piping systems with fusion jointing and mechanical jointing - Part 3: Fittings
DIN EN ISO 16486-4	Plastics piping systems for the supply of gaseous fuels - Unplasticized polyamide (PA-U) piping systems with fusion jointing and mechanical jointing - Part 4: Valves
DIN EN ISO 16486-5	Plastics piping systems for the supply of gaseous fuels - Unplasticized polyamide (PA-U) piping systems with fusion jointing and mechanical jointing - Part 5: Fitness for purpose of the system
DIN CEN ISO/TS 16486-7	Plastics piping systems for the supply of gaseous fuels - Unplasticized polyamide (PA-U) piping systems with fusion jointing and mechanical jointing - Part 7: Assessment of conformity
ISO 17885	Plastics piping systems - Mechanical fittings for pressure piping systems - Specifications
DVS 2205-1 Supplement 8	Calculation of tanks and apparatus made of thermoplastics – characteristic values for the material group Unplasticized polyamide
ISO 8149	Unplasticized polyamide (PA-U) pipes – Effect of time and temperature on the expected strength
DVGW GW 335	Components for Plastic Piping Systems in Pipe Networks

D 2 General

Annex D of this certification scheme applies to all molding materials (materials) with the material designation plasticizer-free polyamide (PA-U) for the manufacture of high-pressure pipes and fittings for gas supply systems in accordance with DIN EN ISO 16396-1. In conjunction with sections 1 to 7 (main part), it contains all the requirements for awarding the DIN*plus* quality mark for materials for plastic pipe systems.

The plus in quality is summarized in Table D 1.

Compliance with the requirements specified in this certification program (BRT, Table D 3) must be confirmed to the customer by an inspection certificate, Type 3.1 according to DIN EN 10204 for each delivery.

Table D 1 Quality Enhancement

Requirements	Annex D	DIN CEN ISO/TS 16486-7	See section:
Daily updated publication of certified materials	+	/	D 3
Inclusion of the materials in the KRV materials list	+	/	D 3
Inspection certificate 3.1 according to DIN EN 10204 for each delivery	+	/	D 2
Half-yearly external inspection Colour	+	/	Table D 4
Half-yearly external inspection Density	+	/	Table D 4
Half-yearly external inspection Viscosity / viscosity index	+	/	Table D 4
Half-yearly external inspection Carbon black content (only for black materials)	+	/	Table D 4
Half-yearly external inspection Dispersion of pigment or carbon black (for black and yellow materials)	+	/	Table D 4
Half-yearly external inspection resistance to rapid crack propagation (Laboratory test, S4-Test)	+	/	Table D 4
Half-yearly external inspection Longitudinal reversion	+	/	Table D 4
Half-yearly external inspection Charpy notched impact strength	+	/	Table D 4

Verification of long-term strength (creep rupture behavior) must be provided in accordance with the procedure laid down in DIN EN ISO 9080. The creep rupture internal pressure curves thus determined must not fall below the respective reference characteristics (minimum curves) specified in DVS 2205-1 Supplement 8 resp. ISO 8149 at any point. For 20 °C and 50 years, the respective σ_{LPL} value must correspond to the corresponding reference value of DIN EN ISO 16486-1, Table 3. The raw material manufacturer must file these corresponding verifications with DIN CERTCO

D 3 Product groups

The certification is carried out separately for each molding compound and production facility.

In addition to an initial inspection for each production facility and type testing for each compound and production facility, certification requires the establishment of a monitoring contract between the raw material manufacturer or certificate holder, DIN CERTCO and a qualified testing laboratory . The raw material manufacturer or certificate holder thus undertakes to carry out regular factory production control (BRT/PVT) and regular surveillance tests (AT) according to Table D 3.

In order to maintain the certificate, an annual surveillance audit per production site by DIN CERTCO is also required, during which an inspection of production, laboratory, factory production control and quality management takes place.

