



TÜVRheinland®

DIN CERTCO

Precisely Right.



## Certification Scheme

# Materials for Plastic Pipe System

(Edition: June 2020)

## Preface

DIN CERTCO was founded in 1972 by DIN Deutsches Institut für Normung e.V. (German Institute for Standardization) in order to issue DIN logos and provides certification for products, persons, services and companies on the basis of DIN standards and similar specifications.

In order to prove our impartiality, independency and competence, we are voluntary accredited according to DIN EN ISO/IEC 17065. For the satisfaction and trust of our clients and their data, we maintain furthermore a certified

- Quality Management System according to DIN EN ISO 9001
- Environmental Management System according to DIN ISO 14001
- Occupational Health and Safety Management System according to OHSAS 18001

This certification scheme has been prepared with the collaboration of DVGW (Deutscher Verein des Gas- und Wasserfaches e. V.) and Kunststoffrohrverband e.V. It combines all relevant requirements of the the certification schemes Plastic pipe systems (pressure pipes and fittings) 2017-05 and Plastic pipe systems (Sewer tunnel and sewage systems) 2015-03. In addition, requirements of PAS 1031, PAS 1075 and corresponding standard are involved. Particularly, this document summarizes the hygienic suitability requirements of DVGW and of the German Environment Agency (Umweltbundesamt). Thus, this certification scheme constitutes comprehensive work in coordination with all relevant valid standards.

Alongside the General Terms and Conditions and Testing, Registration and Certification Regulation in place at DIN CERTCO, this certification forms the basis for enabling providers of materials for plastic pipe systems to label their products with the "DIN*plus*" quality mark. They document hereby that their products meet all the requirements of the underlying standards and exceed them in several cases.

The "DIN*plus*" quality mark creates customer confidence: they can rest assured that an independent, neutral and specialist institution has carefully investigated and reviewed all the inspection criteria. External quality controls also ensure that product quality is kept at a high level during ongoing manufacture. Thus, customers receives a benefit that they can take into consideration when making purchase decisions.

Materials for plastic pipe systems are awarded the "DIN*plus*" quality mark if they meet the requirements listed in section 4 and in respective annexes in accordance with the procedure described in this certification scheme.

All certificate holders are published on the DIN CERTCO homepage ([www.dincertco.tuv.com](http://www.dincertco.tuv.com)) which is updated on a daily basis.

## Start of validity

This certification scheme enters into force on 2020-06-01. Certificates for material for plastic pipe systems issued on the basis of the certification scheme "Plastic pipe systems (pressure pipes and fittings)" shall be revised within a transition period until 2022-06-30.

## Changes

First edition of the scheme by merging of the relevant requirements on materials of the certification schemes Plastic pipe systems (pressure pipes and fittings) 2017-05 and Plastic pipe systems (Sewer tunnel and sewage systems) 2015-03 based on the requirements of PAS 1031, PAS 1075, DVGW working sheets, advices of the German Environment Agency and corresponding standards.

In coordination with the standards, the following changes were taken:

- Adaption of the required MFR interval
- Adaption of the color designations
- Increased requirements on the thermal stability
- Modification of the requirements on the weathering stability
- Revision of the hygienic suitability requirements

### **Remark**

The German version of this certification scheme shall be taken as authoritative. No guarantee can be given to the English translation.

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## 1 Scope of application

This certification scheme applies for materials for plastic pipe systems (materials, pipes, piping fittings, fittings, seals) and contains, in conjunction with the testing specifications listed below, all requirements for the award of the quality mark "DIN*plus*".

The certification scheme presented here states the requirements for the product itself as well as for the testing, monitoring and certification of same. In section 1 to 8 of the main part, the certification procedure is described, whereas the application-specific requirements (testing scope etc.) can be found in the respective annexes:

**Annex A** Materials Polyethylen (PE 80 and PE 100) for the manufacture of pressure pipes and fittings in the fields of gas, drinking water, waste water and industry

**Annex B** Materials Polyethylen (PE 100-RC) for the manufacture of pressure pipes and fittings for alternative installation techniques according to PAS 1075

**Annex C** Stripe material Polyethylene (PE 80, PE 100, PE 100-RC) for the manufacture of pressure pipes for gas, drinking water, sewage and industrial applications

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

### 1.1 DIN CERTO quality mark DIN*plus*

Products for which the provider is authorized by a valid certificate to use the DIN CERTCO quality mark "DIN*plus*" are characterized by an increased quality compared to the required resp. standard normative minimum requirements.

The increased quality for each specific scopes of this certification scheme is represented in the corresponding annexes.

### 1.2 Trademark of the Kunststoffrohrverband e.V. (KRV)

Products that are certified in accordance with this certification scheme can, by adherence to the license rights, also be marked with the trademark of the "Kunststoffrohrverband e.V" (KRV) (Plastic Piping Association) (see section **Fehler! Verweisquelle konnte nicht gefunden werden.**).

## 2 Testing and certification specifications

The basis for testing and certification is stated for each scope of application in the corresponding annexes. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

In addition for all products, the following applies:

- this certification scheme
- the general terms of business of DIN CERTCO
- the Testing, Registration and Certification Regulation of DIN CERTCO
- the valid schedule of fees issued by DIN CERTCO
- the testing specifications of each annex

### 3 Terms, abbreviations and symbols

**Type test TT:** A test to be performed that renders the demonstration, that the product meets the underlying technical specifications and requirements.

**Batch release test BRT:** A test to be performed by the manufacturer on a batch of the product in which all requirements of the underlying technical specifications must be met prior to the release of the batch.

**Process verification test PVT:** A test to be performed by the manufacturer at stated intervals to confirm that products continue to be produced by the production process meet the requirements of the underlying technical specifications.

**Factory production control (FPC):** A monitoring and control of the production by the manufacturer for each manufacturing plant/production facility with that he ensures, that the manufactured products from him meet the underlying technical specifications. FPC includes BRT and PVT.

**Audit test AT:** A test to be performed by or on behalf of a certification authority to confirm, that the product continues to meet the requirements of the underlying technical specifications and to provide information for the evaluation of the quality assurance system.

