Project Planning

Design and maintenance tips

- Perform a risk assessment of the installation to assess the consequences of flooding due to blockages of silt and scale build up within the pipe system. Repeat this assessment for unexpected hydraulic demands due to accidental spillage, thunderstorms and extraneous events.
- Perform the necessary risk assessment if the system is likely to be subjected to thermal shock. Within design limits, ACO Pipe® is particularly tolerant of sudden temperature changes without risk of damage.
- Avoid selecting pipe sizes that are at, or close to, their hydraulic capacities, as the long-term effects of silt and scale can reduce a system's hydraulic capacity over time.
- For stormwater applications, check the geographical location to confirm the design rainfall intensity.
- Confirm the actual gradient of the installed pipe system. A level (or nearly level) gradient will have a reduced hydraulic performance compared to installations with defined gradients.
- Assess the fluids to be drained in the system to avoid corrosion of the pipe and/or seals. Checklist as follows:
  – Identify each chemical contained in the fluid.
  – Establish chemical concentration(s).
  – Confirm maximum temperature of the solution.
- Given the above information, the correct seal (see page 34) can be selected.
- Design the system with the minimum number of joints and limit the number of bends. This will help to reduce both costs and hydraulic losses.
- Provide good access points for cleaning/rodding to maintain the hydraulic performance of the system.
- Care should be taken to avoid damage, both during and after installation, as dents and kinks will affect the hydraulic performance. For above ground applications, damage will also affect the system's aesthetics.

The following standards will assist designers select the correct size of pipe system for a particular application:

EN 12056: *Gravity Drainage Systems Inside Buildings.*

EN 752: *Drain and Sewer Systems Outside Buildings.*

Refer to pages 8 and 9 for hydraulic data for ACO Pipe®.

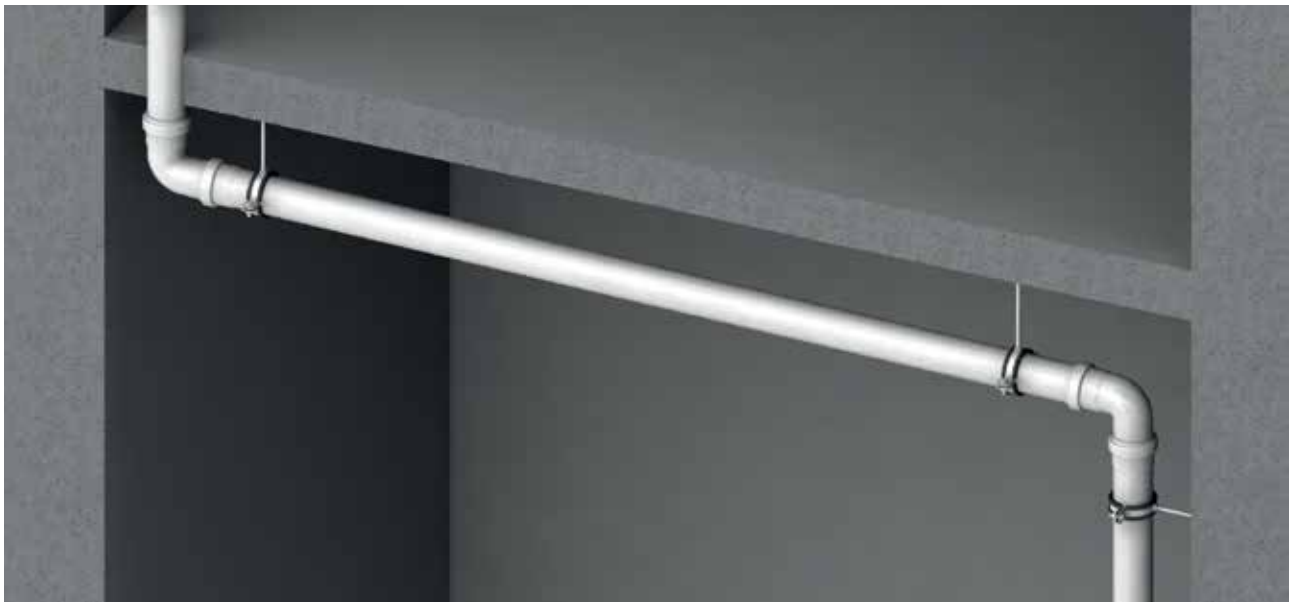
Pipework support

Installation should be in accordance with the manufacturer's recommendations, EN 12056–2, EN 12056–3 and EN 752.

