Annex A Material Polyethylene (PE 80 and PE 100) for the manufacture of pressure pipes and fittings for gas, drinking water, waste water and industry

(Edition: 2020-06)

A 1 Testing and certification specifications (also refer to section A 2):

DIN 8074	Polyethylene (PE) pipes – PE 80, PE 100 – Dimensions
DIN 8075	Polyethylene (PE) pipes – PE 80, PE 100 – General quality specifications
DIN EN 1555-1	Plastics piping systems for the supply of gaseous fuels – Polyethylene (PE) – Part 1: General
DIN CEN/TS 1555-7	Plastics piping systems for the supply of gaseous fuels – Polyethylene (PE) – Part 7: Guidance for assessment of conformity
DIN EN 12201-1	Plastics piping systems for water supply, and for drainage and sewerage under pressure – Polyethylene (PE) – Part 1: General
DIN CEN/TS 12201-7	Plastics piping systems for water supply, and for drainage and sewerage under pressure – Polyethylene (PE) – Part 7: Guidance for the assessment of conformity
DIN EN ISO 15494	Plastics piping systems for industrial applications – Polybutene (PB), polyethylene (PE), polyethylene of raised temperature resistance (PE-RT), crosslinked polyethylene (PE-X), polypropylene (PP) – Metric series for specifications for components and the system
ISO 4427-1	Plastics piping systems for water supply and for drainage and sewerage under pressure – Polyethylene (PE) – Part 1: General
ISO 4437-1	Plastics piping systems for the supply of gaseous fuels – Polyethylene (PE) – Part 1: General
DVGW GW 335-A2	Plastics piping systems for gas and water distribution – Requirements and tests – Part A2: PE 80 and PE 100 pipes
DVGW GW 335-B2	Plastics piping systems for gas and water distribution – Specifications and tests – Part B2: PE 80 and PE 100 fittings
UBA KTW-BWGL	Evaluation basis for plastics and other organic materials in contact with drinking water
UBA	Guidance – Assessment of conformity of the drinking water hygiene suitability of products
TZW Karlsruhe	DVGW-Forschungsstelle "Verfahrensvorschlag für eine Kurzzeitprüfung zur Beurteilung der organoleptischen Eigenschaften von PE-Granulaten", dated 1985-12-04
PAS 1031:2004-09	Material Polyethylene (PE) for the manufacture of pressure pipes and fittings – Requirements and tests
PAS 1075:2009-04	Pipes made from Polyethylene for alternative installation techniques – Dimensions, technical requirements and testing

A 2 General

Annex A of this certification scheme applies to all molding compounds (materials) of the material type polyethylene (PE 80 and PE 100) for the manufacture of pressure pipes and fittings for fields of application: gas, drinking water, waste water and industry. The certification scheme includes in association with sections 1 to 8 (main part) all the requirements for the award of the "DINplus" quality mark for materials.

The quality enhancement is summarized in Table A 1.

Compliance with the requirements specified in this certification scheme (BRT, Table A 3) shall be confirmed to the customer by a certificate according to DIN EN 10204 Type 3.1 for each delivery.

Table A 1 Quality Enhancement

Requirements	Annex A	DIN 8074	DIN 8075	DIN EN 1555	DIN EN 12201	DVGW GW 335-A2	Refer to:
Daily updated publication of certified materials	+	/	/	/	/	/	A 3
Materials are listed in the KRV material list	+	/	/	/	/	/	A 3
Certificate according to DIN EN 10204 Typ 3.1. for each delivery	+	/	/	/	/	x	A 1
Thermal stability (OIT) 30 min bei 200 °C	+	/	/	x	x	/	A 4
Weather resistance of coloured material Creep rupture internal pressure test and elongation at break after weathering with 7.0 GJ / m2	+	/	/	x	x	/	A 4

A 3 Product Groups

The certification is conducted separately for each material designation and production site.

In addition to the initial inspection of each production site and type testing per molding compound and production site, the prerequisite for certification is the conclusion of a monitoring contract between the raw material manufacturer or certificate holder, DIN CERTCO and a qualified testing laboratory . The molding compound manufacturer or certificate holder thus undertakes to carry out regular factory production control (BRT/PVT) and regular audit test (AT) in accordance with Table A 3.