**Witness Testing WT:** A test conducted by the manufacturer or on behalf of the manufacturer under the supervision of a qualified appointee of the certification authority for the test and is recognized by the certification authority as initial type testing and/or monitoring assessment.

**Material type:** class of materials of a similar chemical composition (e.g. PE 80).

**Material:** Polymer with a specific name put on the market and supplied to the pipe manufacturer by the material manufacturer, with or without additives and with a filed composition.

**List of approved material:** specific list of approved materials for plastic pipe systems issued by the Plastic Piping Association. (KRV).

**Moulding compound:** well-defined homogeneous composition of a base material (PE) and additives, like antioxidants, pigments, carbon black, UV stabilizers and other additives in a dosage that is needed for the manufacturing and the use of piping parts.

**Batch:** uniquely identifiable production unit of a certain material or moulding compound defined by its amount, production period and accompanying FPC. Production stops of less than 24 h (e.g. by maintenance) are not deemed an interruption of the production batch.

**New material:** Material, for example in form of pellets that have not yet been used or in form of a processing technique, except for the one that was needed for manufacturing and that is not mixed with circulating material, external reprocessable material or recyclable.

**Material in circulation:** Material from rebuffered, clean, unused pipes, piping fittings or fittings plus the blend from the own pipe-, piping fittings- and fitting manufacture of a manufacturer that gets recycled in a plant by the same manufacturer and that, for example, comes from an extrusion or injection moulding dissemination.

**External reprocessable material:** Material that is present in one of the following types:  
Type A material from unused pipes and piping fittings provided with the quality mark for plastic pipes by DIN CERTCO.  
Type B material from other unused plastic produce as pipes and piping fittings.

**Recyclable:** (recyclable material) Material that exists in the following types:

Type A material made from used pipes and fittings, provided with the quality mark by DIN CERTCO for plastic pipes that were cleaned and hackled or milled.

Type B material made from other used plastic products than pipes and fittings that was cleaned and hackled or milled.

**Reclaim:** Material that exists in the following types:

Type A circulating material, external reprocessible material Type A and/or recyclable Type A manufactured through compounding while adding additives.

Type B external reprocessible material Type B and/or recyclable Type B manufactured through compounding while adding additives.

### **Abbreviations:**

DN nominal diameter; numeric ratio for the size of a piping part, that is another, as through the size of a thread, termed piping part that has the approximate manufacturing measure, in mm.

LPL foretold lower prediction limit

SDR standard dimension ratio

FM moulding compound

PS manufacturing site

EG product group

FS fitting

FG manufacturing group (also dimension group)

## **4 Product requirements**

The requirements for materials for plastic pipe systems are elucidated for every scope in the corresponding Annex.

## **5 Testing**

### **5.1 General Information**

The certification is based on the assessment and examination of the product as well as of the appropriate quality management system within a factory inspection (see 8.2).

For the performance of the tests required as the basis for the assessment and certification of the products, DIN CERTCO avails itself of the testing laboratories to which it has awarded recognition.

The testing scope for particular materials can be found in the respective annexes.

### **5.2 Types of tests**

#### **5.2.1 Initial test (Type test TT)**

The initial test is a type test (design test, type test), which serves to determine whether the product meets the requirements laid down in section 4 of this certification scheme.

The initial test is the condition to the certification of a new product.

The testing scope is determined in the respective annex or the corresponding testing and certification specifications. The classification of groups shall be taken into account.



The initial test is to be conducted by an accredited or DIN CERTCO recognized testing laboratory. The samples for the initial inspection can be obtained by the manufacturer.

Besides the product specific initial testing, a factory inspection (see paragraph 8.2) is required. Within this initial inspection, evidence shall be given that the factory production control (see paragraph 7.1) is in line with the requirements of this certification scheme. If there is no existing type of tests of the product, the sample for the initial inspection can be sampled within the initial inspection. The transport of the samples to the testing laboratory is the responsibility of the manufacturer.

### **5.2.2 Supplementary test**

A supplementary test shall take place when additions, extensions or modifications (see section 6.10) are made to the certified product, which may influence the product's conformity with the pertinent, fundamental requirements.

### **5.2.3 Surveillance test (Audit test AT)**

The surveillance test is carried out at regular, fixed intervals and is designed to establish whether the certified product corresponds to the type-tested product during the production phase.

In addition to the product-specific audit tests, the surveillance test includes an inspection of the factory facility (see paragraph 8.2), by which it will be determined, if the manufacturing and organizational requirement for an ongoing conformity of the products in the respective factory with the requirements according to paragraph 4 given.

The surveillance test will be commissioned or realized through DIN CERTCO. Foundation therefore is a monitoring contract between the certificate owner, DIN CERTCO and, if applicable, a recognized testing laboratory.

Type, scope and frequency of the surveillance tests are determined in the annexes.

If negative test results are detected during the surveillance test, a repeat test shall follow (see 5.2.4).

With positive outcome of the tests, the samples can be blighted immediately, with negative outcome of the tests, the affected samples shall be kept up to three months after issuing of a test report.

### **5.2.4 Repeat test**

A repeat test occurs after negative result of a surveillance test. The repeat test is to be introduced 5 weeks after obtaining the test result at the latest. The test report has to be present 3 weeks after completion of the test.

The certificate holder receives a deviation report with the corrective actions that need to be conducted and the corresponding deadlines for the implementation.

The type and scope of repeat test is determined in line with the particular requirement on a case-by-case basis following consultation between DIN CERTCO and the testing laboratory.

If the mentioned deadlines for technical or other basis from the certificate holder do not comply with those of DIN CERTCO, a new binding date shall be proposed for the repeat test by naming the reasons.

If the repeat test is not passed, the certification is suspended until a special test according to section 5.2.5.

### **5.2.5 Special test**

A special test is conducted if

- defects are detected
- the production has been suspended for a period of more than 6 months
- required by DIN CERTCO - reasons to be specified
- requested in writing by a third party if a particular interest in the maintenance of proper conduct of market procedures in relation to competition or quality is involved.

