TYPES OF ALUMINIUM

Descriptions and General Uses

1050	Low strength alloy usually available in sheet forms. Excellent decorative appearance with an excellent anodising quality. Typical application as nameplates.
1100	General purpose commercially pure aluminium very similar to Alloy 1200 with slightly better fabrication properties. Typical applications include spinnings, holloware and general sheet metal work.
1150	General sheet metal work where moderate strength is adequate. Typical Applications include, lightly stressed panels, architectural flashings, brightly polished trim, lamp reflectors, cable sheathing, equipment and containers for food and chemical industries.
1200	General purpose commercially pure aluminium. Good formability. Excellent resistance to corrosion. Low strength, easily weldable. Typical applications include spinning and holloware, ie. domestic cooking utensils, general sheet metal work, paneling and mouldings.
3003	An alloy with a high capacity for plastic deformation. Excellent corrosion resistance. Typical applications include roofing material for buses and curtain side trucks.
5005	A medium strength alum-magnesium. Not susceptible to stress corrosion, fine-grained suitable for pressings. Suitable for anodising. Typical applications include appliances and utensils, general sheet metal work and marine applications.
5052	Similar to 5251 with comparable mechanical properties but with a slightly higher magnesium content. Typical applications include sheet metal work, appliances and marine applications.
5083	The highest strength non heat-treatable alloy in general commercial use. Possesses high as-welded properties and excellent corrosion resistance. Not recommended for use in corrosive environments at temperatures above 60°C. Typical applications include welded assemblies such as pressure vessels, marine applications such as ship superstructures, aircraft, cryogenics, TV towers and drilling rigs.
5086	A medium strength alloy with mechanical properties that lie between 5083 and 5454. Excellent corrosion resistance and good weldability. Formability is better than 5083. Typical applications are the same as 5083.
5251	A medium strength alum-magnesium alloy. Good ductility and corrosion resistance. Weldable. Typical applications include sheet metal work, appliances, marine and road vehicles, pressings and containers.
5454	A strong alum-magnesium alloy resistant to stress corrosion in all tempers. Good weldability. Typical applications include road transport such as tipper, dump trucks and petroleum tankers and marine applications.
5754	A medium strength alum-magnesium alloy. Typical application as treadplates.
7075	A very high strength aluminium zinc alloy used as tooling plate. Good machinability and hardness. Not suitable for welding. Poor corrosion resistance. The strength of this alloy is equal to that of commercial quality steel. Typical application is tooling.
7079	A very high strength aluminium similar to 7075. Typical applications are moulds, tooling, jigs and fixtures.
6005	A medium to high strength alum-magnesium-silicon alloy having similar mechanical properties to those specified for alloy 6351. Typical applications are structural such as ladder sections, transport and marine.
6060	A medium to high strength alum-magnesium-silicon alloy. Good mechanical properties, corrosion resistance and weldability. Similar to alloy 6063. Used to obtain highly complex shapes. Typical applications include architectural and general-purpose extrusions.
6061	A medium to high strength alum-magnesium-silicon alloy. Good mechanical properties, corrosion resistance and weldability. Typical applications include structural uses where corrosion resistance is needed such as cranes and bridges, road and rail transport, marine, bolts and nuts.
6063	A medium strength alum-magnesium-silicon alloy for intricate extruded sections. Forms well in T4 temper. High corrosion resistance, good surface finish. Typical applications include furniture, architectural extrusions, general purpose extrusions and irrigation tubing.
6261	A medium strength alum-magnesium-silicon special purpose structural alloy. Good surface finish and corrosion resistance. Good weldability. Responds well to anodising. Typical applications include yacht masts, road transport sections, ladder sections.
6351	A high strength alum-magnesium-silicon alloy. General corrosion resistance and good weldability. The recommended alloy for structural purposes. Typical applications include heavy duty structures where corrosion resistance is needed like that required in vehicles, bridges, cranes, roof trusses and marine applications.
Supercut 20	A high strength alum-copper alloy, true free machining, giving highly fragmented chips. Attractive surface finish. Suitable for die stamping. Not suitable for decorative anodising.

The values indicated in this Aluminium Alloy Data are considered to be a general guide. Suitability for a particular end use is not implied and data should not be used for design. If you require details for specific conditions not supplied in these tables contact your Mico Metals team - you'll find their address at the back of this catalogue.

TEMPER DESIGNATIONS

Extrusions and Sheet

F	As fabricated. Applies to material that acquires some temper from shaping processes not having special control over the amount of strain hardening.
O	Annealed, recrystallised. Applies to the softest temper of wrought products.

