Strohm

Document title:

TS729

PA12 Liner Specification

Document nr:	TS729
Security class:	Classified
Revision:	01
Status:	Draft
Date:	19-10-2021
Number of pages:	10

	name	date:	signature:
Prepared by / author:	J. Latto		
Approved Technology:	A. Paternoster		
Approved Engineering:	M. Booij		
Approved Operations	D. Decroocq		
Approved QA:	H. Sluijer		

Strohm
P.O.box 127
1970 AC IJmuiden
Monnickendamkade 1
1976 EC IJmuiden
The Netherlands
Tel. +31(0)25 5763500
www.strohm.eu

Revision log

rev.	rev. date	status	description / reason of change	page
01	19/10/2021	Draft	Initial issue	-

Table of Contents

1 Reference documents

No.	Description	Author	Date
RD-01	VESTAMID NRG 3001 – Product information	Evonik	2012
RD-02	ASTM E1269 Determining specific heat capacity by Differential Scanning Calorimetry (DSC)	ASTM	
RD-03	ISO 11357 - Plastics - Differential scanning calorimetry (DSC)	ISO	2009
RD-04	ASTM D792 Density and specific gravity (relative density) of plastics by displacement	ASTM	
RD-05	ISO 1183 - Plastics - Methods for determining the density of non-cellular plastics	ISO	2012
RD-06	ASTM D638 Standard test method for tensile properties of plastics	ASTM	
RD-07	ISO 527 - Plastics - Determination of tensile properties	ISO	2012
RD-08	EN 10204 - Metallic products - Types of inspection documents	EN	2004
RD-09	DIN 8074 - Polyethylene (PE) pipes - Dimensions	DIN	
RD-10	EN 1555 - Plastics piping systems for the supply of gaseous fuels	BSI	2010
RD-11	EN 12201 - Plastics piping systems for water supply, and for drainage and sewerage under pressure	BSI	2011
RD-12	AOG1600156R002 rev01 – TCP Liner Standardisation	Strohm	2016
RD-13	ISO 1:2016 Geometrical product specifications (GPS) — Standard reference temperature for the specification of geometrical and dimensional properties	ISO	2016
RD-14	API17J Fourth Edition, May 2017	API	2017

2 Introduction

This document serves as a generic specification for PA12 liners from 1.0" to 7.75" Internal Diameter (ID). Section 3 provides requirements for the liner material, the mechanical properties, dimensional control and for packaging and transport. The requirements for certification, documentation and quality control are stated in section 4.

A unique ID (material code) has been assigned to each liner material and size in section 2.1 of this document. In the case of 3rd party supply, this material number will be used for Purchase Order placement. Note that the liner geometry provided in these tables is only indicative and should only be used for liner identification. Please refer to section 3 for the exact dimensions and tolerances and material specifications.

