

8. HANDLING & STORAGE

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Handling and Storage

8.1 GENERAL PRINCIPLES

Polyethylene is a tough resilient material which is relatively light and easy to handle although it is prone to damage through scoring by sharp objects. Therefore careful handling is always required and the dragging of straight pipe and coils should be avoided whenever possible.

1. The maximum allowable depth of scoring of the external surface of the pipe is 10% of the wall thickness. Pipes and fittings showing obvious defects or excessive scoring should be withdrawn, clearly identified as unsuitable and, where appropriate, returned to the source of supply.
2. The general properties of polyethylene are unaffected by low ambient temperatures but having very smooth surfaces, the pipes and fittings become slippery in wet or frosty weather. Particular attention should be given to effective securing and storage under such conditions.
3. As far as practicable the protective packaging (pallets, strapping, bags etc) should be kept intact until the material is required for use.
4. Pipes likely to be stored outside for periods longer than 12 months should be covered to prevent degradation from sunlight. Electrofusion fittings should be stored under cover and in their protective packaging.
5. Coiled Pipes

Pipe section >63mm should be moved and uncoiled using an approved dispensing trailer.

Before unstrapping pipe from the coil or drum, both pipe ends must be firmly mechanically restrained. The band securing the outer end of the pipe should be removed first and the movement of the free end carefully controlled. This removal should be followed with those securing successive layers. No more bands should be removed than necessary to release the length of pipe immediately required. After sufficient pipe has been cut from the coil the protective end cap must be replaced on the remainder. The outer end of the pipe should be suitably re-marked as such.

When removed from the coil or drum, the pipe will be oval and curved. The extent of the ovality and curvature will depend upon the temperature, SDR rating, pipe diameter, coil diameter and material type. Although both ovality and curvature will reduce naturally with time, special hardware is available to facilitate handling and joining.

8.2 HANDLING

Pipes

MDPE pipes are lighter in weight than other commonly used pipeline materials, and are relatively robust and resistant to damage. Notwithstanding these features, care must be exercised at all times to prevent damage to the pipes.

Pipes should be inspected on delivery to ensure that the packing has not come loose, allowing pipes to move over each other. Where pipes are damaged they must be removed from the remainder of the pipes and the supplier notified.

Damaged pipes must not be used in the installation.

PE pipes are supplied in either coils from smaller diameters (up to 125mm) or in straight lengths. The straight lengths may be up to 15 metres long, depending on transport and site conditions.

Coiled pipes may be supplied either on pallets, or as individual coils. These may be handled with a fork lift truck, using protected tines. The tines must not be forced into the layers of the coils, as this will damage the pipe walls.

Do not roll the coils off the back of trucks as this can lead to damage.

Only webbing slings should be used these must be passed fully through the complete coil layers.

Wire slings must not be used.

Straight length pipes can be handled either with a fork lift, or slings passed around the pipe. Bundled pipes can be handled under the timber packaging using the complete packaging to help protect the pipes.

For larger diameter pipes, a spreader bar may be required to help distribute the load and up to four sling points may be needed.

Pipes must not be dragged from trucks, or trailers, as this will cause scoring along the walls of the pipes, and damage ends of the pipes, or pre welded end fitting assemblies.

8.3 STORAGE

Pipes

All pipes and fittings should be inspected prior to storage and any damage items isolated and removed from stock. The supplier should be notified immediately of any defective product.

As PE pipes are date stamped at the time of manufacture, stocks should be arranged so that the earliest date production is used first in installation. The same procedure should be followed with fittings, where the packaging indicates a date of manufacture.

Where pipes are stored on site, the ground should be flat, and free from all rocks. Pipes must not be stored near high temperature sources and kept away from combustible materials and potential contaminants.

Handling and Storage

Full colour pipes must be covered when stored in direct sunlight for any extended period (12 months). Where covers are used, these should allow free air movement between pipe stacks to prevent temperature build up. Black pipes may be stored for extended periods without covers. Stack sites should be selected to allow ready access around, and between any stacks by handling equipment and staff. Care must be taken to ensure security and site safety of any stack sites.

In principle, stack heights should be kept to a minimum.

Different grades of PE and different pressure classes should be segregated to prevent confusion in selection at the time of installation.

Coiled pipes should be store flat to prevent distortion and where coils are stacked on top of each other, the maximum number of stacked coils should be limited to 5 for pipe diameters up to 32mm, 4 for pipe diameters 50mm and 63mm and 2 for pipe diameters 90mm and 110mm.

Crated pipes may be stacked on top of each other, if the timber frames bear on each other. The maximum stack height under these circumstances should be limited to 2 metres.

Where flanges, or other end fittings are pre assembled on the pipe ends, these must not be allowed to bear directly on each other, the pipe barrels, or directly on the ground as a point load.

Pipe Strings

Where pipes are strung out along the proposed pipeline alignment, they should be located at a distance to allow free access to excavation equipment. The pipes should be restrained to prevent any possibility of the pipes rolling.

Fittings

Fittings should be stored in original packaging until required for actual installation. The containers should be stored under cover at all times.

Large diameter fittings should be stored on an even base, and not subject to other loads. Fittings should not be stacked on top of each other.

End fittings, and gasket sealing surfaces must be protected at all times to prevent distortion, or gouging of the surfaces.

All sealing gaskets and rings must be stored in light proof containers, and kept away from heat sources and contaminants such as petrol and oils.

8.4 TRANSPORT

Where pipes are transported by road, or rail, they must be evenly supported at all times.

Coiled pipes should be transported laid flat on the bed of the tray.

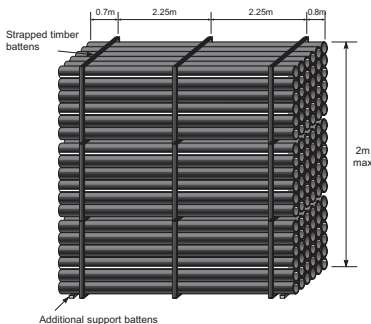
For transporting, vehicles should be provided with a clean flat bed, free from nails or other projections which may cause damage. If high sided lorries are used, special care must be taken to prevent slippage or excessive bowing of the pipes and extra protection given at all sharp edges.

Coils may be stacked on top of each other, provided that they are evenly placed on top of each other and firmly secured to prevent movement. If coils are transported vertically, then they must be secured to prevent movement, and any distortion at the bottom of the coils. Other materials must not be placed on top of the coils.

Care should be taken to avoid positioning pipes and fittings near or adjacent to exhaust systems or other head sources and to avoid possible contamination from materials such as diesel oil.

Straight length pipes must be stacked evenly along the length of the truck trays, and evenly supported using timber spacers 75mm wide, and spaced at gaps of 3 metres. All end fittings must be protected and raised up above the tray floors, and not allowed to bear directly on any pipes, or other surfaces. Large diameter, or low pressure class, pipes can be subject to localised distortion and should have internal supports placed in the ends of the pipes.

All pipes should be covered by tarpaulins during transport to prevent road film contamination, and the pipes must be kept away from all heat sources and other sources of contamination.



Individual straight pipes may be stored in either pyramid shape stacks, or side supported stacks.

For pyramid stacks, the bottom pipes must be securely supported to prevent any movement. The pipes can then be stacked neatly on the lower layer up to a maximum stack height of 1.5 metres.

Pipes should be supported with timber spacers 75mm wide, located at 1.5 metre gaps along the length of the pipes. Care must be taken to ensure localised distortion does not take place. The maximum stack heights should not exceed 2 metres.

Large diameter pipes should not be stacked on top of each other.

Only webbed slings of polyethylene or nylon are recommended. Straight pipes should be fully supported and bound together. Pipes must not rest on the integral socket, if one is incorporated.

When transporting fabricated fittings, these should not be loaded in a way that could distort the end, or left exposed to direct sunlight.

Both vertical and horizontal deliveries of coiled pipes are permissible, although in the case of horizontal transportation special notification may be required for highway authorities in respect of wide load regulations.

No other cargo, or loads, should be placed on top of PE pipes during transport.

8.5 PVC PIPE HANDLING

8.5.1 Handling and Storage

PVC pipe is very robust, but still can be damaged by rough handling. Pipes should not be thrown from trucks or dragged over rough surfaces. Plastic piping becomes more susceptible to damage in very cold weather so extra care should be taken when the temperature is low.

Since the soundness of any pipe joint depends on the condition of the spigot and the socket, special care should be taken not to allow them to come into contact with sharp edges or protruding nails or made oval by poor storage.

8.5.2 Transportation of PVC Pipes

While in transit pipes should be well secured and supported. Chains or wire ropes may be used only

if suitably padded to protect the pipe from damage. Care should be taken that the pipes are firmly tied so that the sockets cannot rub together.

Pipes may be unloaded from vehicles by rolling them gently down timbers, care being taken to ensure that the pipes do not fall onto one another or onto any hard or uneven surface.

8.5.3 Storage of PVC Pipes

Pipes should be given adequate support at all times. Pipes should be stacked in layers with sockets placed at alternate ends of the stack and with the sockets protruding.