Rolled Product

H111	Strain hardened less than the amount required for controlled H11 temper.
H112	Some temper is aquired incidental to the shaping process and for which there are mechanical property limits or mechanical property testing is required.
H12	Strain hardened – ¼ hard
H14	As for H12 but to a greater degree – ½ hard
H24	Strain hardened then partially annealed
H32	Strain hardened then stabilised – magnesium alloys only – ¼ hard
H321	Strain hardened less than the amount required for a controlled H32 temper. It is especially fabricated to have acceptable resistance to stress corrosion cracking and exfoliation attack. H116 is also used for this application.
H116	Especially fabricated to have acceptable resistance to stress corrosion cracking and exfoliation attack. Similar to H321
H34	Strain hardened then stabilised – magnesium alloy only – ½ hard
T651	Solution heat-treated. Artificially aged. Stress relieved by controlled stretching 1.5 – 3%

Extrusions

T3	Solution heat treated then cold worked and naturally aged
T4	Solution heat treated then naturally aged
T5	Cooled from elevated temperature then artificially aged
T6	Solution heat treated then artificially aged
T8	Solution heat treated, cold worked and then artificially aged (usually drawn tube)
T651	Solution heat-treated. Artificially aged. Stress relieved by controlled stretching 1.3%

HANDLING AND STORING ALUMINIUM

Aluminium is one of the easiest materials to keep in good condition. It has a high natural resistance to corrosive conditions normally encountered during shipment and storage and a little care will maintain its original appearance for a long time. The principal things to guard against are conditions that might cause surface abrasions or water stains.

Suppliers make every effort to pack Aluminium so that traffic marks or rub marks do not occur during shipment and so that it remains dry. All incoming shipments should be inspected promptly as suppliers generally have a time limit in which damage claims will be honoured. Traffic marks may appear as scratches, surface abrasions, or a condition resembling cinders embedded in the metal. They result from mechanical abrasion and subsequent oxidation of the abraded areas. Their principal disadvantage lies in their unsightliness and their effect on finishing operations.

To avoid traffic marks suppliers pack the metal so that it is not subjected to undue flexing or twisting and so that the units within a package do not rub against each other. Products subject to damage by flexing or bending are usually packed on skids or in timber boxes. Paper or cardboard is used where necessary for cushioning thin or soft metal. Steel strapping is used to reinforce skids and boxes and to bind wrapped bundles.

Water stains are non-metallic in appearance and while usually whitish, may appear iridescent, depending upon the alloy or degree of oxidation. They are caused by the entrapment of moisture between the adjacent surfaces of closely packed material. The purer Aluminium alloys are more resistant to water stain, while the condition seems most pronounced on those alloys having high magnesium content. Water stain is a superficial condition and the mechanical properties of the metal having such stain are not affected. If a shipment of Aluminium arrives in a wet condition, it should be thoroughly dried before storing. This may be done by evaporation in air or by means of dry air currents. When the moisture is removed in this manner within a short period after the metal becomes wet, no stain will result. If stain has occurred and the moist condition causing it is removed, the stain will not develop further. Once safely dry, the metal should not be stored near such obvious water sources as steam and water pipes and it should be kept at reasonable distance from open doors and windows.

Condensation is perhaps the most troublesome cause of water stains. Under severe conditions, condensation may also cause surface deterioration, which may only become apparent if the material is subsequently etched and anodised. It may be prevented by avoiding conditions where the temperature of the metal drops below the dew point of the surrounding air, or, conversely, conditions where the moisture of the air increases enough to carry the dew point above the metal temperature. It is thus important to ensure that a sudden fall in temperature or increase in humidity does not occur in the places of storage.

Aluminium packed in original boxes should never be left in the open, because the greater variations in temperature and humidity outdoors increase the possibility of condensation. Even if the package is wrapped with "waterproof" paper, the impossibility of obtaining a perfect seal makes outdoor storage highly undesirable. So-called waterproof packages are designed solely for the protection of the metal during shipment and are not meant to withstand any extended exposure to the weather.

If possible, cold metal should be placed in a dry storage place until its temperature has increased substantially before it is brought into a heated room with a higher humidity. This may be accomplished by placing a new shipment in temporary storage where its temperature is raised slowly to that of the permanent storage room.

Where water stains have occurred, the degree of staining may be judged fairly accurately by the relative roughness of the stained area. If the surface is reasonably smooth, the stain is merely superficial and its appearance can be improved by mechanical or chemical treatments. Scratch-brushing or the use of a steel wool and oil is effective in removing water stain. If a chemical dip without undue etching is preferred, an aqueous solution containing 10% by volume of sulphuric acid and 3% by weight of chromic acid at 80°C may be employed.

In storing Aluminium it is desirable to avoid contact between it and other metals since this sometimes results in scratches or other marks. The use of plastic or woodfaced shelving racks and bins is recommended. It is also good practice to keep Aluminium away from caustics, nitrates, phosphates and some acids.

In the continuous use of large quantities of metal, the oldest stock should be used first. Occasional checking of the stock on hand will help to prevent any serious corrosion and assist with the problem of age hardening.

WORKING AND SHAPING

The cleanest possible working conditions and good housekeeping are a must to prevent contamination of surfaces by metal swarf and/or dust of other aluminium.

Physical damage or surface alteration (removal of the natural oxide layer of initial surface roughness should be avoided.

Scribing of parts during the production process should be with a hard pencil lead – steel scribing tools should not be employed.

