Certificate No : RQM5567

Certificate of Registration

# QUALITY MANAGEMENT SYSTEM

This is to certify that
the quality management system of

## HYUNDAIPIPE CO.,LTD.

at
Head Quarter: #9-12, Pyeongcheongongdan-gil, Gongseong-myeon, Sangju-si, Gyeongsangbuk-do, Korea
Plant: #80, Magonggongdan-ro, Cheongni-myeon, Sangju-si, Gyeongsangbuk-do, Korea

Has been found to conform to the Quality Management System Standards:

*KS Q ISO 9001:2015/ISO 9001:2015*

This Certificate is valid for the following product or service ranges:

*Production of Polyethylene Pipes and Joints*
*[(Polyethylene for Water, Gas, Polyethylene (PE) Pipe, General Use, Drainage and Sewage Non-Pressure Burial (PE-Double Wall Pipe, Multi-Wall/Pipe)]*

Issue Date : Aug. 30. 2021

Certification Date : Sep. 7. 2021 Valid Date : Sep. 6. 2024

ISO 9001

KAB-QC-17

Authorized By E J Hwang
Eun-Ju Hwang, President

Korea Management Registrar
1dong,12F,Ace High Tech City #775,Gyeongin-ro
Yeongdeungpo-gu, Seoul, 07299, Korea
T: 82-2-6309-9001 / F: 82-2-6309-9004

- KMR is accredited by the KAB (No. KAB-QC-17)
- IAF Mark indicates that KMR is Accredited by the member of the International Accreditation Forum Multilateral Recognition Arrangement.
- KSIC CODE:14/ Initial certification date: Sep. 7. 2009

Certificate No : ROH1187

# Certificate of Registration

# OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT SYSTEM

This is to certify that
the occupational health and safety management system of

## HYUNDAIPIPE CO.,LTD.

at

#9-12, Pyeongcheongongdan-gil, Gongseong-myeon, Sangju-si, Gyeongsangbuk-do, Korea

Has been found to conform to the Occupational Health and Safety Management System Standards:

*KS Q ISO 45001:2018/ISO 45001:2018*

This Certificate is valid for the following product or service ranges:

*Production of Polyethylene Pipes and Joints*
*[(Polyethylene for Water, Gas, Polyethylene (PE) Pipe, General Use, Drainage and Sewage Non-Pressure Burial (PE-Double Wall Pipe, Multi-Wall/Pipe)]*

Issue Date : Nov. 11. 2022

Certification Date : Nov. 11. 2022 Valid Date : Nov. 10. 2025

ISO 45001

KAB-OC-12

Authorized By E J Hwang

**Eun-Ju Hwang,** President

Korea Management Registrar
1dong,12F,Ace High Tech City #775,Gyeongin-ro
Yeongdeungpo-gu, Seoul, 07299, Korea
T: 82-2-6309-9001 / F: 82-2-6309-9004

- KMR is accredited by the KAB (No. KAB-OC-12)
- IAF Mark indicates that KMR is Accredited by the member of the International Accreditation Forum Multilateral Recognition Arrangement.
- KSIC CODE:14/ Initial certification date: Nov. 11. 2016

Certificate No : REM2351

# Certificate of Registration

# ENVIRONMENTAL MANAGEMENT SYSTEM

This is to certify that
the environmental management system of

## HYUNDAIPIPE CO.,LTD.

at

#9-12, Pyeongcheongongdan-gil, Gongseong-myeon, Sangju-si, Gyeongsangbuk-do, Korea

Has been found to conform to the Environmental Management System Standards:

*KS I ISO 14001:2015/ISO 14001:2015*

This Certificate is valid for the following product or service ranges:

*Production of Polyethylene Pipes and Joints*
*[(Polyethylene for Water, Gas, Polyethylene (PE) Pipe, General Use, Drainage and Sewage Non-Pressure Burial (PE-Double Wall Pipe, Multi-Wall/Pipe)]*

Issue Date : Aug. 29. 2022

Certification Date : Aug. 29. 2022 Valid Date : Aug. 28. 2025

ISO 14001 KAB-EC-17

Authorized By E J Hwang

**Eun-Ju Hwang**, President

Korea Management Registrar
1dong,12F,Ace High Tech City #775,Gyeongin-ro
Yeongdeungpo-gu, Seoul, 07299, Korea
T: 82-2-6309-9001 / F: 82-2-6309-9004

- KMR is accredited by the KAB (No. KAB-EC-17)
- IAF Mark indicates that KMR is Accredited by the member of the International Accreditation Forum Multilateral Recognition Arrangement.
- KSIC CODE:14/ Initial certification date: Aug. 29. 2016

*Certificate*

# KS CERTIFICATE

*This is to certify that the Korean Standard Mark(KS mark) of :*

HYUNDAIPIPE Co.,Ltd.

*9-12, Pyeongcheongongdan-gil, Gongseong-myeon, Sangju-si,*
*Gyeongsangbuk-do, Republic of Korea*

*Cho SunJae*

*has been approved by Korean Standards Association*
*to the following Korean Standard :*

*KS M 3408-2*

*Plastics piping systems for water supply - Polyethylene(PE) -Part 2: Pipes*

*MP1-PE100 16~500, MP1-PE80 16~500, SP1-PE100 16~1000, SP1-PE80 16~1000,*
*SP2-PE100 16~1000, SP2-PE80 16~1000. End.*

*in accordance with the Korean Industrial Standardization Act.*

*Certificate number :* 8070

*Date certified :* 1990-12-20
*Expiry date :* 2022-03-28
*Date issued :* 2020-11-03

