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NATIONAL TECHNICAL ASSESSMENT ITB-KOT-2018/0525 edition 2

This National Technical Assessment has been issued in accordance with the regulation of the Minister of Infrastructure and Construction of 17th November 2016 on national technical assessments (Dz. U. z 2016 r., poz. 1968) by the Instytut Techniki Budowlanej in Warsaw, on the request of:

AQUATHERM GmbH
Biggen 5, 57439 Attendorn, Germany

National Technical Assessment ITB-KOT-2018/0525 edition 2 is a positive assessment of performance of the following construction products for the intended use:

Pipes aquatherm blue pipe SDR 7,4 / 11 / 17,6 MF and aquatherm blue pipe SDR 7,4 / 9 / 11 / 17,6 MF RP

Validity date of the National Technical Assessment:
25th September 2025

DIRECTOR
of Instytut Techniki Budowlanej

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1. TECHNICAL DESCRIPTION OF THE PRODUCT

The subject of this National Technical Assessment are pipes aquatherm SDR 7,4 / 11 / 17,6 MF and aquatherm blue pipe SDR 7,4 / 9 / 11 / 17,6 MF RP (product-type).

The pipes aquatherm SDR 7,4 / 11 / 17,6 MF and aquatherm blue pipe SDR 7,4 / 9 / 11 / 17,6 MF RP are manufactured by AQUATHERM GmbH, Biggen 5, 57439 Attendorn, Germany, in the manufacturing plant in Germany. The authorised representative of the manufacturer in Poland is Aquatherm – Polska Jacek Ligaszewski, Puławska St. 538, 02-884 Warsaw.

The pipes aquatherm blue pipe SDR 7,4 / 11 / 17,6 MF are built of three layers arranged centrically:

- internal, made of homogenous material – polypropylene (PP-R80),
- central, made of polypropylene PP-R80 reinforced (stabilized) with glass fibre,
- external, made of homogenous material – polypropylene (PP-R80).

The pipes aquatherm blue pipe SDR 7,4 / 9 / 11 / 17,6 MF RP are built of three layers arranged centrically:

- internal, made of homogenous material – polypropylene (PP-RCT), trade name PP-RP,
- central, made of polypropylene PP-R80 reinforced (stabilized) with glass fibre (PP-RCT-GF), trade name PP-RP-GF,
- external, made of homogenous material – polypropylene (PP-RCT), trade name PP-RP.

The middle (reinforced) layer is 40% of the wall thickness. The internal and external layer are 30% of the wall thickness. The reinforcement of the layer is made of glass fibre in the quantity of 20% by weight (in case pipes of aquatherm blue pipe SDR 7,4 / 11 / 17,6 MF) and in quantity of 20% by weight (in case of pipes aquatherm blue pipe SDR 7,4 / 11 / 17,6 MF).

The National Technical Assessment covers pipes aquatherm blue pipe SDR 7,4 / 11 / 17,6 MF with outside diameters 20, 25, 32, 40, 50, 63, 75, 90, 110, 125, 160, 200, 250, 315, 355, 400, 450, 500, 560 and 630 mm, of dimensional series SDR 7,4; 11 and 17,6, manufactured as straight sections 4 m long in case of diameters 20 ÷ 125 mm and 5,8 m long in case of diameters 160 ÷ 630 mm.

The National Technical Assessment includes also pipes aquatherm blue pipe SDR 7,4 / 9 / 11 / 17,6 MF RP with outside diameters 20, 25, 32, 40, 50, 63, 75, 90, 110, 125, 160, 200, 250, 315, 355, 400, 450, 500 and 630 mm, of dimensional series SDR 7,4; 11 and 17,6, manufactured as straight sections 4 m long in case of diameters 20 ÷ 125 mm and 5,8 m long in case of diameters 160 ÷ 630 mm.