Horizontal support of about 75 mm wide should be spaced not more than 1.0m centre-to-centre beneath the pipes to provide even support. Vertical side supports should also be provided at intervals of 2m along rectangular pipe stacks.

For long term storage (longer than 3 months) the maximum free height should not exceed 1.0m. The heaviest pipes should be on the bottom. The crates used for delivery are adequate for long term storage provided additional bearers (approx. 75mm wide) are placed under the pipes between the crate frames.

If it is planned to store pipes in direct sunlight for a period in excess of one year, then the pipes should be covered with a material such as hessian. Coverings such as black plastics must not be used as these can greatly increase the temperatures within the stack (see Weathering).

NOTE: Many pipe failures can be traced to faults in handling and storage. Refer to AS/NZ 2032 and 2033

Handling and storing on site



Incorrect way to load pipes



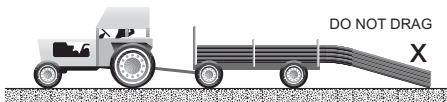
Correct way to load pipes



Incorrect way to off-load



Correct way to off-load



On-site transport



Individual pipe stacks on site

8.6 ABOVE GROUND INSTALLATION

**(refer to AS/NZ 2566.1,
AS/NZ 2032, AS/NZ 2033)**

8.6.1 General Conditions

In above ground installation, pipes should be laid on broad, smooth bearing surfaces wherever possible to minimise stress concentration and to prevent physical damage e.g. cable trays.

PVC pipe should not be laid near steam lines or in proximity to other high temperature surfaces.

Where PVC pressure pipeline is used to supply cold water to a hot water cylinder, the last two metres of pipe should be made of copper and a non return valve fitted between the PVC and copper line to prevent pipe failure.

If a pipeline is subjected to continuous vibration such as the connection with a pump, it should be connected by a flexible joint or, if possible, the system should be redesigned to eliminate the vibration.

PVC pipe must not be used to reticulate compressed air.

The pipe must be adequately supported in order to prevent sagging and excessive distortion. Clamp, saddle, angle, spring or other standard types of supports and hangers may be used where necessary. Pipe hangers should not be over tightened. Metal surfaces should be insulated from the pipe by plastic coating, wrapping or other means.

9. TESTING & COMMISSIONING

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Testing and Commissioning

PVC Pipeline Testing

Testing and Commissioning

The pipeline may be tested as a whole or in sections, depending on the diameter and length of the pipe, the spacing between sectioning valves or blank ends and the availability of water.

Pipelines should be bedded and backfilled, but with the joints left uncovered for inspection before and after testing.

All thrust supports for fittings and valves must be finished and the concrete properly cured (the minimum time is seven days). Blank ends installed temporarily should be adequately supported to take the pressure thrust.

Fill the pipeline with water and remove air from the system as far as possible. Pressurise the system. Additional water will be required to bring the line up to pressure because the pipe expands slightly. For example, to reach 1.5 times working pressure requires about 1% additional volume.

After reaching test pressure, note the drop in pressure over time. It is normal for a pressure drop to occur as the remaining air goes into solution, and some further expansion of the pipe (around 0.1%) will also occur.

The expansion due to temperature rise of 1°C will decrease the pressure by about 3.4 kPa.

Re-pressurise and again note the drop in pressure over the same time period. A diminished pressure drop indicates a satisfactory test. A similar pressure drop may indicate a leak. It may be necessary to repeat the procedure several times to be sure.

An absolute maximum test pressure of 1.5 times the design pressure should be applied to the pipe test section. This pressure should be measured at the lowest point in the system. When using pressures higher than the design pressure, ensure that the thrust blocks, valves or other fittings have been designed to take these higher pressures. The procedure is specified in AS/NZ 2032 and 2033.

Flushing

Following successful testing, the line should be thoroughly flushed and dosed with a sterilising agent such as chlorine. Local authority requirements should be followed.

Testing and Commissioning

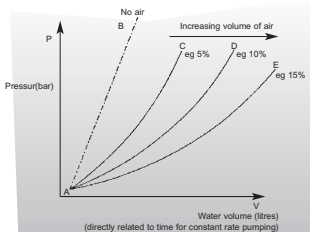
Polyethylene Pipeline Testing

9.1 INTRODUCTION

All completed PE pipelines should be tested to ensure that all joints, fittings, anchorage blocks are installed correctly and that there are no defects in the pipes causing leakage or loss of fluid.

The actual testing procedures to be adopted will vary on the actual application of each pipeline and the specific requirements laid down by the relevant Local Authority in tender contract documents.

The local authority specifications must be followed at all times.



Typical Pressure/volume characteristic during pressurisation

The introduction of the PE63, PE80 and PE100 rating systems in AS/SNZ 4130 and the modification to the applied design factor applied to calculate each of the pressure class wall thicknesses, has resulted in reduced pipe wall section thicknesses, when compared to the previous AS1159. This means that the hydrostatic test pressure applied for pressure pipes must also be reduced from the previous values applied to AS 1159 pipes.

All PE materials listed in AS/NZS 4130 behave in an elastic manner when internally pressure tested and this shows up as an apparent pressure loss, or lead on the test recording gauge due to the increase in pipe volume as the pipeline expands. This means that, as distinct from rigid pipeline materials, a makeup volume of water may be needed to be added to the pipeline during the test period to maintain a constant pressure reading. PE pipelines subjected to extended periods of high test pressure may also creep over the test period and this may show up as a drop in the pressure readings.

Neither of these observations means that a leak is present in the pipeline.

9.2 PRE TESTING CONSIDERATIONS

Prior to carrying out any testing activities, a number of precautions need to be observed.

- All facilities must be available and sufficient notice given to relevant Local Authority to allow compliance inspection prior to any testing being carried out.
- All residential construction materials must be removed from the trench or embankment, alignments so that no additional materials are in direct contact with the PE pipes or fittings. There should be no point loading on fittings.
- PE pipelines must be supported by either backfilling with soil or loaded with sandbags to prevent movement and possible mechanical seal joint displacement. Where PE pipes are partially backfilled over the entire length, leaving open only the joints at the start and end of the pipe run.
- Where cast insitu concrete thrust blocks are used, a minimum period of 7 days should be allowed before testing. Where timber or moulded blocks are used then testing can start as soon as required. All blanked off ends, including valves, must be fully supported.
- All intermediate valves should be opened to allow full venting of entrapped air from the PE pipeline.
- Where water is used as the test fluid, then PE pipeline testing should not be performed in wet weather, unless any potential leakage can be readily observed on site.
- Where thermal fusion joints are used in the PE pipeline, no testing should proceed until the last joint made has completely cooled to ambient temperature.

9.3 PE PRESSURE PIPELINE TESTING

PE pipelines may be tested as a single section for lengths up to 800 metres, depending on the size of the pipe and the availability of test water. Beyond this length, the pipeline should be progressively tested in sections.

The test section must be swabbed and flushed clean before introducing test water. The test water should be introduced at the lowest available point to assist air venting and all air vent valves opened.

Testing and Commissioning

As PE pipes are subject to thermal expansion and contraction the testing should take place at ambient temperature and the water should be introduced and the pipeline kept full of water (but **not under pressure**) for 12 hours where elevated temperatures are encountered. Where pipes are at ambient temperature testing may commence as soon as required.

Pressure test gauges or recording devices should be placed at the lowest elevation point accessible in the pipeline.

The test water should be fed into the pipeline evenly and without pulsation up to the nominated test pressure value. The actual test pressures adopted may vary depending on the Local Authority requirements and these must be adhered to at all times.

For **small diameter PE pipelines** (up to 110mm diameter) a test pressure of a **maximum of 1.2 WP** (working pressure) may be applied for a period of 15 minutes or for sufficient time to allow the pipeline to be inspected for leakage at all joints. The same procedures may be adopted for small length additions to existing pipelines. The pressure gauge reading should not drop once the pressure has stabilised.

For PE pipe property service connections using PN16 class PE pipe, a standard test pressure of 1.5 MPa may be applied uniformly for all applications. For **large diameter PE pipelines** and for pipeline lengths up to 800 metres, the volume change in the pipes under the action of the test pressure needs to be evaluated. Pipes should be brought up to test pressure and the pressure stabilised by introducing make up water.

A test pressure of a maximum of 1.25 times WP (working pressure) may be applied for a period of up to 8 hours, or for sufficient time to inspect all joints and connections for signs of leakage. Pressure gauge readings should be taken at regular time intervals during the test period to ensure that leakage does not take place.

High pressure testing using air must not be carried out.

The following are identified as contributing factors to variations in the pressure test results:

- length of the test section
- diameter of the pipe
- temperature changes
- range of test pressure imposed
- rate of pressure loading
- presence of air in the pipeline
- relative movement of 'mechanical' fittings
- efficiency of the bedding and compacted surround to resist pipe movement.
- accuracy and efficiency of testing apparatus.

