Plastics Industry Pipe Association of Australia Limited ACN 086 511 686

Industry Guidelines

TEMPERATURE RERATING OF PE PIPES

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Pipelines Integrity For a Cleaner Environment

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.

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TEMPERATURE RERATING OF PE PIPES

The Maximum Allowable Operating Pressure (MAOP) of a polyethylene (PE) pipe system is influenced by the temperature of the pipe wall. The nominal pressure rating (PN) assigned to an AS/NZS 4130 PE pipe equates to performance at 20°C, i.e. a PN16 pipe is capable of withstanding a MAOP of 160m head (or 1.6MPa or 16 bar pressure) when operating continuously at 20°C. However, as the temperature of the pipe wall increases, the MAOP of the pipe is reduced progressively – in other words the pipe system is re-rated with increasing temperature.

The guidance provided in this document is based on select PE compounds used in Australia and New Zealand to manufacture AS/NZS 4130 PE pipe and listed in PIPA Guideline POP004, *Polyethylene Pipe Compounds* and POP004A, *Supplementary List – Materials Specific to Electrofusion and Moulded Fittings,* and designated "POP013 conformity demonstrated – Yes".

For materials listed in POP004 and/or POP004A that have not demonstrated conformity with POP013 ("Not assessed"), refer to AS/NZS 2033 Tables 3.1 and 3.2 for guidance.

Where appropriate, specific advice should be obtained from the pipe manufacturer.

These guidelines apply to pipe used for the conveyance of water. Where other incompressible fluids are being considered, the designer must assess the effect of the fluid on the PE pipe system at the operating temperature.

The rerating factors in this guideline are expressed in terms of metre head of water and are not for use with compressed air or gas applications.

The following information details how to determine the temperature of the pipe wall and, then using the tables, determine the de-rated MAOP value for the system.

These recommendations are not to be taken as detailed specifications.

The rerating factors in Issue 2 of POP013, differed slightly from those appearing in earlier issues. This is a consequence of an analysis of more current test data available for some of the PE100 compounds listed in POP004 and POP004A. Any changes in rerating factors should not be taken as implying pipeline designs undertaken using rerating factors given in earlier issues of POP013 were wrong. Pipelines designed and operated using the rerating factors published in earlier issues will still meet the expected service life.

Note: *The service life extrapolations used in this guideline are based on ISO 9080 data and extrapolation rules. Actual service lifetime of the pipeline system depends on application conditions. ISO 9080 does not infer pipeline system service lifetime.*

Determining the temperature of the pipe wall

The pressure rating of PE pressure pipe systems is based on the temperature of the pipe wall, which may be determined from either:

a) an assumption of a constant pipe wall temperature typical for continuous service at a set temperature, e.g. cold water service; or
b) the determination of an average service temperature where temperature variations are likely to occur in a predictable pattern (refer below), e.g. in cavity walls or roof spaces; or
c) the maximum service temperature less 10°C for installations where large unpredictable temperature variations occur up to a maximum of 80°C, e.g. above-ground installations such as irrigation systems.

Predictable temperature variations

For installations where predictable temperature variations occur, the average material temperature is determined from Item (d) or Item (e) as follows:

a) *Across the wall of the pipe* — the material temperature taken as the mean of the internal and external pipe surface temperatures, where a temperature differential exists between the fluid in the pipe and the external environmental. The pressure and temperature condition, where flow is stopped for prolonged periods, should also be checked. In this event, fluid temperature and outside temperature may equalise.
b) *With respect to time* — the average temperature may be considered as the weighted average of temperatures for the proportion of time spent at each temperature under operational pressures; it is calculated with the equation:

$$T_m = T_1L_1 + T_2L_2 + \bullet\bullet\bullet + T_nL_n$$

where

T_m = average pipe material temperature for the period of time under consideration, in °C

T_n = average pipe material temperature for a proportion of pipe life, in °C

L_n = proportion of life spent at temperature T_n.

Determining the MAOP value

Once the temperature of the pipe wall has been determined using any one of the methods (a), (b) or (c) above - the following tables can be used to determine the re-rated MAOP for the PE pipe system.

Table 1 nominates the corresponding MAOP for a given temperature for PE80B material. Table 2 provides the same information for PE100 material.

Table 1: Maximum Allowable Operating Pressure - PE80B

Temp (°C)	Min Life (yr)	Design Factor	PN 3.2	PN 4	PN 6.3	PN 8	PN 10	PN 12.5	PN 16	PN 20
20	100	1.0	32	40	64	80	102	128	160	200
25		1.0	32	40	64	80	102	128	160	200
30		1.2	27	33	53	67	85	107	133	167
35		1.3	25	31	49	62	78	98	123	154
40		1.3	25	31	49	62	78	99	123	154
45		1.4	23	29	46	57	73	91	114	143
50	36	1.6	20	25	40	50	63	80	100	125
55	24	1.7	19	24	38	47	60	75	94	118
60	12	1.8	18	22	36	44	56	71	89	111
80	1	2.4	13	17	27	33	42	53	67	83

Table 2: Maximum Allowable Operating Pressure – PE100

Temp (°C)	Min Life (yr)	Design Factor	PN 4	PN 6.3	PN 8	PN 10	PN 12.5	PN 16	PN 20	PN25
			SDR41	SDR26	SDR21	SDR17	SDR13.6	SDR11	SDR9	SDR7.4
20	100	1.0	40	64	80	100	127	160	200	250
25	100	1.1	36	58	73	91	115	145	182	227
30	100	1.1	36	58	73	91	115	145	182	227
35	50	1.2	33	53	67	83	106	133	167	208
40	50	1.2	33	53	67	83	106	133	167	208
45	35	1.3	31	49	62	77	99	123	154	192
50	22	1.4	29	46	57	71	91	114	143	179
55	15	1.4	29	46	57	71	91	114	143	179
60	7	1.5	27	43	53	67	85	107	133	167
80	1	2.0	20	32	40	50	63	80	100	125

Note the minimum life periods may be considered to be the minimum potential service lives and represent the maximum extrapolated periods permitted by the ISO9080 extrapolation rules given the available test data.