Rinsing fabricated, welded, and/or drilled parts with nitric acid solution of strength not less than 15% by volume will ensure a clean surface and proper restoration of the protective natural oxide film.

Welding operations must be carried out in accordance with recognised good practice, and with maximum care and attention, to avoid subsequent problems of filtration, retention, cracking and maintenance.

Greases can be used in certain cases to protect or seal spaces and openings forming part of removable items (bolted or screwed assemblies). On no account should use be made of greases containing graphite or molybdenum disulphate.

In the case of bonded assemblies, the adhesive should be chosen with an eye not only to the basic technical requirements but also to avoidance of deleterious side effects (eg. Decomposition of the adhesive caused by moisture).

The need for care and maintenance of natural, anodised or prepainted surfaces will depend basically on the environment and the type of exposure. These factors are taken into account in determining frequency of washing and, generally speaking, use will be made of products that have no harmful action on the surface concerned. In the case of applications relating to foodstuffs, it must be checked that the substances employed comply with current legislation.

ALUMINIUM ALLOY DATA

Usual Form Available

	1050	1100	1150	1200	2011	SUPERCUT 20	3003	5005	5052	5083	5086
Foil	▲	▲		▲			▲	▲	▲		
Sheet	•	▲	▲	•			▲	•	•	•	▲
Plate	▲	▲		▲			▲	•	•	•	▲
Coil	▲	▲	▲	•			•	•	•	•	▲
Treadplate									▲	▲	▲
Circles	•	•	•	•			▲	▲	▲	▲	▲
Tube	▲									▲	
Bar	▲			▲	•	•				▲	
Extrusions	▲			▲						▲	
Wire				▲	▲						

• Available as a normal stock item
▲ Available on indent only

Chemical Composition % (figures are approximate only)

		1050	1100	1150	1200	2011	SUPERCUT 20	3003	5005	5052	5083	5086
Aluminium	Al	99.5 min	99.0 min	remainder	99.0 min	remainder	remainder	remainder	remainder	remainder	remainder	remainder
Silicon	Si	0.25				0.40	max 0.80	0.60	0.30	0.25	0.40	0.40
Iron	Fe	0.40	Si + Fe 0.95	Si + Fe 0.45	Si + Fe 1.00	0.70	max 0.80	0.70	0.70	0.40	0.40	0.50
Copper	Cu	0.05	0.05-0.20	0.05-0.20	0.05	5.00-6.00	3.30-4.60	0.05-0.20	0.20	0.10	0.10	0.10
Manganese	Mn	0.05	0.05	0.05	0.05	-	0.50-1.00	1.00-1.50	0.20	0.10	0.40-1.00	0.20-0.70
Magnesium	Mg	0.05	-	0.05	-	-	0.40-1.80	-	0.50-1.10	2.20-2.80	4.00-4.90	3.50-4.5
Chromium	Cr	-	-	-	-	-	-	-	0.10	0.15-0.35	0.05-0.25	0.05-0.25
Zinc	Zn	0.05	0.10	0.05	0.10	0.30	max 0.80	0.10	0.25	0.10	0.25	0.25
Titanium	Ti	0.03	-	0.03	0.05	-	max 0.20	-	-	-	0.15	0.15
Other	each (total)	0.03	0.05 (0.15)	0.03	0.05 (0.15)	0.05 (0.15)	max 1.70	0.05(0.15)	0.05 (0.15)	0.05 (0.15)	0.05 (0.15)	0.05 (0.15)

Typical Mechanical Properties (for the tempers given)

Temper	H14	H14	0	H14	T3	T3	H16	H14	H34	H321	H32
Ultimate Tensile Strength MPa	110	125	70	125	380	400[5]	180	160	260	315	290
Ultimate Yield Strength MPa	95	115	30	115	295	275[5]	170	150	215	230	205
Elongation (% min in 50mm, 1.5mm thick specimen)	10	9	35	9	15[4]	8[5]	5	6	10	16	12
Hardness Brinell[1]	31	32	-	32	95	105[5]	47	-	68	82	72
Hardness Vickers	32	-	24	-	110	-	-	45	-	-	-
Ultimate Shear Stress MPa	-	76	-	76	221	-	103	97	145	179	172
Fatigue Strength Endurance Limit[2] MPa	-	48	-	48	124	-	69	-	124	159	152
Modulus of Elasticity[3] MPa x 10^3	69	69	69	69	70	-	69	69	70	71	71

[1] 500kg load, 10mm ball
[2] Based on 500,000,000 cycles of completely reversed stress using the R.R. Moore type of machine and specimen
[3] Average of tension and compression moduli. Compression modulus is about 2% greater than tension modulus
[4] Round test specimens used
[5] Material thickness = rod ≤ 80 mm

Typical Physical Properties (for the tempers given)