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

All materials approved by DIN CERTCO are published daily in the DIN CERTCO certification database at www.dincertco.tuv.com. This means that they meet the requirement to be included in the material list of the Plastic Pipe Association at www.krv.de.

Table A 2 Material List

Manufacturer	Production Site	Material Designation	Material type	Colour	Weathering Verification 7 GJ/m²	Proven Rapid Crack Propagation (RCP) S4- or FS-test				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
…	…	…	…	…	…	…	…	…	…	…	…..	…	…

A 4 Material Test

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

Table A 3 Material Test (per molding compound)

	Properties	Requirements according to or based on	Specification/Reference Value(s)		Testing Standard/Testing Method	Field of application				Scope of tests			
						TW	G	AW	DA	TT	FPC BRT	FPC PVT	AT
Table A 3 Material Test (per molding compound)	**Physical Properties:**												
	Creep internal pressure behavior Classification / MRS-Value (Proof of the long-term hydrostatic strength)	PAS 1031 DIN EN 1555-1 DIN EN 12201-1 ISO 15494	Values and creep internal pressure curves showing the MRS, LPL value	Above the reference characteristic (minimum curve) PE 80: LPL value ≥ 8 MPa PE 100: LPL value ≥ 10 MPa	DIN EN ISO 9080 or DIN 16887 DIN EN ISO 1167-1 and DIN EN ISO 1167-2 DIN EN ISO 12162	x	x	x	x	x	/	/	/
		DIN EN 1555-1 DIN EN 12201-1 ISO 15494		PE 80: > 100 h at 20 °C / 10 MPa and > 2.500 h at 20 °C / 9,1 MPa resp. PE 100: > 100 h at 20 °C / 12 MPa and > 2.500 h at 20 °C / 11,1 MPa	DIN EN ISO 1167-1 and DIN EN ISO 1167-2	x	x	x	x	/	/	1x / 2 years/PS	1x / 2 years/PS
	Density	PAS 1031 DIN EN 1555-1 DIN EN 12201-1 ISO 15494 DVGW GW335-A2	Indication of the minimum value of the basic material (basic density)	≥ 930 kg/m³ at 23 °C ± 2 °C	DIN EN ISO 1183-1 DIN EN ISO 1183-2 DIN EN ISO 1183-3 DIN EN ISO 17855-1	x	x	x	x	x	1x/ batch/ 7 days	/	2x / year/PS
	Loss on Drying (volatile content or moisture content (1))	PAS 1031 DIN EN 1555-1 DIN EN 12201-1 ISO 15494 DVGW GW335-A2	Proportion of volatile components	≤ 350 mg/kg	DIN EN 12099	x	x	x	x	x	1x/ batch/ 7 days	/	/
			Humidity content (water)	< 0,03 % resp. ≤ 300 mg/kg	ISO 760 (Karl Fischer Method) resp. DIN EN 12118								

