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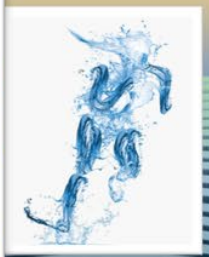
# WEBINAR I



February 2022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# SAPPMA QUALITY WORKSHOPS / WEBINARS

SAPPMA WORKSHOP 1 - 16-11-2019

SAPPMA WORKSHOP 2 - 17-07-2019

SAPPMA WORKSHOP 3 - 19-02-2020

SAPPMA WORKSHOP 4 - 22-07-2020

SAPPMA WORKSHOP 5 - 22-10-2020

SAPPMA WEBINAR 1 - 25-02-2021

SAPPMA WEBINAR 2 - 24-03-2021

SAPPMA WEBINAR 3 - 20-04-2021

SAPPMA WEBINAR 4 - 25-05-2021

SAPPMA WEBINAR 5 - 24-06-2021

SAPPMA WEBINAR 6 - 22-07-2021

SAPPMA WEBINAR 7 - 25-08-2021

SAPPMA WEBINAR 8 - 21-10-2021 - *PETER FISCHER*

SAPPMA WEBINAR 8 - 21-10-2021 - *PROF MARANGONI*

SAPPMA WEBINAR 8 - 21-10-2021 - *MIKE SMART*

SAPPMA WEBINAR 8 - 21-10-2021 - *DARREN*

SAPPMA WEBINAR 9 - 24-11-2021


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# Recent CPD training event


CPD Continued
Professional Development



Focus Drives Outcome

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21-10-2021

## Thermoplastic Pipe Systems:

**Important aspects to understand and keep in mind during design and specification**




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21-10-2021

We Hope to See You at the Next Event

# Understand your product features

ISO 4427:2019 Revision

Latest International updated Standard

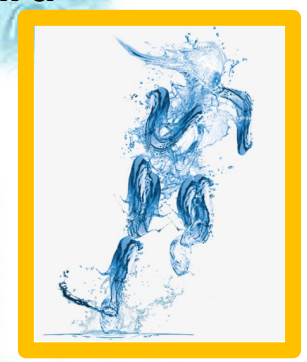
Part 5 System

Part 3 Fittings

Series standard

Part 2 Pipes

Part 1 General



1922 2022

*** ” Research on long term performance prediction of PE water distribution systems shows a possible service life of at least 100 years”**

* ISO 4427-1:2019



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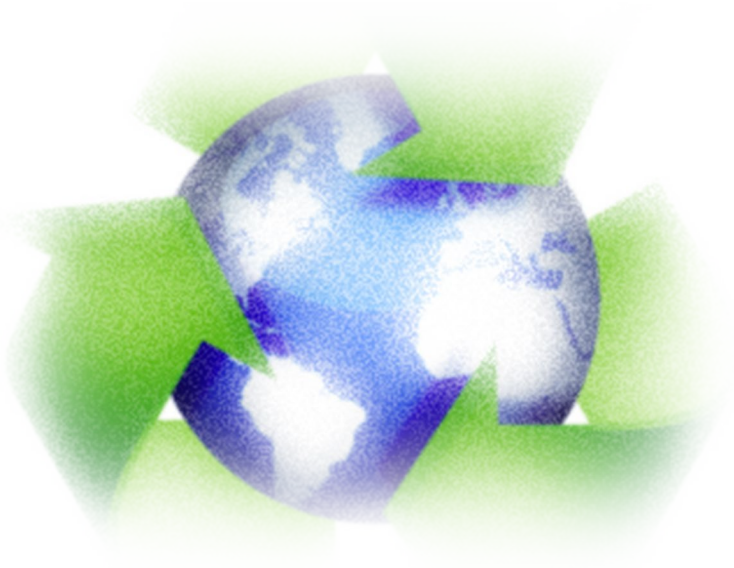
# Potable water systems