The color of the pipes aquatherm blue pipe SDR 7,4 / 9 / 11 / 17,6 MF RP is blue and the color of the pipes aquatherm blue pipe SDR 7,4 / 11 / 17,6 MF is blue with four green longitudinal strips.

The dimensions, appearance and marking of the pipes covered by the National Technical Assessment are given in Annex A. The required characteristics of raw materials used for production of the pipes are given in Annex B.

2. INTENDED USE OF THE PRODUCT

The pipes aquatherm blue pipe SDR 7,4 / 11 / 17,6 MF and aquatherm blue pipe SDR 7,4 / 9 / 11 / 17,6 MF RP are intended to use in ice water systems in air conditioning installations and central heating installations.

The pipes aquatherm blue pipe SDR 7,4 / 11 / 17,6 MF and aquatherm blue pipe SDR 7,4 / 9 / 11 / 17,6 MF RP can be connected with aquatherm green fittings.

The pipes aquatherm blue pipe SDR 7,4 / 11 / 17,6 MF and aquatherm blue pipe SDR 7,4 / 9 / 11 / 17,6 MF RP should be joined with fittings by the following methods:

- socket fusion jointing (thermal polifusion),
- mechanical jointing using joining fittings with thread and neck bush with nut,
- butt fusion jointing in case of diameters over 125 mm.

Jointing elements in installation shall be carried out in accordance with the manufacturer's instructions and with appropriate tools. Cutting of the pipes should be carried out perpendicular to the axis.

Performance parameters of the pipes covered by the National Technical Assessment in specific installations including temperature and work times distribution during 50-year period of application are presented in table 1.

Table 1

Type of installation	Working temp. T_D,°C	Working time t in T_D, years	Max. temp. T_{max},°C	Working time t in T_{max}, years	Permissible emergency temp. T_{mal} [2],°C	Permissible working time T_{mal}, h
Cold water installation	20	50	-	-	-	-
Ice water systems in air conditioning installations	$5 \leq T_D \leq 12$	50	-	-	-	-
Application class 4 [3] (underfloor heating and low temperature radiators)	20 next 40 next 60 [1]	2,5 next 20 next 25	70	2,5	100	100
Application class 5 [3] (high temperature radiators)	20 next 60 next 80 [1]	14 next 25 next 10	90	1	100	100

[1] temperatures taken for calculation (design value)
[2] emergency temperature applies to periods of system failure (e.g. control failure), in which the temperature may rise to the value specified in table 1, within a total working time of 100 operation hours throughout 50 years of operation, whereas a one-time operation in the state of emergency shall not exceed 3 hours
[3] application classes according to PN-EN ISO 15874-1:2013

Design pressure value p_D for water transfer at ≤ 20°C is 20 bar in case of pipes of dimensional series SDR 7,4; 9 i 11 and 10 bar in case of pipes of dimensional series SDR 17,6. The design pressure values p_D for different installations and application classes are specified in table 2.

Table 2

Pipe series S	SDR	Design pressure p_D, bar	
		Application class 4	Application class 5
3,2	7,4	10	6
4	9	8	6
5	11	6	4
8,3	17,6	4	2

The products covered by this National Technical Assessment shall be used in accordance with the technical design taking into account:

- Polish standards and building regulations, in particular the regulation of the Minister of Infrastructure of 12th April 2002, on technical conditions to be met by buildings and their location (Dz. U. z 2019 r., poz. 1065, as amended),
- provisions of this National Technical Assessment,
- assembly instructions, prepared by the manufacturer.

3. PERFORMANCE OF THE PRODUCT AND METHODS USED FOR ITS ASSESSMENT

3.1. Performance of the product

The performance of the pipes aquatherm blue pipe SDR 7,4 / 11 / 17,6 MF and aquatherm blue pipe SDR 7,4 / 9 / 11 / 17,6 MF RP are specified in table 3.