The type and scope of the special test shall be laid down in accordance with the specific, respective purpose on a case by case basis by DIN CERTCO in conjunction with the testing laboratory.

Generally, it contains the scope of a monitoring test. DIN CERTCO shall be provided with the report of the special test no later than 3 weeks after completion of the test.

If deficiencies are established during a special audit, or if a special audit is performed due to a production stop, then the certificate holder must cover the costs of the special audit.

If no defects are detected during special test that has been carried out at the request of a third party, the costs will be charged to the third party in question.

## **5.3 Sampling**

The samples for type are usually taken by the manufacturer. Samples for surveillance testing are collected within a factory surveillance and from market and the pipe manufacturers. Materials that could not be sampled will be requested from the manufacturer.

The number of samples required for product inspections is agreed between DIN CERTCO and the testing laboratory unless not specified in the respective testing specifications or in the annexes.

The cost of sampling and sending the samples to the testing laboratory are born by the certificate holder.

## **5.4 Test procedure**

The scope and procedure of the tests is carried out in accordance with the annexes and the normative requirements of the relevant certification specifications of section 2 unless otherwise stated.

## **5.5 Test report**

The testing laboratory shall inform the principal of the test and examination results in the form of a test report. This must be submitted to DIN CERTCO in the original form.

As a rule, the test report may not be older than 6 months on submitting the application. In individual cases, older test reports can be recognized if the testing laboratory provides written confirmation of the current validity of the information given in said test report.

The test report must be in conformity with DIN EN ISO/IEC 17025, Section 5.10 and contain at least the following information:

- Name and address of the manufacturer
- Name and address of the applicant (if not the manufacturer)
- Test basis with date of issue (standards and certification scheme)
- Type of test (e.g. type test, surveillance test etc.)
- surveillance period
- Type, batch, registration number of the tested material
- Date and place of sampling
- Date/Time of test
- test results and assessment
- Name and signature of the person responsible for the examination

## 6 Certification

Certification in the sense of this certification scheme relates to the assessment of conformity of a product by DIN CERTCO on the basis of test reports submitted by testing laboratories recognized by DIN CERTCO. To this end, the products to be certified are examined and subsequently monitored in respect of conformity with the requirements laid down in section 4.

The right to use the the quality mark "DIN*plus*" will be granted by the issuing of the respective certificate.

### 6.1 Application for certification

Both manufacturers according to the German Product Liability Act (ProdHaftG) and distributors who, with the written consent of the certificate holder, bring the products onto the market under their own responsibility in the sense of the Product Liability Act, may apply.

The applicant must submit the following documents to DIN CERTCO:

- The original application for certification with a legally binding signature.
- Current test report according to section 5.5 on an initial test (see section 5.2.1), if the test was not ordered by DIN CERTCO.
- Report of the initial inspection of each affected manufacturing site
- Technical Data Sheet

The applicant shall receive from DIN CERTCO, following receipt of the application, a confirmation of order with a process number and notes regarding the further course of the procedure and, as applicable, queries concerning any missing documents.

### 6.2 Definition of Types

Materials that are distinguishable on the basis of certification-relevant characteristics, trade name or manufacturing site shall be defined as type. For each type an independent certificate shall be issued. Also, separate certificates are issued for materials that apply to different annexes. Further details can be found in the annexes for each application scope.

### 6.3 Conformity Assessment

On the basis of the documents submitted, DIN CERTCO conducts the conformity examination. To this end, an assessment is made with the aid of the examination report as to whether the product meets the requirements of the certification scheme and of the standard. The applicant shall receive written notification from DIN CERTCO in the event of any possible deviations.

### 6.4 The Certificate and the Right to Use the Mark

After successful testing and conformity assessment of the submitted documents, DIN CERTCO issues a certificate to the applicant and awards the right to use the quality mark "DINplus" in conjunction with a corresponding registration number.

Certificate holders with a valid right to use the quality label "DINplus" are, by adherence to the license rights, also authorized to use the trademark of KRV.



Format of the registration number: **P1W0000**

Material for which the right to use the quality mark "DINplus" has been awarded must be marked with the respective quality mark "DINplus" and the respective registration number.

The mark and the registration number may only be used for the type for which the certificate has been issued and which corresponds to the type-tested product. For each respective type, a registration number shall be issued.

In addition to this, the General Terms and Conditions of DIN CERTCO and the Testing, Registration and Certification Regulation of DIN CERTCO shall apply.

### 6.5 Sublicenses

According to DINCERTCO's General Terms and Conditions sublicenses are necessary if certified products are intended to be brought onto the market on behalf of companies other than the main certificate holder.

It's possible to issue sublicences for all products in the name of this certification scheme. They give the possibility bring products onto the market in the name of sublicense holder. Sub-licences are dependent upon the validity of the main certificate. Products may not be changed by sublicense holders.

The following documents must be submitted by the applicant to DIN CERTCO:

- The original application for certification with a legally binding signature.
- Declaration of the sublicense holder that the products of the main certificate holder unchanged reach the markt.
- Declaration of understanding by the main certificate holder to issuing of sublicences.

The issuance of a sublicense certificate can be done

- with own registration number
- with registration number of the main certificate holder.

## 6.6 Publications

All certificate holders can be viewed under <Certificate Holders> on the DIN CERTCO homepage [www.dincertco.tuv.com](http://www.dincertco.tuv.com), which is updated on a daily basis. Manufacturers, users and consumers can use this research feature in order to learn more about certified products.

In addition to the contact details of the certificate holder (phone, fax, email, Home page), the technical data of certified material can be viewed.

## 6.7 Validity of the Certificate

The certificate is valid for 5 years. The period of validity is shown on the certificate. On expiry of the certificate, the right to use the mark also expires.

## 6.8 Renewal of the Certificate

If the certification shall continue to apply beyond the date shown on the certificate, a positive assessment of the extension is required. Based on the past periods of surveillance, the conformity assessment is performed by DIN CERTCO.