2.1 PA12 reference table

Material code	ID [inch]	wt [mm]	OD [mm]	Material	Description
02.002. 00061	1.00	3	31.4	PA12	Liner PA12 1 inch ID, wt=3, OD=31.4mm
02.002. 00062	1.25	3	37.8	PA12	Liner PA12 1.25 inch ID, wt=3, OD=37.8mm
02.002. 00063	1.50	3	44.1	PA12	Liner PA12 1.5 inch ID, wt=3, OD=44.1mm
02.002. 00064	1.75	4	52.5	PA12	Liner PA12 1.75 inch ID, wt=4, OD=52.5mm
02.002. 00065	2.00	4	58.8	PA12	Liner PA12 2 inch ID, wt=4, OD=58.8mm
02.002. 00066	2.25	4	65.2	PA12	Liner PA12 2.25 inch ID, wt=4, OD=65.2mm
02.002. 00067	2.50	5	73.5	PA12	Liner PA12 2.5 inch ID, wt=5, OD=73.5mm
02.002. 00068	2.75	5	79.9	PA12	Liner PA12 2.75 inch ID, wt=5, OD=79.9mm
02.002. 00069	3.00	5	86.2	PA12	Liner PA12 3 inch ID, wt=5, OD=86.2mm
02.002. 00070	3.25	6	94.6	PA12	Liner PA12 3.25 inch ID, wt=6, OD=94.6mm
02.002. 00071	3.50	6	100.9	PA12	Liner PA12 3.5 inch ID, wt=6, OD=100.9mm
02.002. 00072	3.75	6	107.3	PA12	Liner PA12 3.75 inch ID, wt=6, OD=107.3mm
02.002. 00073	4.00	7	116	PA12	Liner PA12 4 inch ID, wt=7, OD=116mm
02.002. 00074	4.25	7	122	PA12	Liner PA12 4.25 inch ID, wt=7, OD=122mm
02.002. 00075	4.50	8	130	PA12	Liner PA12 4.5 inch ID, wt=8, OD=130mm
02.002. 00076	4.75	8	137	PA12	Liner PA12 4.75 inch ID, wt=8, OD=137mm
02.002. 00077	5.00	9	145	PA12	Liner PA12 5 inch ID, wt=9, OD=145mm
02.002. 00078	5.20	9	150	PA12	Liner PA12 5.2 inch ID, wt=9, OD=150mm
02.002. 00079	5.25	9	151	PA12	Liner PA12 5.25 inch ID, wt=9, OD=151mm
02.002. 00080	5.50	9	158	PA12	Liner PA12 5.5 inch ID, wt=9, OD=158mm
02.002. 00081	5.60	9	160	PA12	Liner PA12 5.6 inch ID, wt=9, OD=160mm
02.002. 00082	5.75	9	164	PA12	Liner PA12 5.75 inch ID, wt=9, OD=164mm
02.002. 00083	6.00	10	172	PA12	Liner PA12 6 inch ID, wt=10, OD=172mm
02.002. 00084	6.25	10	179	PA12	Liner PA12 6.25 inch ID, wt=10, OD=179mm
02.002. 00085	6.50	10	185	PA12	Liner PA12 6.5 inch ID, wt=10, OD=185mm
02.002. 00086	6.75	10	191	PA12	Liner PA12 6.75 inch ID, wt=10, OD=191mm
02.002. 00087	7.00	10	198	PA12	Liner PA12 7 inch ID, wt=10, OD=198mm
02.002. 00088	7.25	10	204	PA12	Liner PA12 7.25 inch ID, wt=10, OD=204mm
02.002. 00089	7.50	10	211	PA12	Liner PA12 7.5 inch ID, wt=10, OD=211mm
02.002. 00090	7.75	10	217	PA12	Liner PA12 7.75 inch ID, wt=10, OD=217mm

3 Specification

3.1 Material grades

Material	Grade	Reference document
PA12	Vestamid NRG 3001	**Error! Reference source not found.**1

3.2 Material properties

Sample	Characteristic	Value & Range	Reference document	Control	Method	Frequency / amount
Granulates	Material grade	See section 3.1	See section 3.1	Supplier, Strohm, upon receiving the granulate	Certificate control	1
Liner DSC specimen*	Crystalline content	35% ±5	RD-02 or RD-03	Supplier, Strohm, on the first piece of liner produced	DSC	3
Liner DSC specimen*	Crystalline content	35% ±5	RD-02 or RD-03	Supplier, Strohm, on the last piece of liner produced	DSC	3
Liner density specimen*	Density [g/cm3]	1.02 +0.01 / -0.02	RD-04 or RD-05	Supplier, Strohm on the first piece of liner produced	Density measurement	3
`Liner density specimen*	Density [g/cm3]	1.02 +0.01 / -0.02	RD-04 or RD-05	Supplier, Strohm, on the last piece of liner produced	Density measurement	3

3.3 Mechanical properties

For each continuously produced length, the following measurements are to be obtained and supplied with the product inspection certificate. These values are indicative, any results outside of this range are to be approved / accepted by Strohm technical authority (before delivery in case of purchased liner).

Characteristic	Value & Range	Reference document	Location	Method	Frequency / amount
Modulus at 23°C [MPa]	1250 ± 20%	RD-06 or RD-07	Sample to be obtained from starting section of produced liner*	Tensile test - speed: 1mm/min	3
Modulus at 23°C [MPa]	1250 ± 20%	RD-06 or RD-07	Sample to be obtained from finishing section of produced liner*	Tensile test - speed: 1mm/min	3
Strain at maximum stress at 23°C [%]	>6	RD-06 or RD-07	Sample to be obtained from starting section of produced liner*	Tensile test - speed: 50mm/min	3
Strain at maximum stress at 23°C [%]	>6	RD-06 or RD-07	Sample to be obtained from finishing section of produced liner*	Tensile test - speed: 50mm/min	3

* Samples shall be obtained from an additional section of the liner (outside of the required project length). If there are multiple liners to be obtained, then this testing must be carried out for each delivered length.