	Properties	Requirements according to or based on	Specification/Reference Value(s)		Testing Standard/Testing Method	Field of application				Scope of tests			
										TT	FPC		AT
						TW	G	AW	DA		BRT	PVT	
Table A 3 Material Test (per molding compound)	Colour	PAS 1031 DIN EN 1555-1 DIN EN 12201-1 ISO 15494 DVGW GW335-A2	Adherence to the reference value	Uniformly black, blue, royal blue, yellow, orange yellow, brown or green, with reference to RAL	visually	x	x	x	x	x	1x/ batch/ 7 days	/	2x / year/PS
	Melt index (MFR)	PAS 1031 DIN EN 1555-1 DIN EN 12201-1 ISO 15494 DVGW GW335-A2	Indication of the MFR range	0,15 to 1,40 g / 10 min at 190 °C / 5 kg (nominal MFR-value) (2)	DIN EN ISO 1133-1 resp. DIN EN ISO 1133-2	x	x	x	x	x	1x/ batch/ 7 days	/	2x / year/PS
	Weldability(3)	PAS 1031 DIN EN 1555-1 DIN EN 12201-1 ISO 15494	Adherence to the long-term welding factor	Rupture outside the joining plane	DVS Richtlinie 2203-4	x	x	x	x	x	/	/	/
	Thermal stability (OIT)	PAS 1031 DIN EN 1555-1 DIN EN 12201-1 ISO 15494 DVGW GW335-A2	Adherence to the reference value	> 30 min at 200°C or > 20 min at 210°C or > 10 min at 220°C with 15 ± 2 mg (4)	DIN EN 11357-6	x	x	x	x	x	1x/ batch/ 7 days	/	2x / year/PS
	Homogeneity (carbon black resp. pigment dispersion and appearance)	PAS 1031 DIN EN 1555-1 DIN EN 12201-1 ISO 15494 DVGW GW335-A2	Adherence to the reference value	≤degree 3; Picture A1, A2, A3 or B	ISO 18553	x	x	x	x	x	1x/ batch/ 7 days	/	2x / year/PS
	Resistance to slow crack growth (SCG) (5) (6)	PAS 1031 DIN EN 1555-1 DIN EN 12201-1 ISO 15494 DVGW GW335-A2	Adherence to the reference value in the Notch Test on SDR 11 pipes DN 110	PE 80: > 500 h at 80°C / 8 bar resp. PE 100: > 500 h at 80°C / 9,2 bar	DIN EN ISO 13479	x	x	x	x	x	/	3 samples / year/PS	3 samples / year/PS

	Properties	Requirements according to or based on	Specification/Reference Value(s)		Testing Standard/Testing Method	Field of application				Scope of tests			
										TT	FPC		AT
						TW	G	AW	DA		BRT	PVT	
	Resistance to rapid crack propagation (RCP) (6)	PAS 1031 DIN EN 1555-1 DIN EN 12201-1 ISO 15494 DVGW GW335-A2	Crack stop in the S4 test preferably on pipes DN 110 mm SDR 11 or larger	PE 80: $P_{c,S4}$ > 1,6 bar at 0°C and/or PE 100: $P_{c,S4}$ > 8 bar at 0°C	DIN EN ISO 13477	x	x	x	x	x	/	1x / year/PS	/
	Resistance to rapid crack propagation (RCP) using pipes with a wall thickness of more than ≥ 32 mm (6)	PAS 1031 DIN EN 12201-1 ISO 15494 DVGW GW335-A2	Adherence to the reference values in the S4 Test preferably on SDR 11 pipes DN 250 mm or	PE 80: $P_{c,S4}$ ≥ 8 bar at 0 °C resp. PE 100: $P_{c,S4}$ ≥ 10 bar at 0 °C	DIN EN ISO 13477	x	/	x	x	x	/	1x / 5 years/PS	1x / 5 years/PS
			Full-Scale Test preferably on SDR 11 pipes DN 500 mm	PE 80: $P_{c,FS}$ ≥ 20 bar at 0 °C resp. PE 100: $P_{c,FS}$ ≥ 24 bar bei 0 °C	DIN EN ISO 13478								
	Resistance to rapid crack propagation (RCP) using pipes with a wall thickness of up to … mm (optional) (6) (7)	PAS 1031 DIN EN 1555-1 DVGW GW335-A2	Adherence to the reference values in the S4 Test preferably on SDR 11 pipes DN 250 or	PE 80: $P_{c,S4}$ ≥ 1,36 bar at 0°C resp. PE 100: $P_{c,S4}$ ≥ 3,44 bar at 0°C	DIN EN ISO 13477	/	x	/	/	x	/	1x / 2 years/PS	1x / 2 years/PS
			Full-Scale Test preferably on SDR 11 pipes DN 500	PE 80: $P_{c,FS}$ ≥ 7,5 bar at 0°C resp. PE 100: $P_{c,FS}$ ≥ 15 bar at 0°C	DIN EN ISO 13478								
	Gas stability	PAS 1031 DIN EN 1555-1 DVGW GW335-A2	No rupture during the test period	Conditioning 1.500 h at 23°C Creep internal pressure test ≥ 20 h bei DN 32 mm SDR 11 / 80°C/2MPa	DIN EN ISO 1167-1 and DIN EN ISO 1167-2 ISO 4437-1	/	x	/	/	x	/	/	/