9.3.1 Air Testing

All openings must be sealed prior to testing. Air should be pumped slowly into the PE pipeline

until a test pressure of 50 KPa is reached on a recording gauge fitted to the pipeline. The test pressure of 50 KPa must be maintained for a minimum time of 3 minutes and if no leaks are detected or pressure loss is observed on the gauge, then the air supply control valve should be turned off.

The pressure should be held for a minimum time of 1 minute and if the gauge pressure reading has not fallen below 35 KPa after this time then the test pressure should be released.

When the test pressure drops below 35 KPa after 1 minute, then the pressure should be returned to 50 KPa and this pressure maintained until a full inspection of the PE pipeline has been completed. All joints and connections need to be individually inspected for leakage and a solution of water and detergent should be poured over any suspect joint. If a leak is present, it will cause the detergent solution to bubble and foam.

The test must be accepted by the relevant Local Authority representative before completing the testing.

9.3.2 Deflection Testing

PE drainage pipelines are designed to support external loading within the acceptable limits of diameter deflection (or ovality) for hydraulic or structural reasons.

Where this is a critical feature of the installation, then the effectiveness of the backfill compaction may require testing.

In these cases a resized plug, or proving tool can be pulled through the pipeline between manholes or other entry points.

For flanged, electrofusion or mechanically jointed PE pipelines without any protrusions into the pipe bore due to the joints, the plug can be sized to the maximum diameter reduction allowed in the design.

For butt welded PE pipes, unless the internal beads are removed, the plug needs to be sized to account for the weld bead presence.

In either case, the plug should be able to be pulled completely through the PE pipeline.

9.4 GAS PIPE TESTING

For gas pipe installations, testing should not proceed until the last completed fusion joint has had adequate time to fully cool to ambient temperature. Hydrostatic pressure testing may be carried out using inert liquid (such as water), air or an inert gas approved by the utility.

Test pressure such as $TP = 1.10 \times WP$ may be applied for pipelines provided that the test pressure is not less than 100 KPa and does not exceed 1.5 times the design pressure of the pipeline system. For larger diameter or longer pipelines, progressive testing may be applied such that:

| Test Device | Test Pressure | Test Duration |
|--------------------------|---------------|------------------------------------|
| Dial gauge | 700 KPa | Overnight |
| Differential leak tester | 700 KPa | 30 mins stability then 5 mins test |

Testing and Commissioning

Final testing may be applied or required by the utility after progressive test in the form of:

| Test Device | Test Pressure | Test Duration |
|-------------|---------------|-------------------|
| Dial gauge | 700 KPa | 24 hours, no drop |
| Recorder | 700 KPa | 24 hours, no drop |

9.5 PRESSURE TEST

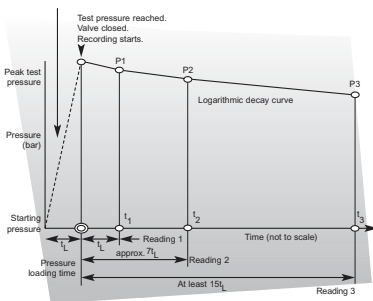
9.5.1 Large Bore Commissioning

On reaching the test pressure and satisfying the condition for minimal air entrapment, the pipeline is isolated and the pressure allowed to decay. The pressure decay readings (L) to achieve test pressure is used as a reference. The natural pressure decay readings at predetermined times are then recorded in minutes from the movement of valve closure.

The analysis will be more comprehensive with larger numbers of readings being taken throughout the test.

Since the pipeline begins to relax within the period of pressurisation, a correction factor has to be applied to allow for this. Experience suggests that this correction should be 0.4t_L.

A typical sequence of readings is illustrated below.



9.6 PRESSURE TEST ANALYSIS – Three Point Analysis

To demonstrate that the PE pipeline is sound, an analysis of the pressure test is carried out as follows:

As the pressure decay is of exponential form, the use of logarithms is necessary when comparing readings taken during the test but the use of pocket calculator is all that is required for 'on site' calculations.

9.6.1

Take a first reading of pressure P₁ at t₁, where t₁ is equal to the pressure loading time (t_L).

9.6.2

Take a second reading of Pressure P₂, at a time approximately 7t_L; Let this be t₂.

To allow for the stress relaxation behavior of PE pipelines, calculate the corrected values of t₁ and t₂.

- calculate corrected t₁
 $t_{1c} = t_1 + 0.4t_L$
- calculate corrected t₂
 $t_{2c} = t_2 + 0.4t_L$

9.6.3

The measure of the slope of the pressure decay curve between t₁ and t₂ is then calculated as the ratio n₁.

$$\text{Calculate } n_1 = \frac{\log P_1 - \log P_2}{\log t_{2c} - \log t_{1c}}$$

For a sound main, experience suggests that the ratio n₁ should be;

- 0.08 – 0.10 for pipes without constraint (eg sliplined or not backfilled).
- 0.04 – 0.05 for pipes with compacted backfill.

Bearing in mind the identified compaction, if the values are significantly less than the minimum identified, then there is too great a volume of air in the main. This air will have to be removed before a satisfactory test can be performed.

9.6.4

Take a further reading of pressure P₃ at a decay time not less than 15t_L. Let this be t₃. Again to allow for the stress relaxation behavior of PE pipelines, calculate the correct value for t₃.

$$T_{3c} = t_3 + 0.4t_L$$

9.6.5

The measure of the slope of the pressure decay curve between t₂ and t₃ is then calculated as the ratio of n₂.

$$\text{Calculate } n_2 = \frac{\log P_2 - \log P_3}{\log t_{3c} - \log t_{2c}}$$

For a pipe system with no leakage and bearing in mind the identified compaction, then the ratio of n₂ should be:

- 0.08 – 0.10 for pipes without soil constraint,
- 0.04 – 0.05 for pipes in compacted backfill.

Testing and Commissioning

The figure below shows the results of test (using graphical analysis with multiple results from a data logger) on mains without leaks in unconstrained and constrained situations respectively.

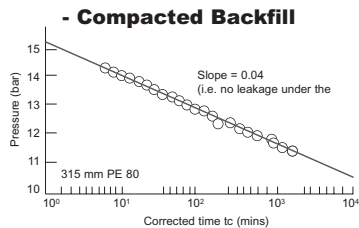
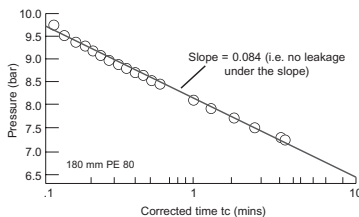
The sensitivity of the test can be increased by extending the value of t_3 i.e. extending the test duration.

9.6.6

The procedure detailed above identifies the principle. However it is strongly advised that the slopes n_1 and n_2 are obtained from more than three points.

PRESSURE REGRESSION

- Unrestrained



9.7 PRESSURE TEST ANALYSIS

- Predicted Pressures

9.7.1

To allow an early indication of problems such as leakage or air entrapment, a supplementary analysis can be carried out during the pressure test. This necessitates comparing the recorded pressure at any point in time with the predicted pressure since the logarithmic plot of pressure decay in an ideal PE pipeline system should be linear. Any deviation from linearity indicates the possibility of leakage or air entrapment.

9.7.2

The predicted pressure can be calculated from

$$P = P_L \left[2.5 \left(\frac{t}{t_L} \right) + 1 \right]^{-n}$$

Where

- P = predicted pressure at time t
- P_L = test pressure (at start of test when the test pressure is first reached)
- t = time (from reaching the test pressure)
- t_L = loading time

From experience it has been shown that:

For pipes installed in compacted soil $n = 0.04$

For pipes installed without support $n = 0.10$

9.7.3

If the actual pressure recorded was found to differ significantly from the predicted value, then a formal slope analysis using all the data collected so far could be conducted.

The data should be plotted on log paper or converted to logs prior to plotting on normal paper. If the graph shows an increasing slope with time (A - C) (ie the actual recorded pressures were less than the predicted values), this indicates leakage. If the graph shows a decreasing slope with time (A - B), ie the actual recorded pressure were greater than the predicted values), this indicates air entrapment. If the slope is linear but between the slopes identified (ie 0.04 - 0.05 and 0.08 - 0.1) this probably indicates poor backfill compaction, but not a failed test.

Note: It is possible to predict leakage rates as a function of water volume added.

9.7.4

If at any stage during the pressure test an unacceptable leak is indicated, it is advisable to check all mechanical fittings before visually inspecting the fusion joints. Any defect in the installation revealed by the test should be rectified and the test repeated.

For smaller pipelines, <500m in length and/or >80mm diameter and <200 metres in length, the test pressure of 700 KPa may be reduced to a test time of 5 minutes duration after allowing the pipe pressure to act for 30 minutes without any observed pressure drop on the gauge.

In all instances, where bubble testing is carried out using a soft soap solution, no leakage shall be permitted at any tested point.

Testing and Commissioning

9.8 COMMISSIONING

PE pipelines should be commissioned following the standard practices adopted by the relevant Local Authority.

This applies for both pressure and non pressure applications.

In the case of potable water applications, the standard flushing and disinfection procedures must be followed. PE pipes made to AS/NZ 4130 do not impart additional water quality flushing or disinfection requirements due to corrosion products, heavy metal uptake, or pH change, and where these aspects have been included in standard commissioning procedures, then consideration should be given to the need for these elements.