All manufacturer scrap/rework material has to be processed in the manufacturer's own premises and may not be outsourced – with the results of an improvement in potable water pipe systems compliance





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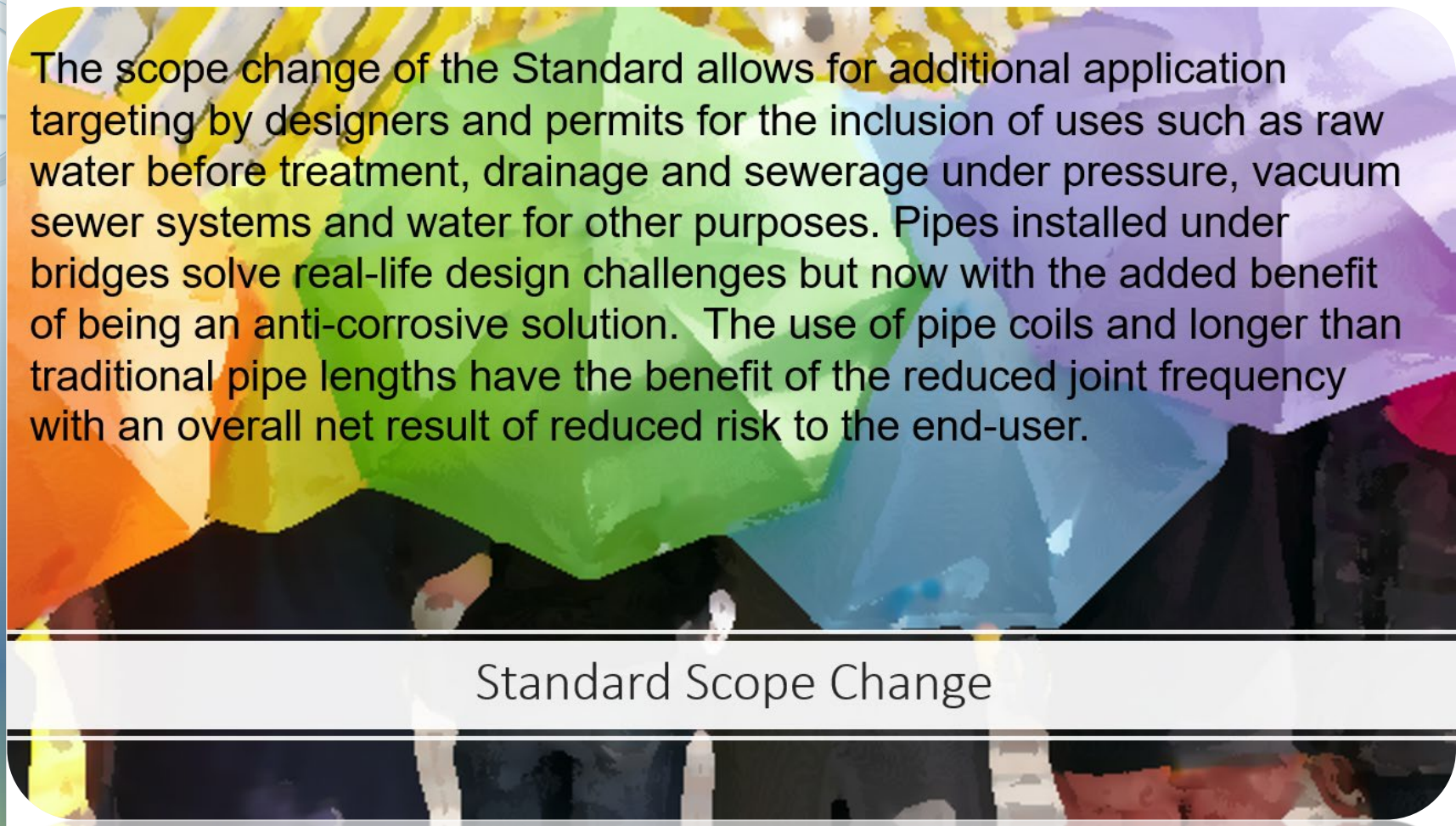




