PIPA
PLASTICS INDUSTRY PIPE ASSOCIATION OF AUSTRALIA LIMITED

INDUSTRY GUIDELINES
POP004
Polyethylene Pipe and Fittings Compounds

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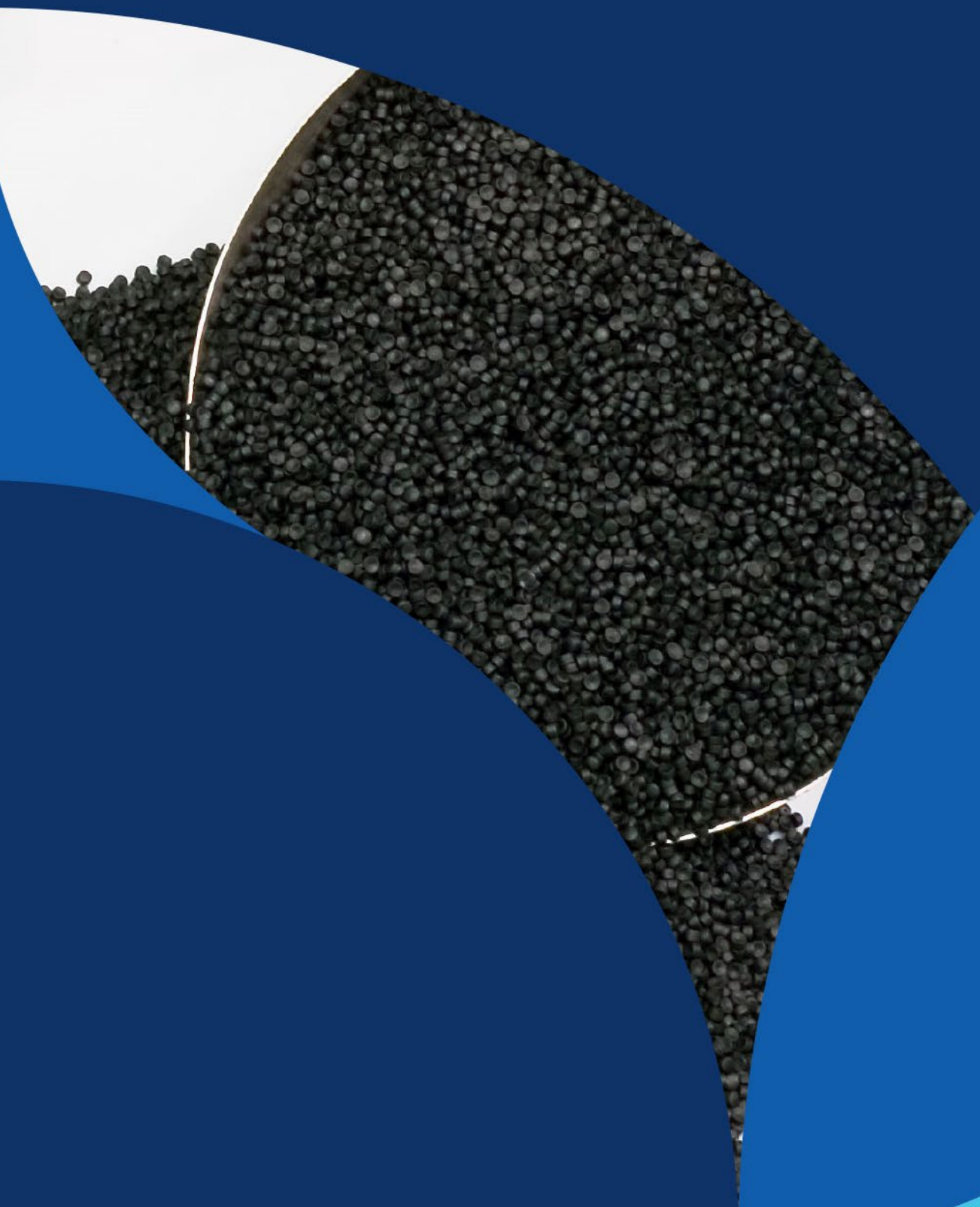

Polyethylene Pipe and Fittings Compounds

1.0 BACKGROUND

This document is a listing of PE pipe compounds evaluated against the requirements of AS/NZS 4131 and stripe and jacket compounds evaluated for use with PE pipe manufactured to AS/NZS 4130. In addition, it identifies the PE 100 pipe compounds with enhanced properties, namely, PE 112, Raised Crack Resistant (PE 100-RC) and High Stress Crack Resistant (PE 100 HSCR).