All molding compounds approved by DIN CERTCO are published daily in the DIN CERTCO certification database at www.dincertco.tuv.com. This means that they meet the requirements for inclusion in the materials list of the Plastic Pipe Association at www.krv.de.

Table D 2 Product groups / Material list (example)

Manufacturer	Facility	Stripe material	Material Designation	Colour	Weathering proof 7 GJ/m²	Proven Rapid Crack Propagation (RCP) S4- or FS-test 2)				Application			
						Application also for pipes ≥ 32 mm wall thickness			Application for pipes up to ... mm wall thickness				
						DA	TW	AW	G	DA	G	TW	AW
…	…	…	…	…	…	-	-	-	…	-	…	-	-
Name of material manufacturer													
Name of molding compound chosen by the manufacturer	…	…	PA-U 12 180	…	…	…			…	-	x	-	-

D 4 Material tests

The material tests (TT, BRT/PVT, AT) are summarized in Table D 3. The TT and AT are carried out by qualified test laboratories . For the regular factory inspection (BRT / PVT) the material manufacturer or certificate holder is responsible.

Table D 3 Material tests (per molding compound)

	Properties	Requirements according to	Specification / Reference Values		Test standard / Test method	Scope of tests			
						TT	FPC		AT
							BRT	PVT	
Table D 3 Material tests (per molding compound)	Proof of the Long term hydrostatic strength (Creep internal pressure behavior)	DIN EN ISO 16486-1 Clause 5.4	Values and creep internal pressure curves showing the MRS value	Above the reference characteristic (minimum curve) PA-U 11 180 or PA-U 12 180: MRS ≥ 18 MPa	DIN EN ISO 9080, DIN EN ISO 1167-1 and DIN EN ISO 1167-2, DIN EN ISO 12162	x	-	-	-
				PA-U 11 180 or PA-U 12 180: > 100 h at 20 °C / 23,1 MPa and > 2.500 h at 20 °C / 21,0 MPa	DIN EN ISO 1167-1 and DIN EN ISO 1167-2	-	-	1x / 2 years	1x / 2 years
				PA-U 11 180 or PA-U 12 180: > 5.000 h at 80 °C / 10,5 MPa	DIN EN ISO 1167-1 and DIN EN ISO 1167-2	-	-	1x / 8 J years	1x / 8 years
	Color	DIN EN ISO 16486-1 Clause 5.2.2		Yellow and black		x	1x / Batch / 7 days	-	1x / half year

	Properties	Requirements according to	Specification / Reference Values		Test standard / Test method	Scope of tests			
						TT	FPC		AT
							BRT	PVT	
Table D 3 Material tests (per molding compound)	Density	DIN EN ISO 16486-1 Clause 5.2.5	Indication of the minimum value of the basic material (basic density)	PA-U 11 180: 1020 – 1050 kg/m³ PA-U 12 180: 1000 – 1040 kg/m³ conditioning at 23 °C	DIN EN ISO 1183-1, DIN EN ISO 1183-2	x	1x / Batch / 7 days	-	1x / half year
	Volatile content or moisture content	DIN EN ISO 16486-1 Clause 5.2.5	Volatile content (water)	≤ 0,10 %	DIN EN ISO 15512, method B or E	x	1x / Batch / 7 days	-	-
	Viscosity / viscosity index	DIN EN ISO 16486-1 Clause 5.2.5		≥ 180 ml/g / Solvent m-Kresol	DIN EN ISO 307	x	1x / Batch / 7 days	-	1x / half year
	Carbon black content (only for black materials)	DIN EN ISO 16486-1 Clause 5.2.5		1,0 – 2,5 % (Proportion by mass)	ISO 6964	x	1x / Batch / 7 days	-	1x / half year
	Dispersion of pigment or carbon black (for black and yellow materials)	DIN EN ISO 16486-1 Clause 5.2.5	Adherence to the reference value	≤ Grad 3 Bild A1, A2, A3 oder B	ISO 18553	x	1x / Batch / 7 days	-	1x / half year
	Chemical resistance	DIN EN ISO 16486-1 Clause 5.2.5	Details according to standard	Change in the bursting circumferential stress or the yield stress ≤ 20 %	DIN EN ISO 16486-1 Anexx A and B, DIN EN ISO 527-1 and DIN EN ISO 527-2	x	-	-	-