Temper		1050	1100	1150	1200	2011	SUPERCUT 20	3003	5005	5052	5083	5086
Thermal Conductivity at 25°C	(W/(m.K)	234	222	222	222	151		193	201	-	117	126
Electrical Conductivity at 20°C	(MS/m)	35	34	34	34	23		29	30	21	17	18
Electrical Resistivity at 20°C	($\mu\Omega$.m)	0.028	0.029	0.029	0.029	0.044		0.034	0.033	0.047	0.059	0.055
Density	(kg[3] x 10^3)	2.7	2.71	2.70	2.71	2.82		2.73	2.7	2.69	2.66	2.66
Coefficient of Thermal Expansion[1]	°C	24	23.6	24.0	24.0	22.8		23.2	23.8	24.0	23.8	23.8
Melting Range (approx.)	°C	650-660	645-655	645-655	645-655	535-645	530-650	645-655	630-650	595-650	570-640	585-640

[1] Figures are average in the temperature range 20-100 °C. The coefficient tabulated must be multiplied by 10^{-6}; eg. 23.6 x 10^{-6} = 0.0000236

Fabrication Properties

	1050	1100	1150	1200	2011	SUPERCUT 20	3003	5005	5052	5083	5086
Corrosion Resistance	A,A	A,A	A,A	A,A	D,D	D,D	A,A	A,A	A,A	A,C	A,C
Machining	D,C	D,C	D,C	D,C	A,A	A,A	D,C	D,C	C,B	C,B	C,B
Anodising	B,B	B,B	A,A	B,B	D,D	D,D	B,B	B,B	C,C	C,C	C,C
Brazing	A	A	NR	A	D	D	A	B	C	D	D
Cold Forming	A,D	A,C	A,D	A,C	C,D	C,D	A,C	A,,C	A,C	A,C	A,C
Gas Welding	A	A	NR	A	D	D	A	A	A	C	C
Inert Gas Welding	A	A	NR	A	D	D	A	A	A	A	A
Resistance Spot Welding	B,A	B,A	B,C	B,A	D	D	B,A	B,A	B,A	B,A	B,A
Heat Treatment	NR	NR	NR	NR	Yes	Yes	NR	NR	NR	NR	NR

Fabrication Properties are shown as relative ratings in decreasing order of merit = A, B, C, D. NR = Not recommended in relation to usual end use alloy. Where applicable, ratings for both annealed an hardest temper are given.

ALUMINIUM ALLOY DATA - Continued

Usual Form Available

	5251	5454	6005A	6060	6061	6063	6261	6351	7075
Foil	▲								
Sheet	•	•			▲				
Plate	•	•			▲				•
Coil	•	•							
Treadplate	•	▲							
Circles	▲	▲			▲				
Tube				•	•	•	•	•	
Bar			•	•	•	•	•	•	•
Extrusions			•	•	•	•	•	•	
Wire	▲		▲	▲	▲	▲	▲	▲	

• Available as a normal stock item
▲ Available on indent only

Chemical Composition % (figures are approximate only)

		5251	5454	6005A	6060	6061	6063	6261	6351	7075
Aluminium	Al	remainder	remainder	remainder	remainder	remainder	remainder	remainder	remainder	remainder
Silicon	Si	0.40	0.25	0.50-0.90	0.30-0.60	0.40-0.80	0.20-0.60	0.40-0.70	0.70-1.30	0.40
Iron	Fe	0.50	0.40	0.35	0.10-0.30	0.70	0.35	0.40	0.50	0.50
Copper	Cu	0.15	0.10	0.30	0.10	0.15-0.40	0.10	0.15-0.40	0.10	1.20-2.00
Manganese	Mn	0.10-0.50	0.50-1.00	0.50	0.10	0.15	0.10	0.20-0.35	0.40-0.80	0.30
Magnesium	Mg	1.70-2.40	2.40-3.00	0.40-0.70	0.35-0.60	0.80-1.20	0.45-0.90	0.70-1.00	0.40-0.80	2.10-2.90
Chromium	Cr	0.15	0.05-0.20	0.30	0.05	0.04-0.35	0.10	0.10	-	0.18-0.28
Zinc	Zn	0.15	0.25	0.20	0.15	0.25	0.10	0.20	0.20	5.10-6.10
Titanium	Ti	0.15	0.20	0.10	0.10	0.15	0.10	0.10	0.20	0.20
Other	each (total)	0.05 (0.15)	0.05 (0.15)	0.05 (0.15)	0.05 (0.15)	0.05 (0.15)	0.05 (0.15)	0.05 (0.15)	0.05 (0.15)	0.05 (0.15)

Typical Mechanical Properties (for the tempers given)

Temper	H32	H34	H32	T5	T5	T6	T5	T6	T6	T6/T651
Ultimate Tensile Strength MPa	220	250	275	285	220	310	220	310	330	570
Ultimate Yield Strength MPa	185	205	205	265	180	275	180	295	310	505
Elongation (% min in 50mm, 1.5mm thick specimen)	10	7	10	12	12	12	12	11	11	11
Hardness Brinell[1]	-	-	73	-	68	95	-	-	-	150
Hardness Vickers	74	80	-	100	70	-	-	-	103	-
Ultimate Shear Stress MPa	-	138	165	225	-	207	117	207	-	330
Fatigue Strength Endurance Limit[2] MPa	-	124	-	-	-	97	69	-	-	160
Modulus of Elasticity[3] MPa x 10^3	-	-	70	-	-	69	69	-	69	-