The relevant Australian Standards are:

(i) AS/NZS 4131, Polyethylene (PE) compounds for pressure pipes and fittings. This Standard specifies requirements for compounds used in the manufacture of pressure pipes.

(ii) AS/NZS 4130, Polyethylene (PE) pipes for pressure applications. This Standard specifies requirements for pipes, and includes stripes and jackets (co-extrusions), plus the relevant compound attributes for these co-extrusions.

Note 1: Pipes conforming to AS/NZS 4130 must be extruded from fully pre-compounded material conforming to AS/NZS 4131.

Note 2: It is recommended that individual pipe manufacturers confirm colour conformity of stripe and jacket compounds when measured on extruded pipes.

The evaluation process is a desktop review where documentation provided by the compound manufacturer is examined by a panel comprised of pipe manufacturing members with appropriate expertise in this field. This evaluation is undertaken at an identified point in time.

For PE 100 materials, including those with enhanced properties, demonstration of ongoing conformity is also periodically required in order to maintain listing in this document. The requirements for ongoing conformity testing are set out in Section 2.6.

The evaluation is not a formal product certification and there is no audit of the manufacturing site.

2.0 EVALUATION REQUIREMENTS

2.1 ACCEPTED INFORMATION SOURCES

The evaluation process involves the acceptance by PIPA of testing and/or analysis conducted by organisations deemed sufficiently competent and have international recognition.

Accepted organisations are those acceptable to PE 100+ (listed on the PE 100+ website https://www.pe100plus.com) and PIPA accepted NATA Laboratories in Australia. Additional organisations specifically related to AS/NZS 4020 testing include the Australian Water Quality Centre and Eurofins AMS Laboratories.

Some attributes may be assessed using information provided by the original product manufacturer – for example information relating to carbon black particle size and toluene extract may be provided by the carbon black supplier.

2.2 MANUFACTURERS' DECLARATION

Pipe Compounds: All submissions require a Manufacturers' Declaration that states that the material is fully pre-compounded and in conformity with AS/NZS 4131 and include where necessary any additional performance claims e.g., POP013 or POP016.

Stripe and Jacket Compounds: For stripe and jacket compounds the declaration shall state that the material conforms to AS/NZS 4130 and meets the additional requirements as required in POP004 e.g., melt flow rate.

2.3 AS/NZS 4020 CERTIFICATION

Conformity with AS/NZS 4020 is a requirement of AS/NZS 4131 for all black, blue, and purple (lilac) compounds. AS/NZS 4131 requires this certification be renewed every 5 years. The POP004 listing contains information about the date of AS/NZS 4020 certification presented at the time of evaluation or provided in subsequent updates by the manufacturer.

Currency of the AS/NZS 4020 certification needs to be confirmed by the resin processor. i.e., the pipe or fitting manufacturer.

The pipe diameters quoted in the listing are the minimum to be used in potable water applications. Diameters smaller than those tested may not be suitable for drinking water applications.

2.4 ADDITIONAL REQUIREMENTS OF POP004

There are references in this document relating to elevated temperature performance and high stress crack resistant PE 100 materials (PE 100-RC and PE 100 HSCR) not included in AS/NZS 4131.

Also, there are additional requirements relating to MFR (Melt Flow Rate) and RC/HSCR based materials for stripe and colour compounds not included in the Australian Standards. Detailed explanations of elevated temperature performance are included in the Appendix of this document.

In addition to this document, a supplementary list of additional materials, used in the manufacture of electrofusion and moulded fittings is provided in POP004A.

2.5 MARKET SURVEILLANCE

PIPA reserves the right to:

- Obtain product from the market and undertake conformity testing.
- Consult with Member companies to obtain test information.

Where such testing or information identifies non-conformity PIPA may choose not to list a compound or to delist an existing compound based on the individual circumstances associated with the non-conformity.