3.4 Dimensions

The tolerances on the liner wall thickness (t) and Outer Diameter (OD) are based on RD-09 & RD-10. Specification of the liner wall thickness and allowable reel MBR follow from RD-12.

Note: Nominal values for ID, WT and OD are given. Multiple measurements are required at each pipe length position, any deviation outside of the allowable range is to be assessed and approved by the Strohm technical authority (prior to delivery in the case of purchased liner).

ID [inch]	ID* [mm]	wt [mm]	Range [mm]	OD [mm]	Range [mm]	MBR [mm]
1.00	25.4	3.0	-0.0 / +0.4	31.4	-0.1 / +0.2	≥400
1.25	31.8	3.0	-0.0 / +0.4	37.8	-0.2 / +0.2	≥400
1.50	38.1	3.0	-0.0 / +0.4	44.1	-0.2 / +0.2	≥500
1.75	44.5	4.0	-0.0 / +0.5	52.5	-0.2 / +0.3	≥550
2.00	50.8	4.0	-0.0 / +0.5	58.8	-0.3 / +0.3	≥600
2.25	57.2	4.0	-0.0 / +0.5	65.2	-0.3 / +0.3	≥750
2.50	63.5	5.0	-0.0 / +0.6	73.5	-0.3 / +0.4	≥900
2.75	69.9	5.0	-0.0 / +0.6	79.9	-0.4 / +0.4	≥1000
3.00	76.2	5.0	-0.0 / +0.6	86.2	-0.4 / +0.4	≥1100
3.25	82.6	6.0	-0.0 / +0.7	94.6	-0.4 / +0.5	≥1150
3.50	88.9	6.0	-0.0 / +0.7	100.9	-0.5 / +0.5	≥1150
3.75	95.3	6.0	-0.0 / +0.7	107.3	-0.5 / +0.5	≥1200
4.00	102.0	7.0	-0.0 / +0.8	116.0	-0.5 / +0.6	≥1200
4.25	108.0	7.0	-0.0 / +0.8	122.0	-0.5 / +0.6	≥1250
4.50	114.0	8.0	-0.0 / +0.9	130.0	-0.6 / +0.6	≥1300
4.75	121.0	8.0	-0.0 / +0.9	137.0	-0.6 / +0.7	≥1350
5.00	127.0	9.0	-0.0 / +1.0	145.0	-0.7 / +0.7	≥1350
5.20	132.0	9.0	-0.0 / +1.0	150.0	-0.7 / +0.7	≥1350
5.25	133.0	9.0	-0.0 / +1.0	151.0	-0.7 / +0.7	≥1350
5.50	140.0	9.0	-0.0 / +1.0	158.0	-0.7 / +0.8	≥1350
5.60	142.0	9.0	-0.0 / +1.0	160.0	-0.7 / +0.8	≥1350
5.75	146.0	9.0	-0.0 / +1.0	164.0	-0.7 / +0.8	≥1350
6.00	152.0	10.0	-0.0 / +1.1	172.0	-0.8 / +0.8	≥1350
6.25	159.0	10.0	-0.0 / +1.1	179.0	-0.8 / +0.9	≥1400
6.50	165.0	10.0	-0.0 / +1.1	185.0	-0.8 / +0.9	≥1450
6.75	171.0	10.0	-0.0 / +1.1	191.0	-0.9 / +0.9	≥1500
7.00	178.0	10.0	-0.0 / +1.1	198.0	-0.9 / +0.9	≥1600
7.25	184.0	10.0	-0.0 / +1.1	204.0	-0.9 / +1.0	≥1700
7.50	191.0	10.0	-0.0 / +1.1	211.0	-0.9 / +1.0	≥1850
7.75	197.0	10.0	-0.0 / +1.1	217.0	-1.0 / +1.0	≥2000

3.5 Dimensional control

The table below defines key dimensions to be controlled during manufacture. All measurements are to be corrected for thermal expansion and represented at a value equivalent to standard ambient temperature (20°C) in accordance with RD-13

All equipment used to acquire the measurements below is to be properly maintained and calibrated in accordance with supplier's or Strohm's quality procedures. All measurement equipment serial numbers are to be recorded within inspection certificate and calibration documentation shall be available on demand.