[1] 500kg load, 10mm ball
[2] Based on 500,000,000 cycles of completely reversed stress using the R.R. Moore type of machine and specimen
[3] Average of tension and compression moduli. Compression modulus is about 2% greater than tension modulus
[4] Round test specimens used
[5] Material thickness = rod ≤ 80 mm

Typical Physical Properties (for the tempers given)

Temper	All	All	-	T5	T6	T5		T6	
Thermal Conductivity at 25°C (W/(m.K))	138	134	-	209	167	209		172	130-160
Electrical Conductivity at 20°C (MS/m)	20	20	-	32	25	32		28	17-20
Electrical Resistivity at 20°C ($\mu\Omega$.m)	0.049	0.051	-	0.031	0.04	0.031		0.036	-
Density ($kg^3 \times 10^3$)	2.68	2.68	-	2.70	2.70	2.70		2.70	2.80
Coefficient of Thermal Expansion[1] °C	23.8	23.6	-	23.4	23.6	23.4		23	23.3
Melting Range (approx.) °C	595-650	600-645	-	615-650	580-650	615-650		555-650	500 - 640

[1] Figures are average in the temperature range 20-100 °C. The coefficient tabulated must be multiplied by 10^{-6}; eg. $23.6 \times 10^{-6} = 0.0000236$

Fabrication Properties

	5251	5454	6005A	6060	6061	6063	6261	6351	7075
Corrosion Resistance	A,A	A,A	A,A	A,A	B,B	A,A	B,B	A,B	C
Machining	C,B	C,B	B,C	C,C	B,C	C,C	B,C	B,C	A
Anodising	C,C	C,C	B,B	A,A	B,B	A,A	B,B	B,B	C
Brazing	C	D	A	A	A	A	A	A	D
Cold Forming	A,C	A,C	A,C	A,C	A,C	A,C	A,C	A,C	C
Gas Welding	A	C	A	A	A	A	A	A	D
Inert Gas Welding	A	A	A	A	A	A	A	A	C
Resistance Spot Welding	B,A	B,A	B,A	B,A	B,A	B,A	B,A	B,A	B
Heat Treatment	NR	NR	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Fabrication Properties are shown as relative ratings in decreasing order of merit = A, B, C, D. NR = Not recommended in relation to usual end use alloy. Where applicable, ratings for both annealed an hardest temper are given.

SHEET AND PLATE BENDING RADII

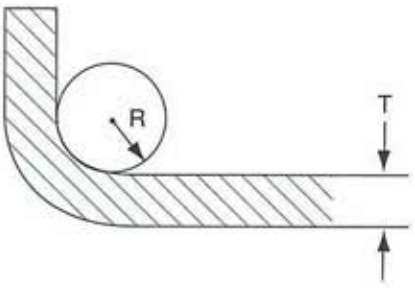
Cold Bend Radii 90°, t = thickness

Alloy	Temper	Material Thickness							
		0.4mm	0.8mm	1.6mm	3.0mm	4.0mm	6.0mm	10.0mm	12.0mm
1050	H12	0t	0t	0t	0t	0t	0.5t	1t	1.5t
1100	O	0t	0t	0t	0t	0t	0.5t	1t	1.5t
1200	H12	0t	0t	0t	0.5t	1t	1t	1.5t	2t
	H14	0t	0t	0t	1t	1t	1.5t	2t	2.5t
	H16	0t	0.5t	1t	1.5t				
	H18	1t	1.5t	2t	3t				
3003	O	0t	0t	0t	0t	0.5t	1t	1t	1.5t
5005	H32	0.5t	1t	1t	1.5t				
	H34	1t	1.5t	2t	3t				
5052	H32	0t	0t	0t	0.5t	1t	1t	1.5t	1.5t
5083	H321/116	2t	2t	2t	2.25t	2.25t	2.5t	3t	3.25t
5086	H321/116	2t	2t	2t	2.25t	2.25t	2.5t	3t	3.25t
5251	H32	0t	0t	1t	1.5t	1.5t	1.5t	1.5t	2.0t
	H34	0t	1t	1.5t	2t	2t	2.5t	2.5t	3t
	H36	1t	1t	1.5t	2.5t				
	H38	1t	1.5t	2.5t	3t				
5454	H32	0t	0.5t	1t	1.5t	1.5t	2t	2.5t	3.5t
	H34	0.5t	1t	1.5t	2t	2.5t	3t	3.5t	4t
	H112						2t	2.5t	3t

TREADPLATE BENDING RADII

With pattern outside, t = thickness

Alloy	Temper	Material Thickness					
		1.5mm	2.0mm	3.0mm	4.0mm	5.0mm	6.0mm
5251	O	2.4t	3.0t	4.5t	6.0t	7.5t	9.0t
	F	3.2t	4.0t	7.5t	10.0t	15.0t	18.0t



Sheet and plate are capable of being bent cold through an angle of 90 deg. around a pin having a radius equal to N times the thickness of the sheet without cracking.