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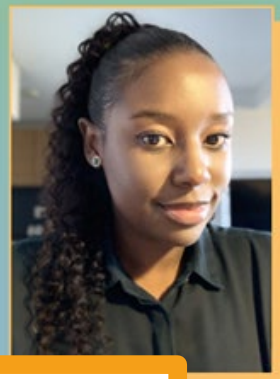
# SAPPMA Webinar I 2022

**Polyethylene (PE) pressure pipe material:**

**"An excellent track record"**

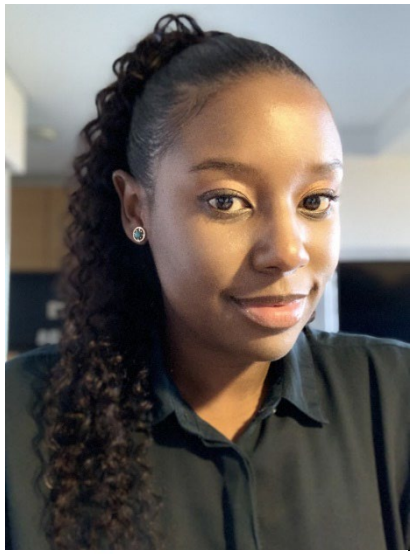


*Ayanda Zwane, Technical service and development Engineer, Safripol, will share some PE100 compound properties that make polyethene systems and applications unique and highly suitable for today's harsh applications.*


# Presenter



**23 February 2022**



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**Ayanda Zwane**

# HDPE Pressure Pipe material

# "an excellent track record"

*Safripol Technology Conference 2019*

*26 – 27 February 2019*

George Diliyannis
Technical Service Leader
Safripol a division of KAP Diversified Industrial (Pty) Ltd

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## Agenda

- About Safripol
- History of HDPE with special focus on pipe applications
- Overview failure and ageing mechanisms for HDPE pressure pipes
- Case study and lifetime expectation of early HDPE pipes
- HDPE pressure pipe evolution
- The future
- Conclusion

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# About Safripol

- **Our Offices/Facilities**
  - Head Office → Bryanston, Gauteng
  - Coastal Sales Office → Durban, KZN
  - HDPE, PET and PP Manufacturing Plants
  - Distributor – Countrywide
- **Our People**
  - Safripol employs +/- 470 people
- **Production Capability**
  - 160 kT/annum HDPE (Hostalen Slurry technology)
  - 120 kT/annum PP (Spheripol technology)
  - 240kT/annum PET (Invista technology)


Producing bimodal pipe material since 1981 and ISO 4427 compliant pipe materials since 1997

LyondellBasell technology licensee for HDPE and PP and Qenos licensee for PE100 pipe material

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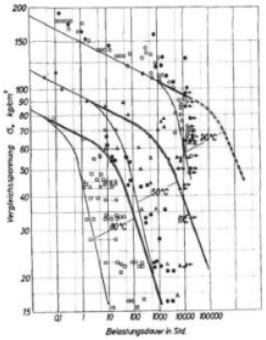
# *HDPE as a pipe material*

Plastics Fair in Dusseldorf 1955


Ruhrchemie exhibits pipe at K55 produced from Ziegler HDPE

The first creep rupture tests on pipes made from HDPE were already started in 1955

On October 18th 2012, two pipe specimens in this "historical" test have celebrated their 56th anniversary of continuous testing!