## 6.9 Expiry of the Certificate

In the event that the new standard conformity examination according to section 5 has not been completed before expiry of the validity period, the right to use the quality mark "DIN*plus*" and the registration number expires without the necessity for explicit notification from DIN CERTCO.

Furthermore, the certificate can also expire if:

- The surveillance according to section 8 is not performed punctually or completely,
- The quality mark "DIN*plus*" is misused by the certificate holder,
- The requirements laid down in the certification scheme or its accompanying documents are not fulfilled,
- The certification fees are not paid on the due date
- The prerequisites for the issuing of the certificate are no longer fulfilled

## 6.10 Alterations/Amendments

### 6.10.1 Alterations/Amendments to the Product

The certificate holder is obliged to inform DIN CERTCO immediately of all changes made to the product. The testing laboratory and DIN CERTCO will together decide the extent of the

supplementary examination required in accordance with section 5.2.2 and whether this comprises a significant change. The testing laboratory sends the associated test report to DIN CERTCO.

If DIN CERTCO decides that a significant change has been made, the certificate and associated registration number are rendered invalid. A new application for initial certification and the utility right for the "DIN*plus*" quality mark can be submitted for the modified product.

The certificate holder is also obliged to provide information about all changes relating to formal information (e.g., relating to the certificate holder or its address).

### **6.10.2 Alterations to the Basic Test Specifications**

If the basic test specifications for the certification is modified, an application for the alteration of the certification shall be submitted within 6 months of receiving notification from DIN CERTCO and, as a rule, after 12 months, proof of conformity with the modified examination specifications shall be submitted in the form of a positive test report (see section 5.5).

Provided a positive assessment, DIN CERTCO issues a modified certificate.

### **6.11 Product defects**

If defects are identified in a product that has been certified once it is on the market, the certificate holder will receive a written notification from DIN CERTCO to rectify the defect. DIN CERTCO will consult with the testing laboratory to determine whether the defect in question is classified as a minor or major defect.

If defects are identified that have a direct or indirect effect on the safety or correct functioning of the product (major defects), the manufacturer must ensure that the product no longer displays the certification mark until the defect has been rectified.

The flaws in production are to be stopped immediately. Already produced, production batches with detected defects are not to be delivered any longer or to be retrieved from the market feasibly to the technical and commercial extent.

The manufacturer must provide evidence to DIN CERTCO within 3 months by submitting a test report from a special test pursuant to Section 5.2.5 that the deficiencies have been remedied and that the product in question again meets the requirements.

If the defects do not affect the safety or correct functioning of the product (minor defects), the manufacturer must use suitable means to prove to DIN CERTCO within a 3 month period that the defects affecting the product in question have been remedied.

If the manufacturer does not comply with these deadlines, then the certificate and manufacturer's and distributor's right to use the "DIN*plus*" quality mark are revoked.

If there continue to be grounds for objection, the certificate is temporarily revoked by DIN CERTCO and a final deadline for remedying the deficiencies is granted. If the certificate holder fails to comply with the request or does not meet the deadline, or if the manufacturer fails to prove that the defect has been remedied, the certificate is revoked.

## 7 Surveillance by the Manufacturer

The constant surveillance of the certified product during the entire duration of the certification period is an integral component of the certification itself. The manufacturer shall ensure, by suitable quality management measures, that the product characteristics confirmed by the certification are maintained. This can be accomplished by means of an in-house factory production control (FPC) focussed on the product itself or on the production and, in addition, can be guaranteed within the framework of a quality management system (QM-System) in accordance with the standard series DIN EN ISO 9000 ff.

### 7.1 Factory Production Control (FPC)

Factory production control comprises the continual monitoring of the production process by the manufacturer, which guarantees the conformity of the products manufactured with the specified requirements.

Appropriate records shall be submitted to DIN CERTCO or its authorised representative on request. These records must contain at least the following information:

- Designation of the test object
- Date of manufacture
- Date of examination
- Result of the examination and, if envisaged, comparison with the stipulated requirements
- Signature of the person responsible for the examination
- Date of the report

In the event of a negative test result, the manufacturer shall take all necessary steps to rectify the defect. Faulty products are to be marked and set apart. The test shall be repeated regularly to verify whether the defect has been rectified.

Scope and frequency of the FPC control are described in the annexes.

### 7.2 Quality management system

DIN CERTCO recommends the installation and certification of a quality management system in conformity with the standard series DIN EN ISO 9000ff.

## 8 Surveillance by DIN CERTCO

### 8.1 General Information

In addition to the FPC, the quality assurance of the products is supported by the surveillance by DIN CERTCO. DIN CERTCO examines the conformity of the product with the requirements laid down in the certification scheme as well as, where applicable, within the framework of plant inspections, the effectiveness of the FPC according to section 7.1.

After successful type testing, initial inspection and issuance of a certificate, the surveillance shall be performed at regular intervals (section **Fehler! Verweisquelle konnte nicht gefunden werden.**). The surveillance includes factory inspections (see section 8.2) as well as product-specific audit tests (see annexes).

## 8.2 Inspections

Within the framework of factory inspections, DIN CERTCO, or one of its authorised representatives, inspects the manufacturing and testing facilities as well as the quality assurance measures (QA measures). The inspection will take place annually.

The factory inspection also serves to determine whether the technical manufacturing prerequisites are met for the continual conformity of the products with the requirements laid down in section 4.

The result of the inspection shall be communicated to the client in a separate report. This must be presented to DIN CERTCO in original and the requirements correspond to DIN EN ISO/IEC 17020 section 13.

If the results of the inspection are not satisfactory, the applicant shall be informed accordingly without delay. In this case, the scope of additional measures needed to fulfil all requirements shall be determined between the certification body and the applicant. If the applicant is unable to implement the required measures, the procedure shall be terminated.

## 8.3 Surveillance Tests (Control Tests)

The verification tests shall take place with scope and frequency of the audit testing according to section 5.2.3 and described in the respective annexes.



## **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: 2020-06-01)

### **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 moulding 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 / m <sup>2</sup>	+	/	/	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 moulding 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 testing laboratory recognized by DIN CERTCO. The moulding 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](http://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](http://www.krv.de).