R is the bending radius
T is the thickness of the sheet

CORROSION RATINGS FOR ALUMINIUM

These corrosion tables apply specifically to the 1000 and 5000 series of wrought alloys, but may be applied to the 4000 and 6000 series of wrought alloys and to Casting Alloys 135, 160 Q, 123, 360, 320, 340 and 360.
Anodising improves the resistance because of the more perfect and thicker oxide film and because of its scratch and abrasion resistance.

Powder Coating has excellent resistance to natural weathering that provides good chemical and corrosion resistance.

A Excellent Resistance (corrosion so slight as to be harmless).
B Good Resistance (satisfactory service expected).
C Fair Resistance (satisfactory service only under specific conditions; aluminium not recommended without additional data).
D Poor Resistance (satisfactory for temporary service only; aluminium should not be used without test experiment).

Note: The following guide list indicates in a very general way the resistance of commercially pure aluminium to attack by chemicals and other common substances. Because the chemical behaviour of aluminium is dependent upon conditions of service, environment, the actual composition of the metal etc., engineers should always be consulted in cases of doubt.

Test Solution	Corrosion Resistance
A	
Acetaldehyde	A
Acetanilide	A
Acetic Acid, Glacial, 95% & higher	A
Acetic Acid, Dilute (elevated temp)	C
Acetic Anhydride	A
Acetone	A
Acetylene (dry)	A
Acrylonitrile (dry)	A
Acrylonitrile (wet)	B
Adipic Acid	A
Albumen	A
Aluminium Chloride	C
Aluminium Formate	A
Aluminium Nitrate (no free nitric acid)	A
Aluminium Sulphate	B
Ammonia (dry)	A
Ammonium Acid Fluoride	D
Ammonium Aluminium Sulphate	B
Ammonium Bicarbonate	A
Ammonium Bromide	C
Ammonium Carbonate	B
Ammonium Fluoride	C
Ammonium Hydroxide	B
Ammonium Lactate	B
Ammonium Nitrate	A
Ammonium Phosphate (up to 3%)	B
Ammonium Sulphate (no free sulphuric acid)	B
Ammonium Sulphate	B
Ammonium Thiocyanate (pure)	A
Amyl Acetate	A
Aniline (liquid)	C
Aniline Hydrochloride	C
Aniline Sulphate	B
Aniline (vapours)	A
Animal Oils	A
Anthracene	A
Anthranilic Acid	D
Anthraquinone	A
Apple Juice	B
Arsenic Iodide	B
Asphalt	A
B	
Barium Chloride	C
Barium Hydroxide	D
Beer	A
Benzaldehyde	A
Benzene	A
Benzoic Acid	A
Benzol (Benzel alcohol)	A
Benzoyl Chloride (dry & below 200°F)	B
Bitumen	A
Bituminous Compounds	A
Borax	B
Boric Acid	A
Brandy	B
Bromine	D
Bromoform	C
Buttermilk	A
Butyl Acetate	A
Butyraldehyde	A
Butyric Acid	B
C	
Calcium Carbide (dry)	A
Calcium Carbonate	B
Calcium Chloride	C
Calcium Hydrosulphide	A
Calcium Hydroxide	C
Calcium Hypochlorite	C
Calcium Nitrate	A
Calcium Oxalate	C
Calcium Sulphate	B
Calcium Sulphide	B
Camphor	B
Carbolic Acid (phenol) below 100°C	A
Carbon Black	B
Carbon Dioxide	A
Carbon Disulphide	A
Carbonic Acid (dilute)	A
Carbon Monoxide	A
Carbon Tetrachloride (dry)	B
Castor Oil	A
Cellulose	A
Cellulose Acetate	A
Cement, Wet	B
Cement, Dry	A
Ceresine	A
Cereals (dry)	A
Cerium Nitrate	A
Chalk (dry)	A
Cheese	B
Chloride of lime (Calcium Hypochlorite)	C
Chlorine (dry)	A
Chlorine (v.c. with water)	D
Chloroform (boiling)	C
Chloroform (room tem-dry)	B