	Properties	Requirements according to	Specification / Reference Values		Test standard / Test method	Scope of tests			
						TT	FPC		AT
							BRT	PVT	
Table D 3 Material tests (per molding compound)	Weather resistance	DIN EN ISO 16486-1 Clause 5.2.5	Prescribed weathering	7,0 GJ / m^2	DIN EN ISO 16871 (natural weathering) or DIN EN ISO 4892-2 (artificial weathering)	x	-	-	-
			Zeitstand Innendruckprüfung nach Bewitterung	PA-U 11 180 or PA-U 12 180: > 165 h at 80 °C / 11,5 MPa	DIN EN ISO 1167-1 and DIN EN ISO 1167-2				
			Elongation at breake after Wethering	≥ 160 % at 25 mm/min	DIN EN ISO 6259-1				
			Peel strength of a heating coil welded joint after Wethering	≤ 33 % brittle fracture at DN 110 mm SDR 11 / 23 °C	ISO 13954				
	Resistance to rapid crack propagation (field test, Full-Scale-Test)	DIN EN ISO 16486-1 Clause 5.2.5		at e ≥ 5 mm p_c ≥ 1,5 MOP at 0° C	DIN EN ISO 13478	x	-	-	-
	Resistance to rapid crack propagation (Laboratory test, S4-test) (1)	DIN EN ISO 16486-1 Clause 5.2.5		$P_{c,S4}$ at 0 °C	DIN EN ISO 13477	x	-	1x / 2 years	1x / half year
	Longitudinal Reversion	DIN EN ISO 16486-1 Clause 5.2.5		≤ 3 % at 150 °C	DIN EN ISO 2505	x	-	-	1x / half year

Properties	Requirements according to	Specification / Reference Values		Test standard / Test method	Scope of tests			
					TT	FPC		AT
						BRT	PVT	
Resistance to slow crack growth	DIN EN ISO 16486-1 Clause 5.2.5	No failure in notch testing	≥ 500 h at 80 °C, DN 110 mm SDR 11 or DN 125 mm SDR 11 PA-U 11 180 and PA-U 12 180: 20 bar	DIN EN ISO 13479	x	-	1x / year	1x / year
Charpy notched impact strength	DIN EN ISO 16486-1 Clause 5.2.5		a_{cN} ≥ 10 kJ/m² at 0 °C / 1eA	DIN EN ISO 179-1	x	-	-	1x / half year
Weldability for butt-welded joints	DVS 2207-16		fs ≥ 0,8	DVS 2207-16	x	-	-	-
Determination of the type of failure of butt-welded joints	DIN EN ISO 16486-1 Clause 5.3	Test for ductile fracture, no brittle fracture	DN 110 mm SDR 11 at 23 °C	DIN EN ISO 16486-3, DIN EN ISO 16486-5 ISO 13953	x	-	-	-

(1) If no negative results are found within two consecutive years, the frequency of external testing is set at 1x / year from the following year. If a negative result is found, the monitoring frequency is immediately reset to 1x / half-year.

D 5 Changes and start of validity

The following changes have been made:

Edition 2020-06:
First Edition.

Edition 2025-06:

New edition as a separate document. Adaptation of the requirements to the current standards and regulations. Adjustment of the frequency of the monitoring tests to be carried out. At the same time, editorial changes have been made.

This annex of certification scheme ‘Materials for plastic pipe systems’ is valid from 2025-06-30. All valid certificates issued to date will be reissued during a transition period. The transition period ends on 2027-06-30.