Designers must ensure that all pipework is supported with brackets according to the requirements of AS/NZ 3500 (see page 35).

Pipe weights

Engineers should be aware of minimum and maximum weights when designing vertical stack and horizontal pipe run systems (see page 35).



Maintenance

Advice is often sought regarding the frequency of cleaning stainless steel. Generally, it is usually acceptable to only clean the metal when it is dirty to restore its original appearance. This may vary from one to four times a year for external applications or it can be daily in hygienic or aggressive environments.

Stainless steel is easy to clean. Washing with soap or mild detergent and warm water, followed by a clear water rinse is usually quite adequate for many industrial applications. An enhanced aesthetic appearance will be achieved if the cleaned surface is finally wiped dry.

If professional maintenance is required (e.g. for building upgrades), stainless steel can be mechanically cleaned or electropolished by specialists on site.

See page 38 for more information on care and maintenance.

Operating pressures

The ACO Pipe® socketed stainless steel pipe systems are fitted with a unique, double lip seal, manufactured from either EPDM, NBR or FPM. The double lip seal arrangement provides added security for the ultimate long term reliability. The ACO Pipe® socketed stainless steel pipe systems are tested and approved for operating pressures in gravity, siphonic and vacuum systems.

ACO Pipe® stainless steel pipe systems are designed for maximum working pressure 0.5 bar according to EN 1124. In cases where higher pressure may apply, it is necessary to combine the system with socket clamps.

Operating pressure		
Pipe diameter [mm]	Without socket clamp [bar]	With socket clamp [bar]
50	-0.8 – 0.5	-0.8 – 2.0
75	-0.8 – 0.5	-0.8 – 2.0
110	-0.8 – 0.5	-0.8 – 2.0
125	-0.8 – 0.5	-0.8 – 2.0
160	-0.8 – 0.5	-0.8 – 1.0
200	-0.8 – 0.5	-0.8 – 1.0
250	-0.8 – 0.5	-0.8 – 1.0
315	-0.8 – 0.5	-0.8 – 1.0

Full bore flow rate tables for varying gradients for rainwater/storm drainage applications

Flow rates based on Colebrook-White formula.
Roughness coefficient ks = 0.6 mm

Gradient	Pipe ø 50 mm		Pipe ø 75 mm		Pipe ø 110 mm		Pipe ø 125 mm	
[%]	Flow rate Q [l/s]	Velocity v [m/s]	Flow rate Q [l/s]	Velocity v [m/s]	Flow rate Q [l/s]	Velocity v [m/s]	Flow rate Q [l/s]	Velocity v [m/s]
10.0	2.74	1.52	8.40	2.01	23.81	2.60	33.61	2.83
7.5	2.38	1.31	7.28	1.74	20.62	2.25	29.11	2.45
5.0	1.94	1.07	5.94	1.42	16.83	1.84	23.77	2.00
4.5	1.84	1.02	5.64	1.35	15.97	1.74	22.55	1.90
4.0	1.73	0.96	5.31	1.27	15.06	1.64	21.26	1.79
3.5	1.62	0.90	4.97	1.19	14.08	1.54	19.88	1.67
3.0	1.50	0.83	4.60	1.10	13.04	1.42	18.41	1.55
2.5	1.37	0.76	4.20	1.00	11.90	1.30	16.80	1.41
2.0	1.23	0.68	3.76	0.90	10.64	1.16	15.03	1.26
1.5	1.06	0.59	3.25	0.78	9.22	1.01	13.01	1.10
1.0	0.87	0.48	2.66	0.63	7.53	0.82	10.63	0.89