	Properties	Requirements according to or based on	Specification/Reference Value(s)		Testing Standard/Testing Method	Field of application				Scope of tests			
						TW	G	AW	DA	TT	FPC BRT	FPC PVT	AT
	Weather resistens of black material	PAS 1031 DIN EN 1555-1 DIN EN 12201-1 ISO 15494 DVGW GW335-A2	Carbon black content	2.0 - 2.5 mass fractions in %	ISO 6964	x	x	x	x	x	x	/	/
Table A 3 Material Test (per molding compound)	Weather resistance of coloured material	PAS 1031 DIN EN 1555-1 DIN EN 12201-1 ISO 15494 DVGW GW335-A2	Prescribed weathering	(1) 7,0 GJ / m^2 (2) 3,5 GJ / m^2	DIN EN ISO 16871 (natural weathering) or DIN EN ISO 4892-2 (artificial weathering)	x	x	x	x	x	/	/	/
			Creep internal pressure test after weathering (1)	PE 80: > 165 h at 80°C/4,5MPa or > 1.000 h at 80°C/4MPa PE 100: > 165 h at 80°C/5,4MPa or > 1.000 h at 80°C/5MPa	DIN EN ISO 1167-1 and DIN EN ISO 1167-2								
			Elongation at breake after Wethering (1)	≥ 350 % at 100/50/25/10 mm/ min	DIN EN ISO 6259-1								
			Peel strength of a heating coil welded joint after Wethering (2)	≤ 33 % brittle fracture at DN 110 mm SDR 11 / 23 °C	ISO 13954								
	Bending creep modulus	PAS 1031 DWA A127 Teil 10	Adherence to the prescribed values	$E_{bc,1min}$ ≥ 800 MPa and $E_{bc,24h}$ ≥ 380 MPa and $E_{bc,2.000h}$ ≥ 250 MPa	DIN 16841	/	/	x	/	x	/	1x /year/PS	/

	Properties	Requirements according to or based on	Specification/Reference Value(s)		Testing Standard/Testing Method	Field of application				Scope of tests			
						TW	G	AW	DA	TT	FPC BRT	FPC PVT	AT
	Tensile strength from a butt-fused joint	DIN EN 1555-1 DIN EN 12201-1	Test of ductile failure mode, no brittle failure mode	DN 110 mm SDR 11 at 23 °C	ISO 13953	x	x	x	x	x	/	/	/
Table A 3 Material Test (per molding compound)	**Hygienic Propeties:**												
	Composition requirements	PAS 1031 KTW-BWGL section 5.2 and Annex A	Raw materials must correspond to the positive lists according to KTW-BWGL Annex A Section A2	Conformity of raw materials with the positive lists according to KTW-BWGL Annex A Section A2	Recipe check according to KTW-BWGL section 6.1	x	/	/	x (8)	x	/	/	1x / 5 years/PS
		UBA Conformity hygiene section 7.4.1	Test specimens must be made from the specified raw materials	Agreement of the results of the fingerprint methods	Fingerprint method, e.g. FTIR, TG	x	/	/	x (8)	x	/	/	quarterly/PS
	Organoleptic testing	PAS 1031 KTW-BWGL section 5.3.2 DVGW GW335-A2	No adverse change in smell	TON ≤ 2	Based on KTW-BWGL section 6.3.1 and DIN EN 1420 (see A 5)	x	/	/	x (8)	x	x	/	quarterly/PS
	Requirements relating to promoting of microbial growth	PAS 1031 KTW-BWGL section 5.6 DVGW GW335-A2	Adherence to the prescribed values	Growth ≤ (0,05 + 0,02) ml / 800 cm^2	On test panels according to DIN EN 16421, method 2	x	/	/	x (8)	x	/	/	1x / 5 years/PS

