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SANS/ISO 4427 PLASTIC PIPING SYSTEMS

HDPE MATERIAL & PIPE REQUIREMENTS, Issue 2

By François Prinsloo, NDip & BTech: Polymer Technology, 02 October 2017

INTRODUCTION

Plastic piping systems in South Africa are manufactured to the strictest of standards, mostly adopted from specifications published by the International Standards Organization (ISO). ISO was founded in 1946 by delegates from 25 countries at the Institute of Civil Engineers in London. To date, over 21801 International Standards have been published, covering most aspects of manufacturing and technology. ^[01]

SANS/ISO 4427 was adopted in 2008 from ISO 4427, which was published in August 2007. To date, thermoplastic raw material manufacturers have developed material to meet, and exceed, the minimum requirements as set in SANS/ISO 4427. This standard specifically focuses on the required properties of raw material, pipes, fittings, systems and jointing that is manufactured from polyethylene. Many studies have been conducted and found that the estimated service life of polyethylene pipes could meet 100 years. ^[02]

This document has been compiled by P.E.S.C. Laboratory to provide a summary of SANS/ISO 4427's requirements for plastic piping manufactured from polyethylene, which can be used by engineers, contractors, state owned enterprises and end-users that require information on the following:

- Raw material requirements, as per SANS4427-01:2008 ^[03]
- Plastic piping requirements, as per SANS4427-02:2008 ^[04]
- Documentation requirements from piping manufacturers
- When to submit piping for testing
- On-site inspections for optimal quality

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MATERIAL REQUIREMENTS, as per SANS/ISO 4427-01:2008 ^[03]

Table 01: Properties of pipe compound (polyethylene) as granules (raw/virgin material)

Test	Unit	Requirements ¹	Method of Test
Material Density	kg/m ³	≥ 930	ISO 1183-2
Dispersion of Carbon Black	-	≤ grade 3	ISO 18553
Content of Carbon Black	%	2 to 2.5 (<i>mass</i>)	ISO 6964
Content of Volatiles	mg/kg	≤ 350	EN 12099
Content of Water	mg/kg	≤ 300	ISO 15512
Oxidation Induction Time (OIT)	min	≥ 20 <i>Virgin PE100 material could range between 80 and 120</i>	ISO 11357-6
Melt Flow Rate	g/10min	0.2 to 1.4 ± 20 % deviation of the agreed upon value ² <i>Virgin PE100 material could range between 0.2 and 0.4</i>	ISO 1133
1: Conformance of these requirements shall be provided by the raw material manufacturer			
2: Agreed upon value provided by the raw material manufacturer. Result can vary 20% max above or below this value.			

Table 02: Properties of pipe compound (polyethylene) in pipe form

Test	Unit	Requirements ¹	Method of Test
Tensile Properties for Butt-fusion ^b	-	Destructive test: Ductile failure – Conforms Brittle failure – Non-conformance	ISO 13953
Slow Crack Growth, SDR11 pipe, size of 110mm or 125mm	-	During the test period, no failure may occur	ISO 13479
Water Quality Testing	-	Where applicable, national regulations will apply	-
a: Conformance of these requirements shall be provided by the raw material manufacturer			



PLASTIC PIPING REQUIREMENTS, as per SANS/ISO 4427-02:2008 ^[04] (For each batch)

Table 03: Characteristics of Polyethylene Pipes

Test	Unit	Requirements ¹	Method of Test
Visual Appearance of Piping Products	-	The visual appearance of HDPE piping for both the external and internal surfaces shall be clean, smooth and free from cavities, scoring and other defects that would prevent conformity of the pipe to SANS/ISO 4427. The ends of piping shall be neatly cut and square to the axis.	-
Piping Colour	-	HDPE pipes shall either be black or blue, or black with blue coloured stripes (intended for drinking water) <i>- Different coloured stripes to be discussed and agreed upon with manufacturers</i>	-
Dimensions (Outside diameter, wall thicknesses and ovality)	mm	Relevant to pipe size and type, as per tables 1 and 2 in SANS/ISO 4427-02:2008	ISO 3126
Hydrostatic Strength, 20°C, 100 h	-	During the test period, no failure may occur	ISO 1136-01; ISO 1167-02
Hydrostatic Strength, 80°C, 165 h	-	During the test period, no failure may occur	ISO 1136-01; ISO 1167-02
Hydrostatic Strength, 80°C, 1000 h	-	During the test period, no failure may occur	ISO 1136-01; ISO 1167-02
Elongation at Break, all pipe sizes	%	≥ 350	ISO 6259-01; ISO 6259-03
Thermal/ Longitudinal reversion	%	≤ 3, No surface defects after testing	ISO 2505
Melt Flow Rate	g/10min	Change in MFR value after processing ± 20 ^a <i>(Typical value of HDPE PE100 = 0.2 to 0.4)</i>	ISO 1133
Oxidation Induction Time (OIT)	min	≥ 20 <i>Virgin PE100 material could range between 80 and 120</i>	ISO 11357-6
Water Quality Testing	-	Where applicable, national regulations will apply	-
Chemical Characteristics, should pipes be in contact with chemicals	-	Where applicable, pipes shall be classified in accordance with ISO4433-1 and ISO4433-02 (inner or outer pipe contamination)	Guidance for resistance to chemicals: ISO/TR 10358



Table 03: Characteristics of Polyethylene Pipes (Continued)

Test	Unit	Requirements ¹	Method of Test
Pipe Markings	-	Pipe markings shall be visible and permanent. Markings may not initiate cracks or other types of failure. Minimum required markings shall list the standard number, manufacturers name or ID, dimensions, SDR series, material type and designation, pressure rating in BAR, production date (date or code)/batch number	-
a: Result measured on the pipe relative to the value measured on the raw material used. Result can vary 20% max above or below this value.			