Test Solution	Corrosion Resistance
Chromic Nitrate	B
Chromic Sesquoxide	A
Cider	B
Citric Acid	B
Clay	A
Coal, Coke	A
Coal, Gas	B
Cobaltous Chloride	D
Cod Liver Oil	A
Cognac	B
Copal	A
Cork (dry)	A
Cork (wet)	C
Cottonseed Oil	A
Cream of Tartar	B
Creosote	B
Cresol (below 100°C)	A
Crotonaldehyde	A
Crude Petroleum	A
Cupric Acetate	D
Cupric Chloride	D
Cupric Nitrate	D
Cupric Sulphate	D
Cyanoacetic Acid	B
D	
Dairy Products	A
Diammonium Hydrogen Phosphate	C
Dichlorodifluoromethane (Freon-E-12)	A
Dichloroethylene (dry)	B
Dichloromonofluoromethane (Freon F-21)	B
Dichlorotetrafluoromethane (Freon F-114)	A
Diethyl Ether	A
Dialycolic Acid	C
Dipetene	A
Diphenyl Ether	A
Distilled Water	A
Dried Bulk Vegetables	A
Dyestuffs (acid or direct)	B
Dynamite	A
E	
Eau de Cologne	C
Edible Fats	A
Edible Oils	A
Essential Oils	A
Ethers	A
Ethyl Alcohol (not anhydrous)	A
Ethyl Chloride (dry)	A
Ethylene Bromide	C
Ethylene Glycol	B
Ethyl Oxalate	A
Eucalyptus Oil	A
F	
Fats	A
Fatty Acids	A
Ferric Chloride	D
Ferric Nitrate	C
Ferrous Ammonium Sulphate	B
Ferrous Carbonate (up to 10% conc.)	B
Ferrous Sulphate	B
Flour, other Milled Products	A
Fluoboric Acid	D
Fluorine Gas (dry)	A
Fluorspar	A

Test Solution	Corrosion Resistance
Fly Ash	C
Forest Products	B
Formaldehyde	B
Freon 11	B
Freon 22	A
Freon 113	B
Fruit Juices	B
Fuels, Liquid	A
Furfural	A
G	
Gallic Acid	A
Gas, illuminating	A
Gases, Argon, Helium, Hydrogen, Nitrogen, Oxygen, LPG, others	A
Gasoline (anhydrous)	A
Gelatine	A
Gin	B
Gluconic Acid	A
Glucose	A
Glue (neutral)	B
Glycerine (pure)	A
Glyceryl Phosphate	A
Grape Sugar (glucose)	A
H	
Hexamethylenetetramine	A
Hydrobromic Acid	D
Hydrochloric Acid	D
Hydrocyonic Acid	A
Hydrofluoric Acid	D
Hydrogen Peroxide (30% and higher)	A
Hydrogen Peroxide (dilute)	B
Hydrogen Sulphide	A
Hydroquinone	A
I	
Ice	A
Indole	A
Ink	C
Iodine	C
K	
Kerosene	A
L	
Lacquers	A
Lactic Acid	B
Lactose	A
Lard Oil	A
Latex	A
Lead Acetate, Basic	C
Lead Acetate, Primary	C
Lead Acetate, Secondary	C
Lead Arsenate	B
Lemon Juice	B
Levulinic Acid	A
Lignite Wax	A
Lime, Dry	A
Lime, Wet	C
Linseed Oil	A
Liquid Fuels	A
Liquors	B
Lithium Hydroxide	C
Lubricating Oils	A

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Test Solution	Corrosion Resistance
M	
Madder Lacquer	A
Magnesium Acetate (up to 10% conc.)	A
Magnesium Chloride	C
Magnesium Formate (up to 1% conc.)	B
Magnesium Nitrate (up to 10% conc.)	B
Magnesium Perchlorate	A
Magnesium Sulphate	B
Maleic Anhydride	C
Malic Acid	B
Mannitol	A
Margarine	A
Meat, Unsalted	A
Mercury	D
Menthol	A
Mercuric Chloride	D
Mercury Fulminate	D
Mercury Salts	D
Metaldehyde	A
Methylamine	A
Methyl Chloride	D
Methyl Cyclohexamine	A
Methyl Formate	A
Methyl Salicylate	A
Milk	A
Milk Sugar	A
Mineral Oils	A
Molasses, Blackstrap or Residual	B
Molasses, Refined	A
Moulds	A
Methyl Ethyl Ketone	A
Monoethanolomine	A
N	
Naphthalene	B
Naphthenic Acids (up to 82°C)	A
Naphthol	A
Naphthylamine	C
Naval Stores	A
Nickel Acetate (up to 10% conc.)	B
Nickel Ammonium Sulphate (up to 10% conc.)	C
Nickel Chloride	D
Nickel Nitrate (up to 10% conc.)	C
Nickel Sulphate (up to 10% conc.)	C
Nicotine	A
Nicotine Sulphate	A
Nitric Acid (dilute)	D
Nitric Acid (concentrated over 80%)	A
Nitrogen	A
Nitrogen Fertilisers	A
Nitroglycerine	A
Nitrous Acid	B
Nitrous Oxide (dry)	A
Nitrous Oxide (wet)	C
O	
Oils, Fuels & Lube	A
Oils, Transformer	A
Oils, Animal	A
Oils, Edible	A
Oils, Mineral	A
Oils, Vegetable	A
Oleic Acid	A
Olive Oil	A
Onion Juice	B
Orange Juice	B
Ores, Bauxite, Zinc, Lead, Nickel	A
Ores, Copper, Mercury	C
Organic Amines	B
Oxalic Acid	C
Oxygen	A
Ozone (dry)	A
Ozone (wet)	A
P	
Paints, Oil Base	A
Paints, Copper Mercury	C
Palmitic Acid	B
Palm Oil	A
Paraffin	A
Paraldehyde	B
Paste	A
Peanut Oil	A
Perchlorethylene (dry)	A
Perlite	A
Petroleum (chloride free)	A
Petroleum Products, refined	A
Phosphate Fertilisers	C
Phosphate Rock	C
Phosphoric Acid	C
Pickles	C
Plaster	B
Phenol (up to 100°C)	A
Phloroglucinol	A
Phosphorus (dry)	A
Phosphorus Pentoxide (dry)	A
Phosphorus Sesquisulphide (dry)	A
Phthalic Acid (pure)	A
Picric Acid	A
Pinene	A
Pine Oil	A
Plastic Pellets, Polyethylene Polyvinyl Chloride Polypropylene, Polystyrene	A
Potassium Bicarbonate	A
Potassium Bichromate	A
Potassium Bitartrate	B
Potassium Bromide	B
Potassium Carbonate	C
Potassium Chlorate	A
Potassium Chloride	B
Potassium Chromate	A
Potassium Cyanide	C
Potassium Dichromate	A
Potassium Ferricyanide	A
Potassium Hydroxide	D
Potassium Nitrate	A
Potassium Nitrite	A
Potassium Permanganate	A
Potassium Phosphate	C
Potassium Silicate	B
Potassium Sulphate	A
Potassium Thiocyanate	A
Propionic Acid (conc.)	B
Propionic Acid (dilute)	C
Propylene Glycol	A
Pyridine	B
Pyrogallol	A
Pyroligneous Acid	B
R	
Rayon	A
Refrigerants	B