	Properties	Requirements according to or based on	Specification/Reference Value(s)	Testing Standard/Testing Method	Field of application				Scope of tests			
					TW	G	AW	DA	TT	FPC		AT
										BRT	PVT	
	(1) In arbitration cases, the moisture content requirement applies. (2) The manufacturer of the molding compound must specify the nominal MFR value. The measured MFR value may deviate by a maximum of ± 20% from the nominal MFR value, whereby the smallest measured MFR value must not fall below 0.15 g / 10 min at 190 ° C / 5 kg. (3) Only to be carried out for materials with a nominal MFR value outside the range 0.15 to 1.40 g / 10 min at 190 ° C / 5 kg. (4) The test may be carried out at 220 °C if there is a reliable correlation. In arbitration cases, the requirement applies at 200 ° C. (5) Results from other tests of the type water-in-water with wetting agent can be used, but the stated test duration remains unchanged. (6) The resistance to rapid crack propagation and slow crack growth shall be measured on pipes made from the same batch of molding materials. (7) If applicable, the resistance to rapid crack propagation (RCP) must also be determined at the expected lowest operating temperature below 0 ° C. (8) Verification only if application TW is also provided.											

A 5 Method for the evaluation of the organoleptic properties of PE granulates

Equipment: thermostatic water bath (with integrated or separate magnetic stirrer)
Erlenmeyer flask with ground glass stopper, 200 ml
(Alternatively other sizes may be used. In that case, the mass of granulate shall be adapted proportionally. A ratio of 1 g granulate / 25 ml nominal volume of flask applies.)
Magnetic stirrer
Magnetic stirring bar

Chemicals: test water: demineralized (distilled) water, alternatively drinking water without perceptible taste or smell
PE-Granulate

Execution: Short-term test within the batch release test (BRT) and audit test (AT)
8 g (+ 1 g) of the PE granulate to be tested are rinsed in demineralised water for max. 1 min using a stainless steel sieve and then placed in the Erlenmeyer flask with inserted magnetic stirrer. The Erlenmeyer flask is filled with demineralized water of 30 °C ± 2 °C free of air bubbles, sealed and placed in the water bath of a temperature of 30 °C ± 2 °C. The water bath is placed on the magnetic stirrer in such a way that the granules in the Erlenmeyer flask are sufficiently well in uniform contact with the test water. At the same time, a blank test is carried out without PE granules.
After a stirring time of 4 h (± 10 min), the Erlenmeyer flasks are removed from the water bath and cooled down to room temperature (23 ± 2) °C either forcibly or by leaving it standing. The migration water and the zero water are then transferred into TON bottles (e.g. 250 ml wide-neck bottles) and tested for odour. The threshold odour number (TON) of the migration water is determined by comparison with the zero water obtained in the blank test according to DIN EN 1622 (pair test with free choice).

3 x 3 days test within the type testing (TT)

8 g (+ 1 g) of the PE granules to be tested are placed in the Erlenmeyer flask. The flask is filled with drinking water and left to stand for 24 h (± 1 h) at room temperature without stirring. After 24 h (± 1 h), the granulate from the Erlenmeyer flask is rinsed with drinking water for 2 h h (± 5 min) using a top-mounted device. Afterwards, the drinking water is removed from the Erlenmeyer flask, a magnetic stirring bar is inserted and the Erlenmeyer flask is filled with deionized water free of air bubbles. It is sealed and placed on the magnetic stirring device at room temperature 23 °C ± 2 ° in such a way that the granules in the Erlenmeyer flask are sufficiently well in uniform contact with the test water. At the same time, a blank test without PE granules is carried out.
The contact time is 3 x 72 h (± 1 h). The migration water and zero water of each of the three runs are transferred into TON bottles (e.g. 250 ml wide-neck bottles) and tested for the parameter odour. The threshold odour number (TON) of the migration waters is determined by comparison with the zero water obtained in the blank test according to DIN EN 1622 (pair test with free choice).

Evaluation: A PE granulate is considered to be faultless if the assessment of the short-term test or of the 3rd migration period of the 3 x 3 days test can be made as TON ≤ 2.

A 6 Changes and start of validity

The following changes have been made:

Edition 2020-06:
First Edition.

Edition 2020-06 Rev. 01:
Reissue as a separate document.

This annex to the certification scheme ‘Materials for plastic pipe systems’ is valid from 2020-06-30.