Gradient	Pipe ø 160 mm		Pipe ø 200 mm		Pipe ø 250 mm		Pipe ø 315 mm	
Gradient [%]	Flow rate Q [l/s]	Velocity v [m/s]	Flow rate Q [l/s]	Velocity v [m/s]	Flow rate Q [l/s]	Velocity v [m/s]	Flow rate Q [l/s]	Velocity v [m/s]
10.0	64.15	3.31	116.89	3.83	218.31	4.45	401.51	5.15
7.5	55.56	2.87	101.22	3.32	188.95	3.85	347.54	4.46
5.0	45.36	2.34	82.65	2.71	154.13	3.14	283.52	3.64
4.5	43.03	2.22	78.40	2.57	146.17	2.98	268.90	3.45
4.0	40.57	2.10	73.92	2.43	137.77	2.81	253.45	3.25
3.5	37.95	1.96	69.14	2.27	128.82	2.63	236.99	3.04
3.0	35.13	1.81	64.01	2.10	119.20	2.43	219.31	2.82
2.5	32.07	1.66	58.43	1.92	108.74	2.22	200.09	2.57
2.0	28.68	1.48	52.26	1.71	97.18	1.98	178.83	2.30
1.5	24.84	1.28	45.26	1.48	84.05	1.71	154.70	1.99
1.0	20.28	1.05	36.95	1.21	68.48	1.40	126.07	1.62

Note: The flow rates shown above assume an unrestricted discharge from the pipe. For installations without an unrestricted discharge, the flow rate will be affected by the downstream throttle.

For shallow gradients, the Colebrook-White formula underestimates flow rates (because when gradient tends towards zero %, velocity also tends to zero). For level or nearly level installations (slope < 1 %), spatially varied flow tables should be used.

Full bore flow rate tables for varying gradients for sewage drainage applications

Flow rates based on Colebrook-White formula.
Roughness coefficient ks = 0.6 mm

Gradient	Pipe ø 50 mm		Pipe ø 75 mm		Pipe ø 110 mm		Pipe ø 125 mm	
[%]	Flow rate Q [l/s]	Velocity v [m/s]	Flow rate Q [l/s]	Velocity v [m/s]	Flow rate Q [l/s]	Velocity v [m/s]	Flow rate Q [l/s]	Velocity v [m/s]
10.0	2.74	1.52	8.40	2.01	23.81	2.60	33.61	2.83
7.5	2.38	1.31	7.28	1.74	20.62	2.25	29.11	2.45
5.0	1.94	1.07	5.94	1.42	16.83	1.84	23.77	2.00
4.5	1.84	1.02	5.64	1.35	15.97	1.74	22.55	1.90
4.0	1.73	0.96	5.31	1.27	15.06	1.64	21.26	1.79
3.5	1.62	0.90	4.97	1.19	14.08	1.54	19.88	1.67
3.0	1.50	0.83	4.60	1.10	13.04	1.42	18.41	1.55
2.5	1.37	0.76	4.20	1.00	11.90	1.30	16.80	1.41
2.0	1.23	0.68	3.76	0.90	10.64	1.16	15.03	1.26
1.5	1.06	0.59	3.25	0.78	9.22	1.01	13.01	1.10
1.0	0.87	0.48	2.66	0.63	7.53	0.82	10.63	0.89