**Table A 2 Material List**

Manufacturer	Production Site	Material Designation	Material type	Colour	Weathering Verification 7 GJ/m <sup>2</sup>	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 test laboratories recognized by DIN CERTCO. For the regular factory production control (BRT / PVT) the material manufacturer or certificate holder is responsible.

**Table A 3 Material Test (per moulding 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		AT	
										BRT	PVT		
Table A 3 Material Test (per moulding compound)	<b>Physical Properties:</b>												
	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 $\geq$ 8 MPa PE 100: LPL value $\geq$ 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)	$\geq$ 930 kg/m <sup>3</sup> at 23 °C $\pm$ 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 <sup>(1)</sup> )	PAS 1031 DIN EN 1555-1 DIN EN 12201-1 ISO 15494 DVGW GW335-A2	Proportion of volatile components	$\leq$ 350 mg/kg	DIN EN 12099								
Humidity content (water)			< 0,03 % resp. $\leq$ 300 mg/kg	ISO 760 (Karl Fischer Method) resp. DIN EN 12118	x	x	x	x	x	1x/ batch/ 7 days	/	/	

	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	
Table A 3 Material Test (per moulding 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) <sup>(2)</sup>	DIN EN ISO 1133-1 resp. DIN EN ISO 1133-2	x	x	x	x	x	1x/ batch/ 7 days	/	2x / year/PS
	Weldability <sup>(3)</sup>	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 <sup>(4)</sup>	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) <sup>(5)</sup> <sup>(6)</sup>	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			
						TW	G	AW	DA	TT	FPC		AT
											BRT	PVT	
	Resistance to rapid crack propagation (RCP) <sup>(6)</sup>	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 $\geq 32$ mm <sup>(6)</sup>	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: $P_{c,S4} \geq 8$ bar at 0 °C resp. PE 100: $P_{c,S4} \geq 10$ 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: $P_{c,FS} \geq 20$ bar at 0 °C resp. PE 100: $P_{c,FS} \geq 24$ 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) <sup>(6)</sup> <sup>(7)</sup>	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: $P_{c,S4} \geq 1,36$ bar at 0°C resp. PE 100: $P_{c,S4} \geq 3,44$ 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: $P_{c,FS} \geq 7,5$ bar at 0°C resp. PE 100: $P_{c,FS} \geq 15$ 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 $\geq 20$ 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		AT
											BRT	PVT	
	Weather resists 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 moulding 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 <sup>2</sup> (2) 3,5 GJ / m <sup>2</sup>	DIN EN ISO 16871 (natural weathering) or DIN EN ISO 4892-2 (artificial weathering)								
			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	x	x	x	x	x	/	/	/
			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 <sub>bc,1min</sub> ≥ 800 MPa and E <sub>bc,24h</sub> ≥ 380 MPa and E <sub>bc,2.000h</sub> ≥ 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		AT
											BRT	PVT	
	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 moulding compound)	<b>Hygienic Properties:</b>												
	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 <sup>(8)</sup>	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 <sup>(8)</sup>	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 <sup>(8)</sup>	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 <sup>2</sup>	On test panels according to DIN EN 16421, method 2	x	/	/	x <sup>(8)</sup>	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  $\pm 20\%$  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.

#### A5 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 $\pm$ 2 °C free of air bubbles, sealed and placed in the water bath of a temperature of 30 °C $\pm$ 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 ( $\pm$ 10 min), the Erlenmeyer flasks are removed from the water bath and cooled down to room temperature (23 $\pm$ 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 ( $\pm 1$  h) at room temperature without stirring. After 24 h ( $\pm 1$  h), the granulate from the Erlenmeyer flask is rinsed with drinking water for 2 h ( $\pm 5$  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  $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}$  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 ( $\pm 1$  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  $\text{TON} \leq 2$ .

## **Annex B Material Polyethylen (PE 100-RC) for the manufacture of pressure pipes and fittings for alternative installation techniques according to PAS 1075**

(Edition: 2020-06-01)

### **B 1 Testing and certification specifications (also refer to section B 2):**

DIN 8074	Polyethylene (PE) pipes – PE 80, PE 100
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	Recommendation - Assessment of conformity of the drinking water hygiene suitability of products
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

## B2 General

Annex B of this certification scheme applies to all moulding compounds of the material type polyethylene (PE 100-RC) for the production of pressure pipes and fittings for alternative installation techniques according to PAS 1075 in the application areas TW, G, DA and AW. 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 B 1.

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

**Tabelle B 1 Quality enhancement**

Requirements	Annex B	DIN 8074	DIN 8075	DIN EN 1555	DIN EN 12201	DVGW GW 335-A2	See section
Daily updated publication of the certified materials	+	/	/	/	/	/	B 3
Materials are listed in the KRV material list	+	/	/	/	/	/	B 3
Certificate according to DIN EN 10204 type 3.1 for each delivery	+	/	/	/	/	x	B 1
Stress cracking test of the raw material > 8,760 h, at 80 °C, 4 N/mm <sup>2</sup> , 2 % Arkopal N-100 (Accelerated procedures allowed)	+	/	/	/	/	/	PAS 1075, Table 1a, 2
Stress crack test of the pipe > 3,300 h, at 80 °C, 4 N/mm <sup>2</sup> , 2 % Arkopal N-100 (Accelerated procedures allowed)	+	/	/	/	/	/	PAS 1075, Table 3, 4
Point load test on solid wall pipe 8,760 h, at 80 °C, 4 N/mm <sup>2</sup> , 2 % Arkopal N-100 (Accelerated procedures allowed)	+	/	/	/	/	/	PAS 1075, Table 3, 4
Thermal ageing test > 100 a at 20 °C	+	/	/	/	/	/	PAS 1075, Table 1a
Notch test on solid wall pipe > 8,760 h at 80 °C (Accelerated procedures allowed)	+	/	/	/	/	/	PAS 1075, Table 1a, 2

Requirements	Annex B	DIN 8074	DIN 8075	DIN EN 1555	DIN EN 12201	DVGW GW 335-A2	See section
Penetration test After 9,000 h residual wall thickness $\geq 50$ %	+	/	/	/	/	/	PAS 1075, Table 3
Protective layer scratch test Penetration depth $\leq 75$ % of the protective jacket thickness	+	/	/	/	/	/	PAS 1075, Annex A6

The certification according to Annex B is to be understood as an "add-on" to the certification according to Annex A material polyethylene (PE 80 and PE 100) for the production of pressure pipes and fittings for gas, drinking water, waste water and industrial applications.

