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NATIONAL TECHNICAL ASSESSMENT ITB-KOT-2019/1053, Edition 1

This National Technical Assessment was issued in accordance with the Regulation of the Minister of Infrastructure and Construction of 17 November 2016 on national technical assessments (Journal of Laws of 2016, item 1968) by the Building Research Institute in Warsaw, at the request of:

AQUATHERM GmbH
Biggen 5, D-57439 Attendorn, Germany

The National Technical Assessment ITB-KOT-2019/1053, Edition 1, constitutes a positive assessment of the performance of the following construction products for the intended use:

Aquatherm green pipe SDR 7,4 MF and aquatherm green pipe SDR 9 MF

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The document of the National Technical Assessment ITB-KOT-2019/1053, Edition 1, contains 14 pages, including 2 Annexes. The text of this document must only be copied in full. Publishing or disseminating fragments of the text of the National Technical Assessment in any other form requires a written agreement with the Building Research Institute. National Technical Assessment ITB-KOT-2019/1053, Edition 1, applies to products covered by Technical Approvals ITB AT-15-9345/2014 and AT-15-8505/2015.

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1. TECHNICAL DESCRIPTION OF THE PRODUCT

The subject of this BRI National Technical Assessment are: aquatherm green pipe SDR 7.4 MF and aquatherm green pipe SDR 9 MF (product type designation). The products are manufactured by Aquatherm GmbH, Biggen 5, D-57439 Attendorn, Germany, at the production plants of Aquatherm GmbH, Biggen 5, D-57439 Attendorn, Germany and Wilhelm-Rönsch-Strafte 4, D-01454 Radeberg, Germany. Aquatherm - Polska Jacek Ligaszewski, ul. Puławska 538, 02-884 Warszawa is the authorised representative of the manufacturer in Poland.

Aquatherm green pipes SDR 7.4 MF are made of three concentrically arranged layers:

- Inner layer made of homogeneous material - polypropylene (PP-R),
- A middle layer made of polypropylene reinforced (stabilised) with glass fibre (PP-R-GF),
- An outer layer, made of homogeneous material - polypropylene (PP-R).

Aquatherm green pipes SDR 9 MF are made of three concentrically arranged layers:

- An inner layer made of homogeneous material - polypropylene (PP-RCT), with the trade name PP-RP,
- A middle layer made of polypropylene reinforced (stabilised) with glass fibre (PP-RCT-GF), with the trade name PP-RP-GF,
- An outer layer made of homogeneous material - polypropylene (PP-RCT), with the trade name PP-RP.

The middle (reinforced) layer of the pipe constitutes 40% of the wall thickness, while the outer and inner layers constitute 30% of the wall thickness. The reinforcement of the middle layer is glass fibre amounting to 18 ±3% by weight.

Aquatherm green pipe SDR 7.4 MF and aquatherm green pipe SDR 9 MF are produced in 4 m long straight sections.

The National Technical Assessment covers aquatherm green pipes of the SDR 7.4 standard size series with outer diameters from Ø 20 to Ø 355 mm, green, with four longitudinal dark green stripes and aquatherm green pipes of the SDR 9 size series with outer diameters from ∅ 32 to ∅ 355 mm, green, with four longitudinal dark green stripes.

The dimensions, external appearance and labelling of pipes are given in Annex A, while the description of raw materials and materials in Annex B.

2. INTENDED USE OF THE PRODUCT

Aquatherm green pipes SDR 7.4 MF and aquatherm green pipes SDR 9 MF are intended for use in cold and hot water systems and central heating systems.

Aquatherm green pipes SDR 7.4 MF and aquatherm green pipes SDR 9 MF covered by this National Technical Assessment meet the hygienic requirements and can be used for water intended for human consumption, in accordance with the Hygienic Certificate No. BK/W/0690/01/2018 issued by the National Institute of Hygiene.

Aquatherm green pipes SDR 7.4 MF can be used interchangeably with homogeneous pipes and composite pipes (aquatherm green pipe MS with aluminium insert) with SDR 7.4 size series, taking into account different values of linear expansion coefficient for each pipe type.

Aquatherm green pipes SDR 7.4 MF and aquatherm green pipes SDR 9 MF are connected with fittings by means of the following methods:

- Socket polyfusion welding,
- Mechanical connection by means of transition fittings with a thread and a sleeve for flange connections with a nut,
- Butt welding (for diameters over 125 mm).

Connecting components of the installation should be carried out in accordance with the pipe manufacturer's assembly instructions and using appropriate tools.