Certified by

Chairman & CEO

KSA
KOREAN STANDARDS ASSOCIATION

**KOREAN STANDARDS ASSOCIATION**

305, Teheran-Ro, Gangnam-Gu, Seoul, Korea

*Certificate*

# KS CERTIFICATE

*This is to certify that the Korean Standard Mark(KS mark) of :*

HYUNDAIPIPE SUDIA Factory

*80, Magonggongdan-ro, Cheongni-myeon, Sangju-si, Gyeongsangbuk-do, Republic of Korea*

*Cho SunJae*

***has been approved by Korean Standards Association to the following Korean Standard :***

*KS M 3408-2*

*Plastics piping systems for water supply - Polyethylene(PE) -Part 2: Pipes*

*SP1-PE100 630~1400. End.*

***in accordance with the Korean Industrial Standardization Act.***

*Certificate number :* 19-0399

*Date certified :* 2019-10-30
*Expiry date :* 2022-10-29
*Date issued :* 2020-11-03

Certified by

Chairman & CEO

KSA
KOREAN STANDARDS ASSOCIATION

**KOREAN STANDARDS ASSOCIATION**

305, Teheran-Ro, Gangnam-Gu, Seoul, Korea

# SANITATION AND SAFETY CERTIFICATE

1. CERTIFICATE NUMBER : KCW-2011-0041
2. MANUFACTURER : HYUNDAI PIPE Co., Ltd.
3. OWNER : CHO SUN JAE
4. LOCATION OF HEAD OFFICE : 19-12, Pyeongcheongongdan-gil, Gongseong-myeon, Sangju-si, Gyeongsangbuk-do, Republic of Korea
5. LOCATION OF FACTORY : 19-12, Pyeongcheongongdan-gil, Gongseong-myeon, Sangju-si, Gyeongsangbuk-do, Republic of Korea
6. PRODUCT : Polyethylene pipe for water works
7. TYPE : Refer to reverse side
8. USE : Water supply facilities for general water works



This is to certify that the sanitation and safety products described above have been produced according to the Article 14 of WATER SUPPLY AND WATERWORKS INSTALLATION ACT of the Republic of Korea

*Certification Date : Sep-22-2011*

*Certified by* 권영진
*President*

KWWA

**Korea Water and Wastewater Works Association**

244, Daerim-ro, Yeongdeungpo-gu, Seoul, Korea

# Certificate of Compliance

This certificate is issued for the following:

**Polyethylene (PE) Pipe and Fittings for Underground Fire Protection Service**
**(see full listing attached)**

**Prepared for:**

**Hyundai Pipe Co., Ltd.**
9-12 Pyungchun gongdan-gil
Gongsungmyun
Sangju City
Republic of Korea

**Manufactured at:**

**Hyundai Pipe Co., Ltd. (Pipe)**
9-12 Pyungchun gongdan-gil
Gongsungmyun
Sangju City
Republic of Korea

**SUDIA Factory (Fittings)**
80, Magonggongdan-ro, Cheongni-myeon Gongsungmyun
Sangju City
Republic of Korea

FM Approvals Class: 1613 (February 2017)

Approval Identification: PR452277

Approval Granted: June 4, 2019

To verify the availability of the Approved product, please refer to www.approvalguide.com

Said Approval is subject to satisfactory field performance, continuing Surveillance Audits, and strict conformity to the constructions as shown in the Approval Guide, an online resource of FM Approvals.

David B. Fuller
VP, Manager - Fire Protection
FM Approvals
1151 Boston-Providence Turnpike
Norwood, MA 02062 USA

Member of the FM Global Group

FM APPROVED

# Certificate of Compliance

| *Product Designation* | *O.D., Pipe Size, mm.* | *Pressure Rating, psi (kPa)* | *Remarks* |
|---|---|---|---|
| SDR9 | | | |
| Pipe | 63, 75, 90, 110, 125, 140, 160, 180, 200, 225, 250, 280, 315, 355, 400, 450, 500, 560, 630 | 250 (1725) | a |
| Reducer, Molded | 75x63, 90x(63~75), 110x(63~90), 125x(63~110), 140x(63~125), 160x(63~125), 180x(110~160), 200x(63~180), 225x(110~200), 250x(110~225), 280x(110~250), 315x(110~280), 355x(110~315), 400x(200~355), 450x(200~400), 500x(200~450), 560x(315~500), 630x(315~560) | 250 (1725) | a |
| Eccentric Reducer, Molded | 355x315 | 250 (1725) | a |
| Elbow, Molded, 90° | 63, 180, 200, 225, 250, 280, 315 | 250 (1725) | a |
| Elbow, Fabricated (7 Segment), 90° | 355, 400, 450, 500, 560, 630 | 250 (1725) | a |
| Elbow, Molded, 45° | 63, 180, 200, 225, 250, 280, 315 | 250 (1725) | a |
| Elbow, Fabricated (4 Segment), 45° | 355, 400, 450, 500, 560, 630 | 250 (1725) | a |
| End Cap, Molded | 63, 75, 90, 110, 125, 140, 160, 180, 200, 225, 250, 280, 315, 355, 400, 450, 500, 560, 630 | 250 (1725) | a |
| Stub End Flange, Molded | 63, 75, 90, 110, 125, 140, 160, 180, 200, 225, 250, 280, 315, 355, 400, 450 | 250 (1725) | a |
| Equal Tee, Molded | 63, 75, 90, 110, 125, 140, 160, 180, 200, 225, 250, 280, 315 | 250 (1725) | a |
| Reducing Tee, Molded | 160x110, 250x160, 315x110, 315x160, 315x200 | 250 (1725) | a |
| Equal Tee, Fabricated | 355, 400, 450, 500, 560, 630 | 200 (1380) | a |
| Reducing Tee, Fabricated | 75x63, 90x(63~75), 110x(63~90), 125x(63~110), 140x(63~125), 160x(63~125), 180x(110~160), 200x(63~180), 225x(110~200), 250x(110~225), 280x(110~250), 315x(110~280), 355x(110~315), 400x(200~355), 450x(200~400), 500x(200~450), 560x(315~500), 630x(315~560) | 200 (1380) | a |