Table 3

Item	Essential characteristics	Performance	Assessment methods
1	*2*	*3*	*4*
1	Tolerances on dimensions	according to tables A1 and A2 in Annex A, and PN-EN 15874-2:2013	PN-EN ISO 3126:2006
2	Melt flow rate MFR (2,16 kg; 230°C), g/10 min	maximum difference compared with compound from the same batch Δ MFR ± 30%	PN-EN ISO 1133-1:2011
3	Longitudinal reversion, %	≤ 2	PN-EN ISO 2505:2006 methods B (oven test) test parameters: PN-EN ISO 15874-2:2013
4	Impact resistance in temp. 0°C	defectiveness < 10%	PN-EN ISO 3127:2017 or ISO 9854-1:1994
5	Opacity	pipes with the smallest wall thickness do not transmit more than 0,2% of visible light	PN-EN ISO 7686:2006 (examination with a luxmeter with a sensitivity of ≥ 1 lux)
6	Resistance to internal pressure	no deformation and cracks	see clause p. 3.2.1

Table 3 cont.

Item	Essential characteristics	Performance	Assessment methods
1	*2*	*3*	*4*
7	Tightness of joints in 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
8	Behavior of glass fibre reinforcement over time	the structure of the pipe reinforcement does not change	see clause p. 3.2.2
9	Thermal cycling test	no leaks and damage	PN-EN ISO 19893:2018 test parameters: PN-EN ISO 15874-5:2013

3.2. Methods used to assess the performance

Assessment methods of pipes aquatherm blue pipe SDR 7,4 / 11 / 17,6 MF and aquatherm blue pipe SDR 7,4 / 9 / 11 / 17,6 MF RP are shown in table 3 and in clause 3.2.1 and 3.2.2.

3.2.1. Resistance to internal pressure. Resistance to internal pressure test should be carried out according to the standards PN-EN ISO 1167-1:2007 and PN-EN ISO 1167-2:2007 in accordance with parameters given in table 4.

Table 4

Hoop stress in pipe's wall, MPa [1]		Test temperature, °C	Exposure time, h	Test environment
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] hoop stress in pipe's wall according to the standard PN-EN ISO 15874-2:2013
[2] homogeneous pipe wall

3.2.2. Behavior of glass fibre reinforcement over time. From pipes, which pass the resistance to internal pressure test at the temperature 110°C and time ≥ 10000 hours and stress in wall pipes 1,9 MPa, shall be taken samples and made microscopic examination in transmitted light, at 150 times magnification. The image shall be compared to the appearance of sample taken from pipe which has not been tested in pressure test.

4. PACKAGING, TRANSPORT, STORAGE AND THE METHOD OF PRODUCT MARKING

Pipes in straight sections shall be arranged parallel, in bundles. Each bundle shall be packed in a plastic sleeve. The bundles may also be palletized. Pipe ends shall be protected by plugs. The way of marking the product with the construction mark shall be made in accordance with the regulation of the Minister of Infrastructure and Construction of 17th November 2016 on the manner of declaring the

performance of construction products and marking them with the construction mark (Dz. U. z 2016 r., poz. 1966, as amended).

The marking of a product with the construction mark shall be accompanied by the following information:

- the last two digits of the year in which the construction mark was placed for the first time on a construction product,
- the name and address of the manufacturer's registered office or identification mark allowing to clearly identify the name and address of the registered office of the manufacturer,
- the name and product-type of the construction product,
- the number and year of issuing the national technical assessment, according to which the performance has been declared (ITB-KOT-2018/0525 edition 2),
- 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 national declaration of performance, a safety data sheet and/or information on hazardous substances contained in the construction product shall be provided or made available where appropriate, referred to in Article 31 or 33 of Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) and establishing the European Chemicals Agency.

In addition, the marking of a construction product that is a hazardous mixture under REACH shall 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, amending and repealing Directives 67/548/EEC and 1999/45/EC and amending Regulation (EC) No 1907/2006.

5. ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

5.1. National system of assessment and verification of constancy of performance

In accordance with the regulation of the Minister of Infrastructure and Construction of 17th November 2016 on the manner of declaring the performance of construction products and marking them with the construction mark (Dz. U. z 2016 r., poz. 1966, as amended), the system 3 of assessment and verification of constancy of performance applies.

5.2. Type test

The performance, assessed in clause 3, constitute a type test of the product until changes of raw materials, ingredients, production line or manufacturing plant occur.

5.3. Factory production control

The manufacturer shall have implemented a system of factory production control in the manufacturing plant. All elements of this system, requirements and provisions adopted by the

manufacturer shall be documented in a systematic manner in the form of principles and procedures, including records from the conducted tests. The factory production control shall be adapted to the production technology and ensure in the serial production declared performance of the product is maintained.

The factory production control includes the specification and checking of raw materials and components, inspection and testing in the production process and control tests (according to p. 5.4), conducted by the manufacturer in accordance with the established test plan and according to the rules and procedures set out in the factory production control documentation.

The results of production control shall be systematically recorded. The records shall confirm that the products meet the criteria for assessment and verification of constancy of performance. Individual products or batch of products and related production details must be fully identifiable and reproducible.

5.4. Control test

Test program. The test program includes:

a) ongoing tests,
b) periodic tests.

5.4.1. Ongoing tests. The ongoing tests include the verification of:

a) appearance and color,
b) dimensions,
c) melt flow rate MFR (of the product),
d) longitudinal reversion,
e) impact resistance in temp. 0°C,
f) resistance to internal pressure (1h at the temperature 20°C, 22 h and 165 h at the temperature 95°C).

5.4.2. Periodic tests. The periodic tests include the verification of:

a) resistance to internal pressure (1000 h at temperature 95°C),
b) thermal cycling test,
c) tightness of joints in internal pressure.

5.5. Frequency of testing

Ongoing tests shall be conducted in accordance with the established test plan, but not less frequently than for each batch of products. The size of products batch shall be specified in the documentation of the factory production control.

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

6. PROVISIONS

6.1. National Technical Assessment ITB-KOT-2018/0525 edition 2 replaces National Technical Assessment ITB-KOT-2018/0525 edition 1.

6.2. National Technical Assessment ITB-KOT-2018/0525 edition 2 is a positive assessment of the performance of these essential characteristics of pipes aquatherm SDR 7,4 / 11 / 17,6 MF and aquatherm blue pipe SDR 7,4 / 9 / 11 / 17,6 MF RP which according to the intended use resulting from the provisions of the Assessment, affect the fulfillment of basic requirements by construction works, in which the product will be used.

6.3. National Technical Assessment ITB-KOT-2018/0525 edition 2 does not authorize a manufacturer to mark a construction product with the construction mark.

In accordance with the Act on construction products of 16th April 2004, as amended (Dz. U. z 2020 r., poz. 215, as amended), products covered by this National Technical Assessment may be placed on the market or made available on the national market, if the manufacturer has performed the assessment and verification of constancy of performance, drawn up a national declaration of performance in accordance with the National Technical Assessment ITB-KOT-2018/0525 edition 2 and marked the products in accordance with applicable regulations.

6.4. National Technical Assessment ITB-KOT-2018/0525 edition 2 does not violate the applicant's rights resulting from the industrial property protection regulations, and particularly from the Act of 30th June 2000 – The industrial property right (Dz. U. z 2020, poz. 286, as amended). The assurance of these rights is the responsibility of users of this National Technical Assessment.

6.5. By issuing of the National Technical Assessment, ITB takes no responsibility for possible infringements of any exclusive or acquired rights.

6.6. National Technical Assessment does not relieve the manufacturer of the products from the responsibility for the relevant quality, and the contractors of construction works from the responsibility for their proper application.