The operating parameters of the aquatherm green pipe SDR 7.4 MF, depending on the type of system, taking into account the temperature distribution and service life, are given in Tables 1 and 2.

Table 1

System type	Operating temp. T_D,°C	Service life with T_D, years	Maximum temp. T_{max}, °C	Service life t in T_{max}, years	Maximum failure temperature t_{mal}[2)],°C	Maximum service life in t_{mal}, h
1	2	*3*	*4*	*5*	*6*	7
Cold water system	20	50	-	-	-	-
Class 1[3)] application (hot water system)	60[1)]	49	80	1	95	100
Class 4[3)] application (central surface heating system)	20 subsequently 40 subsequently 60[1)]	2.5 subsequently 20 subsequently 25	70	2.5	100	100
Class 5[3)] application (radiator central heating heating)	20 subsequently 60 subsequently 80[1)]	14 subsequently 25 subsequently 10	90	1	100	100

[1)] Temperatures considered as calculated temperatures (design temperatures)
[2)] Failure temperature refers to periods of system failure (e.g. control system) during which the temperature may increase to that given in Table 1, in a total time of operation of 100 hours during 50 years of service operation of the system, with one-time continuous operation period with failure should not exceed 3 hours
[3)] Classification of operating conditions acc. to PN-EN ISO 15874-1:2013 Standard

Table 2

Design pressure, bar		
Class 1 application	**Class 4 application**	**Class 5 application**
1	**2**	*3*
8	**10**	**6**

The design pressure for transport of water with temperature ≤ 20°C is 10 bar.

The operating parameters of the aquatherm green pipe SDR 9 MF, depending on the type of system, taking into account the temperature distribution and service life, are given in Tables 3 and 4.

Table 3

System type	Operating temp. T_D,°C	Service life in T_D, years	Maximum temp. T_{max},°C	Service life t in T_{max}, years	Maximum failure temperature t_{mal}[2)],°C	Maximum service life in t_{mal}, h
1	2	*3*	*4*	5	*6*	7
Cold water system	20	50	-	-	-	-
Class 1[3)] application (hot water system)	60[1)]	49	80	1	95	100
Class 2[3)] application (hot water system)	70	49	80	1	95	100
Class 4[3)] application (central surface heating system)	20 subsequently 40 subsequently 60[1)]	2.5 subsequently 20 subsequently 25	70	2.5	100	100
Class 5[3)] application (radiator central heating heating)	20 subsequently 60 subsequently 80[1)]	14 subsequently 25 subsequently 10	90	1	100	100

[1)] Temperatures considered as calculated temperatures (design temperatures)
[2)] Failure temperature refers to periods of system failure (e.g. control system) during which the temperature may increase to that given in Table 1, in a total time of operation of 100 hours during 50 years of service operation of the system, with one-time continuous operation period with failure should not exceed 3 hours
[3)] Classification of operating conditions acc. to PN-EN ISO 15874-1:2013 Standard

Table 4

Design pressure, bar			
Class 1 application	**Class 2 application**	**Class 4 application**	**Class 5 application**
1	*2*	*3*	*4*
8	8	8	6

Products covered by this National Technical Assessment should be used in accordance with:

- The technical design developed for a specific facility, taking into account the Polish Standards and technical and construction regulations, in particular the Regulation of the Minister of Infrastructure of 12 April 2002 on the technical conditions to be met by buildings and their location (Journal of Laws of 2019, item 1065),
- Requirements of this National Technical Assessment,
- Instructions developed by the manufacturer and delivered to customers.

3. PERFORMANCE CHARACTERISTICS OF THE PRODUCT AND METHODS APPLIED FOR THEIR ASSESSMENT

3.1. Product performance characteristics

Performance characteristics of aquatherm green pipes SDR 7,4 MF and aquatherm green pipes SDR 9 MF are given in Table 5.