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# Certificate of Compliance

| *Product Designation* | *O.D., Pipe Size, mm.* | *Pressure Rating, psi (kPa)* | *Remarks* |
|---|---|---|---|
| SDR11 | | | |
| Pipe | 110, 125, 140, 160, 180, 200, 225, 250, 280, 315, 355, 400, 450 | 150 (1035) | a |
| | 63, 75, 90, 500, 560, 630 | 200 (1380) | a |
| Reducer, Molded | 75x63, 90x(63~75), 110x(63~90), 125x(63~110), 140x(63~125), 160x(63~125), 180x(110~160), 200x(63~180), 225x(110~200), 250x(110~225), 280x(110~250), 315x(110~280), 355x(110~315), 400x(200~355), 450x(200~400), 500x(200~450), 560x(315~500), 630x(315~560) | 200 (1380) | a |
| Elbow, Molded, 90° | 63, 75, 90, 110, 125, 140, 160, 180, 200, 225, 250, 280 | 200 (1380) | a |
| | 630 | 150 (1035) | a |
| Elbow, Molded, 45° | 63, 75, 90, 110, 125, 140, 160, 180, 200, 225, 250, 280 | 200 (1380) | a |
| End Cap, Molded | 63, 75, 90, 110, 125, 140, 160, 180, 200, 225, 250, 280, 315, 355, 400, 450, 500, 560, 630 | 200 (1380) | a |
| Stub End Flange, Fabricated | 63, 75, 90, 110, 125, 140, 160, 180, 200, 225, 250, 280 | 200 (1380) | a |
| Equal Tee, Molded | 63, 75, 90, 110, 125, 140, 160, 180, 200, 225, 250, 280 | 200 (1380) | a |
| | 630 | 150 (1035) | a |
| Reducing Tee, Molded | 75x63, 90x(63~75), 110x(63~90), 125x(63~110), 140x(63~125), 160x(63~125), 180x(110~160), 200x(63~180), 225x(110~200), 250x(110~225), 280x(110~250) | 200 (1380) | a |

Remarks:

a. Pipe and fittings may be directly connected together by the butt fusion process. Manufacturer’s fusion instructions must be strictly followed for a proper fusion joint. The pipe may also be joined to other Approved steel flanged pipe and fittings by using FM Approved flange adapters.

FM Approvals®

*Member of the FM Global Group*

CU16-00180

Final Report

# ISO 4427 testing of pipes from HYUNDAI PIPE Co.,Ltd

KOREA CONFORMITY LABORATORIES

PLASTIC RELIABILITY CENTER

252-7, Techno 2-ro, Yuseong-gu, Daejeon, 34027, Korea
Tel. 82-42-934-1894 Fax. 82-42-934-1895
http://www.kcl.re.kr

| CU16-00180 | |
|---|---|
| Client | HYUNDAI PIPE Co.,Ltd<br>9-12, Pyeongcheongongdan-gil, Gongseong-myeon, Samgju-si, Gyeongsangbuk-do, Korea<br>T) +82 54 534 3614 F) +82 54 533 8398 |

Testing of 110 mm SDR11 pipes according to ISO 4427-1:2007 and ISO 4427-2:2007 from HYUNDAI PIPE using KPIC PE100 resin P600BL.

## Abstract

The aim of this work was to perform testing according to ISO 4427-1:2007 and ISO 4427-2:2007 of black pipes from HYUNDAI PIPE co.,Ltd. The resin used is the PE100 resin P600BL produced by KPIC(Korea Petrochemical Ind.Co.,Ltd). The KPIC P600BL resin is classified PE100 according to ISO 9080 and ISO 12162.
KCL performed the testing in this report.
The tested resin and pipes have passed test in ISO 4427-1,-2.

May 3, 2016

Korea Conformity Laboratories

| Note | |
|---|---|

# List of contents




Tested by

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# 1. Aim of the work

The aim of this work was to perform testing according to ISO 4427-1:2007 and ISO 4427-2:2007 of black pipes from HYUNDAI PIPE co.,Ltd. The resin used is the PE100 resin P600BL produced by KPIC(Korea Petrochemical Ind. Co.,Ltd). This material attained a PE100 classification in 2005 according to Bodycote polymer. The tests performed are shown in Table 1 and 2 below.

Table 1. Characteristics of the PE compound(ISO 4427-1)

| Test | Test Method | Sample form | Lab. |
|---|---|---|---|
| Compound density | ISO 1183-1 | Pellets | KCL |
| Carbon black content | ISO 6964 | Pellets | KCL |
| Carbon black dispersion | ISO 18553 | Pellets | KCL |
| Volatile content | EN 12099 | Pellets | KCL |
| Oxidation induction time | ISO 11357-6 | Pellets<br>Pipe | KCL |
| Melt mass-flow rate (MFR) | ISO 1133-1<br>Condition T | Pellets<br>Pipe | KCL |
| Classification | ISO 9080 | Pipe | Bodycote |
| Slow crack growth (SCG-Notched pipe test) | ISO 13479 | Pipe | Bodycote |
| Effect on water quality | AS/NZS 4020<br>BS 6920-1 | Pipe | WQC[1)]<br>WRAS[2)] |

1) WQC : Australian Water Quality Centre(http://www.awqc.com.au)

2) WRAS : Water Regulations Advisory Scheme(http://www.wras.co.uk/directory)