2.6 DEMONSTRATING ONGOING CONFORMITY – RETESTING OF PE 100 PIPE COMPOUNDS

To maintain the listing in this document the product tests listed below shall be carried out every three years by the compound manufacturer. Results from these tests, undertaken by accepted information sources, must be provided to PIPA within 3 months of the nominated retest period falling due.

2.6.1 Testing required for PE 100 Compounds consist of:

Slow Crack Growth Resistance - determined using the Notched Pipe Test according to ISO 13479. *Note: for PE100+ listed materials the ISO 13479 test results submitted as part of their current listing within the PE100+ process will be accepted as means of demonstrating conformity with POP004.*

The following tests are to be performed on the material supplied to conduct the Notched Pipe Test in the Slow Crack Growth Resistance above:

- MFR5; MFR21 and FRR 21/5 according to ISO1133
- Carbon Black content according to ISO6964
- Carbon Black dispersion according to AS1462.28 or ISO equivalent
- Density according to ISO 1183
- Thermal stability via OIT according to ISO11357

Hydrostatic Pressure Testing: Either of the options defined in a or b below.

a. In accordance with the note accompanying Table A2 of AS/NZS 4131- That is, perform pressure tests at a minimum of 2 stress levels at test temperatures of 20°C and 80°C. The lowest stress level for each temperature is to correspond to the 2500 h failure time from the original ISO 9080 analysis. Three samples are to be tested at each level. The times to failure of these shall not fall below the calculated 99.5% LPL value for the corresponding stress level as derived from the original classification data. Failure to meet this requirement will mean that the compound has changed sufficiently to require full evaluation.

b. In accordance with CEN/TS 1555-7 and CEN/TS 12201-7 – testing at 2 stress levels 12.0 MPa (20 °C, min 100 h) and 11.1 MPa (20 °C, min 2500 h). In addition, every 8 years a test at 4.8 MPa (80 °C, min 5000 h) shall be carried out.

2.6.2 Testing required for PE 100-RC³ compounds conforming with POP016 consists of:

Full Notch Creep Test (FNCT) or its accelerated (ACT) form according to POP016

The following tests are to be performed on the material supplied to conduct the FNCT test:

- MFR5; MFR21 and FRR 21/5 according to ISO1133
- Carbon Black content according to ISO6964
- Carbon Black dispersion according to AS1462.28 or ISO equivalent

- Density according to ISO 1183
- Thermal stability via OIT according to ISO11357.

Hydrostatic Pressure Testing: Either of the options defined in a or b below.

a. In accordance with the note accompanying Table A2 of AS/NZS 4131 - That is, perform pressure tests at a minimum of 2 stress levels at test temperatures of 20°C and 80°C. The lowest stress level for each temperature is to correspond to the 2500 h failure time from the original ISO 9080 analysis. Three samples are to be tested at each level. The times to failure of these shall not fall below the calculated 99.5% LPL value for the corresponding stress level as derived from the original classification data. Failure to meet this requirement will mean that the compound has changed sufficiently to require full evaluation.

b. In accordance with CEN/TS 1555-7 and CEN/TS 12201-7 – testing at 2 stress levels 12.0 MPa (20 °C, min 100 h) and 11.1 MPa (20 °C, min 2500 h). In addition, every 8 years, a test at 4.8 MPa (80 °C, min 5000 h) shall be carried out.

[3] PE 100 HSCR materials are in the process of being superseded by PE 100-RC materials. When these materials are due for reconformity, the full suite of tests required to demonstrate conformity with PE 100-RC will be required.