Table 5

Item	Essential characteristics	Performance	Assessment method
1	2	*3*	*4*
1	Dimensional tolerances	acc. to Annex A, tables A1 and A2 and PN-EN 15874-2:2013	PN-EN ISO 3126:2006
2	Melt Flow Rate (MFR) (2.16 kg; 230°C), g/10 min	The maximum change as a result of processing the raw material into pipes: A MFR ± 30%	PN-EN ISO 1133-1:2011
3	Longitudinal contraction,%	≤ 2	PN-EN ISO 2505:2006 Method B (test in the dryer) Test parameters: acc. to PN-EN ISO 15874-2:2013 Standard
4	Impact resistance at 0°C	**H_{50} ≥** 1.0 m	PN-EN 11173:2017
5	Opacity	Pipes with the smallest wall thickness, tested with a luxmeter with sensitivity ≥ 1 lux, transmit less than 0.2% of visible light	PN-EN ISO 7686:2006
6	Resistance of pipes to internal pressure	no leaks and damage	section 3.2.1
7	Resistance of connections to cyclic temperature changes	no leaks and damage	PN-EN ISO 19893:2018 Test parameters: acc. to PN-EN ISO 15874-5:2013 Standard
8	Tightness of connections under internal pressure	no leaks and damage	PN-EN ISO 1167-1:2007 PN-EN ISO 1167-2:2007 Test parameters: PN-EN 15874-5:2013
9	Homogeneity	The cross-sectional area of single inhomogeneity does not exceed 0.02 mm^2	section 3.2.2
10	Glass fibre content in the middle layer, %	18±3	PN-EN ISO 3451-1:2019, Method A

3.2. Methods used to evaluate performance characteristics

The methods used to evaluate the performance characteristics of the aquatherm green pipes SDR 7.4 MF and aquatherm green pipes SDR 9 MF are given in Table 5 and in section 3.2.1 and 3.2.2.

3.2.1. Resistance of pipes to internal pressure. Testing of the pipe pressure resistance to internal pressure should be carried out according to PN-EN ISO 1167-1: 2007 and PN-EN ISO 1167-2: 2007 under the conditions given in Table 6.

Table 6

Hydrostatic (circumferential) stress in the pipe wall[1)]		Test temperature, °C	Test time, h	Type of test
of PP-R[2)], MPa	of PP-RCT[2)], MPa			
16	15	20	≥ 1	water in water
4.3	4.2	95	≥ 22	
3.8	4.0	95	≥ 165	
3.5	3.8	95	≥ 1000	

[1)] Circumferential stress in the pipe wall acc. to PN-EN ISO 15874-2: 2013
[2)] Homogeneous pipe wall

3.2.2. Homogeneity. From each of the three pipe samples after testing the resistance of the pipes to internal pressure at 95°C, at least one microtome section about 10 microns thick should be taken, transversely from the pipe axis. Microtome cross-sections should be examined at a minimum 75x magnification to assess possible structure defects. The minimum total test surface should be 100 mm^2.

4. PACKING, TRANSPORT AND STORAGE AS WELL AS THE METHOD OF PRODUCT MARKING

Pipes in straight sections should be packed in parallel bundles without crossing them. Tube bundling should be done at the ends and in the middle of the bundle length. Each bundle should be packed in a plastic film sleeve. Bundles can be stacked on pallets.

Products packed in bundles and plastic sleeves should be transported in a manner that protects them from damage and destruction, as specified in the transport instructions prepared by the manufacturer.

Products packed in bundles and plastic film sleeves should be stored in a manner that protects them from damage or destruction.

The marking method of a product with the construction mark should be in accordance with the Regulation of the Minister of Infrastructure and Construction of 17 November 2016 on methods to declare the performance of construction products and the method of labelling them with a construction reference number (Journal of Laws of 2016, item 1966, as amended).

Product labelling with the construction mark should be accompanied by the following information:

- The last two digits of the year in which the construction mark was first affixed to the construction product,
- Name and address of the manufacturer's registered office or identification mark allowing to clearly identify the name and address of the manufacturer's registered office,
- Name and type designation of the construction product,
- The number and year of the issue of the National Technical Assessment in accordance with which the performance characteristics were declared (ITB-KOT-2019/1053 edition 1),
- The number of the national declaration of performance,
- The level or class of declared performance,
- The manufacturer's website address if the national declaration of performance is made available on it.

Along with the national declaration of performance, a safety data sheet and/or information on hazardous substances contained in a construction product, as referred to in Art. 31 or 33 of the Regulation (EC) No. 1907/2006 of the European Parliament and of the Council on the registration, assessment, authorization and restriction of chemicals (REACH), establishing a European Chemicals Agency.

In addition, labelling of a construction product constituting a hazardous mixture under REACH should comply with the requirements of Regulation (EC) No. 1272/2008 of the European Parliament and of the Council on classification, labelling and packaging of substances and mixtures (CLP), amending and repealing Directive 67/548/EEC and 1999/45/EC and amending Regulation (EC) No 1907/2006.

5. ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

5.1. The national system of assessment and verification of constancy of performance

According to the Regulation of the Minister of Infrastructure and Construction of 17 November 2016 on methods to declare the performance of construction products and the method of labelling them with a construction reference number (Journal of Laws of 2016, item 1966, as amended) system 3 for the assessment and verification of constancy of performance applies.

5.2. Type test

The performance characteristics assessed in section 3 constitute the test of the product type until future changes in raw materials, components, the production line or the production plant.

5.3. Factory Production Control

The manufacturer should have a Factory Production Control system implemented at the production plant. All elements of this system, requirements and provisions adopted by the manufacturer should be documented in a systematic manner in the form of policies and procedures, including records of performed tests. The Factory Production Control should be adapted to the production technology and ensure that the declared performance of the product is maintained in series production.

Factory Production Control includes the specification and inspection of raw materials and components, control and research in the production process and control tests (according to section 5.4) conducted by the manufacturer in accordance with the established test plan and according to the principles and procedures specified in the documentation of the Factory Production Control.

The results of the production control should be systematically recorded. The records of the register should confirm that the products meet the criteria for assessment and verification of constancy of performance. Individual products or product batches and associated production details must be fully traceable and reproducible.

5.4. Control tests

5.4.1. Test programme. The test programme includes:

a) Ongoing testing,
b) Periodic testing.

5.4.2. Ongoing testing. Ongoing testing includes the control of:

a) External appearance and colour,
b) Dimensions,
c) Melt Flow Rate (MFR) (in the product),
d) Longitudinal contraction,
e) Impact resistance at 0°C,
f) Resistance of pipes to internal pressure (1 h at 20°C and 165 h at 95°C).

5.4.3. Periodic testing. Periodic testing includes the control of:

a) Connection resistance to cyclic temperature changes,
b) Resistance of pipes to internal pressure (1000 h at 95°C).

5.5. Frequency of tests

Ongoing tests should be carried out in accordance with the test plan, but not less frequently than for each batch of products. The size of the product batch should be specified in the factory production control documents.

Periodic tests should be carried out at least once every 3 years.

6. INSTRUCTIONS

6.1. The National Technical Assessment ITB-KOT-2019/1053, Edition 1, is a positive assessment of the performance of these essential characteristics of aquatherm green pipes SDR 7.4 MF and aquatherm green pipes SDR 9 MF which, according to the intended use, resulting from the provisions of the Assessment, have an impact on fulfilment of basic requirements by buildings in which the product will be used.

6.2. National Technical Assessment ITB-KOT-2019/1053, Edition 1, is not a document authorizing the labelling of a construction product with a construction mark.

Pursuant to the Act of 16 April 2004 on construction products (Journal of Laws of 2019, item 266, as amended), the products covered by this National Technical Assessment may be placed on the market or made available on the domestic market, if the manufacturer has assessed and verified the constancy of performance, has drawn up a national declaration of performance in accordance with the National Technical Assessment ITB-KOT- 2019/1053, Edition 1, and marked the products with a construction mark in accordance with the applicable regulations.

6.3. National Technical Assessment ITB-KOT-2019/1053 edition 1 does not violate the rights arising from the provisions on the protection of industrial property, in particular the Act of 30 June 2000, Industrial Property Law (Journal of Laws of 2017, item 776, as amended). Assuring these rights is the responsibility of those using this BRI National Technical Assessment.

6.4. BRI, when issuing the National Technical Assessment, is not responsible for any violation of exclusive and acquired rights.

6.5. The National Technical Assessment does not release the manufacturer of the products from liability for their proper quality, and the contractors of construction works from the liability for their proper application.