Table 2. Characteristics of the PE pipe(ISO 4427-2)

| Test | Test Method | Sample form | Lab. |
|---|---|---|---|
| Hydrostatic strength (20 ℃, 100 h) | ISO 1167-1,-2 | Pipe | KCL |
| Hydrostatic strength (80 ℃, 165 h) | ISO 1167-1,-2 | Pipe | KCL |
| Hydrostatic strength (80 ℃, 1 000 h) | ISO 1167-1,-2 | Pipe | KCL |
| Elongation at break | ISO 6259-1,-2 | Pipe | KCL |
| Longitudinal reversion | ISO 2505 | Pipe | KCL |
| Geometrical characteristics and marking | ISO 4427-2<br>ISO 3126 | Pipe | KCL |

## 2. Investigated pipe material

The pipes and granules have been delivered to KCL as follows;

Table 3. Investigated pipe material

| | Form | Dimensions | Arrival date at KCL |
|---|---|---|---|
| Resin(P600BL) | Pellets | - | 2016-03-18 |
| PIPE | Pipe | 110 × 10 ㎜ | 2016-03-18 |

# 3. Experimental procedures

The test procedures for the tests performed by Bodycote are covered in paragraph 3.1 and by the KCL in paragraph 3.2 through to 3.4.

## 3.1 MRS classification

The classification of the resin P600BL produced by KPIC was conducted in 2005.

## 3.2 Hydrostatic strength

The hydrostatic pressure testing was performed according to ISO 1167-1:2006 and ISO 1167-2:2006, using water on the inside and on the outside of the pipe specimens. The accuracy for the temperature and the pressure are better than ±1 ℃ and +2/-1 %, respectively. The measurements of the wall thickness are accurate within ±0.01 ㎜ and the diameters within ±0.1 ㎜. the pipes were fitted with commercial stainless end-cap.

## 3.3 Geometrical characteristics and marking

The mean outside diameter, minimum wall thickness and ovality has been measured on 110 ㎜ SDR11 pipes according to ISO 3126:2005.

## 3.4 Physical characteristics

The test should be within the past 24h after manufacture and after conditioning for at least 4h at (23±2) ℃.

# 4. Results

The results from the testing performed by Bodycote are covered in paragraph 4.1 and the results from the testing performed by KCL are covered in paragraph 4.2.

## 4.1 Test results from tests performed by Bodycote

The table below shows a summary of results of the tests carried out at Bodycote.

Table 4. Results from evaluations performed by Bodycote

| Characteristic | Form | Result | Pass/Fail |
|---|---|---|---|
| Classification | Pipe | PE100 | Pass |
| SCG | Pipe | 12 912 h | Pass |

### 4.1.1 MRS classification

The KPIC resin P600BL is classified PE100 according to ISO 9080 and ISO 12162. The original report covering the MRS classification can be received from KPIC.

### 4.1.2 Slow Crack Growth

The KPIC resin P600BL is satisfied PE100 according to ISO 13479. The results are presented in Table 4. The three started pipe specimens of the PE pipe material P600BL have been terminated. The average test time is 12 912 h. The original report covering the SCG can be received from KPIC.

4.2 Test results from tests performed by KCL

The table below shows a summary of results of the tests carried out at KCL.

Table 5. Results from evaluations performed by KCL

| Characteristic | Form | Requirement | Result | Pass/Fail |
|---|---|---|---|---|
| Compound density | Pellets | ≥930 kg/m³ | 955 kg/m³ | Pass |
| Carbon black content | Pellets | 2 to 2.5 % | 2.2 % | Pass |
| Carbon black dispersion | Pellets | ≤ grade 3 | 1.3 | Pass |
| Volatile content | Pellets | ≤ 350 mg/kg | 202 mg/kg | Pass |
| Oxidation induction time | Pellets | ≥ 20 min | > 60 min | Pass |
| | Pipe | ≥ 20 min | > 60 min | Pass |
| Melt mass-flow rate (MFR) | Pellets | 0.2 to 1.4 g/10min | 0.22 g/10min | Pass |
| | Pipe | ± 20 % change by processing | 9 % | Pass |
| Hydrostatic strength (20 ℃, 100 h) | Pipe | No failure of any test piece during test period | No failure | Pass |
| Hydrostatic strength (80 ℃, 165 h) | Pipe | | No failure | Pass |
| Hydrostatic strength (80 ℃, 1 000 h) | Pipe | | No failure | Pass |
| Elongation at break | Pipe | ≥ 350 % | 623 % | Pass |
| Longitudinal reversion | Pipe | ≤ 3 %<br>No effect on surface | 1.1 % | Pass |
| Geometrical characteristics | Pipe | ISO 4427-2 | - | Pass |
| Marking | Pipe | ISO 4427-2 | - | Pass |

4.2.1 Compound density

Test method ; ISO 1183-1:2012 (Method A)

Test condition ; Temperature (23 ± 1) ℃

| Specimen | Density | | | Mean |
|---|---|---|---|---|
| Measured on MFR string | 954 | 955 | 955 | 955 kg/m³ |

4.2.2 Carbon black content

Test method ; ISO 6964:1986

Test condition ;

- Temperature (550 ± 30) ℃
- Weight precision 0.1 ㎎

| Specimen | Measured C/B content | | | Mean |
|---|---|---|---|---|
| Pellet | 2.26 | 2.34 | 2.11 | 2.2 % |

4.2.3 Carbon black dispersion

Test method ; ISO 18553:2002

Specimen preparation ; Compression procedure

| | Sample | | | | | | Mean |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | |
| Grade | 2 | 1 | 1 | 1.5 | 1 | 1.5 | 1.3 |
| Appearance | A2 | A1 | A1 | A2 | A1 | A1 | |