6.7. Validity of the National Technical Assessment may be extended for subsequent periods, not longer than 5 years.

7. LIST OF DOCUMENTS USED IN THE PROCEDURE

7.1. Test reports, assessments, classification

1. 01542/20/Z00NZF. Opinia specjalistyczna. Zakład Fizyki Cieplnej, Akustyki i Środowiska ITB. Warszawa, 2020 r.
2. Raporty z badań rur aquatherm blue pipe SDR 11 i 17,6 MF RP. Laboratorium aquatherm GmbH, 57439 Attendorn – Biggen, Niemcy, 2020 r.
3. 201371/19-I i 201371/19-II. Raporty z badań. SKZ Das Kunststoff-Zentrum, Niemcy, 2020 r.
4. PLA-0278/19-1. Raport z badań. Laboratorium centro de ensayos, innovación y servicios CEIS, Madryt, 2019 r.
5. PLA-0475/16-2. Raport z badań. Laboratorium centro de ensayos, innovación y servicios CEIS, Madryt, 2018 r.
6. Raporty z badań bieżących i okresowych rur aquatherm blue pipe SDR 7,4 / 11 / 17,6 MF. Laboratorium aquatherm GmbH, 57439 Attendorn – Biggen, Niemcy, 2015 r., 2016 r. i 2017 r.

7. Raporty z badań bieżących i okresowych rur CLIMATHERM. Laboratorium aquatherm GmbH, 57439 Attendorn – Biggen, Niemcy, 2010 r. i 2011 r.
8. Official Listing potwierdzający spełnienie wymagań NSF / ANSI Standard 14. NSF International, USA, 2012 r.

7.2. Standards and reference documents

PN-EN ISO 1133-1:2011	*Plastics. Determination of the melt mass-flow rate (MFR) and melt volume-flow rate (MVR) of thermoplastics. Part 1: Standard method*
PN-EN ISO 1183-1:2019	*Plastics. Methods for determining the density of non-cellular plastics. Part 1: Immersion method, liquid pycnometer method and titration method*
PN-EN ISO 3126:2006	*Plastics piping systems. Plastics components. Determination of dimensions*
ISO 9854-1:1994	*Thermoplastics pipes for the transport of fluids. Determination of pendulum impact strenght by the Charpy method*
PN-EN ISO 3127:2017	*Thermoplastics pipes. Determination of resistance to external blows. Round-the-clock method*
PN-EN ISO 1167-1:2007	*Thermoplastics pipes, fittings and assemblies for the conveyance of fluids. Determination of the resistance to internal pressure. Part 1: General method*
PN-EN ISO 1167- 2:2007	*Thermoplastics pipes, fittings and assemblies for the conveyance of fluids. Determination of the resistance to internal pressure. Part 2: Preparation of pipe test pieces*
PN-EN ISO 2505:2006	*Thermoplastics pipes. Longitudinal reversion. Test method and parameters*
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 purpose of the system*
PN-EN ISO 7686:2006	*Plastics pipes and fittings. Determination of opacity*
PN-EN ISO 19893:2018	*Plastics piping systems. Thermoplastics pipes and fittings for hot and cold water. Test method for the resistance of mounted assemblies to temperature cycling*
ITB-KOT-2018/0525 edition 1	*Pipes aquatherm blue pipe SDR 7,4 / 11 / 17,6 MF*

ANNEXES

Annex A.

A.1. Dimensions

Dimensions and tolerances on dimensions of the pipes aquatherm blue pipe SDR 7,4 / 11 / 17,6 MF are given in table A1.

Dimensions and tolerances on dimensions of the pipes aquatherm blue pipe SDR 7,4 / 9 / 11 / 17,6 MF RP are given in table A2.