6.6. The validity of the National Technical Assessment may be extended for further periods, not exceeding 5 years.

7. A LIST OF DOCUMENTS USED IN THE PROCEDURE

7.1. Reports, test reports, assessments, classifications

1. BK/W/0690/01/2018. NIH Hygienic Certificate. National Institute of Hygiene in Warsaw, 2018.
2. Test Reports Nos.: 574118/1.1/130774, 573718/1.1/129614, 574019/1.1/134731, 574119/1.1/134732, 574017/2.1/127511, 574117/2.1/127512, 574018/2.1/133176, 574118/2.1/133177, 573718/2.1/132078, 290218/1.1/130771, 544718/1.1/129612, 544818/1.1/129613, 289419/1.1/134727,290219/1.1/134728, 289418/2.1/133173, 290218/2.1/133174, 544718/2.1/132076, 544818/2.1/132077, SKZ Das Kunststoff-Zentrum, Germany, 2018 and 2019
3. Test Report Nos. 21/03/2018 PLA-0438/17-1, 12/03/2018 PLA-0471/17-1, 25/06/2018 PLA-0475/16-2, 30/11/2018 PLA-0386/18-1, 19/02/2019 PLA-0652/17-2, 22/10/2018 PLA-0287/18-1 for the aquatherm green pipes and fittings. Centro de ensayos, innovación y servicios CEIS, Madrid, 2018 and 2019
4. Ongoing and periodic tests for aquatherm green pipes SDR 7,4 MF and SDR 9 MF. Laboratory of aquatherm GmbH, 57439 Attendorn - Biggen, Germany, 2015, 2016 and 2017
5. Nos. 544814/2.1/113252, 544714/2.1/113249, 289414/2.1/114243, 290214/2.1/114244. SKZ Das Kunststoff-Zentrum, Germany, 2015
6. Test Report No. PLA-0018/14-1 for aquatherm green pipes and fittings. Centro de ensayos, innovación y servicios CEIS, Madrid, 2014
7. Report No. PLA-0432/14-1 for aquatherm green pipes. Centro de ensayos, innovación y servicios CEIS, accredited by ENAC, Madrid, 2014
8. Test reports for green pipes SDR 9 MF RP, tests were carried out in the manufacturer's laboratory in 2012 and 2013.

7.2. Standards and related documents

PN-EN ISO 1133-1:2011	*Plastics. Determination of the melt mass-flow rate (MFR) and melt volume-flow rate (MVR) of thermoplastics*

PN-EN ISO 1167-1 and 2:2007	*Thermoplastics pipes, fittings and assemblies for the conveyance of fluids. Determination of the resistance to internal pressure. Part 1: The general method, Part 2: Preparation of pipe test pieces*
PN-EN ISO 1183-1:2013	*Plastics. Methods for determining the density of non-cellular plastics. Part 1: The immersion method, the liquid pycnometer method and the titration method*
PN-EN ISO 2505:2006	*Thermoplastics pipes. Longitudinal reversion. Test methods and parameters*
PN-EN ISO 3126:2006	*Plastics piping systems. Plastics components. Determination of dimensions.*
PN-EN ISO 19893:2018	*Plastics piping systems. Thermoplastics pipes and fittings for hot and cold water. The test method for the resistance of mounted assemblies to temperature cycling*
PN-EN ISO 15874-1:2013	*Plastics piping systems for hot and cold water installations. Polypropylene (PP). Part 1: General*
PN-EN ISO 15874-2:2013	*Plastics piping systems for hot and cold water installations. Polypropylene (PP). Part 2: Pipes*
PN-EN ISO 15874-5:2013	*Plastics piping systems for hot and cold water installations. Polypropylene (PP). Part 5: Fitness for the purpose of the system*
PN-EN ISO 7686:2006	*Plastics pipes and fittings. Determination of opacity*
PN-EN ISO 3451-1:2019	*Plastics. Determination of ash. Part 1: General methods*
PN-EN 11173:2017	*Plastics piping systems. Thermoplastics pipes. Determination of resistance to external blows. The staircase method*
ISO 10508:2006	*Thermoplastics pipes and fittings for hot and cold Systems*
AT-15-9345/2014	*Green pipe multilayer pipes SDR 9 MF-RP type PP-RP/PP-RP- GF/PP-RP for hot water and central heating systems*
AT-15-8505/2015	*Aquatherm green pipes SDR 7.4 MF type PP-R/PP-R-GF/PP-R with a glass fibre-reinforced layer*

ANNEXES

Annex A.

A1. Dimensions

Dimensions and tolerances of aquatherm green SDR 7.4 MF pipes are given in table A1, while dimensions and tolerances of aquatherm green SDR 9 MF pipes are given in Table A2.