< Figure : continue >

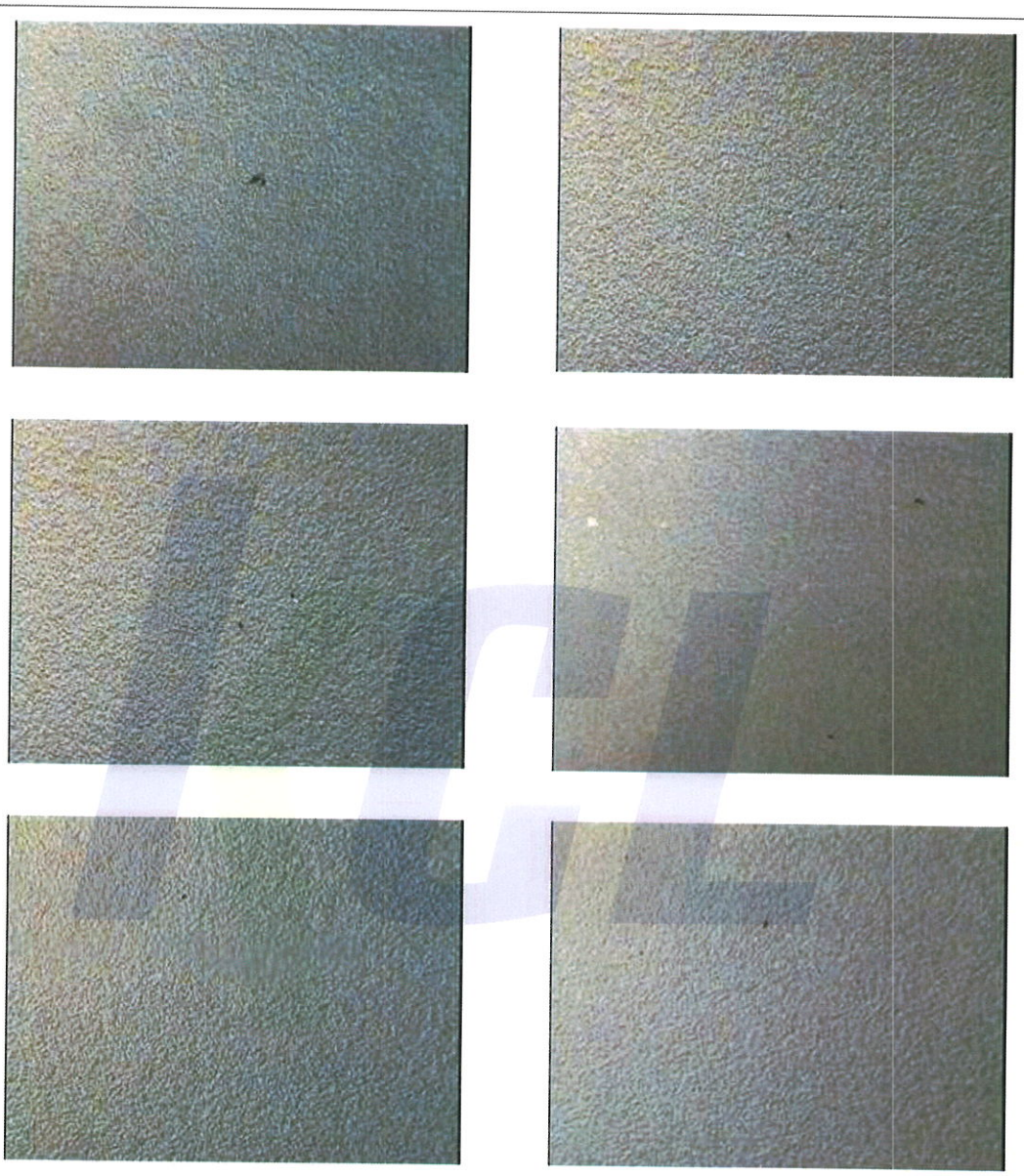


Fig 1. Carbon black dispersion figure

4.2.4 Volatile content

Test method ; EN 12099

Test condition ;

- Temperature ; (105 ± 2) ℃, Time ; 1 hours
- Weight precision 0.1 ㎎

| Specimen | Volatile content |
|---|---|
| Pellet | 201.8 ㎎/kg |

4.2.5 Oxidation induction time

Test method ; ISO 11357-6:2008

Test Temperature ; (200 ± 0.2) ℃

| Specimen | 1 | 2 | 3 | Result |
|---|---|---|---|---|
| Pellet | > 60 | > 60 | > 60 | > 60 min |
| Pipe | > 60 | > 60 | > 60 | > 60 min |

4.2.6 Melt mass-flow rate(MFR)

Test method ; ISO 1133-1:2011

Test conditions ;

- Temperature ; (190 ± 0.5) ℃
- Load ; 5 ㎏ ± 0.5 %
- Weight precision 0.1 ㎎

| Specimen | 1 | 2 | 3 | Result |
|---|---|---|---|---|
| Pellet | 0.223 | 0.221 | 0.217 | 0.22 g/10min |
| Pipe | 0.246 | 0.241 | 0.235 | 0.24 g/10min |
| | Change by preocessing | | | 9.2 % |

4.2.7 Hydrostatic strength

Test method ; ISO 1167-1,-2:2006

Test conditions ;