Dissertation by Dr. Erwin Gaube, 1959: "Given a permissible hoop stress of 50 kg/cm², the pipes will still have a 1.3-fold resistance to cracking after 50 years

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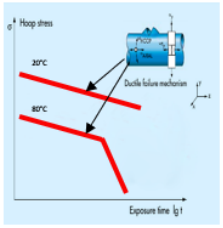
# HDPE pressure pipe failure mechanisms




**Ductile Failure:**

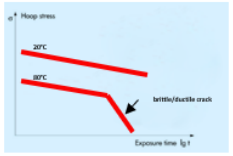
Plastic – Viscoelastic Mechanical property

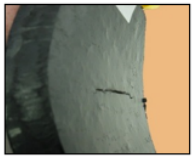
Long Term Hydrostatic Strength (MRS)

**Brittle Failure:**

Slow Crack Growth

Slow Crack Growth (SCG)

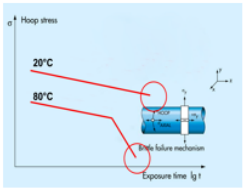


Rapid Crack Propagation (RCP)

**Brittle Failure:**

Oxidative degradation of the polymer

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# *Lifetime expectation of early pipes*

Between 1960 and 1977
~10.000 km of gas pipes and
~20.000 km of water pipes
were installed in Germany, made from first generation HDPE

For this research project

14 house connections – water - from 1967 and 1968 (42 years old)

and

24 house connections – gas - from 1975 and 1976 (35 years old)

were excavated and investigated by KIWA

**German gas utility, DVGW project on residual lifetime (2010)**

Entnahmestellen: Havixbeck und Altenberge

Images courtesy KIWA Gas Technology

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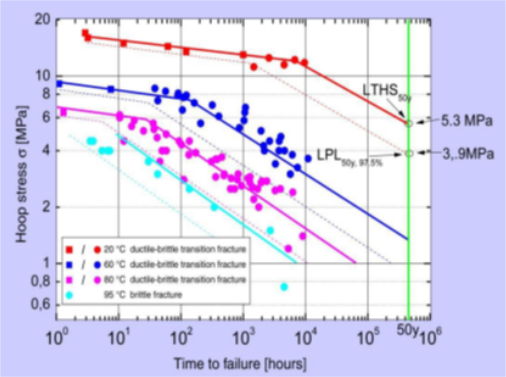
# *Lifetime expectation of early pipes*

**DVGW project on residual lifetime - findings**

Water pipes made from *Hostalen* HDPE *ø40, SDR11, installation 1967/68*

Test results:




Test points, mean value curve (LTHS) and lower confidence limit of 97.5% (LPL)
according to three-parameter model for water pipes in *Hostalen*

Image courtesy KIWA Gas Technology, Apeldoorn

Summary:

- Low resistance to SCG values however still in the typical range of these early materials
- Analytical testing showed no signs of premature degradation i.e. oxidation not yet started
- Creep rupture testing (ISO9080) carried out at two test institutes
  - 50 years *additional* service life expected
  - At stress of 3.9MPa and 20 deg. C
  - No additional bending stresses
  - Adequate backfill and compaction

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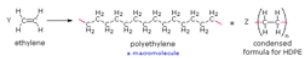
# HDPE Pressure pipe evolution

Creep Rupture tests on HDPE pipes started already in 1955

***Polymerisation of ethylene under mild conditions***
***November 1953***

**Karl Ziegler**

**Giulia Natta**




**Type 50**
1955
First Pressure pipes produced

**PE 63**
1959
Continuous Pressure pipes

**PE 80**
1977
Improved stiffness
Improved Resistance to cracking

**PE 100**
1990's
Bimodal developments further improve resistance to cracking and also stiffness

**PE 100 RC**
2000's
Next Generation pressure pipe material

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## HDPE PE100 → Future

Pipes are the arteries of modern civilization and will become even more important as technologies are further developed and trends toward increasing urbanization continue