Pipe Material Compounds – assessed in accordance with AS/NZS 4131

PE80

MANUFACTURER	MANUFACTURING SITE	MATERIAL	POP013 CONFORMITY	DATE OF LATEST SUBMISSION	DATE OF AS/NZS 4020
Borealis	Finland	ME3441 (Yellow)	Not Assessed	January 2008	December 2019 (16mm ID)
	Finland	ME3444	Not Assessed	January 2008	May 2025 (DN20)
Borouge	Ruwais, Abu Dhabi	ME3440	Not Assessed	November 2023	February 2022 (DN32)
	Ruwais, Abu Dhabi	ME3441	Not Assessed	January 2014	
SCGC	Rayong, Thailand	SCGC HDPE H5211PC	Not Assessed	2008	September 2009 (12.5mm ID)

Pipe Material Compounds – assessed in accordance with AS/NZS 4131

PE 100

MANUFACTURER	MANUFACTURING SITE	MATERIAL	POP013 CONFORMITY	DATE OF LATEST SUBMISSION	DATE OF AS/NZS 4020
Lyondell Basell	Wesseling, Germany	CRP 100 Black	Yes	March 2022	April 2023 (DN16)
	SEPC, Saudi Arabia	CRP 100 Black	Yes	December 2024	February 2022 (DN16)
Borealis	Porvoo, Finland	HE3490 – LS-HP	Not Assessed	May 2023	April 2023 (DN20)
	Porvoo, Finland	HE3494 – LS-HP (Blue)	Not Assessed	May 2023	April 2023 (DN20)
Borouge	Ruwais, Abu Dhabi	HE 3490-LS	Yes	October 2022	June 2022 (DN32)
	Ruwais, Abu Dhabi	HE 3490 LS-H	Not Assessed	July 2023	June 2022 (DN32)
	Ruwais, Abu Dhabi	HE 3490 ELS-H	Yes	March 2022	February 2022 (DN32)
	Ruwais, Abu Dhabi	HE3492 LS-H (Orange)	Not Assessed	December 2023	
IRPC Public Company Limited	Rayong, Thailand	P901BK	Yes	December 2024	May 2024 (DN16)
KPIC	Ulsan, South Korea	P600 BL	Yes	December 2023	September 2024(DN32)

MANUFACTURER	MANUFACTURING SITE	MATERIAL	POP013 CONFORMITY	DATE OF LATEST SUBMISSION	DATE OF AS/NZS 4020
SCGC	Rayong, Thailand	SCGC HDPE H1000PC	Yes	December 2022	December 2024 (19mm ID)
	Rayong, Thailand	SCGC HDPE H1000PBL Blue	Not Assessed	November 2025	May 2022 (25mm ID)
	Rayong, Thailand	SCGC HDPE H112PC	Yes	December 2022	April 2022 (20mm ID)
Formosa Plastic Corporation	Kaohsiung, Taiwan	Taisox 8001BL (Black)	Yes	March 2020	February 2018 (24mm ID)
Hanwha TotalEnergies Petrochemical Co., Ltd.	Republic of Korea	XS10B (Black)	Yes	December 2021	October 2021 (25mm ID)
	Republic of Korea	XLS10B	Yes	May 2024	February 2024 (32mm ID)
PTT Global Chemical Public	Rayong, Thailand	HD8100 MB (Black)	Not Assessed	July 2025	April 2021 (26mm ID)
SABIC	Saudi Yansab and Saudi Kayan	P6006 Black	Yes	June 2013	Feb 2025 (DN32 – See Note 1)
	Saudi Kayan	P6006AD	Yes	May 2025	September 2021 (DN32)

Note 1: There is no AS/NZS 4020 certificate specific to the Saudi Kayan site for P6006 Black. The Saudi Kayan site has been listed on the basis that all other data meets the requirements of AS/NZS 4131 and a Manufacturer's Declaration that all feedstock, additives, and processing is the same as the Saudi Yansab site which does have a specific AS/NZS 4020 certificate.

Pipe Material Compounds – assessed in accordance with AS/NZS 4131 and meeting the requirements of POP016 Raised Cracked Resistance & High Stress Crack Resistance PE100 Materials