- Test medium (internal/external) ; Water-in-Water
- Conditioning time ; 3 hours
- End-cap ; Stainless fittings (Type A)
- Pipe length (total/free) ; 700 / 540 ㎜

| No. | Temp. | $e_{min}$ 1) | $d_{em}$ 2) | P 3) | H.S 4) | Failuer time | Failure mode | Remark 5) |
|---|---|---|---|---|---|---|---|---|
| | ℃ | ㎜ | ㎜ | bar | MPa | h | | |
| 20-1 | 20 | 10.55 | 110.0 | 26.35 | 12.42 | - | - | > 100 |
| 20-2 | 20 | 10.59 | 110.0 | 26.35 | 12.37 | - | - | > 100 |
| 20-3 | 20 | 10.57 | 110.0 | 26.35 | 12.39 | - | - | > 100 |
| 80-1 | 80 | 10.58 | 110.0 | 11.47 | 5.41 | - | - | > 165 |
| 80-2 | 80 | 10.55 | 110.0 | 11.47 | 5.38 | - | - | > 165 |
| 80-3 | 80 | 10.56 | 110.0 | 11.47 | 5.40 | - | - | > 165 |
| 80-4 | 80 | 10.57 | 110.0 | 10.63 | 5.0 | - | - | > 1 000 |
| 80-5 | 80 | 10.56 | 110.0 | 10.63 | 5.01 | - | - | > 1 000 |
| 80-6 | 80 | 10.57 | 110.0 | 10.63 | 5.0 | - | - | > 1 000 |

1) Minimum wall thickness
2) Mean outside diameter
3) Internal pressure
4) Hoop stress
5) The pipe specimen passed the required exposure time without failure and has been terminated.

4.2.8 Elongation at break

Test method ; ISO 6259-1,-2:2015

Test conditions ; (23 ± 2) ℃

Test speed ; 50 ㎜/min

| Specimen | 1 | 2 | 3 | 4 | 5 | Mean |
|---|---|---|---|---|---|---|
| Pipe Type 1 | 612.8 | 595.9 | 629.3 | 623.2 | 653.8 | 623.0 % |

4.2.9 Longitudinal reversion

Test method ; ISO 2505:2005

Test conditions ; (110 ± 2) ℃, 120 min

| Specimen | 1 | 2 | 3 | Mean |
|---|---|---|---|---|
| Pipe | 1.23 | 0.95 | 1.17 | 1.12 % |

4.2.10 Geometrical characteristic according to ISO 4427-2

Test method ; ISO 3126:2005

Test conditions ; (23 ± 2) ℃

| Characteristics | Value | Measured tolerance | Conformity |
|---|---|---|---|
| Mean outside diameter | 110.03 ㎜ | + 0.03 ㎜ | Grade B |
| Nominal wall thickness | 10 ㎜ | n/a | SDR11 / PN16 |
| Minimum wall thickness | 10.56 ㎜ | + 0.56 ㎜ | Grade T |
| Ovality | | 0.97 ㎜ | Grade N |

4.2.11 Marking according to ISO 4427-2

| Aspect | Pipe marking |
|---|---|
| Standard number | ISO 4427-2 |
| Manufacturer identification | HYUNDAI PIPE |
| Dimensions | 110 × 10.0 |
| SDR series | SDR11 |
| Material and designation | PE100 |
| Pressure rating in bar | PN16 |
| Production period(date or code) | 20160115 |
| | WATER [1)] |

1) The word "water" or code "W" may also be included if the pipe is intended for drinking water.

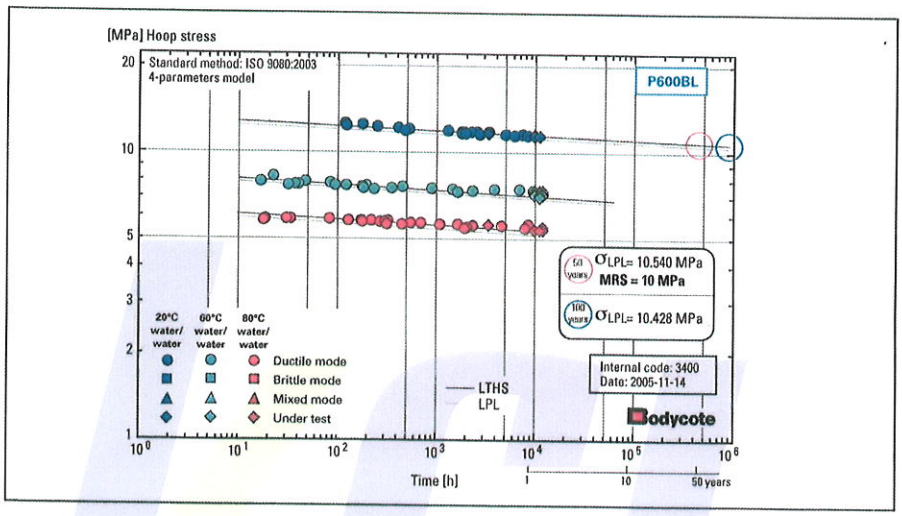
## 5. Conclusion

The 110㎜ SDR11 pipes from HYUNDAI PIPE made of PE100 resin P600BL has passed the ISO 4427-1,-2 tests.

The *effect of water quality of pipes intended for the conveyance of water for human consumption*, has been satisfied according to a report produced by WQC and WRAS. This report of water quality was provided by KPIC.

Client: Korea Petrochemical Ind. Co., Ltd.

# Regression analysis according to ISO 9080 of the PE pipe grade P600BL




## Introduction

Bodycote Polymer offers accredited testing and evaluation according to ISO 9080, i.e. hydrostatic pressure testing followed by evaluation of the long-term hydrostatic strength and MRS-classification according to ISO 12162.

## Task

The aim was to use the Standard Extrapolation Method (SEM) according to ISO 9080:2003 in order to obtain a classification of the PE pipe grade P600BL from Korea Petrochemical Ind. Co., Ltd.

The work covers hydrostatic pressure testing at 20, 60 and 80°C and a SEM-evaluation according to ISO 9080:2003.

## Results obtained

The evaluation was performed in accordance with ISO 9080:2003. The 4-parameters model gave the best fit.