Gradient	Pipe ø 160 mm		Pipe ø 200 mm		Pipe ø 250 mm		Pipe ø 315 mm	
Gradient [%]	Flow rate Q [l/s]	Velocity v [m/s]	Flow rate Q [l/s]	Velocity v [m/s]	Flow rate Q [l/s]	Velocity v [m/s]	Flow rate Q [l/s]	Velocity v [m/s]
10.0	64.15	3.31	116.89	3.83	218.31	4.45	401.51	5.15
7.5	55.56	2.87	101.22	3.32	188.95	3.85	347.54	4.46
5.0	45.36	2.34	82.65	2.71	154.13	3.14	283.52	3.64
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3.5	37.95	1.96	69.14	2.27	128.82	2.63	236.99	3.04
3.0	35.13	1.81	64.01	2.10	119.20	2.43	219.31	2.82
2.5	32.07	1.66	58.43	1.92	108.74	2.22	200.09	2.57
2.0	28.68	1.48	52.26	1.71	97.18	1.98	178.83	2.30
1.5	24.84	1.28	45.26	1.48	84.05	1.71	154.70	1.99
1.0	20.28	1.05	36.95	1.21	68.48	1.40	126.07	1.62

Note: The flow rates shown above assume an unrestricted discharge from the pipe. For installations without an unrestricted discharge, the flow rate will be affected by the downstream throttle.

For shallow gradients, the Colebrook-White formula underestimates flow rates (because when gradient tends towards zero %, velocity also tends to zero). For level or nearly level installations (slope < 1 %), spatially varied flow tables should be used.

Seal material data

Seal suitability

ACO Pipe® sockets are fitted with EPDM seals as standard for regular drainage applications. For particularly aggressive applications, FPM and NBR seals are available. Refer to the table below to assess suitability, and then contact ACO.

EPDM (Ethylene Propylene Diene Monomer)

EPDM was originally developed during the 1950s for vehicle tyre applications. It reached wider applications because of its suitability for outdoor use.

FPM (Fluoroelastomer)

FPM is a fluorocarbon and the best material for resistance to hostile chemical and oil environments at normal and elevated temperatures. This material is widely used in the chemical and pharmaceutical industries, but is significantly more expensive than EPDM.

NBR (Nitrile rubber)

NBR has good water resistance, excellent chemical resistance and durability.

ACO Pipe® can withstand 120°C steam or water with EPDM seals. ACO Pipe® can withstand 200°C steam or water with FPM seals.

Seal assembly replacement or upgrade

The double lip seal is easily removed and replaced from the female end of all ACO Pipe® pipes and fittings. This allows easy on-site upgrade of the seal material.

Seal installation notes

1. If changing the seal, ensure the correct size and grade of seal is selected for the application (see table below).

2. Ensure the seal itself and the zone around the pipe and/or fitting receiving the seal is clean, dry and free from dust, grit and any metallic particles.

3. Insert the dry seal into the pipe and/or fitting recess. NOTE: the seal MUST be inserted so the double sealing lips face away from the opening of the pipe and/or fitting.

4. Do not use tools to aid the assembly process otherwise damage to the pipes, fittings and seals may occur.

			EPDM	FPM	NBR
Water Resistance			Excellent	Good	Good
Chemical Resistance	Acids		Good	Excellent	Excellent
	Bases		Good	Good	Good
Solvent Resistance (20°C)	Alcohol		Good	Good	Good
	Acetone		Good	Unsuitable	Unsuitable
	Benzene		Unsuitable	Good	Unsuitable
Oil Resistance (including tradewaste - FOGs)	ASTM Oil No. 1	@ 20°C	Fair	Excellent	Excellent
		@ 100°C	Unsatisfactory	150°C Excellent	150°C Good
	ASTM Oil No. 3	@ 20°C	Unsatisfactory	Excellent	Excellent
		@ 100°C	Unsatisfactory	150°C Excellent	150°C Good
Fuel Resistance	ASTM Fuel B	@ 20°C	Unsatisfactory	Excellent	Excellent
Resistances	Oxidation		Excellent	Outstanding	Outstanding
	Ozone & Weathering		Outstanding	Outstanding	Low
Heat Resistance	Maximum Continuous		130°C	205°C	80°C
	Maximum Continuous		150°C	300°C	100°C
Low Temperature Resistance			– 50°C	– 20°C	– 30°C
Gas Permeability			Fairly Low	Very Low	Very Low
Physical Strength			Good	Good	Good
Compression Set Resistance			Good	Good	Good
Tear & Abrasion Resistance			Good	Good	Good
Cost Factor (1 = low)			1	20	2

Installation

Pipework support details

The discretion of the installer should be applied in each instance to ensure that the pipe is adequately supported.