MANUFACTURER	MANUFACTURING SITE	MATERIAL	PE I00-RC CONFORMITY	PE 100 HSCR CONFORMITY	POP013 CONFORMITY	DATE OF AS/NZS 4020
Borealis	Porvoo, Finland	HE3490 – LS-HP	May 2023		No	April 2023 (DN20)
	Porvoo, Finland	HE3494 – LS-HP (Blue)	May 2023		No	April 2023 (DN20)
Borouge	Ruwais, Abu Dhabi	HE3490-ELS-H	December 2022		Yes	February 2022 (DN32)
	Ruwais, Abu Dhabi	HE3490-LS-H	May 2024		No	June 2022 (DN32)
	Ruwais, Abu Dhabi	HE3492 LS-H (Orange)	December 2023		No	
Hanwha TotalEnergies Petrochemical Co., Ltd	Republic of Korea	XLS10B	December 2024		Yes	February 2024 (32mm ID)
	Republic of Korea	XRC30B	December 2024		Yes	November 2024 (32mm ID)
LyondellBasell	Wesseling, Germany	CRP100RCD Black	May 2023		Yes	November 2022 (DN20)
	Wesseling, Germany	CRP100 Resist Black		February 2023	Yes	November 2023 (DN20)
SCGC	Rayong, Thailand	SCGC HDPE H1000PCH	March 2023		No	May 2022 (25mmID)

Note: PE100 HSCR and PE100-RC materials are considered to be equivalent and interchangeable.

With the development of PE 100-RC International Standards it is intended that PE 100-RC will supersede PE 100 HSCR as Australia moves to align with international practices. Moving forward POP004 will have no new listings and no further reconformity of materials to PE 100 HSCR. Refer to POP016 Raised Cracked Resistance & High Stress Crack Resistance PE 100 Materials for more information.

Stripe and Jacket materials – assessed in accordance with AS/NZS 4130 PE 100

MANUFACTURER	PE 100	DATE SUBMITTED
VIVA ENERGY AUSTRALIA PTY LTD	EH6747 U Blue	Prior 2008
	EH5348 U Red	Prior 2008
	EH6574 U Purple	Prior 2008
	EH3748 U Yellow	Prior 2008
	EH0349 U White	Prior 2008
	EH0349 US White	September 2024
	EH6747 US Blue	September 2024
	EH3748 US Yellow	September 2024
	EH6574 US Purple	September 2024
	EH3479 US Cream	February 2025
	EH8416 US Grey	February 2025
	EH4477 US Orange	February 2025
	EH7519 US Green	February 2025
	EH5348 US Red	February 2025
POLYMER DIRECT	SCGC H1000PWI White	February 2012
	SCGC H112PBL Blue	June 2022
	SCGC H112PYL Yellow	June 2022

MANUFACTURER	PE 100	DATE SUBMITTED
MARTOGG	HDPE 0103 UV R01 R02 YW1150 Yellow	November 2024
	HDPE 0103 UV R01 R02 WT1406 White	November 2024
	HDPE 0103 UV R01 R02 BE2216 Dark Blue	November 2024
	HDPE 0103 UV R01 R02 BE2821 Light Blue	November 2024
	HDPE 0103 UV R01 R02 OG612 Orange	November 2024
	HDPE 0103 UV R01 R02 RD1937 Lilac	November 2024
	HDPE 0102 UV R01 R02 BE2216 Dark Blue	March 2025
	HDPE 0102 UV R01 R02 BE2821 Light Blue	March 2025
	HDPE 0102 UV R01 R02 OG612 Orange	March 2025
	HDPE 0102 UV R01 R02 RD1937 Lilac	March 2025
	HDPE 0102 UV R01 R02 WT1406 White	March 2025
	HDPE 0102 UV R01 R02 YW1150 Yellow	March 2025
	HDPE 0102 UV R01 R02 FN1562 Cream	March 2025
	HDPE 0102 UV R01 R02 RD1938 Red	March 2025
	HDPE 0102 UV R01 R02 GY2077 Grey	March 2025
	HDPE 0102 UV R01 R02 GN2480 Light Green	March 2025
	HDPE 0102 UV R01 R02 GN1924 Dark Green	March 2025
	HDPE 0103 UV R01 R02 FN1562 Cream	March 2025
	HDPE 0103 UV R01 R02 RD1938 Red	March 2025
	HDPE 0103 UV R01 R02 GY2077 Grey	March 2025
	HDPE 0103 UV R01 R02 GN2480 Light Green	March 2025
	HDPE 0103 UV R01 R02 GN1924 Dark Green	March 2025
	HDPE 0104 UV R01 R02 BE2216 Dark Blue	July 2025
	HDPE 0104 UV R01 R02 BE2821 Light Blue	July 2025
	HDPE 0104 UV R01 R02 FN1562 Cream	July 2025
	HDPE 0104 UV R01 R02 GN1924 Dark Green	July 2025
	HDPE 0104 UV R01 R02 GN2480 Light Green	July 2025
	HDPE 0104 UV R01 R02 GY2077 Grey	July 2025
	HDPE 0104 UV R01 R02 OG612 Orange	July 2025
	HDPE 0104 UV R01 R02 RD1937 Lilac	July 2025
	HDPE 0104 UV R01 R02 RD1938 Red	July 2025
	HDPE 0104 UV R01 R02 WT1406 White	July 2025
	HDPE 0104 UV R01 R02 YW1150 Bright Yellow	July 2025