Yamba case study - Qenos

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Qenos

# Yamba Sewerage Augmentation Project

—

PE100 pipe installation

Qenos

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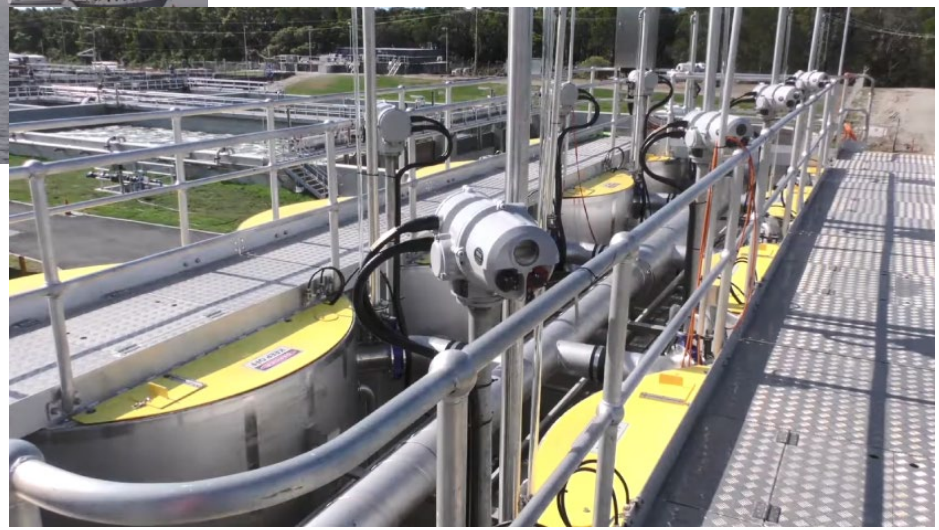
Qenos





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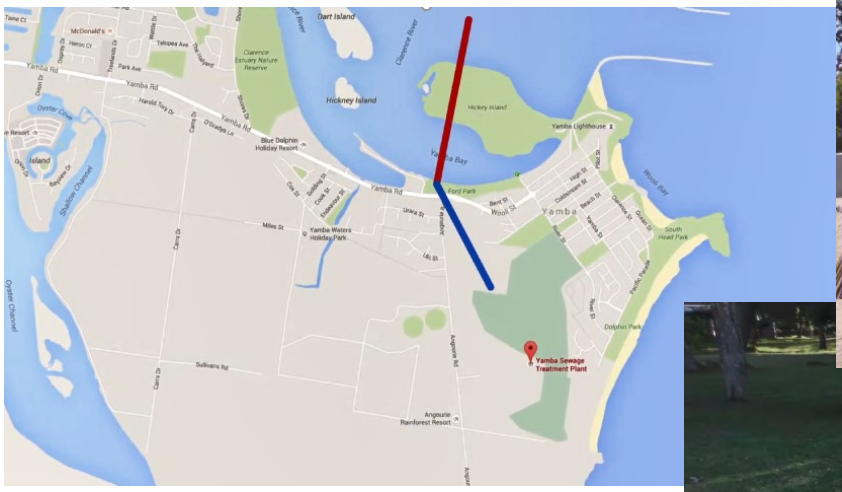
Qenos







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Qenos

# Alkadyne® PE100

Engineered to Outperform™



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## HDPE PE100 → Future

The future is here:

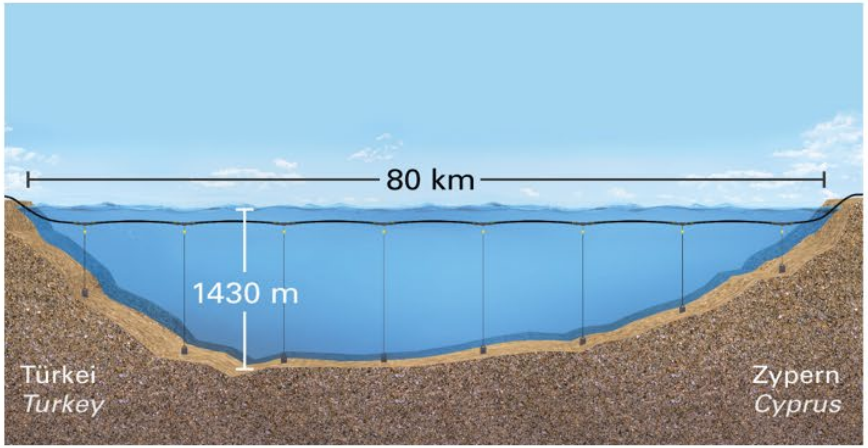


Image courtesy Reinert-Ritz GmbH

**1600mm HDPE flexible jointed pipeline installed 20m under the sea between Turkey and Crete - 2016**

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## Conclusion

- HDPE polymer design and bimodal polymerization technology has led to vast improvements in SCG resistance and pressure handling capacity
- The knowledge of failure mechanisms and the limits under these conditions allows a safe and reliable design of HDPE pressure piping systems which life expectancy exceeds 100 years *(according to ISO 9080 calculation)*
- Further polymer and technology development results in improved processability and product properties for:
  - Large bore / thick wall pipes for large volumes / high pressures
  - Alternative installation techniques – HDD, pipe bursting etc.
- Modern generation PE100 materials give designers and end users improved confidence and life expectancy in today's challenging built environment

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# THANK YOU

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# Questions and Answers

**23 February 2022**

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**Ayanda Zwane**


# BE READY FOR ALL FLUCTUATIONS & CHANGES

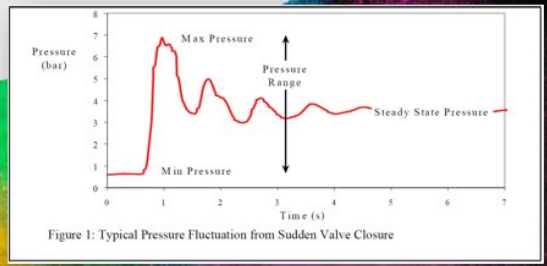

Figure 1: Typical Pressure Fluctuation from Sudden Valve Closure

| Total Cycles | Approx. No. Cycles /day for 100y life | FATIGUE LOAD FACTORS | | | | |
|---|---|---|---|---|---|---|
| 26,400 | 0.7 | 1.00* | 1.00* | 1.00 | 1.00* | 1.00* |
| 100,000 | 3 | 1.00 | 1.00 | 0.67 | 1.00 | 1.00 |
| 500,000 | 14 | 0.62 | 0.79 | 0.41 | 0.95 | 0.76 |
| 1,000,000 | 27 | 0.50 | 0.71 | 0.33 | 0.88 | 0.67 |
| 5,000,000 | 137 | 0.31 | 0.55 | 0.21 | 0.74 | 0.50 |
| 10,000,000 | 274 | 0.25 | 0.50 | 0.17 | 0.68 | 0.44 |
| 50,000,000 | 1369 | 0.15 | 0.39 | 0.10 | 0.57 | 0.33 |
| 100,000,000 | 2738 | 0.13 | 0.35 | 0.08 | 0.53 | 0.29 |

Online Browsing Platform (OBP)

Search | ISO 4427-1:2019(en) ×

**ISO 4427-1:2019(en)** Plastics piping systems for water supply and for drainage and sewerage under pressure — Polyethylene (PE) — Part 1: General

- Table of contents
- Tables
- Parts

ISO 4427-1:2019(en)
ISO 4427-2:2019(en)
ISO 4427-3:2019(en)
ISO 4427-5:2019(en)