Table A1

Nominal outside diameter of the pipe and tolerance, mm	Pipe wall thickness and tolerance, mm	Reinforced layer thickness, mm	Pipe series S	SDR
20 $^{+0,3}$	2,80 $^{+0,5}$	1,1 ÷ 1,4	3,2	7,4
25 $^{+0,3}$	3,50 $^{+0,6}$	1,4 ÷ 1,8	3,2	7,4
32 $^{+0,3}$	4,40 $^{+0,5}$	1,8 ÷ 2,2	3,2	7,4
32 $^{+0,3}$	2,90 $^{+0,5}$	1,2 ÷ 1,5	5	11
40 $^{+0,4}$	3,70 $^{+0,6}$	1,5 ÷ 1,9	5	11
50 $^{+0,5}$	4,60 $^{+0,7}$	1,9 ÷ 2,3	5	11
63 $^{+0,6}$	5,80 $^{+0,8}$	2,4 ÷ 2,9	5	11
75 $^{+0,7}$	6,80 $^{+0,9}$	2,8 ÷ 3,4	5	11
90 $^{+0,9}$	8,20 $^{+1,1}$	3,3 ÷ 4,1	5	11
110 $^{+0,9}$	10,00 $^{+1,2}$	4,0 ÷ 5,0	5	11
125 $^{+1,2}$	11,40 $^{+1,4}$	4,6 ÷ 5,7	5	11
160 $^{+1,5}$	14,60 $^{+1,7}$	5,8 ÷ 7,3	5	11
200 $^{+1,8}$	18,2 $^{+2,1}$	7,3 ÷ 8,9	5	11
200 $^{+1,8}$	11,4 $^{+1,4}$	4,6 ÷ 5,7	8,3	17,6
250 $^{+2,3}$	22,7 $^{+2,5}$	9,1 ÷ 11,8	5	11
250 $^{+2,1}$	14,2 $^{+1,7}$	5,7 ÷ 7,1	8,3	17,6
315 $^{+2,9}$	28,6 $^{+3,1}$	11,4 ÷ 13,9	5	11
315 $^{+2,5}$	17,9 $^{+2,0}$	7,2 ÷ 9,0	8,3	17,6
355 $^{+3,2}$	32,2 $^{+3,5}$	12,9 ÷ 16,1	5	11
355 $^{+3,2}$	20,1 $^{+2,3}$	8,0 ÷ 10,1	8,3	17,6
400 $^{+3,6}$	36,3 $^{+3,7}$	14,5 ÷ 18,2	5	11
400 $^{+3,6}$	22,7 $^{+2,5}$	9,1 ÷ 11,4	8,3	17,6
450 $^{+3,8}$	40,9 $^{+4,3}$	16,4 ÷ 20,5	5	11
450 $^{+3,8}$	25,5 $^{+2,8}$	10,2 ÷ 12,8	8,3	17,6
500 $^{+4,0}$	28,4 $^{+3,1}$	11,4 ÷ 14,2	8,3	17,6
560 $^{+4,3}$	31,7 $^{+3,4}$	12,7 ÷ 15,9	8,3	17,6
630 $^{+4,6}$	35,7 $^{+3,8}$	14,3 ÷ 17,9	8,3	17,6