Table A1

The outer diameter of the DN pipe	The outer diameter d_n and the tolerance	The wall thickness (overall) and the tolerance, mm
20	20.0 $^{+0.3}$	2.8 $^{+0.5}$
25	25.0 $^{+0.3}$	3.5 $^{+0.6}$
32	32.0 $^{+0.3}$	4.4 $^{+0.7}$
40	40.0 $^{+0.4}$	5.5 $^{+0.8}$
50	50.0 $^{+0.5}$	6.9 $^{+0.9}$
63	63.0 $^{+0.6}$	8.6 $^{+1.1}$
75	75.0 $^{+0.7}$	10.3 $^{+1.3}$
90	90.0 $^{+0.9}$	12.3 $^{+1.5}$
110	110.0 $^{+1.0}$	15.1 $^{+1.7}$
125	125.0 $^{+1.2}$	17.1 $^{+2.0}$
160	160.0 $^{+1.5}$	21.9 $^{+2.4}$
200	200.0 $^{+1.8}$	27.0 $^{+3.0}$
250	250.0 $^{+2.1}$	34.2 $^{+3.7}$
315	315 $^{+1.5}$	42.6 $^{+4.5}$
355	355 $^{+3.2}$	48.0 $^{+5.1}$

Table A2

The outer diameter of the DN pipe	The outer diameter d_n and the tolerance	The wall thickness (overall) and the tolerance, mm
32	32 $^{+0.3}$	3.60 $^{+0.6}$
40	40 $^{+0.4}$	4.50 $^{+0.7}$
50	50 $^{+0.5}$	5.60 $^{+0.8}$
63	63 $^{+0.6}$	7.10 $^{+1.0}$
75	75 $^{+0.7}$	8.40 $^{+1.1}$
90	90 $^{+0.9}$	10.10 $^{+1.3}$
110	110 $^{+0.9}$	12.30 $^{+1.5}$
125	125 $^{+1.2}$	14.00 $^{+1.7}$
160	160 $^{+1.5}$	17.90 $^{+2.0}$
200	200 $^{+1.8}$	22.40 $^{+2.5}$
250	250 $^{+2.1}$	27.90 $^{+3.0}$
315	315 $^{+1.5}$	35.20 $^{+3.8}$
355	355 $^{+3.2}$	39.70 $^{+4.2}$

A2. The appearance and the colour

The inner and outer surfaces of the pipes should be smooth, without bubbles, signs of collapse, scratches, inhomogeneity and foreign inclusions, and the colour of the pipes should be uniform throughout the entire surface in terms of shade and intensity.

A3. Marking

The pipes should be marked permanently. The label should contain at least the following information:

- Name or trademark of the manufacturer,
- Commercial name,
- The type of the raw material/material,
- Rated outside the diameter and the rated wall thickness,
- Size series,
- Class of application,
- Production date or code.

Annex B.

The raw material used for the production of the inner and outer layers of aquatherm green pipes SDR 7.4 MF should be polypropylene (PP-R) according to PN-EN ISO 15874-2:2013. The middle layer of pipes should be made of a mixture of polypropylene and glass fibres (PP-R-GF). The weight of glass fibres in the middle layer of the pipe should be 18 ± 3%. The glass fibre constituting the reinforcement of the middle layer should be covered with a substance improving the adhesion of plastic with the glass fibre. The properties of polypropylene used for the production of pipes are given in Table B1.

Table B1

Item	Properties	Requirements	Test methods
1	Melt Flow Rate (MFR) (230°C/2.16 kg), g/10 min	0.2 ÷ 0.5	PN-EN ISO 1133-1:2011
2	Density g/cm^3	≥ 0.9	PN-EN ISO 1183-1:2013

The raw material used for the production of the inner and outer layers of aquatherm green pipes SDR 9 MF should be polypropylene (PP- RCT) according to PN-EN ISO 15874-2:2013. The middle layer of the pipes should be made of a mixture of polypropylene and glass fibres (PP-RCT-GF). The weight of glass fibres in the middle layer of the pipe should be 18 ± 3%. The glass fibre constituting the reinforcement of the middle layer should be covered with a substance improving the adhesion of plastic with the glass fibre. The properties of polypropylene used for the production of pipes are given in Table B2.

Table B2

Item	Properties	Requirements	Test methods
1	Melt Flow Rate (MFR) (230°C/2.16 kg), g/10 min	≤ 0.5	PN-EN ISO 1133-1:2011
2	Melt Flow Rate (MFR) (190°C/5 kg), g/10 min	≤ 1.0	PN-EN ISO 1133-1:2011
3	Density g/cm^3	≥ 0.9	PN-EN ISO 1183-1:2013

Only the original raw material from the manufacturer's original packaging should be used for the production of aquatherm green pipes SDR 7.4 MF and aquatherm green pipes SDR 9 MF. The raw material should be in the form of regular, hard granules with uniform colour. There should be no lumps, inclusions or impurities. Granules should be delivered in packaging or containers protecting it from the effects of ambient conditions.