Within the scope of the certification scheme, correlating test methods are permitted (see also PAS 1075). Requirements for this are:

- Verification of the correlation of the test procedure, whereby the target value (e.g. 8760 h) must be included. The correlation coefficient must be  $> 0.9$ . The minimum requirement must be demonstrated with a "lower confidence limit" of 2.5 %.
- Accreditation of the testing laboratory and recognition by DIN CERTCO.
- Recognition of the test procedure by DIN CERTCO.

The minimum requirement of correlating test procedures have to be regularly adapted to the current state of knowledge from the existing test series. The current correlations are available to DIN CERTCO. The minimum requirements for test methods recognized by DIN CERTCO with proven correlation independent of material type are laid down in the certification scheme.

### B3 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 moulding 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 testing laboratory recognized by DIN CERTCO. The moulding 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 B 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](http://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](http://www.krv.de).

**Table B 4 Material List**

Manufacturer	Production Site	Material Designation	Material type	Colour	Weathering Verification 7 GJ/m <sup>2</sup>	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
...	...	...	...	...	...	...	...	...	...	...	...	...	...

**B4 Material test**

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

**Table B 3 Material tests (per moulding 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		AT	
										BRT	PVT		
Table B 3 Material tests (per moulding compound)	<b>Physical properties:</b>												
	Stress crack resistance	PAS 1075	No failure on 6 samples from orientation-free processing methods (e.g. press plate)	FNCT > 8.760 h at 80°C/4MPa/2%ArkopalN100 or correlating test method <sup>(2)</sup>	PAS 1075 Annex A1	x	x	x	x	x	x	/	/
	Point Load Resistance	PAS 1075	No failure on 3 samples (solid wall pipe DN 110 SDR 11 or solid wall pipe with minimum wall thickness at the choice of the raw material manufacturer)	PLT > 8.760 h at 80°C/4MPa/2%ArkopalN100 or correlating test method <sup>(2)</sup>	PAS 1075 Annex A3	x	x	x	x	x	/	/	1x / 3 years / PS
	Thermal ageing resistance under point load	PAS 1075	Verification in the thermal ageing test with point loads on pipe sections with a total length of at least 5 m	> 100 years at 20°C Testing at elevated temperature and determination of the activation energy	In accordance with PAS 1075 Annex A5	x	x	x	x	x	/	/	/
	Resistance to slow crack growth (SCG)	PAS 1075	No failure in the notch test on 3 samples (solid wall pipe DN 110 mm SDR 11)	NPT > 8.760 h at 80°C / 9,2 bar or correlating test method <sup>(2)</sup>	DIN EN ISO 13479	x	x	x	x	x	/	/	1x / 3 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	
Table B 3 Material tests (per moulding compound)	Density	PAS 1075	Indication of the minimum density of the base material (base density)	≥ 945 kg/m <sup>3</sup> 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	/	2x / year	
	Melt index (MFR)	PAS 1075	Indication of the MFR range	0,15 up to 0,40 g / 10 min at 190 °C / 5 kg (nominal value) <sup>(1)</sup>	DIN EN ISO 1133-1 or DIN EN ISO 1133-2	x	x	x	x	x	/	2x / year	
<p><sup>(1)</sup> The nominal MFR value is to be specified by the manufacturer of the moulding compound. The measured MFR value may deviate from the nominal MFR value by a maximum of ± 20 %, whereby the smallest measured MFR value may not be less than 0.15 g / 10 min at 190 °C / 5 kg.</p> <p><sup>(2)</sup> Minimum requirements for correlating test methods (tests raw material manufacturers):</p> <p>Stress crack test (FNCT &gt; 8760 h; 80 °C; 4 N/mm<sup>2</sup>; 2 % Arkopal N-100; orientation-free processing method):</p> <ul style="list-style-type: none"> <li>* 400 h in ACT test procedure (90 °C; 4 N/mm<sup>2</sup>; 2 % NM5) [D-PL-11080-01-00; PA FNCT 2.1-3 in conjunction with PA ACT 2.1-9].</li> <li>* 400 h in 2NCT+ test procedure (90 °C; 4 N/mm<sup>2</sup>; 2 % NM5) [D-PL-11080-01-00; PA 2NCT 2.1-2 in conjunction with PA ACT 2.1-9].</li> <li>* 150 h in ACT+ test procedure (90 °C; 5 N/mm<sup>2</sup>; 2 % NM5) on 2 samples, additional 400 h in ACT test procedure (90 °C; 4 N/mm<sup>2</sup>; 2 % NM5) on 2 samples [D-PL-11080-01-00; PA FNCT 2.1-3 in conjunction with PA ACT 2.1-9], batch release after the ACT+ requirement has been met</li> </ul> <p>Point load test (PLT &gt; 8760 h; 80 °C; 4 N/mm<sup>2</sup>; 2 % Arkopal N-100; solid wall pipe Da 110 SDR 11):</p> <ul style="list-style-type: none"> <li>* 450 h in PLT+ test procedure (90 °C; 4 N/mm<sup>2</sup>; 2 % NM5) [D-PL-11080-01-00; PA PLP+ 2.2-4].</li> </ul>													



## **Annex C     Stripe material Polyethylene (PE 80, PE 100, PE 100-RC) for the manufacture of pressure pipes for gas, drinking water, sewage and industrial applications**

(Edition: 2020-06-01)

### **Testing and certification specifications (see refer to section C 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	Plastic 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 B 2: PE 80 and PE 100 fittings
UBA KTW-BWGL	Evaluation basis for plastics and other organic materials in contact with drinking water
UBA	Recommendation - Assessment of conformity of the drinking water hygiene suitability of products
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

**C2 General**

Annex C of this certification scheme applies to all moulding compounds (stripe materials) of the material type polyethylene (PE 80, PE 100 and PE 100-RC) for the manufacture of pressure pipes and fittings for gas, drinking water, waste water and industrial applications. 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 C 1.