10.0 PIPELINE LOCATION, MARKING, RECORDING AND DETECTION

10.1

PE pipes are electrically non conductive and as such cannot be detected by magnetic detection devices.

However, where it is desired to detect buried pipelines, several techniques are available.

Metal Detector Tapes

Custom tapes may be located on top of the PE pipe cover material (150 – 300mm above the top of the pipe) and can be detected by metal detection equipment operating in the 4-20 MHz range at depths up to 600mm.

The tapes also offer colour coded identification and early warning of the presence of the pipeline during later excavations.

Trace Wires

Pipes deeper than 600mm may be detected by the use of tracer wires placed underneath the pipeline. Application of a suppressed current allows the detection of pipes up to 3 metres depth. However, both ends of the wire must be accessible and a complete circuit must be available without breakage of the wire over the length of the pipeline.

Audio Detection

Several types of acoustic detectors are available using either the sound of turbulence from flow in the line or by the introduction of an outside sound source.

10. CHEMICAL RESISTANCE

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Chemical Resistance

Three different classes of chemical resistance degree are conventionally used in this guide ie:

Class 1: HIGH RESISTANCE (corrosion-proof) - all materials belonging to this class are completely or almost completely corrosion-proof against the conveyed fluid, according to the specified operating conditions.

Class 2: LIMITED RESISTANCE - the materials belonging to this class are partially attacked by the conveyed chemical compound. The average life of the material is therefore shorter, and it is advisable to use a higher safety factor by selecting a higher SN rating pipe.

Class 3: NO RESISTANCE - all material belonging to this class are subject to corrosion by the conveyed fluid and they should therefore not be used.

The absence of any class indication means that no data are available concerning the chemical resistance of the material in respect of the conveyed fluid.

ABBREVIATIONS

sat = saturated solution at 20°C, **nd** = undefined concentration,
deb = weak concentration, **comm** = commercial solution. **dil** = diluted solution

| | FORMULA | CONC % | TEMP (°C) | PVC | PE | | FORMULA | CONC % | TEMP (°C) | PVC | PE |
|---|--|---------------------|-----------|--------|--------|---|---|--------|-----------|--------|--------|
| ACETALDEHYDE | CH ₃ CHO | 100 | 25 60 | 3 3 | 1 1 | - FLUORIDE | NH ₄ F | 25 | 25 60 | 2 2 | 1 1 |
| - AQUEOUS SOLUTION | | 40 | 25 | 3 | 1 | - HYDROXIDE | NH ₄ OH | 2B | 25 60 | 2 2 | 1 1 |
| ACETIC ACID | CH ₃ COOH | ≤ 25 | 25 60 | 1 2 | 1 1 | - NITRATE | NH ₄ NO ₃ | sat | 25 60 | 1 1 | 1 1 |
| | | 30 | 25 | 1 | 1 | - PHOSPHATE DBASIC | (NH ₄) ₂ HPO ₄ | all | 25 | 1 | 1 |
| | | 60 | 25 | 1 | 1 | - PHOSPHAT META | (NH ₄) ₂ P ₂ O ₇ | all | 25 | 1 | 1 |
| | | 80 | 25 | 1 | 1 | - PHOSPHATE TRI | (NH ₄) ₂ PO ₃ | all | 25 | 1 | 1 |
| - GLACIAL | | 100 | 25 | 2 | 1 | - PERSULFATE | (NH ₄) ₂ S ₂ O ₈ | all | 25 | 1 | 1 |
| ACETIC ANHYDRIDE | (CH ₃ CO) ₂ O | 100 | 25 | 3 | 2 | - SULFIDE | (NH ₄) ₂ S | deb | 25 | 1 | 1 |
| ACETONE (DIMETHYL KETONE) | CH ₃ COCH ₃ | 10 | 25 | 3 | 1 | - SULFHYDRATE | NH ₄ HSO ₄ | dil | 25 | 1 | 1 |
| | | 100 | 25 | 3 | 2 | | | sat | 25 | 1 | 1 |
| | | 60 | 25 | 3 | 2 | | | 60 | 25 | 1 | 1 |
| ACETOPHENONE (ACETYL BENZENE OR PHENYL METHYL KETONE) | CH ₃ COC ₆ H ₅ | nd | 25 | 60 | | | | all | 25 | 1 | 1 |
| | | | 60 | | | | | dil | 60 | 2 | 1 |
| | | | 60 | | | | | sat | 25 | 1 | 1 |
| | | | 60 | | | | | 60 | 1 | 1 | 1 |
| ACRYLONITRILE (ACRYLONITRILE OR VINYL CYANIDE) | CH ₂ CHCN | technically pure | 25 60 | 3 3 | 1 1 | AMYLACETATE (PENTYL ACETATE) | CH ₃ CO ₂ CH ₂ CH ₂ CH ₂ CH ₃ | 100 | 25 | 3 | 1 |
| ADIPIC ACID AQUEOUS SOLUTION | (CH ₂ CH ₂ CO ₂ H) ₂ | sat. | 25 | 1 | 1 | AMYLALCOHOL | CH ₃ (CH ₂) ₅ CH ₂ OH | nd | 25 | 1 | 1 |
| | | | 60 | 2 | 1 | ALMINE (PHENYLAMINE OR AMINO BENZENE) | C ₆ H ₅ NH ₂ | all | 25 | 3 | 2 |
| ALLYL ALCOHOL | CH ₂ CHCH ₂ OH | 98 | 25 | 1 | 1 | - CHLORHYDRATE (ANILINE HYDROCHLORIDE) | CH ₃ H ₃ NH ₂ HCl | nd | 25 | 2 | 2 |
| | | | 60 | 3 | 2 | ANTIMONY - TRICHLORIDE | SbCl ₃ | 100 | 25 | 1 | 1 |
| ALUM AQUEOUS SOLUTION (POTASH ALUM SOL.) | Al ₂ (SO ₄) ₃ ·xH ₂ O | dil | 25 | 1 | 1 | ANTHRACINONE (SULFONIC ACID) | suspension | 25 | 1 | 1 | 1 |
| | | all | 60 | 2 | 1 | AQUA REGIA | HCl+HNO ₃ | 100 | 25 | 2 | 3 |
| | | sat. | 60 | 2 | 1 | ARSENIC ACID | H ₃ AsO ₄ | deb | 25 | 1 | 1 |
| ALUMINUM - CHLORIDE | AlCl ₃ | all | 25 | 1 | 1 | | | 60 | 2 | 1 | 1 |
| - FLUORIDE | AlF ₃ | 100 | 25 | 1 | 1 | BARUM CARBONATE | BaCO ₃ | all | 25 | 1 | 1 |
| | | | 60 | 1 | 1 | - CHLORIDE | BaCl ₂ | 10 | 25 | 1 | 1 |
| - HYDROXIDE | Al(OH) ₃ | all | 25 | 1 | - | - HYDROXIDE | Ba(OH) ₂ | all | 25 | 1 | 1 |
| | | | 60 | 1 | - | - SULFATE | BaSO ₄ | nb | 25 | 1 | 1 |
| NITRATE | Al(NO ₃) ₃ | nd | 25 | 1 | - | - SULFIDE | BaS | sat | 25 | 1 | 1 |
| | | | 60 | 1 | - | BEER | | comm | 25 | 1 | 1 |
| SULFATE | Al(SO ₄) ₃ | deb | 25 | 1 | - | BENZALDEHYDE | C ₆ H ₅ CHO | nd | 25 | 3 | 2 |
| | | sat | 25 | 1 | 1 | | | 60 | 3 | 2 | 2 |
| | | | 60 | 1 | 1 | | | 60 | 3 | 2 | 2 |
| AMMONIA - AQUEOUS SOLUTION | NH ₃ | deb | 25 | 1 | 1 | | | 60 | 1 | 1 | 1 |
| | | sat | 25 | 1 | 1 | | | 60 | 1 | 1 | 1 |
| | | sat | 60 | 2 | 1 | | | 60 | 1 | 1 | 1 |
| | | sat | 60 | 2 | 1 | | | 60 | 1 | 1 | 1 |
| - DRY GAS | | 100 | 25 | 1 | 1 | | | 60 | 1 | 1 | 1 |
| | | | 60 | 1 | 1 | | | 60 | 1 | 1 | 1 |
| - LIQUID | | 100 | 25 | 2 | 1 | | | 60 | 1 | 1 | 1 |
| | | | 60 | 3 | 1 | | | 60 | 1 | 1 | 1 |
| AMMONIUM - ACETATE | CH ₃ COONH ₄ | sat | 25 | - | 1 | | | 60 | 1 | 1 | 1 |
| - CARBONATE | (NH ₄) ₂ CO ₃ | all | 25 | 1 | 1 | | | 60 | 1 | 1 | 1 |
| | | | 60 | 2 | 1 | | | 60 | 2 | 1 | 1 |