***Number of observations***

| 20°C | 60°C | 80°C |
|---|---|---|
| 34 | 33 | 30 |

***Extrapolated strength values***

| Temp °C | Time yrs | $\sigma_{LPL}$ MPa | $\sigma_{LTHS}$ MPa |
|---|---|---|---|
| 20 | 50.0 | 10.540 | 10.874 |
| 20 | 100 | 10.428 | 10.765 |
| 60 | 7.29 | 6.600 | 6.863 |
| 80 | 1.21 | 5.087 | 5.312 |

**Classification: MRS = 10 MPa**

***Please contact us for further information!***

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www.bodycotepolymer.com info@bodycotepolymer.com

SP150/06-02/JJ

Fig 2. MRS classification

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BODYCOTE/P-03/196

2003-10-21 P-7347

Handled by
Mattias Svedberg

Att: Mr. Hyun Soo, Ha
Korea Petrochemical Ind. Co., Ltd.
Ulsan Plant: R&D CENTER
178, Bukok-dong, Nam-ku
Ulsan, Metropolitan City
Korea P.O.Box #47 Ulsan
KOREA

## NOTCH PIPE TESTING

**Notch pipe testing according to ISO 13479:1997 of the PE pipe material P600BL from Korea Petrochemical Ind. Co., Ltd.**

**Final report**

**Summary**

A notch pipe testing program has been performed on behalf of Korea Petrochemical Ind. Co., Ltd. (herein KPIC). 3 pipe specimens, 110 x 10 mm, of the PE pipe material P600BL from KPIC were notched and pressure tested according to the standard ISO 13479:1997, Test method for slow crack growth on notched pipes (notch test).

The testing conditions were 80°C water/water and 9.2 bar. All pipes have been terminated and the average test time is presented in the table below.

| Material | Bodycote code | Internal pressure | Average test time |
|---|---|---|---|
| P600BL | 2862 | 9.2 bar | 12 912 h |

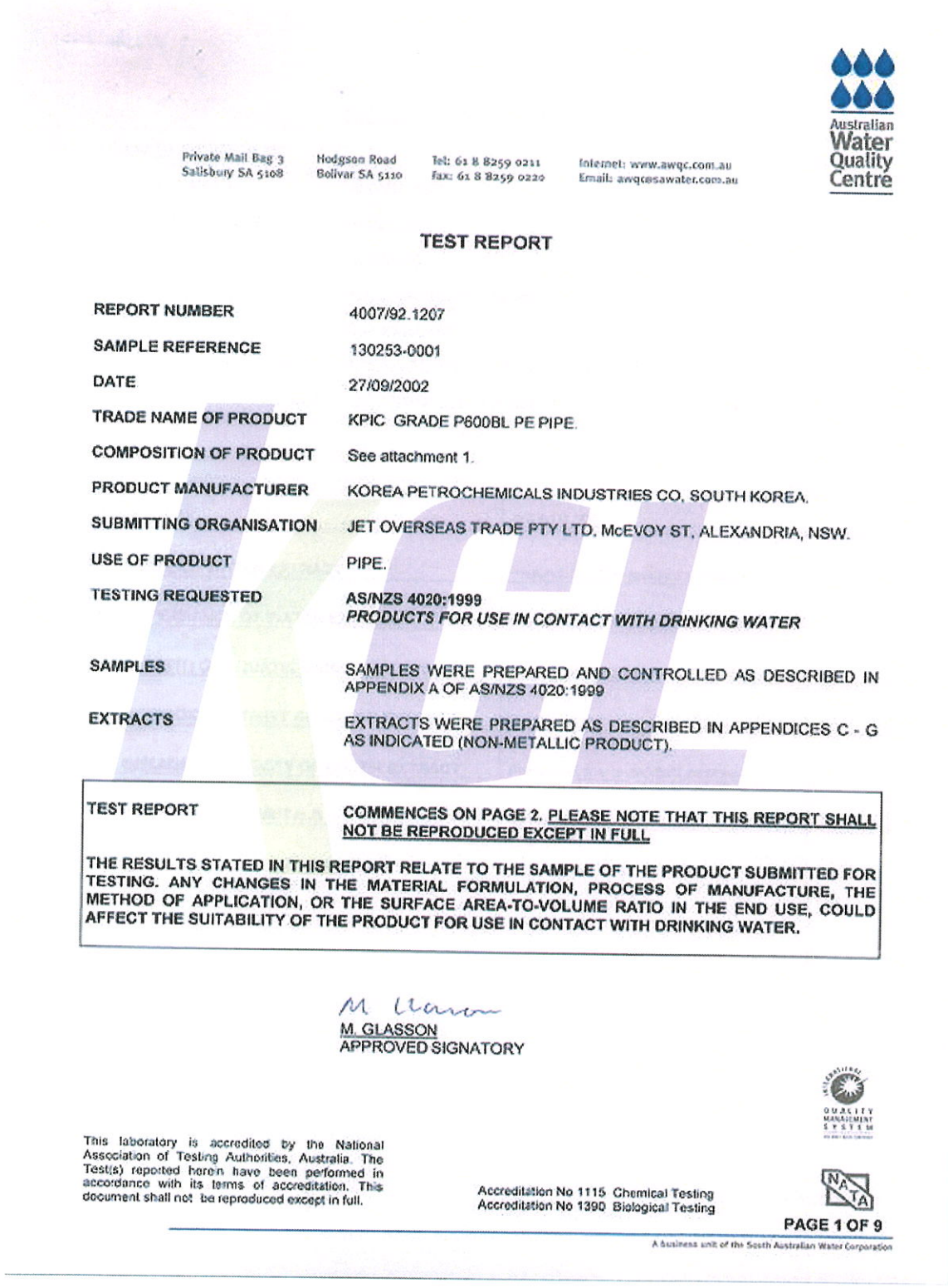
The pipes were after termination evaluated in accordance with ISO 13479:1997.