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

**Table C 5 Quality Enhancement**

Requirements	Annex A	DIN 8074	DIN 8075	DIN EN 1555	DIN EN 12201	DVGW GW 335-A2	See section
Daily updated publication of the certified materials	+	/	/	/	/	/	C 3
Materials are listed in the KRV material list	+	/	/	/	/	/	C 3
Certificate according to DIN EN 10204 type 3.1 for each delivery	+	/	/	/	/	x	C 1

The stripes shall meet the requirements of DVGW GW 335-A2 (see Table C 6).

**Table C 5 Number, width and depth of the stripes**

Outer diameter in mm	Minimum number of stripes	Minimum width in mm	Maximum depth in mm (with wall thickness s in mm, but not more than 3,0 mm)
< 32	3	1	20 % of s
32 to 63	3	2	20 % of s
75 to 160	4	4	15 % of s

Outer diameter in mm	Minimum number of stripes	Minimum width in mm	Maximum depth in mm (with wall thickness s in mm, but not more than 3,0 mm)
180 to 400	4	9	15 % of s
≥ 450	6	12	10 % of s

### C3 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 moulding 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 testing laboratory recognized by DIN CERTCO. The moulding 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 C 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](http://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](http://www.krv.de).

**Table C 6 Material List**

Manufacturer	Production Site	Material Designation	Material type	Colour	Weathering Verification 7 GJ/m <sup>2</sup>	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
...	...	...	...	...	...	...	...	...	...	...	...	...	...

#### C4 Material test (Stripe material)

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

**Tabelle C 3 Material tests (per moulding 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		AT	
										BRT	PVT		
Table C 3 Material tests (per moulding compound)	<b>Physical properties:</b>												
	Creep internal pressure behavior Classification / MRS-Value (Proof of the long-term hydrostatic strength)	DIN EN 1555-1 DIN EN 12201-1 ISO 15494	Must correspond to the same base material of the pipe material	PE 80: > 1.000 h at 80 °C / 4 MPa PE 100: > 1.000 h at 80 °C / 5 MPa	DIN EN ISO 1167-1 and DIN EN ISO 1167-2	x	x	x	x	x	/	/	/
	Density	DIN EN 1555-1 DIN EN 12201-1 ISO 15494	Indication of the minimum value of the basic material (basic density)	≥ 930 kg/m <sup>3</sup> Conditioning 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	x	/	/
	Trockenverlust (flüchtige Bestandteile oder Feuchtegehalt <sup>(1)</sup> )	DIN EN 1555-1 DIN EN 12201-1 ISO 15494	Proportion of volatile components	≤ 350 mg/kg	DIN EN 12099								
Humidity content (water)			< 0,03 % bzw. ≤ 300 mg/kg	ISO 760 (Karl Fischer Methode) bzw. DIN EN 12118 / DIN EN ISO 15512	x	x	x	x	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		AT	
											BRT	PVT		
	Colour	DIN EN 1555-1 DIN EN 12201-1 ISO 15494	Adherence to the reference value	Uniform black, light blue, royal blue, yellow, orange yellow, brown or green, similar to RAL	visually	x	x	x	x	x	x	/	/	
	Melt index (MFR)	DIN EN 1555-1 DIN EN 12201-1 ISO 15494	Indication of MFR range	0,15 to 1,40 g / 10 min at 190 °C / 5 kg (nominal MFR value) <sup>(2)</sup>	DIN EN ISO 1133-1 resp. DIN EN ISO 1133-2	x	x	x	x	x	x	/	2x / year/PS	
	Weldability for materials <sup>(3)</sup>	DIN EN 1555-1 DIN EN 12201-1 ISO 15494	Proof of weldability by creep tensile tests	Rupture outside the joining plane	DVS Guideline 2203-4	x	x	x	x	x	/	/	/	
Table C 3 Material tests (per moulding com-	Thermal stability (OIT)	DIN EN 1555-1 DIN EN 12201-1 ISO 15494	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 <sup>(4)</sup> respectively	DIN EN 11357-6	x	x	x	x	x	x	/	2x / year/PS	
	Homogeneity (Carbon black resp. pigment dispersion and appearance)	DIN EN 1555-1 DIN EN 12201-1 ISO 15494	Adherence to the reference value	≤ Degree 3 Bild A1, A2, A3 or B	ISO 18553	x	x	x	x	x	x	/	2x / year/PS	
	<b>Hygienic properties:</b>													
	Composition requirements	KTW-BWGL Section 5.2 and Annex A	Raw materials must comply with 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	Formulation check according to KTW-BWGL section 6.1	x	/	/	x <sup>(5)</sup>	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	
		UBA Conformity Hygiene section 7.4.1	Test specimens must be prepared from the specified raw materials	Consistency of results of fingerprint methods	Fingerprint method, e.g. FTIR, TG	x	/	/	x <sup>(5)</sup>	x	/	/	1x / half-yearly/PS
	Organoleptic properties	PAS 1031 KTW-BWGL section 5.6 DVGW GW335-A2	No detrimental change in odour	TON ≤ 4	Based on KTW-BWGL section 6.3.1 and DIN EN 1420 (see A5)	x	/	/	x <sup>(5)</sup>	x	x	/	1x / half-yearly/PS
<p>(1) In arbitration cases, the moisture content requirement applies.</p> <p>(2) The manufacturer of the molding materials 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.</p> <p>(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.</p> <p>(4) The test may be carried out at 220 °C provided that there is a reliable correlation. In cases of arbitration the requirement at 200 °C applies.</p> <p>(5) Proof only if application TW is also provided.</p>													

### C5 Method for evaluation of the organoleptic properties of PE granulate (raw material)

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 ( $\pm 10$  min), the Erlenmeyer flasks are removed from the water bath and cooled down to room temperature ( $23 \pm 2$ ) °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 ( $\pm 1$  h) at room temperature without stirring. After 24 h ( $\pm 1$  h), the granulate from the Erlenmeyer flask is rinsed with drinking water for 2 h ( $\pm 5$  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  $23 \text{ °C} \pm 2 \text{ °}$  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 ( $\pm 1$  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  $\text{TON} \leq 2$ .