Chemical Resistance

| | FORMULA | CONC % | TEMP (C) | PVC | PE | | FORMULA | CONC % | TEMP (C) | PVC | PE |
|--|--|------------------|----------|-----|----|-------------------------------------|---|---------------------|----------|-----|----|
| BENZENE (BENZOL) | C ₆ H ₆ | 100 | 25 | 3 | 3 | - CHLORAMINE | NH ₂ Cl | di | 25 | 1 | 1 |
| | | | 60 | 3 | | | | | | | |
| + LIGRON | C ₁₀ H ₈ | 20/80 | 25 | 3 | 3 | - CHLORIC ACID | HClO ₃ | 20 | 25 | 1 | 1 |
| | | | 60 | 3 | | | | | | | |
| - MONOCHLORINE | C ₂ H ₅ Cl | technically pure | 25 | 3 | 2 | - CHLORINE | Cl ₂ | sat | 25 | 2 | 2 |
| | | | 60 | | | | | | | | |
| BENZOIC ACID | C ₆ H ₅ COOH | sat | 25 | 1 | 1 | - DRY GAS | | 10 | 25 | 1 | 1 |
| | | | 60 | 2 | 1 | | | 100 | 25 | 2 | 2 |
| BENZYL ALCOHOL | C ₆ H ₅ CH ₂ OH | 100 | 25 | 1 | 1 | - WET GAS | | 5 g/m ³ | 25 | 1 | 1 |
| | | | 60 | 2 | | | | 10 g/m ³ | 25 | 2 | 2 |
| BORIC ACID (BORACIC ACID) | H ₃ BO ₃ | deb | 25 | 1 | 1 | - LIQUID | | 66 g/m ³ | 25 | 2 | 2 |
| | | sat | 60 | 2 | 1 | | | 100 | 25 | 3 | 3 |
| BRINE | | comm | 25 | 1 | 1 | - CHLOROACETIC ACID | ClCH ₂ COOH | 85 | 25 | 1 | 2 |
| | | | 60 | 1 | 1 | | | | 100 | 25 | 1 |
| BROMIC ACID | HBrO ₃ | 10 | 25 | 1 | 1 | - CHLOROBENZENE | C ₆ H ₅ Cl | all | 60 | 3 | |
| | | | 60 | 3 | 3 | | | | | | |
| BROMINE - LIQUID - VAPOURS | Br ₂ | 100 | 25 | 3 | 3 | - CHLOROFORM | CHCl ₃ | all | 25 | 3 | 2 |
| | | low | 60 | 3 | 3 | | | | | | |
| BUTADIENE | C ₄ H ₆ | 100 | 25 | 1 | 1 | - CHLOROSULPHONIC ACID | ClHSO ₃ | 100 | 25 | 2 | 3 |
| | | | 60 | 1 | 3 | | | | | | |
| BUTANEDIOL AQUEOUS | C ₄ H ₉ O ₂ | 10 | 25 | 1 | 1 | - CHROME ALUM | K ₂ Cr ₂ O ₇ | nd | 25 | 1 | 1 |
| | | concentrated | 60 | 3 | 3 | | | | | | |
| BUTANE GAS | C ₄ H ₁₀ | 10 | 25 | 1 | 1 | - CHROMIC ACID | CrO ₃ +H ₂ O | 10 | 25 | 1 | 2 |
| | | | 60 | 1 | 1 | | | | | 30 | 25 |
| BUTYL - ACETATE (BUTANATE) - ALCOHOL (BUTANOL) | C ₄ H ₉ OH | 25 | 1 | 1 | 1 | - CHROMIC SOLUTION | CrO ₃ +H ₂ O+H ₂ SO ₄ | 50/35/15 | 25 | 1 | 3 |
| | | | 60 | 2 | 1 | | | | | | |
| - PHENOL | C ₆ H ₅ OH | 100 | 25 | 2 | 3 | CITRIC ACID AQ.SOL.min. | C ₆ H ₇ (OH)(CO ₂ H) ₃ | 50 | 25 | 1 | 1 |
| | | | 60 | 2 | 3 | | | | | | |
| BUTYLENE GLYCOL | C ₄ H ₈ (OH) ₂ | 100 | 25 | 1 | 1 | COPPER - CHLORIDE | CuCl ₂ | sat | 25 | 1 | 1 |
| | | | 60 | 2 | 1 | | | | | | |
| BUTYRIC ACID (BUTANOIC ACID) | C ₄ H ₇ COOH | 20 | 25 | 1 | 1 | - CYANIDE | CuCN ₂ | all | 25 | 3 | 3 |
| | | concentrated | 60 | 3 | 3 | | | | | | |
| CALCIUM - BISULFITE - CARBONATE | Ca(HSO ₃) ₂ | nd | 25 | 1 | 1 | - FLUORIDE | CaF ₂ | all | 25 | 1 | 1 |
| | | | 60 | 1 | 1 | | | | | | |
| | CaCO ₃ | all | 25 | 1 | 1 | - NITRATE | Ca(NO ₃) ₂ | nd | 25 | 1 | 1 |
| | | | 60 | 1 | 1 | | | | | | |
| - CHLORATE | CaHCl | nd | 25 | 1 | 1 | - SULFATE | CuSO ₄ | di | 25 | 1 | 1 |
| | | | 60 | 1 | 1 | | | | | | |
| - CHLORIDE | CaCl ₂ | all | 25 | 1 | 1 | | | sat | 25 | 1 | 1 |
| | | | 60 | 2 | 1 | | | | | | |
| - HYDROXIDE | Ca(OH) ₂ | all | 25 | 1 | 1 | COTTONSEED OIL | | comm | 25 | 1 | 1 |
| | | | 60 | 1 | 1 | | | | | | |
| - HYPOCHLORITE | Ca(OCl) ₂ | sat | 25 | 1 | 1 | CRESOL (HYDROXY TOLUENE) | CH ₃ C ₆ H ₄ OH | >90 | 25 | 2 | 1 |
| | | | 60 | 2 | 1 | | | | | | |
| - NITRATE | Ca(NO ₃) ₂ | 50 | 25 | 1 | 1 | | | >90 | 25 | 3 | 3 |
| | | | 60 | 1 | 1 | | | | | | |
| - SULFATE | CaSO ₄ | nd | 25 | 1 | 1 | CRESYLIC ACID | C ₆ H ₄ (CH ₃) ₂ COOH | 50 | 25 | 2 | |
| | | | 60 | 1 | 1 | | | | | | |
| - SULFIDE | CaS | sat | 25 | 1 | 2 | CYCLOHEXANE | C ₆ H ₁₂ | all | 25 | 3 | 1 |
| | | | 60 | 1 | 2 | | | | | | |
| CAMPHOR OIL | | nd | 25 | 1 | 3 | CYCLOHEXANONE | C ₆ H ₁₀ O | all | 25 | 3 | 1 |
| | | | 60 | 3 | 3 | | | | | | |
| CARBON - DIOXIDE AQUEOUS SOLUTION - GAS | CO ₂ | - | 25 | 1 | 1 | DECAHYDRONAPHTALENE | C ₁₀ H ₁₈ | nd | 25 | 1 | 1 |
| | | | 60 | 2 | 1 | | | | | | |
| | | | 100 | 25 | 1 | DEMNERIALIZED WATER | | 100 | 25 | 1 | 1 |
| | | | 60 | 2 | 1 | | | | | | |
| - DISULFIDE | CS ₂ | 100 | 25 | 1 | 2 | DIBUTYPHTHALATE | C ₂ H ₅ (CO ₂ C ₄ H ₉) ₂ | 100 | 25 | 3 | 3 |
| | | | 60 | 3 | | | | | | | |
| - MONOXIDE | CO | 100 | 25 | 1 | 1 | DICHLORO-ACETIC ACID | Cl ₂ CHCOOH | 100 | 25 | 1 | 1 |
| | | | 60 | 1 | 1 | | | | | | |
| - TETRACHLORIDE | CCl ₄ | 100 | 25 | 2 | 2 | DICHLORETHANE (ETHYLENE DICHLORIDE) | Cl ₂ CH ₂ Cl | 100 | 25 | 3 | 3 |
| | | | 60 | 3 | 3 | | | | | | |
| CARBONIC ACID - AQUEOUS SOLUTION - DRY | H ₂ CO ₃ | sat | 25 | 1 | 1 | DICHLOROETHYLENE | Cl(CH ₂) ₂ Cl | 100 | 25 | 3 | 3 |
| | | | 60 | 1 | 1 | | | | | | |
| | | | 100 | 25 | 1 | DIETHYL ETHER | C ₂ H ₅ OC ₂ H ₅ | 100 | 25 | 3 | 3 |
| | | | 60 | 1 | 1 | | | | | | |
| - WET | | all | 25 | 1 | 1 | DIGLYCOLIC ACID | (CH ₂) ₂ O(CO ₂ H) ₂ | 18 | 25 | 1 | 1 |
| | | | 60 | 2 | | | | | | | |
| CARBON OIL | | comm | 25 | 1 | 1 | DIMETHYLAMINE | (CH ₃) ₂ NH | 100 | 25 | 2 | 2 |
| | | | 60 | 1 | | | | | | | |