MANUFACTURER	PE 100	DATE SUBMITTED
POLYPACIFIC	POLYCOMP 6030 UVH 5703 Lilac	October 2013
	POLYCOMP 6030 UVH 8388 White	December 2024
	POLYCOMP 6030 UVH 6270 Orange	October 2014
	POLYCOMP 6030 UVH 7F12 Grey	August 2015
	POLYCOMP 6030 UVH 2340 Dark Blue	November 2015
	POLYCOMP 6030 UVH 4056 Pale Yellow	October 2013
	POLYCOMP 6030 UVH 6350 Bright Orange	December 2024
	POLYCOMP 6030 UVH 4117 Yellow	August 2019
	POLYCOMP 6030 UVH 5714 Purple	May 2025
	POLYCOMP 6030 UVH 5719 Cream	May 2025
	POLYCOMP 6030 UVH 6275 Red	May 2025
	POLYCOMP 6030 UVH 2321 Blue	May 2025
	POLYCOMP 6030 UVH 2359 Light Blue	May 2025
	POLYCOMP 6030 UVH 3284 Lime Green	May 2025
	POLYCOMP 6030 UVH 3236 Green	July 2025
	POLYCOMP 6030 UVH 4069 Yellow	July 2025

Stripe and Jacket materials – assessed in accordance with AS/NZS 4130 and meeting the requirements of POP016 Raised Crack Resistant & High Stress Crack Resistance PE100 Materials

PE 100 HSCR

MANUFACTURER	PE 100 HSCR	DATE SUBMITTED
VIVA ENERGY AUSTRALIA PTY LTD	EH41076U (Blue)	August 2021
	EH61075U (Violet)	August 2021
	EH81074U (Bright White)	August 2021

APPENDIX

ELEVATED TEMPERATURE PERFORMANCE

The majority of PE pipe installations operate at approximately 20°C or lower. It should be noted that 20°C is the temperature at which the minimum required strength (MRS) of the PE compound is defined. The MRS being the lower predicted limit of the hydrostatic strength at a time of 50 years, rounded down[1]. Therefore, for the majority of PE pipelines there is no need to apply any temperature rerating factor when calculating the maximum allowable operating pressure (MAOP). However, there are some polyethylene pipeline applications where temperatures higher than 20°C are encountered- coal seam gas, above ground pipelines and bore water are examples. Because the properties of PE are temperature dependent it is necessary to apply a temperature rerating factor when calculating the MAOP for these higher temperature applications.

To determine the PE material classification according to ISO 9080, as required by AS/NZS 4131, a series of stress rupture pressure tests are performed at 20°C, 60°C and 80°C. ISO 9080 describes the procedure that allows the mathematical relationship between hoop stress, test temperature and time-to-failure to be calculated. It is from this relationship that the temperature rerating design factors in POP013 have been determined. These factors are the ratio of the MRS to the 97.5% lower prediction limit (σLPL) at the given temperature. ISO 9080 also provides explicit rules governing the maximum time to which the failure stress can be extrapolated at any temperature. The longer the pressure tests have been conducted, the longer the extrapolation.

PIPA has used this approach to determine the elevated temperature performance of the several, but not all materials listed in POP004 or POP004A. These are realistic, expected performances based on actual test data.

All materials listed in POP004 and POP004A will, as a minimum, meet the elevated performance nominated in ISO 13761 Plastics pipes and fittings – Pressure reduction factors for polyethylene pipeline systems for use at temperatures above 20°C. But in addition, there are some materials that have sufficient test data confirming they also meet the higher requirements of POP013. Those materials shown to meet not only the requirements of AS/NZS 4131 but also the extended performance of POP013 is identified in this guideline as "POP013 conformity demonstrated – Yes".