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

(Stand: 27.04.2017)

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

- |                 |   |
|-----------------|---|
| DIN 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 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 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 |
| DVGW GW 335-A6  | Plastic Piping Systems in Gas and Water Supply - Requirements and Tests - Part A6 - PA-U 160 and PA-U 180 Pipes and their Joints and Jointing                           |

**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 and DIN ISO 16486-1. 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 a certificate according to DIN EN 10204 Type 3.1 for each delivery.

**Table D 1 Quality Enhancement**

Requirements	Annex P ZP 24.26.45	DIN ISO 16486-1	DVGW GW 335-A6	See section:
Daily updated publication of certified materials	+	/	/	D 3
Materials are listed in the KRV material list	+	/	/	D 3
Certificate according to DIN EN 10204 type 3.1 for each delivery	+	/	X	D 2
External testing of the density	+	/	X	Table D 3
External testing of the viscosity number	+	/	X	Table D 3
External testing DSC	+	/	X	Table D 3

External testing Water content	+	/	/	Table D 3
Third party testing black carbon content	+	/	/	Table D 3
External testing Dispersion of pigment or black carbon	+	/	/	Table D 3
External testing fast crack propagation	+	/	X	Table D 3
External testing slow crack growth	+	/	X	Table D 3

Verification of long-term strength (creep rupture behaviour) 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 DIN ISO 16486-1 at any point. For 20 °C and 50 years, the respective LCL value must correspond to the corresponding reference value of DIN ISO 16486-1, Table 3. The raw material manufacturer must file these corresponding verifications with DIN CERTCO.

### Product groups

The certification is carried out separately for each moulding 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 testing laboratory recognized by DIN CERTCO. 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 moulding compounds approved by DIN CERTCO are published daily in the DIN CERTCO certification database at [www.dincertco.tuv.com](http://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](http://www.krv.de).

**Tabelle D 3 Product groups / Material list (example)**

Manufacturer	Material- designation	Colour	Weather- ring proof 7 GJ/m <sup>2</sup>	Proven Rapid Crack Propagation (RCP) S4- or FS-test <sup>2)</sup>				Application			
				Application also for pipes ≥ 32 mm wall thickness			Application for pipes up to ... mm wall thickness				
Material type				DA	TW	AW	G		DA	G	TW

Name of material manufacturer											
Name of moulding compound chosen by the manufacturer	PA-U 12 180	...	-	-	-	-	.....	-	X	-	-

**Material tests**

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

**Table D 4 Material tests (per moulding compound)**

	Properties	Require- ments ac- cording to or based on	Requirement (parameters)	Type test (TT) Initial assessment (ITT)	Factory production con- trol WPK (BRT/ PVT)	Monitoring audit (AT)
Table D 4 Material tests (per moulding compound)	Verification of long-term strength (creep rupture behav- iour under internal pressure)	ISO 9080	DIN ISO 16486-1 Chapter 5.4	X	-	-
	Colour	DVGW GW 335-A6	DVGW GW 335-A6 Chapter 3.2	X	Per batch	at least 1x / half year
	Density	ISO 1183-1, ISO 1183-2	PA-U 11: 1020 to 1050 kg/m <sup>3</sup> at 23 °C PA-U 12: 1000 to 1040 kg/m <sup>3</sup> at 23 °C	X	Per batch	at least 1x / half year
	Water content	ISO 15512, method B	≤ 0,10 %	X	Per batch	-
	Solution viscosity / Viscosity number	DIN EN ISO 307	≥ 180 ml/g / Solventl m-Cresol	X	Per batch	at least 1x / half year

	Properties	Requirements according to or based on	Requirement (parameters)	Type test (TT) Initial assessment (ITT)	Factory production control WPK (BRT/ PVT)	Monitoring audit (AT)
	DSC	DVGW GW 335-A6	DVGW GW 335-A6 Chapter 3.6	X	Per batch	at least 1x / half year
Table D 4 Material tests (per moulding compound)	Weather resistance (for black and yellow moulding compounds)	ISO 16871	$\geq 3,5 \text{ GJ/m}^2$	X	-	-
	Black carbon content (only for black moulding compounds)	ISO 6964	0,5 to 1,0 % (mass portion)	X	Per batch	at least 1x / half year
	Dispersion of pigment or carbon black (for black and yellow moulding)	DIN ISO 16486-1	DIN ISO 16486-1 Annex A.3	X	Per batch	at least 1x / half year
	Rapid crack propagation (practical test, full-scale test)	ISO 13478	at $e \geq 5 \text{ mm}$ $p_c \geq 1,5 \text{ MOP at } 0^\circ \text{ C}$	X	-	-
	Rapid crack propagation (lab test, S4 test)	ISO 13477	g at $0^\circ \text{ C}$	-	-	at least 1x / half year
	Slow crack growth	ISO 13479	$\geq 500 \text{ h}$ at $80^\circ \text{ C}$ , $d_n$ 110 or 125 mm, SDR 11 PA-U 11/12 160: 18 bar PA-U 11/12 180: 20 bar	X	-	at least 1x / year
	Weldability	DVS 2207-16	$f_s \geq 0,8$	X	-	-
	Chemical resistance	DIN ISO 16486-1	DIN ISO 16486-1 Annex B Kerosene Typ Jet A1	X	-	-
	Longitudinal shrinkage	DIN EN ISO 2505	$\leq 3 \%$ at $150^\circ \text{ C}$	X	-	at least 1x / half year
	Charpy notched impact strength	ISO 179-1/1eA	$a_{cN} \geq 10 \text{ kJ/m}^2$ at $0^\circ \text{ C}$	X	-	at least 1x / half year