The final results show that the black PE pipe material, with the Bodycote Polymer internal code 2994, passed the requirement of 165 h at 80°C and 9.2 bar as required in ISO 13479:1997 for a PE 100 pipe material.





Fig 3. SCG(Notch pipe testing)



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Australian Water Quality Centre

**TEST REPORT**

| | |
|---|---|
| **REPORT NUMBER** | 4007/92.1207 |
| **SAMPLE REFERENCE** | 130253-0001 |
| **DATE** | 27/09/2002 |
| **TRADE NAME OF PRODUCT** | KPIC GRADE P600BL PE PIPE. |
| **COMPOSITION OF PRODUCT** | See attachment 1. |
| **PRODUCT MANUFACTURER** | KOREA PETROCHEMICALS INDUSTRIES CO. SOUTH KOREA. |
| **SUBMITTING ORGANISATION** | JET OVERSEAS TRADE PTY LTD. McEVOY ST. ALEXANDRIA, NSW. |
| **USE OF PRODUCT** | PIPE. |
| **TESTING REQUESTED** | **AS/NZS 4020:1999** ***PRODUCTS FOR USE IN CONTACT WITH DRINKING WATER*** |
| **SAMPLES** | SAMPLES WERE PREPARED AND CONTROLLED AS DESCRIBED IN APPENDIX A OF AS/NZS 4020:1999 |
| **EXTRACTS** | EXTRACTS WERE PREPARED AS DESCRIBED IN APPENDICES C - G AS INDICATED (NON-METALLIC PRODUCT). |

**TEST REPORT** **COMMENCES ON PAGE 2. PLEASE NOTE THAT THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL**

**THE RESULTS STATED IN THIS REPORT RELATE TO THE SAMPLE OF THE PRODUCT SUBMITTED FOR TESTING. ANY CHANGES IN THE MATERIAL FORMULATION, PROCESS OF MANUFACTURE, THE METHOD OF APPLICATION, OR THE SURFACE AREA-TO-VOLUME RATIO IN THE END USE, COULD AFFECT THE SUITABILITY OF THE PRODUCT FOR USE IN CONTACT WITH DRINKING WATER.**

M. GLASSON
APPROVED SIGNATORY

This laboratory is accredited by the National Association of Testing Authorities, Australia. The Test(s) reported herein have been performed in accordance with its terms of accreditation. This document shall not be reproduced except in full.

Accreditation No 1115 Chemical Testing
Accreditation No 1390 Biological Testing

PAGE 1 OF 9

A business unit of the South Australian Water Corporation

Fig 4. Effect of water quality of pipes (WQC)

Our Ref: HL/M1203005
Test Report: MAT/LAB 513E & 514E

5th October 2012

WRAS
Water Regulations Advisory Scheme

Korea Petrochemical Ind. Co. Ltd.
178 Bukok-Dong,
Nam-ku,
Ulsan City,
Republic of Korea

**WATER REGULATIONS ADVISORY SCHEME (WRAS)**
**MATERIAL APPROVAL**

The material referred to in this letter is suitable for contact with wholesome water for domestic purposes having met the requirements of BS 6920-1:2000 'Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water'.

The reference relates solely to its effect on the quality of the water with which it may come into contact and does not signify the approval of its mechanical or physical properties for any use.

**POLYETHYLENE – COMPONENTS** **5240**

P600BL & P301E BL. Black coloured, extruded polyethylene pipes. For use with water up to 23°C.

**APPROVAL NUMBER: 1209528**
**APPROVAL HOLDER: KOREA PETROCHEMICAL IND. CO. LTD.**

The Scheme reserves the right to review approval. This approval is valid between September 2012 and September 2017.

An entry, as above, will accordingly be included in the Water Fittings Directory on-line under the section headed, "Materials which have passed full tests of effect on water quality".

The Directory may be found at: www.wras.co.uk/directory

Yours faithfully

Jason Furnival
Approvals & Enquiries Manager
Water Regulations Advisory Scheme

Water Regulations Advisory Scheme Ltd.
30 Fern Close, Pen-y-Fan Industrial Estate,
Oakdale, Gwent NP11 3EH, UK.
Tel: 01495 248454. Fax: 01495 236289.
E-mail: info@wras.co.uk Website: www.wras.co.uk



Fig 5. Effect of water quality of pipes (WRAS)

*Certificate No.* 2019-083

# *Certificate of Designation for an Excellent Company*

*Company : HYUNDAIPIPE Co., Ltd.*

*Representative : Cho Sunjae*

*Products : HDPE Pipe*

*Validity of Certificate : June 21, 2019 ~ June 20, 2024*

This is to certify that the above mentioned company was designated by Public Procurement Service of the Republic of Korea as an Excellent Company for overseas public procurement market.

2019. 6. 21

Jung Mookyung
Administrator

**Public Procurement Service**
**The Republic of Korea**

# Certificate of Public Procurement Quality Assurance

*Company* : **HYUNDAIPIPE Co., Ltd.**
*Representative* : **Cho Sunjae**
*Business Registration No* : **511-81-11457**

*Designation No.* ***2019-24***

*Product Certified Herewith*

* *Product Name* : **Polyethylene pipes for water works**
* *Product classification code* : **4014219702**
* *Grade* : **B**
* *Validity Period* : **October 1, 2019 ~ September 30, 2022**

***This is to certify that the above mentioned product is designated for Public Procurement Quality Assurance Program in accordance with Article 15 of Regulation on Designation and Management of Public Procurement Quality Assurance.***

October 1, 2019

Administrator **Jung Mookyung** Jung. M.K

Public Procurement Service, Republic of Korea