# Plastics piping systems for water supply, and for drainage and sewerage under pressure — Polyethylene (PE) —

## Part 1: General

**Report Date :** 2022-01-31
**Cost Centre(s) :** %
**Page No :** 4 **Of** 5

***PROGRAMME OF WORK : STANDARDS***

SABS

**Total Count:** 42

| Committee Number | SANS Number | Ed | Work Order Number | Title | Date Project Approved | Target Date | Date Standard approved | Current Stage Code | Current Stage Date | Comment | Standards Writer |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SABS/TC 138/SC 06 | SANS 4427-1/ISO 4427-1:2019, IDT, Ed. 2 | 2 | | Plastics piping systems - Polyethylene (PE) pipes and fittings for water supply - Part 1: General | | | | 00.00 | 2021-11-15 | | |
| | SANS 4427-2/ISO 4427-2:2019, IDT, Ed. 2 | 2 | | Plastics piping systems - Polyethylene (PE) pipes and fittings for water supply - Part 2: Pipes | | | | 00.00 | 2021-11-15 | | |
| | SANS 4427-3/ISO 4427-3:2019, IDT, Ed. 2 | 2 | | Plastics piping systems - Polyethylene (PE) pipes and fittings for water supply - Part 3: Fittings | | | | 00.00 | 2021-12-14 | | |
| SABS/TC 138/SC 06 | SANS 4427-5/ISO 4427-5:2019, IDT, Ed. 2 | 2 | | Plastics piping systems - Polyethylene (PE) pipes and fittings for water supply - Part 5: Fitness for purpose of the system | | | | 00.00 | 2021-12-22 | | |



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# ISO 4427-5

FINAL DRAFT

INTERNATIONAL STANDARD

**ISO/FDIS 4427-5**

ISO/TC **138**/SC **2**

Secretariat: SNV

Voting begins on:
**2019-05-17**

Voting terminates on:
**2019-07-12**

**Plastics piping systems for water supply, and for drainage and sewerage under pressure — Polyethylene (PE) —**

Part 5:
**Fitness for purpose of the system**



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# ISO 4427-5

This newly revised 2019 version of ISO 4427-5 was prepared by ISO Technical Committee TC 138, Plastics pipes, fittings and valves for the transport of fluids, Subcommittee SC 2, Plastics pipes and fittings and valves for the transport of fluids. This 2019 edition cancels and replaces the first edition (ISO 4427-5:2007) and has been technically revised. Compared to the previous edition, the main changes are:

- Update of the normative references and technical consistency with ISO 4437-5 (see Reference [1] in the Bibliography).
- The scope of the standard has been expanded into areas previously not covered by the 2007 version.
- The 2019 revision pertinently includes the manufacturer's scope requirements to assess the performance of components according to ISO 4427-2 and or ISO 4427-3 when joined together under normal and extreme conditions. It also clearly states that this 2019 standard is not intended for on-site testing of pipe systems.
- The normative reference section has been updated with the addition of:
  - ISO 1167-4 Thermoplastics pipes, fittings and assemblies for the conveyance of fluids, part 4 preparation of assemblies,
  - ISO 4427-2:- Plastics piping systems for water supply, and drainage and sewerage under pressure – Polyethylene (PE) – Part 2 Pipes
  - ISO 13965 decohesion tests for saddle fusion joints,
  - ISO 17885 Mechanical fittings for pressure piping systems -Specifications.

- This standard focus on the fitness for the purpose of pipes and or fittings assemblies and no longer systems only.

# ISO 4427-5

- The detailed inclusion of butt fusion joints, mechanical joints, and socket fusion joints makes the standard inclusive of most fitting types. In addition, it allows for proper system component design.
- The compound PE63 has been removed in totality.

The Bibliography of the standard has been updated with the inclusion of three reference standards;

ISO 4437-5, Plastics piping systems for the supply of gaseous fuels- Polyethylene (PE)Part 5: fitness for purpose of the system

CEN/TS 12201-7, Plastics piping systems for water supply- Polyethylene(PE) Part 7: Guidance for the assessment of conformity.

ISO 21751, Plastics pipes and fittings- Decohesion test of electrofusion assemblies -Strip Bend Test




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# SAPPMA Webinar I 2022

# Questions and Answers


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