DOCUMENTATION REQUIREMENTS FROM PIPING MANUFACTURERS

Prior to purchasing any piping products, it is highly recommended that a contract review meeting be organized between all parties involved to establish an agreed upon quality control plan. A good quality control plan should list all documentation and product requirements, that will promote product and service quality.

The following documentation needs to be made available upon request from individual manufacturers when purchasing any piping products:

- SAPPMA membership
- Pipe manufacturing certification (SATAS, SABS, etc) – Non-certified piping is always a risk as quality cannot always be proved/ensured.
- Raw material supplier confirmation that raw material conforms to SANS/ISO 4427-01:2008. Certificates of conformance and/or certificates of analyses should be presented in a data pack for each batch of piping.
- Pipe certificates of conformance and/or certificates of analyses documentation requirements:
 - Minimum requirements for piping will be Appearance, Elongation at Break, Longitudinal Reversion, Oxidation Induction Time, Melt mass-flow rate)

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- Hydrostatic Pressure Resistance – Process validation data:
 - Data to be made available upon request
 - Client option for 165 hours at 80°C for batch release testing. It is always wise to request this data prior to delivery of goods.
- Third party test certificates of conformance and/or analyses (where required)
 - Should third party testing be required for any projects, costing needs to be allocated to the contractor or the manufacturer prior to finalizing financial budgets. Proper planning will ensure quality and adequate turnaround times.

WHEN TO SUBMIT PIPING FOR TESTING (buyers and end-users)

One must always ensure that plastic piping is of optimal quality, as just a minor defect can result in huge financial losses and infrastructure damages. To minimize this risk, piping should always be sent for independent testing when:

- Pipe quality is in question
- Non-certified pipe
- To have peace of mind
- Not all raw material and pipe requirements are listed/provided in certificates
- Certificates and documentation have been lost
- For any large projects, a fair portion of piping should be sent for independent testing
- For any governmental projects, piping should be sent for third party testing as required
- After first manufacturer/fabricator site welds has been performed
- Pipe failures or weld failures have occurred
- When tender documents call for equal/approved products
- High risk applications such as eco sensitive projects
- When you want to determine the remaining life expectancy of existing infrastructure
- For product and/or design validations
- To validate statements made by manufacturers and/or distributors of goods

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ON-SITE INSPECTIONS

When plastic piping has been delivered, the buyers, engineers, contractors and/or end-users should inspect the visual appearance of the products. This could prohibit any possible future failures on site. One should look for the following:

- Product markings (manufacturer name, pipe class, material type, dimensions, pipe specification, certification, batch date etc)
- Dimensional checks (Wall thicknesses, outside diameters and ovality/out-of-roundness) – check for irregular readings and specification compliance
- Waviness on the inner or outer surfaces. Pipe surfaces should be smooth.
- Surface agglomerations (bumps, bubbles, nips, sand paper feel etc)
- Flow lines / Die lines
- Scoring and grooving
- Voids in the pipe surface or wall
- Inner or outer surface sink marks
- Visible material contaminants in pipe

SUMMARY

It is required that each batch of HDPE plastic piping, and each size, be tested in accordance with SANS/ISO4427-02:2008. In case of dispute with raw material requirements, the material characteristics should be tested in accordance with SANS/ISO 4427-01 and samples can be sourced from finished pipes.

For assistance, guidance or consultations, please do not hesitate to contact P.E.S.C laboratory.

Yours sincerely,

François Prinsloo

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ABOUT P.E.S.C LABORATORY

Productivity Engineering Services and Consultants (P.E.S.C) was founded in 1997 as a productivity monitoring and enhancement company. In September 2015 P.E.S.C. transitioned into a polymer and plastics testing laboratory, offering full specification testing to the plastics piping sector and many other services to the general polymer market.

P.E.S.C. Laboratory is the preferred third-party test laboratory for the Southern African Plastics Piping Manufacturing Association (SAPPMA), and many plastic piping manufacturers in South Africa. Furthermore, P.E.S.C. Laboratory was also selected to provide independent auditing services to the Association for Rotational Moulders Southern Africa (ARMSA).

NORMATIVE REFERENCES

1. International Standards Organization, webpage: <https://www.iso.org/about-us.html>
 2. Plastics Industry Pipe Association of Australia Limited (PIPA), Polyolefins Technical Information, Life Expectancy for Plastics Pipes
 3. South African National Standard SANS4427-01, 2008, Plastics Piping Systems – Polyethylene (PE) pipes and fittings for water supply, Part 1: General.
 4. South African National Standard SANS4427-02, 2008, Plastics Piping Systems – Polyethylene (PE) pipes and fittings for water supply, Part 2: Pipes.
- SANS4427:2008 Part 1 and part 2 can be purchased online from the SABS webstore:
- <https://store.sabs.co.za/catalog/product/view/id/212794/s/sans-4427-1-2008-ed-1-00/>
 - https://store.sabs.co.za/catalog/product/view/ignore_category/1/id/212797/s/sans-4427-2-2008-ed-1-00/

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