It must be understood that the materials that do not have the additional stress rupture data to demonstrate conformity with POP013 are not inferior with respect to POP004 and POP004A requirements.

For materials listed in this guideline that have not demonstrated conformity with POP013 ("Not assessed"), refer to AS/NZS 2033 Tables 3.1 and 3.2 for guidance.

[1] The complete definition of MRS according to AS/NZS 4131 is "The required value of σ_{LPL} for a temperature of 20°C and a time of 50 years ($\sigma_{20,\ 50\ years,\ 0.975}$), rounded down to the next smaller value of the R10 series or the R20 series conforming to ISO 3, ISO 497 or ISO 12162, depending on the value of the σ_{LPL}. The MRS is expressed as a hoop stress in megapascals.

MELT FLOW RATE

Stripe and jacket compounds listed in POP004 are required to meet the requirements nominated in AS/NZS 4130. In addition to these requirements PIPA has introduced a requirement that must be met before these compounds are listed in POP004. The additional requirement relates to the control of Melt Flow Rate (MFR measured at 190°C/5 kg load) for these compounds.

The additional requirement is for MFR of striping and jacketing compounds to be within +/-30% deviation of the MFR value reported for the base polymer grade used in production of the striping or jacketing compound – measured using the test method specified in ISO 1133.

The reason this requirement has been added is that MFR is an industry accepted indication of the molecular weight of a polymer which in turn determines mechanical strength of the product. A change in the MFR value measured on striping and jacketing compounds relative to the MFR value of the starting base polymer would indicate a change in molecular weight and deterioration of mechanical performance of the compound. This could lead to implications for the quality of the final pipe product where striping or jacketing compound had been used. MFR change of +/-30% is considered, based on current industry experience, acceptable to ensure the quality and integrity of the striping and jacketing compound.

RAISED CRACK RESISTANT & HIGH STRESS CRACK RESISTANT PE 100 MATERIALS

Raised Crack Resistant (PE100-RC) and High Stress Crack Resistant PE100 (PE100 HSCR) are PE100 materials which offers enhanced resistance to slow crack growth than regular PE100. See POP016 for more information about these materials and their minimum performance requirements.

PE 100-RC and PE 100 HSCR materials are considered to be equivalent and interchangeable.

PE 100-RC and PE 100 HSCR compounds must conform to both AS/NZS 4131 and the requirements listed in POP016. Compounds meeting all these requirements are identified in POP004 as PE 100-RC or PE 100 HSCR as applicable.

RAISED CRACK RESISTANT & HIGH STRESS CRACK RESISTANT PE100 COLOURED COMPOUNDS

Where a coloured stripe or jacket is specified for a PE100-RC or PE 100 HSCR pipe it is recommended that the coloured compound meet all the existing requirements for standard PE 100 coloured compounds but in addition the base resin must be a material meeting the requirements of POP016.

PE 112 MATERIALS

PE pipe compounds falling into the PE112 classification are defined by ISO 12162 (i.e., having a 50-year $\sigma_{LPL} \geq$ 11.2MPa at 20°C) are otherwise only assessed against the standard F 13 performance criteria and, where applicable, the additional requirements of POP013. This approach has been taken as there is no current provision in the relevant ISO or AS/NZS standards for defining the complete set of performance criteria for PE112 compounds. Consequently, pipe

compounds with an MRS of 11.2MPa, and proven to meet all other aspects of the PE100 performance criteria, will be listed as PE100 materials.

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Disclaimer

In formulating this guideline PIPA has relied upon the advice of its members and, where appropriate, independent testing.

Notwithstanding, users of the guidelines are advised to seek their own independent advice and, where appropriate, to conduct their own testing and assessment of matters contained in the guidelines, and to not rely solely on the guidelines in relation to any matter that may risk loss or damage.

PIPA gives no warranty concerning the correctness or accuracy of the information, opinions and recommendations contained in the guidelines. Users of the guidelines are advised that their reliance on any matter contained in the guidelines is at their own risk.