Horizontal pipework

Generally, when the pipe is completely full of water, then the vertical deflection of the pipe between brackets should not exceed 1.5mm.

As a guide, use the table below for bracket spacing on horizontal pipes.

Pipe Diameter [mm]	Bracket Spacing [metres]
50	2.0
75	2.3
110	2.5
125	3.0
200	3.0

Vertical pipework

The load applied with a fluid in the pipe is vertically down. Position the highest bracket adjacent to the top inlet of the pipe, then mount brackets at 3 metre spacings. At the bottom of the vertical pipe, use a bracket within 200mm of the bottom. Fit brackets at each change of pipework direction or junction points.

The venting of vertical stacks shall be in compliance with AS/NZ 3500.

Pipework should be at least 35mm from the wall to facilitate maintenance and painting.

Minimum and maximum pipe weights

To assist designers and installers with the selection of appropriate pipe supports, the table below sets out the weights for all pipe sizes.

Pipe Diameter [mm]	Bracket Spacing [metres]	Pipe Weight Full [kg / m]
50	1.2	3.0
75	1.8	6.9
110	2.7	11.9
125	3.3	15.8
160	5.0	24.6
200	7.5	38.0
250	10.6	59.7

Pipe assembly

The installation of ACO Pipe® should be in accordance with the recommendations below and with AS/NZ 3500.

Ensure that all tools are in good condition, electric tools and leads must have current safety tags. Pipe stands must be stable to carry the pipe with no movement and there must be no carbon steel or abrasive material in contact with the stainless steel pipe material.

The assembly of pipe joints is quick and straightforward, requiring only a light application of lubricant (see page 30) to the chamfered pipe end.

1. Make sure both ends are clean and free of dirt.

2. Make sure that the correct seal is in place (see page 34).

3. Ensure that the mating ends of the pipes and fittings are clean and free from contamination. Push-fit the pipe end into the socket but do not wedge into the socket recess. Use a half rotational movement to the right and left as the pipes come together.

4. When the pipes are fully engaged, pull the pipes back 6mm to 12mm to allow for thermal expansion. With a 60° temperature rise, stainless steel expands at a rate of 0.99mm per metre.

Pipe cutting

If it is necessary to adapt or shorten pipe lengths, then the cut must be square, clean and ready chamfered. Cutters are available from ACO (see pages 32 and 33). These tools are designed to form the edge bevel on the male spigoted end of the pipe. Carbon steel wheels are not permitted

Socket clamps

ACO Pipe® pipes and fittings comprise push-fit socket joints. These will not be able to resist internal pressure beyond design limits unless precautions are made to ensure that the joints do not slide apart.

In most cases, appropriate fixing to the building can overcome this. If it is difficult however, or impossible to fix the pipes to the building, socket clamps (see page 29) can prevent the push-fit sockets and spigot ends from sliding apart in the event of overload or the generation of excessive internal pressure.

Structural penetrations

Where it is necessary for pipework to pass through the walls, structural decking or floors with waterproofing, the ACO Aplex Wall Seal system is available, contact ACO.

Pipework protection

The installation of ACO Pipe® should be in accordance with the recommendations below and with AS/NZ 3500.

Below ground installation

When pipework is to be installed in the ground, place the pipe in a sandy bed of 75mm (minimum thickness) free of small gravel, sticks, etc. The sand should be free of chlorides and salt.

During installation, take care to not scratch the surface of the stainless with carbon steel. Similarly, avoid subjecting the stainless steel pipes to welding and grinding airborne hot particles, metal shavings, and chemicals which may cause corrosion.