Chemical Resistance

| | FORMULA | CONC % | TEMP (°C) | PVC | PE | | FORMULA | CONC % | TEMP (°C) | PVC | PE |
|--|---|-----------------------|--------------------|-------------|--------|---|--|-----------|-----------|--------|--------|
| DIETHYLENE GLYCOL TEREPHTHALATE | | all | 25 60 | 3 3 | 1 2 | HYDROCHLORIC ACID (MURIATIC ACID) | HCl | <25 50 | 25 60 | 3 2 | 1 1 |
| DISTILLED WATER | | 100 | 25 60 | 1 1 | 1 | | | ≤37 | 25 60 | 1 1 | 2 |
| DRINKING WATER | | 100 | 25 60 | 1 1 | 1 | HYDROCYANIC ACID (PRUSSIC ACID OR HYDROGEN CYANIDE) | HCN | deb | 25 60 | 1 1 | 1 |
| ETHERS | | all | 25 60 | 3 | 3 | HYDROFLUORIC ACID | HF | 10 | 25 60 | 1 2 | 1 |
| ETHYL -ACETATE (ACETIC ETHER) | CH ₃ CO ₂ C ₂ H ₅ | 100 | 25 60 | 3 | 3 | HYDROGEN | H ₂ | all | 25 60 | 1 1 | 1 |
| -ALCOHOL | CH ₃ CH ₂ OH | nd | 25 60 | 1 2 | 2 | HYDROGEN -PEROXIDE (BLEACH) | H ₂ O ₂ | 30 50 | 25 60 | 1 1 | 1 |
| (ETHANOL) -CHLORIDE | CH ₃ CH ₂ Cl | all | 25 60 | 3 | 2 | | | | 25 60 | 1 1 | 1 |
| -ETHER | CH ₃ H ₂ OCH ₂ CH ₃ | all | 25 60 | 3 | 3 | -SULFIDE DRY | | sat | 25 60 | 1 2 | 1 |
| ETHYLENE -CHLOROHYDRIN | C ₂ H ₄ Cl ₂ OH | 100 | 25 60 | 3 | 3 | -SULFIDE WET | | | 25 60 | 1 2 | 1 |
| -GLYCOL (ETHANEDIOL OR GLYCOL) | HOCH ₂ CH ₂ OH | comm | 25 60 | 1 3 | 1 | HYDROSULPHITE | ≤10 | 25 60 | 25 60 | 1 1 | 1 |
| FATTY ACIDS | | nd | 25 60 | 1 | 1 | HYDROXYLAMINE SULPHATE | (H ₂ NOH) ₂ H ₂ SO ₄ | 12 | 25 60 | 1 | 1 |
| FERRIC -CHLORIDE | FeCl ₃ | 10 | 25 60 | 1 | 2 | ILLUMINATING GAS | | 100 | 25 60 | 1 | 1 |
| | | sat | 25 60 | 1 | 1 | IODINE -DRY AND WET | I ₂ | 3 | 25 60 | 2 | 3 |
| -NITRATE | Fe(NO ₃) ₃ | nd | 25 60 | 1 | 1 | -TINCTURE | | ≤3 | 25 60 | 2 | 3 |
| -DEXTRINE (BRITISH GUM OR STARCH GUM) | C ₆ H ₁₂ OCH ₂ O | nd | 25 60 | 1 | 2 | ISOOCTANE | | 100 | 25 60 | 1 | 1 |
| -SULFATE | Fe(SO ₄) ₃ | nd | 25 60 | 1 | 1 | ISO-OCTANE | (CH ₃) ₂ CHCH ₂ CH ₂ | 100 | 25 60 | 2 | 2 |
| FERROUS -CHLORIDE | FeCl ₂ | sat | 25 60 | 1 | 1 | ISOPROPYL ETHER | (CH ₃) ₂ CHOCH(CH ₃) ₂ | 100 | 25 60 | 2 | 3 |
| -SULFATE | FeSO ₄ | nd | 25 60 | 1 | 1 | -ALCOHOL (ISOPROPANOL) | (CH ₃) ₂ CHOH | 100 | 25 60 | 2 | 2 |
| FERTILIZER | | ≤10 | 25 60 | 1 | 1 | LACTIC ACID | CH ₃ COOH | ≤28 | 25 60 | 1 | 1 |
| | | sat | 25 60 | 1 | 1 | LANOLINE | | nd | 25 60 | 2 | 1 |
| FLUORINE GAS DRY | F ₂ | 100 | 25 60 | 2 | 3 | LEAD ACETATE | Pb(CH ₃ COO) ₂ | sat | 25 60 | 1 | 1 |
| FLUOSILICIC ACID | H ₂ SiF ₆ | 32 | 25 60 | 1 | 1 | LINSEED OIL | | comm | 25 60 | 2 | 2 |
| FORMALDEHYDE | HCHO | - | 25 60 | 1 | 1 | LUBRICATING OILS | | comm | 25 60 | 1 | 3 |
| FORMIC ACID | HCOOH | 50 | 25 60 | 1 | 1 | MAGNESIUM -CARBONATE | MgCO ₃ | all | 25 60 | 1 | 1 |
| | | 100 | 25 60 | 1 | 1 | -CHLORIDE | MgCl ₂ | sat | 25 60 | 1 | 1 |
| FRUIT PULP AND JUICE | | comm | 25 60 | 1 | 1 | -HYDROXIDE | Mg(OH) ₂ | all | 25 60 | 1 | 1 |
| FUEL OIL | | 100 | 25 60 | 1 | 1 | -NITRATE | Mg(NO ₃) ₂ | nd | 25 60 | 1 | 1 |
| | | comm | 25 60 | 1 | 2 | -SULFATE | MgSO ₄ | dil | 25 60 | 1 | 1 |
| FURFUREL ALCOHOL | C ₅ H ₈ OCH ₂ OH | nd | 25 60 | 3 | 2 | MALEIC ACID (HYDROXYSUCCINIC ACID) | COOHCH=COOH | nd | 25 60 | 1 | 1 |
| GAS EXHAUST -ACID | | all | 25 60 | 1 | 1 | | | nd | 25 60 | 1 | 1 |
| -WITH NITROUS -VAPOURS | | traces | 25 60 | 1 | 1 | CHLORIDE | HgCl ₂ | sat | 25 60 | 1 | 1 |
| GAS PHOSGENE | ClCOCl | 100 | 25 60 | 1 | 2 | -CYANIDE | HgCN ₂ | all | 25 60 | 1 | 1 |
| GELATINE | | 100 | 25 60 | 1 | 1 | MERCURIOS NITRATE | Hg ₂ NO ₃ | nd | 25 60 | 1 | 1 |
| GLUCOSE (DEXTROSE) | C ₆ H ₁₂ O ₆ | all | 25 60 | 2 | 1 | MERCURY | Hg | 100 | 25 60 | 2 | 1 |
| GLYCERINE AQ.SOL.(GLYCEROL) | HOCH ₂ CHOHCH ₂ OH | all | 25 60 | 1 | 1 | METHYL -ACETATE | CH ₃ COOCH ₃ | 100 | 25 60 | - | - |
| GLYCOLLE AQUEOUS -GLYCOLIC ACID | HOCH ₂ COOH | 10 37 | 25 60 | 1 1 | 1 | -ALCOHOL (METHANOL OR WOODSPIRIT) | CH ₃ OH | nd | 25 60 | 1 | 1 |
| HEPTANE | C ₇ H ₁₆ | 100 | 25 60 | 1 | 3 | -BROMIDE (BROMOMETHANE) | CH ₃ Br | 100 | 25 60 | 3 | 3 |
| HEXANE | C ₆ H ₁₄ | 100 | 25 60 | 2 | 2 | -CHLORIDE (CHLOROMETHANE) | CH ₃ Cl | 100 | 25 60 | 3 | 1 |
| HYDROBROMIC ACID | HBr | ≤10 60 25 48 | 25 60 1 2 | 1 1 1 | 1 | -ETHYLKETONE | CH ₃ COCH ₂ CH ₃ | all | 25 60 | 3 | 1 |
| | | | 25 60 | 2 | 2 | METHYLAMINE | CH ₃ NH ₂ | 32 | 25 60 | 2 | 2 |