Sample	Characteristic	Value & Range	Control	Method	Frequency / amount
Liner	Outer diameter	See section 3.4	On-line control during production. Measurements to be taken at least in the vertical and horizontal orientation at each length position	Measurement method to be determined by supplier or Strohm Operations. Calibrated equipment is to be used at all times and records retained.	Minimum of one measurement every 20 meter of liner produced
Liner	Wall thickness	See section 3.4	On-line control during production. Measurements are to be taken at least at 4 points (top – bottom – front – back) around the circumference of the pipe at each length position. Each measurement to be assessed, average over the four points is not accepted	Measurement method to be determined by supplier or Strohm Operations. Calibrated equipment is to be used at all times and records retained.	Minimum of one measurement every 20 meter of liner produced
Liner	Inner diameter	See section 3.4	n.a.	n.a.	n.a.
Liner	Liner internal roughness	Spec ≤ 5 µm Nominal value ≤ 1 µm	To be measured on the first piece of liner produced	Measurement method to be determined by supplier or Strohm ~~Operations~~	3
Liner	Liner internal roughness	Spec ≤ 5 µm Nominal value ≤ 1 µm	To be measured on the last piece of liner produced	Measurement method to be determined by supplier or Strohm ~~Operations~~	3
Liner	Length	Minimum required length defined in purchase order or project documentation	On-line control during production.	Contact measurement	1

3.6 Others

Sample	Characteristic	Value & Range	Control	Method	Frequency / amount
Liner	Minimum bend radius	See section 3.4	Supplier, Strohm, during production, storage, and transport	n.a.	n.a.

4 Certificate and quality control

For purchased liner:

- All parts shall be supplied with a type 3.1 inspection certificate in accordance with RD-08.
- For continuous and discrete liner, supply half a meter of the beginning and the end of the liner for the incoming inspection (outside the specified length).

Purchased and internally manufactured liner:

- General requirements for process parameters to be monitored and recorded in accordance with RD-14 Section 7.3.1 & 7.3.2.2
- All measured properties must be within the tolerances detailed in this specification.
- All values measured according to the specified frequencies shall be recorded / provided in a log file.
- For all other characteristics, the following codes/standards apply: DIN 8074 [RD-09], EN 1555 [RD-10], EN 12201 [RD-11], EN 10204 [RD-08].

5 Packaging & Safety Specifications

Purchased liners are to be supplied as standard on a drum unless appropriate alternative packaging has been agreed by the project responsible. The material and dimensional specifications of the liner and the Minimum Bend Radius of the packaging are specified in the Technical Specification of the liner.
To obtain a safe transport and error free delivery the supplier should deliver the liner according to the items specified in this document.

5.1 Drum

The liner is to be received at Strohm free from surface defects like scratches, pits, dents, foreign material or buckling.

The following conditions apply:

- The liner must be coiled on a steel or wooden drum of which core size is specified in the liner spec.
- The core of the drum must be solid.
- The core material must be steel or wood.
- The core of the drum is protected by an extra cover for protection of the pipe.
- The sides/flanges of the drum on the inner side must be covered.
- The drum should have an id. number

5.2 Mechanical termination

- Both ends of the liner must be fitted with a simple Kellum's grip (Chinese finger).
- To prevent uncoiling the liner must be attached to the flange or to the barrel.
- At least one set of straps must secure the liner in position

5.3 Packaging and traceability

The liner must be adequately covered with foil wrapping on the outer layer to protect it during transport and/or storage. Both ends of the liner must be provided with an end cap that works as a cover from dust and other foreign material coming into the liner.
The drum should be labelled with at least the following information:

- name of supplier
- dimensions of liner
- length of liner
- batch number of liner(s)

For traceability reasons the following information should be printed at the liner:

- Length marking
- Dimensions (OD and wall thickness)
- Batch number