Soil cover

Where pipework is to be installed beneath a water table, apply the following soil depths:

- **Pipe diameters 50, 75, 110**
  Low density soil 15kg/m³ 400mm
  High density soil 23 kg/m³ 380mm
- **Pipe diameters 125, 160, 200, 250**
  Low soil density 15kg/m³ 580mm
  High soil density 23kg/m³ 650mm

Where the ground is permanently cold as experienced in some Alpine and southern extremities of Australia and New Zealand, then the drainage may need to be heated.

In general however, the minimum permissible depth to avoid winter freezing of water is 800mm. Note that this recommendation is applicable where the ground does thaw during spring and becomes quite warm during summer.

Backfilling around the pipe can only start when the position of the pipe has been checked and approved.

Care and maintenance

Pipe assembly

All grades of stainless steel will stain and discolour due to surface deposits and can never be 100% maintenance free. In order to achieve maximum corrosion resistance, the surface of the stainless steel must be kept clean.

Factors affecting maintenance

Surface contamination and the formation of deposits must be prevented in order to maintain a durable and hygienic surface.

These deposits may be minute particles of iron or rust from other materials used on the building site which have come in contact with the pipework. Care must be taken to avoid the cutting of carbon steels, including rebar, and the storage and erection of scaffolding, near the pipework.

Industrial and even naturally occurring atmospheric conditions can produce deposits that can also be corrosive, e.g. salt deposits from marine conditions.

The working environment can also produce corrosive conditions e.g. high humidity, such as in a swimming pool, increasing the speed of discolouration and therefore requiring maintenance to be carried out on a more frequent basis. Many cleaners, sterilisers and bleaches, when used in accordance with manufacturers' instructions are safe, but if used incorrectly (e.g. warm or concentrated), they can cause discolouration and corrosion on the surface of any quality of stainless steel.

Strong acid solutions are sometimes used to clean masonry and tiles but they should never be permitted to come into contact with metals, including stainless steel. If this should happen the acid solution must be removed immediately by copious applications of clean water.

Wire brushes and wire wool must not be used to remove marks or cement spillage as this will only serve to introduce iron impurities onto the material surface.

Problem	Cleaning Agent	Comments
Routine cleaning	Soap or mild detergent and water (such as washing up liquid).	Sponge, rinse with clean water, and wipe dry if necessary.
Fingerprints	Soap or warm water or organic solvent (e.g. acetone, alcohol).	Rinse with clean water, wipe dry if necessary.
Stubborn stains and discolouration	Mild cleaning solutions	Rinse well with clean water and wipe dry.
Oil and grease marks	Organic solvents (e.g. acetone, alcohol).	Clean after with soap and water, rinse with clean water and dry
Rust and other corrosion products	Oxalic acid. The cleaning solution should be applied with a swab and allowed to stand for 15–20 minutes before being washed away with water.	Rinse well with clean water (precautions for acid cleaners should be observed).

Stainless steel resistance table

Chemicals	Materials			
1 = Very good service to operating limit of material 2 = Moderate service 3 = Limited or variable service 4 = Unsatisfactory	316 L Stainless	EPDM	NBR	FPM
Acetone	1	1	4	4
Acetic acid (diluted) 30%	1	1	2	2
Acetic acid 100%	1	1	3	3
Acetic acid anhydride	1	2	3	4
Aluminium chloride	4	1	1	1
Aluminium sulfate	1	1	1	1
Ammonium carbonate	1	1	4	2
Ammonium chloride	2	1	1	1
Ammonium hydroxide	1	1	4	2
Amyl chloride	1	4	4	1
Anilin	1	2	4	3
Anilin hydrochloride	4	2	2	2
Barium chloride	2	1	1	1
Barium hydroxide	1	1	1	1
Benzaldehyde	1	1	4	4
Benzene	1	4	4	1
Benzoic acid	1	4	4	1
Borax	1	1	2	1
Boric acid	1	1	1	1
Bromine	4	4	4	1
Bromine chloride acid	4	1	2	1
Bromine hydrogen acid	4	1	4	1
Bromoethylene	1	-	-	-
Butanol	1	4	1	1
Butyl acetat	1	2	2	4
Butyric acid	1	2	4	4
Calcium bisulfate el sulfite	1	4	1	1
Calcium chloride	2	1	1	1
Calcium hydroxide	1	1	1	1
Calcium hypoklorite	2	1	3	1
Carbon disulfide	1	4	4	1
Carbon tetrachloride	1	4	3	1
Chloracetic acid (mono)	4	2	4	4
Chloride	4	-	-	-
Chloril acid	4	1	4	-
Chlorine (dry)	1	1	2	1
Chlorobenzene	1	4	4	1
Chloroform	2	4	4	1
Chlorosulfonic acid	2	4	4	3
Copper chloride	2	1	1	1
Copper nitrate	1	1	1	1
Copper sulfate	1	1	1	1
Ether	1	3	4	3
Ethyl chloride	1	1	1	1
Fatty acid	1	4	2	1
Fluorine (dry)	1	-	-	-
Fluorine hydrogen acid	4	2	4	1
Formaldehyde	1	1	2	1
Formic acid	1	1	2	3
Furfural	1	2	4	4
Gallic acid	1	2	2	1
Hydrochloric acid	4	1	4	1
Hydrogen peroxide	1	3	4	2
Iodine (wet)	4	2	2	1
Lead acetate	1	1	2	4