Chemical Resistance

| | FORMULA | CONC % | TEMP °C | PVC | PE | | FORMULA | CONC % | TEMP °C | PVC | PE |
|--|-----------------------|-----------|---------|-----|----|--|---------------------------|--------|---------|-----|----|
| METHYLENE CHLORIDE (DICHLOROMETHANE) | CH_2Cl_2 | 100 | 25 | 3 | 3 | | | ≤85 | 25 | 1 | 1 |
| METHYL SULPHURIC ACID | CH_3COOSO_4 | 50 | 25 | 1 | 2 | - ANHYDRIDE | P_2O_5 | nd | 25 | 1 | 1 |
| | | 60 | 25 | 2 | 2 | | | | 60 | 2 | 1 |
| | | 100 | 25 | 1 | 3 | - PHOSPHORUS TRICHLORIDE | PCl_3 | 100 | 25 | 3 | 1 |
| | | 60 | 25 | 2 | 3 | PHOTOGRAPHIC - DEVELOPER | | comm | 25 | 1 | 1 |
| MILK | | 100 | 25 | 1 | 1 | - EMULSION | | comm | 25 | 1 | 1 |
| MINERAL ACIDULOUS WATER | | nd | 25 | 1 | 1 | | | 60 | 1 | 1 | |
| MOLASSES | | comm | 25 | 1 | 1 | - PHTHALIC ACID | $C_6H_4(CO_2H)_2$ | 50 | 25 | - | 1 |
| | | 60 | 25 | 2 | 2 | | | 60 | 2 | 1 | |
| NAFHTA | | 100 | 25 | 2 | 2 | - PICRIC ACID (2,4,6 TRINITROPENOL) | $HO_2C_3H_2(NO_2)_3$ | 1 | 25 | 1 | 1 |
| | | 100 | 25 | 1 | 1 | | | ≥1 | 25 | 3 | 1 |
| | | 60 | 25 | 2 | 3 | | | 60 | 1 | - | |
| NAFHTALINE | | 100 | 25 | 1 | 1 | | | 60 | 1 | 1 | |
| | | 60 | 25 | 2 | 1 | | | 60 | 2 | 1 | |
| NICKEL - CHLORIDE | $NiCl_2$ | all | 25 | 1 | 1 | - POTASSIUM - BICHROMATE (POTASSIUM HYDROGENCARBONATE) | $K_2Cr_2O_7$ | 40 | 25 | 1 | 1 |
| | | 60 | 1 | 1 | 1 | | | 60 | 1 | 1 | |
| - NITRATE | $Ni(NO_3)_2$ | nd | 25 | 1 | 1 | - BORATE | $K_2B_2O_7$ | sat | 25 | 1 | 1 |
| | | 60 | 1 | 1 | 1 | | | 60 | 2 | 1 | |
| - SULFATE | $NiSO_4$ | oil | 25 | 1 | 1 | - BROMATE | $KBrO_3$ | nd | 25 | 1 | 1 |
| | | 60 | 1 | 2 | 1 | | | 60 | 2 | 1 | |
| | | sat | 25 | 1 | 1 | - BROMIDEXBr | | sat | 25 | 1 | 1 |
| | | 60 | 1 | 1 | 1 | | | 60 | 1 | 1 | |
| NITRIC ACID | HNO_3 | anhydrous | 25 | 3 | 3 | - CARBONATE (POTASH) | K_2CO_3 | sat | 25 | 1 | 1 |
| | | 20 | 25 | 60 | 2 | | | 60 | 2 | 1 | |
| | | 40 | 25 | 1 | 2 | - CHLORIDE (POTASSIUM MURIATE) | KCl | sat | 25 | 1 | 1 |
| | | 60 | 25 | 1 | 3 | | | 60 | 1 | 1 | |
| | | 60 | 25 | 2 | 3 | - CHROMATE | K_2CrO_4 | 40 | 25 | 1 | 1 |
| | | 98 | 25 | 3 | 3 | | | 60 | 1 | 1 | |
| | | 60 | 25 | 3 | 3 | - CYANIDE | KCN | sat | 25 | 1 | 1 |
| NITROBENZENE | $C_6H_5NO_2$ | all | 25 | 3 | 2 | - FERROCYANIDE | $K_4Fe(CN)_6 \cdot 3H_2O$ | 100 | 25 | 1 | 1 |
| | | 60 | 3 | 2 | 2 | | | 60 | 2 | 1 | |
| OLEIC ACID | $C_{17}H_{33}O_2$ | comm | 25 | 1 | - | - FLUORIDE | KF | sat | 25 | 1 | 1 |
| | | 60 | 1 | 2 | 2 | | | 60 | 1 | 1 | |
| OLEUM (Fuming Sulphuric Acid or Pyrosulphuric Acid) | H_2SO_4 | nd | 25 | 3 | 3 | - HYDROXIDE (CAUSTIC POTASH) | KOH | ≤60 | 25 | 1 | 1 |
| | | 60 | 3 | 3 | 3 | | | 60 | 2 | 1 | |
| - VAPOURS | | low | 25 | 3 | 3 | - NITRATE (NO ₃) (NITRE, SALTPETRE) | sat | 25 | 1 | 1 | 1 |
| | | high | 25 | 3 | 3 | | | 60 | 1 | 1 | |
| | | 60 | 3 | 3 | 3 | - PERBORATE | KBO_3 | all | 25 | 1 | 1 |
| OLIVE OIL | | comm | 25 | 60 | 2 | 3 | | 60 | 1 | 1 | |
| OXALIC ACID | HO_2CCO_2H | 10 | 25 | 1 | 1 | - PERBORATE | KBO_3 | all | 25 | 1 | 1 |
| | | 60 | 2 | 1 | 1 | | | 60 | 1 | 1 | |
| | | sat | 25 | 1 | 1 | - PERMANGANATE (PERMANGANATE OF POTASH) | $KMnO_4$ | 10 | 25 | 1 | 1 |
| | | 60 | 1 | 1 | 1 | | | 60 | 1 | 1 | |
| OXYGEN | O_2 | all | 25 | 1 | 1 | - PERSULFATE | $K_2S_2O_8$ | nd | 25 | 1 | 1 |
| | | 60 | 1 | 1 | 2 | | | 60 | 2 | 1 | |
| OZONE | O_3 | nd | 25 | 1 | 2 | - SULFATE | K_2SO_4 | sat | 25 | 1 | 1 |
| | | 60 | 2 | 3 | 3 | | | 60 | 2 | 1 | |
| PALMITIC ACID | $CH_3(CH_2)_{14}COOH$ | 10 | 25 | 1 | - | - PROPANE - GAS | C_3H_8 | 100 | 25 | 1 | 1 |
| | | 60 | 1 | - | - | | | 60 | 1 | 1 | |
| | | 70 | 25 | 1 | - | - LIQUID | | 100 | 25 | 1 | 2 |
| | | 60 | 1 | - | - | | | 60 | 1 | 2 | |
| PARAFFIN (ALKANE) | | nd | 25 | 2 | 2 | PROPYL ALCOHOL (PROPANOL) | C_3H_7OH | 100 | 25 | 1 | 1 |
| | | 60 | 2 | 2 | 2 | | | 60 | 2 | 1 | |
| - EMULSION | | comm | 25 | 1 | 2 | PYRIDINE | CH_3CH_2CN | nd | 25 | 3 | 1 |
| | | 60 | 1 | 2 | 2 | | | 60 | 3 | 2 | |
| - OIL (KEROSENE) | | nd | 25 | 1 | 1 | RAIN WATER | | 100 | 25 | 1 | 1 |
| | | 60 | 1 | 1 | 1 | | | 60 | 1 | 1 | |
| PERCHLORIC ACID | $HClO_4$ | 100 | 25 | 1 | 1 | SEA WATER | | 100 | 25 | 1 | 1 |
| | | 70 | 25 | 2 | 1 | | | 60 | 1 | 1 | |
| | | 60 | 25 | 1 | 1 | SILICIC ACID | H_2SiO_3 | all | 25 | 1 | 1 |
| | | 60 | 2 | 2 | 2 | | | 60 | 1 | 1 | |
| PETROL | | 100 | 25 | 1 | 1 | SILICONE OIL | | nd | 25 | 1 | 1 |
| - REFINED | | 60 | 1 | 1 | 1 | | | 60 | 3 | 2 | |
| - UNREFINED | | 100 | 25 | 1 | 1 | SILVER - CYANIDE | AgCN | all | 25 | 1 | 1 |
| | | 60 | 1 | 1 | 1 | | | 60 | 1 | 1 | |
| PHENOL | C_6H_5OH | 1 | 25 | 1 | 1 | - NITRATE | $AgNO_3$ | nd | 25 | 1 | 1 |
| | | 60 | 1 | 1 | 1 | | | 60 | 2 | 1 | |
| PHENOLIC SOLUTION (CARBOLIC ACID) | | ≤90 | 25 | 2 | 1 | - PLATING SOLUTION | | comm | 25 | 1 | 1 |
| | | 60 | 3 | 1 | 1 | | | 60 | 2 | 1 | |
| PHENYL HYDRAZINE | $C_6H_5NHNH_2$ | all | 25 | 3 | 2 | - SOAP - AQUEOUS SOLUTION | | comm | 25 | 1 | 1 |
| | | 60 | 3 | 2 | 2 | | | 60 | 2 | 1 | |
| - CHLORHYDRATE | $C_6H_5NHNH_2Cl$ | sat | 25 | 1 | 1 | SODIC LYE | | ≤60 | 25 | 1 | 1 |
| | | 60 | 3 | 3 | 3 | | | 60 | 1 | 1 | |
| PHOSPHORIC - ACID | H_3PO_4 | ≤25 | 25 | 1 | 1 | SODIUM - ACETATE | CH_3COONa | 100 | 25 | 1 | 1 |
| | | 60 | 2 | 1 | 1 | | | 60 | 1 | 1 | |
| | | ≤50 | 25 | 1 | 1 | | | 60 | 1 | 1 | |
| | | 60 | 2 | 1 | 1 | | | 60 | 1 | 1 | |