Table A2

Nominal outside diameter of the pipe and tolerance, mm	Pipe wall thickness and tolerance, mm	Reinforced layer thickness, mm	Pipe series S	SDR
20 $^{+0,3}$	2,80 $^{+0,5}$	1,1 ÷ 1,4	3,2	7,4
25 $^{+0,3}$	3,50 $^{+0,6}$	1,4 ÷ 1,8	3,2	7,4
32 $^{+0,3}$	3,6 $^{+0,6}$	1,4 ÷ 1,8	4	9
40$^{+0,4}$	3,70 $^{+0,5}$	1,5 ÷ 1,9	5	11
50 $^{+0,5}$	4,60 $^{+0,6}$	1,9 ÷ 2,3	5	11
63 $^{+0,6}$	5,80 $^{+0,7}$	2,4 ÷ 2,9	5	11
75 $^{+0,7}$	6,80 $^{+0,8}$	2,8 ÷ 3,4	5	11
90 $^{+0,9}$	8,20 $^{+1,0}$	3,3 ÷ 4,1	5	11
110 $^{+0,9}$	10,00 $^{+1,2}$	4,0 ÷ 5,0	5	11
125 $^{+1,2}$	11,40 $^{+1,3}$	4,6 ÷ 5,7	5	11
160 $^{+1,5}$	14,60 $^{+1,6}$	5,8 ÷ 7,3	5	11
160 $^{+1,5}$	9,10 $^{+1,1}$	3,6 ÷ 4,6	8,3	17,6
200 $^{+1,8}$	11,4 $^{+1,3}$	7,3 ÷ 9,1	5	11
200 $^{+1,8}$	11,4 $^{+1,3}$	4,6 ÷ 5,7	8,3	17,6
250 $^{+2,1}$	22,7 $^{+2,4}$	9,1 ÷ 11,4	5	11
250 $^{+2,1}$	14,2 $^{+1,6}$	5,7 ÷ 7,1	5	11
315 $^{+2,5}$	28,6 $^{+3,0}$	11,4 ÷ 14,3	5	11
315 $^{+2,5}$	17,9 $^{+1,9}$	7,2 ÷ 9,0	8,3	17,6
355 $^{+3,2}$	32,2 $^{+3,3}$	12,9 ÷ 16,1	5	11
355 $^{+3,2}$	20,1 $^{+2,2}$	8,0 ÷ 10,1	8,3	17,6
400 $^{+3,6}$	36,3 $^{+3,7}$	14,5 ÷ 18,2	5	11
400 $^{+3,6}$	22,7 $^{+2,4}$	9,1 ÷ 11,4	8,3	17,6
450 $^{+3,8}$	40,9 $^{+4,3}$	16,4 ÷ 20,5	5	11
450 $^{+3,8}$	25,5 $^{+2,7}$	10,2 ÷ 12,8	8,3	17,6
500 $^{+4,0}$	28,4 $^{+3,0}$	11,4 ÷ 14,2	8,3	17,6
630 $^{+4,6}$	35,7 $^{+3,8}$	14,3 ÷ 17,9	8,3	17,6

A.2. Appearance

Internal and external surfaces of the pipes shall be smooth, without blisters, collapses, scratches and intrusions. The color of the pipes shall be uniform on the entire surface, in terms of tone and intensity.

A.3. Marking

Pipes shall be marked permanent. Marking shall include at least:

- manufacturer's name or manufacturer's mark,
- product trade name,
- type of raw material,
- nominal outside diameter and wall thickness,
- dimensional series,
- application class according to table 1,
- date of manufacture or production code.

Annex B.

The raw material used to production of internal and external layers of the pipes aquatherm blue pipe SDR 7,4 / 11 / 17,6 MF shall be polypropylene (PP-R80) in accordance with table B1.

Table B1

Item	Characteristics	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 to production of internal and external layers of the pipes aquatherm blue pipe SDR 7,4 / 9 / 11 / 17,6 MF RP shall be polypropylene (PP-RCT) in accordance with table B2.

Table B2

Item	Characteristics	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	Melt flow rate MFR (190°C / 5 kg), g/10 min	0,2 - 1,0	PN-EN ISO 1133-1:2011
3	Density, g/cm^3	≥ 0,9	PN-EN ISO 1183-1:2013

For pipes production shall be used only original (virgin) raw material from the original manufacturer's packaging. It is possible to use own secondary material obtained during the production of products. The raw material should be regular, hard granules with a uniform color. There should be no lumps, inclusions and impurities. Granulate should be delivered in packages or containers protecting it against weather conditions and moisture.

The middle (reinforced) layer should be made by co-extrusion from previously prepared granules, containing polypropylene (PP-R80 or PP-RCT) with characteristic according to table B1 and table B2 and glass fibre (GF) in predetermined weight proportions. Glass fibre, which is the reinforcement in the middle layer, should be covered with a substance that improves the adhesion of the material with the glass fibre.