Chemicals	Materials			
1 = Very good service to operating limit of material 2 = Moderate service 3 = Limited or variable service 4 = Unsatisfactory	316 L Stainless	EPDM	NBR	FPM
Magnesium chloride	2	1	1	1
Magnesium sulfate	1	1	1	1
Mercury	1	1	1	1
Methanol	1	1	1	3
Methyl chloride	1	3	4	1
Methylene chloride	2	4	4	2
Natphalene	1	4	4	1
Nickel chloride	2	1	1	1
Nickel sulfate	1	1	1	1
Nitric acid	3	3	4	1
Oxalic acid	3	1	2	1
Perchloric acid	4	2	4	1
Phorsphor acid	1	2	4	1
Picric acid	1	2	2	1
Potassium bromide	1	1	1	1
Potassium carbonate	1	1	2	1
Potassium chlorate	1	1	1	1
Potassium cyanide	1	1	1	1
Potassium hydroxide	1	1	2	2
Potassium nitrate	1	1	1	1
Potassium permanganate	1	1	3	1
Potassium sulfate	1	1	1	1
Potassium sulfide	1	1	1	1
Potassiumchloride	2	1	1	1
Prophylene dichloride	1	4	4	1
Sal ammoniac	2	1	1	1
Silver nitrate	1	1	2	1
Soda (ash)	1	1	1	1
Sodium acetate	1	1	2	4
Sodium bicarbonate	1	1	1	1
Sodium bisulfate	1	1	2	1
Sodium bisulfite	1	1	1	1
Sodium bromide	2	1	3	1
Sodium chlorate	1	1	2	1
Sodium chloride	4	1	1	1
Sodium cyanide	1	1	1	1
Sodium fluoride	1	1	1	1
Sodium hydroxide	1	1	2	2
Sodium hypoklorite	4	2	2	1
Sodium nitrate	1	1	2	2
Sodium sulfate	1	1	1	1
Sodium sulfide	1	1	1	1
Sodium sulfite	1	1	1	1
Stannicous chloride	2	2	1	1
Sulfur	1	1	4	1
Sulfur chloride	1	4	3	1
Sulfur dioxide	1	1	4	1
Sulfuric acid	4	2	4	1
Sulfurous acid	1	2	2	1
Tionyl chloride	1	4	4	1
Toluene (toluol)	1	4	4	1
Trichloroethylene	1	4	3	1
Turpentine	1	4	1	1
Xylene (xylol)	1	4	4	2
Zinc sulfate	1	1	1	1

Note: Concentration levels and length of exposure have a direct influence on the resistance of stainless steel to certain chemicals. Each application should therefore be carefully reviewed to determine the suitability of stainless steel.
Assumptions: Data presented are used as a guide only, for detailed information please contact our Sales/Technical department.