Chemical Resistance

| | FORMULA | CONC % | TEMP (°C) | PVC | PE | | FORMULA | CONC % | TEMP (°C) | PVC | PE | | | | |
|---|--|--------|-----------|-----|----|---------------------------|--|--------|-----------|-----|----|----|---|---|---|
| - BICARBONATE (SODIUM HYDROGEN CARBONATE) | NaHCO ₃ | nd | 25 | 1 | 1 | - FUMING (OLEUM) | | 60 | 3 | 2 | | | | | |
| | | 60 | 1 | 1 | | | | all | 25 | 2 | 2 | | | | |
| - BISULFITE | NaHSO ₃ | 100 | 25 | 1 | 1 | | | 60 | 3 | 3 | | | | | |
| | | 60 | 1 | 1 | | - NITRIC AQUEOUS SOLUTION | H ₂ SO ₄ +HNO ₃ +H ₂ O | 48/49 | 25 | 1 | 3 | | | | |
| - BROMIDE | NaBr | sat | 25 | 1 | 1 | | | | 50/50 | 60 | 2 | 3 | | | |
| | | 60 | 1 | 1 | | | | | 60 | 3 | 3 | 3 | | | |
| - CARBONATE | Na ₂ CO ₃ | sat | 25 | 1 | 1 | | | | 10/20/70 | 25 | 2 | 2 | | | |
| | | 60 | 1 | 1 | | | | 60 | 1 | 2 | | | | | |
| - CHLORATE | NaClO ₃ | nd | 25 | 1 | 1 | | | 80 | 1 | 2 | | | | | |
| | | 60 | 2 | 1 | | | | comm | 25 | 1 | 1 | | | | |
| - CHLORIDE | NaCl | dl | 25 | 1 | 1 | | | 60 | 1 | 2 | | | | | |
| | | 60 | 2 | 1 | | | | 10 | 25 | 1 | 1 | | | | |
| | | 60 | 1 | 1 | | | | 60 | 60 | 1 | 1 | | | | |
| | | 60 | 1 | 1 | | | | all | 25 | 1 | 1 | | | | |
| | | 60 | 1 | 1 | | | | 60 | 2 | 1 | 1 | | | | |
| - CYANIDE | NaCN | all | 25 | 1 | 1 | | | 60 | 2 | 1 | 1 | | | | |
| | | 60 | 1 | 1 | | | | 60 | 2 | 1 | 1 | | | | |
| - FERROCYANIDE | Na ₄ Fe(CN) ₆ | sat | 25 | 1 | 1 | | | 60 | 2 | 1 | 1 | | | | |
| | | 60 | 1 | 1 | | | | 60 | 2 | 1 | 1 | | | | |
| - FLUORIDE | NaF | all | 25 | 1 | 1 | | | 60 | 2 | 1 | 1 | | | | |
| | | 60 | 1 | 1 | | | | 60 | 2 | 1 | 1 | | | | |
| - HYDROXIDE | NaOH | 60 | 25 | 1 | 1 | | | 60 | 2 | 1 | 1 | | | | |
| | | 60 | 1 | 1 | | | | 60 | 2 | 1 | 1 | | | | |
| | | 60 | 1 | 1 | | | | 60 | 2 | 1 | 1 | | | | |
| - HYPOCHLORITE | NaOCl | deb | 25 | 1 | 1 | | | 60 | 2 | 1 | 1 | | | | |
| | | 60 | 2 | 1 | | | | 60 | 2 | 1 | 1 | | | | |
| - HYPOSULFITE | Na ₂ S ₂ O ₃ | nd | 25 | 1 | 1 | | | 60 | 2 | 1 | 1 | | | | |
| | | 60 | 1 | 1 | | | | 60 | 2 | 1 | 1 | | | | |
| - NITRATE | NaNO ₃ | nd | 25 | 1 | 1 | | | 60 | 2 | 1 | 1 | | | | |
| | | 60 | 1 | 1 | | | | 60 | 2 | 1 | 1 | | | | |
| - PERBORATE | NaBO ₃ ·H ₂ O | all | 25 | 1 | 1 | | | 60 | 2 | 1 | 1 | | | | |
| | | 60 | 1 | 1 | | | | 60 | 2 | 1 | 1 | | | | |
| - PHOSPHATE di | Na ₂ HPO ₄ | all | 25 | 1 | 1 | | | 60 | 2 | 1 | 1 | | | | |
| | | 60 | 1 | 1 | | | | 60 | 2 | 1 | 1 | | | | |
| - PHOSPHATE tri | Na ₃ PO ₄ | all | 25 | 1 | 1 | | | 60 | 2 | 1 | 1 | | | | |
| | | 60 | 1 | 1 | | | | 60 | 2 | 1 | 1 | | | | |
| - SULPHATE | Na ₂ SO ₄ | dl | 25 | 1 | 1 | | | 60 | 2 | 1 | 1 | | | | |
| | | 60 | 1 | 1 | | | | 60 | 2 | 1 | 1 | | | | |
| | | 60 | 1 | 1 | | | | 60 | 2 | 1 | 1 | | | | |
| | | 60 | 1 | 1 | | | | 60 | 2 | 1 | 1 | | | | |
| - SULFIDE | Na ₂ S | dl | 25 | 1 | 1 | | | 60 | 2 | 1 | 1 | | | | |
| | | 60 | 2 | 1 | | | | 60 | 2 | 1 | 1 | | | | |
| | | 60 | 1 | 1 | | | | 60 | 2 | 1 | 1 | | | | |
| | | 60 | 1 | 1 | | | | 60 | 2 | 1 | 1 | | | | |
| - SULFITE | NaSO ₃ | sat | 25 | 1 | 1 | | | 60 | 2 | 1 | 1 | | | | |
| | | 60 | 1 | 1 | | | | 60 | 2 | 1 | 1 | | | | |
| | | 60 | 1 | 1 | | | | 60 | 2 | 1 | 1 | | | | |
| | | 60 | 1 | 1 | | | | 60 | 2 | 1 | 1 | | | | |
| STANNIC CHLORIDE | SnCl ₄ | sat | 25 | 1 | 1 | | | 60 | 2 | 1 | 1 | | | | |
| | | 60 | 1 | 1 | | | | 60 | 2 | 1 | 1 | | | | |
| STANNOUS CHLORIDE | SnCl ₂ | dl | 25 | 1 | 1 | | | 60 | 2 | 1 | 1 | | | | |
| | | 60 | 1 | 1 | | | | 60 | 2 | 1 | 1 | | | | |
| STEARIC ACID | CH ₃ (CH ₂) ₁₈ CO ₂ H | 100 | 25 | 1 | 1 | | | 60 | 2 | 1 | 1 | | | | |
| | | 60 | 1 | 2 | | | | 60 | 2 | 1 | 1 | | | | |
| SUGAR SYRUP | | high | 25 | 1 | 1 | | | 60 | 2 | 1 | 1 | | | | |
| | | 60 | 2 | 1 | | | | 60 | 2 | 1 | 1 | | | | |
| SULPHUR | S | 100 | 25 | 1 | 1 | | | 60 | 2 | 1 | 1 | | | | |
| | | 60 | 2 | 1 | | | | 60 | 2 | 1 | 1 | | | | |
| - DIOXIDE AQUEOUS | SO ₂ | sat | 25 | 1 | 1 | | | 60 | 2 | 1 | 1 | | | | |
| - DIOXIDE DRY | | | | | | | all | 25 | 1 | 1 | | 60 | 2 | 1 | 1 |
| | | | | | | | 60 | 1 | 1 | | | 60 | 2 | 1 | 1 |
| - DIOXIDE LIQUID | | 100 | 25 | 2 | 1 | | | 60 | 3 | 2 | | | | | |
| | | 60 | 3 | 2 | | | | 60 | 3 | 2 | | | | | |
| - TRIOXIDE | SO ₃ | 100 | 25 | 2 | 3 | | | 60 | 2 | 3 | | | | | |
| | | 60 | 2 | 3 | | | | 60 | 2 | 3 | | | | | |
| SULPHURIC ACID | H ₂ SO ₄ | ≤ 10 | 25 | 1 | 1 | | | 60 | 1 | 1 | 1 | | | | |
| | | | 60 | 1 | 1 | | | 60 | 1 | 1 | 1 | | | | |
| | | | ≤ 75 | 25 | 1 | 1 | | | 60 | 1 | 1 | 1 | | | |
| | | | 60 | 2 | 2 | | | | 60 | 2 | 2 | | | | |
| | | | ≤ 90 | 25 | 1 | 2 | | | 60 | 2 | 2 | | | | |
| | | 60 | 2 | 2 | | | | 60 | 2 | 2 | | | | | |
| | | ≤ 98 | 25 | 2 | 2 | | | 60 | 2 | 2 | | | | | |

11. DISCLAIMER

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