Test Solution	Corrosion Resistance
Resins	A
Resorcinol	A
Rice	A
Rosin	A
Rubber Products, Crude, Natural, Synthetic	A
S	
Salicylic Acid	A
Salted Herring	C
Salt, Wet or Dry	C
Sand, Gravel	A
Sea Foods, Fish	A
Selenic Acid	A
Selenous Acid	A
Semolina	A
Sewage	B
Shellac	A
Silica Gel	A
Silicon Tetrachloride (dry)	A
Silk	A
Silver Salts	D
Soap	C
Soda Ash	C
Soda Water	B
Sodium Acetate	A
Sodium Bichromate	B
Sodium Bicarbonate (dry)	B
Sodium Bisulphate	C
Sodium Bisulphite	B
Sodium Bitartrate	B
Sodium Borate	B
Sodium Chlorate	B
Sodium Chloride	C
Sodium Chromate	A
Sodium Cyanide	C
Sodium Fluosilicate (up to 1% conc)	A
Sodium Fluoride, Acid	C
Sodium Hydrogen Sulphate	C
Sodium Hydroxide	D
Sodium Lactate	C
Sodium Nitrate	A
Sodium Nitrite	A
Sodium Oxalate	B
Sodium Peroxide	C
Sodium Phosphate	C
Sodium Silicate	B
Sodium Sulphite	B
Sodium Sulphate	A
Sodium Sulphocyanide	A
Sodium Thioarsenate	B
Sodium Thiosulphate	B
Stannous Bromide	D
Stannous Chloride	D
Stannous Sulphate	D
Starch	A
Steam, Low Pressure	A
Stearic Acid	A
Strontium Acetate (up to 10% conc)	A
Succinic Acid	A
Sugar	A
Sugar Solutions	A
Sugar Syrup	A
Sulphur Dioxide (dry)	A
Sulphur, Liquid, Solid, Vapour	A
Sulphur Trioxide (dry)	A
Sulphuric Acid, in excess of 98%	A

Test Solution	Corrosion Resistance
Sulphuric Acid, below 98%	D
Sulphuric Ether	A
Sulphurous Acid	C
Sulphuryl Chloride (dry)	B
Synthetic Resins	B
Synthetic Rubbers	A
T	
Tanners Bate	B
Tannic Acid (pure)	A
Tars	A
Tartaric Acid	B
Tetrachlorethylene (dry)	B
Tetralin	B
Tetramine	A
Thorium Nitrate	C
Tobacco	A
Toluene	A
Transformer Oil	A
Triocetin	B
Trichloroacetic Acid	D
Trichlorethylene (dry)	B
Trichlorotyfluorethane (F-113)	B
Triethonolamine	B
Tripoly Phosphate	C
Tripotassium Phosphate	C
Turpentine	A
U	
Ultramarine	A
Urea	A
V	
Valeric Acid (up to 50% conc)	A
Varnish	A
Vegetable Oils, linseed, cottonseed, soy bean, peanut etc	A
W	
Water, distilled	A
Water, industrial	C
Water, Rain	A
Water, Sea	C
Water, Tap	C
Waxes	A
Wheat, corn and other grains	A
Whisky	B
Wine	B
X	
Xylene	A
Z	
Zinc Acetate (up to 10% conc)	A
Zinc Chloride	D
Zinc Oxide (up to 10% conc)	B
Zinc Sulphate (up to 10% conc)	C

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