ABS Material

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INTRODUCTION

Because of a unique balance of properties, modern ABS copolymers are being used on an ever increasing scale for the manufacture of many industrial and domestic products.
The material is very tough and resilient, has high impact strength, good chemical resistance and is non toxic and taint free. These advantageous properties have attracted engineers in many industries to the use of ABS piping systems rather than traditional materials, which do not have these distinctive benefits.
ABS piping systems are replacing many failed piping systems made from other materials.
The Eurapipe ABS system comprises a range of matched pressure pipes and fittings, joined together by a wide variety of methods including cold solvent cement welding or our rubber ring joint system.

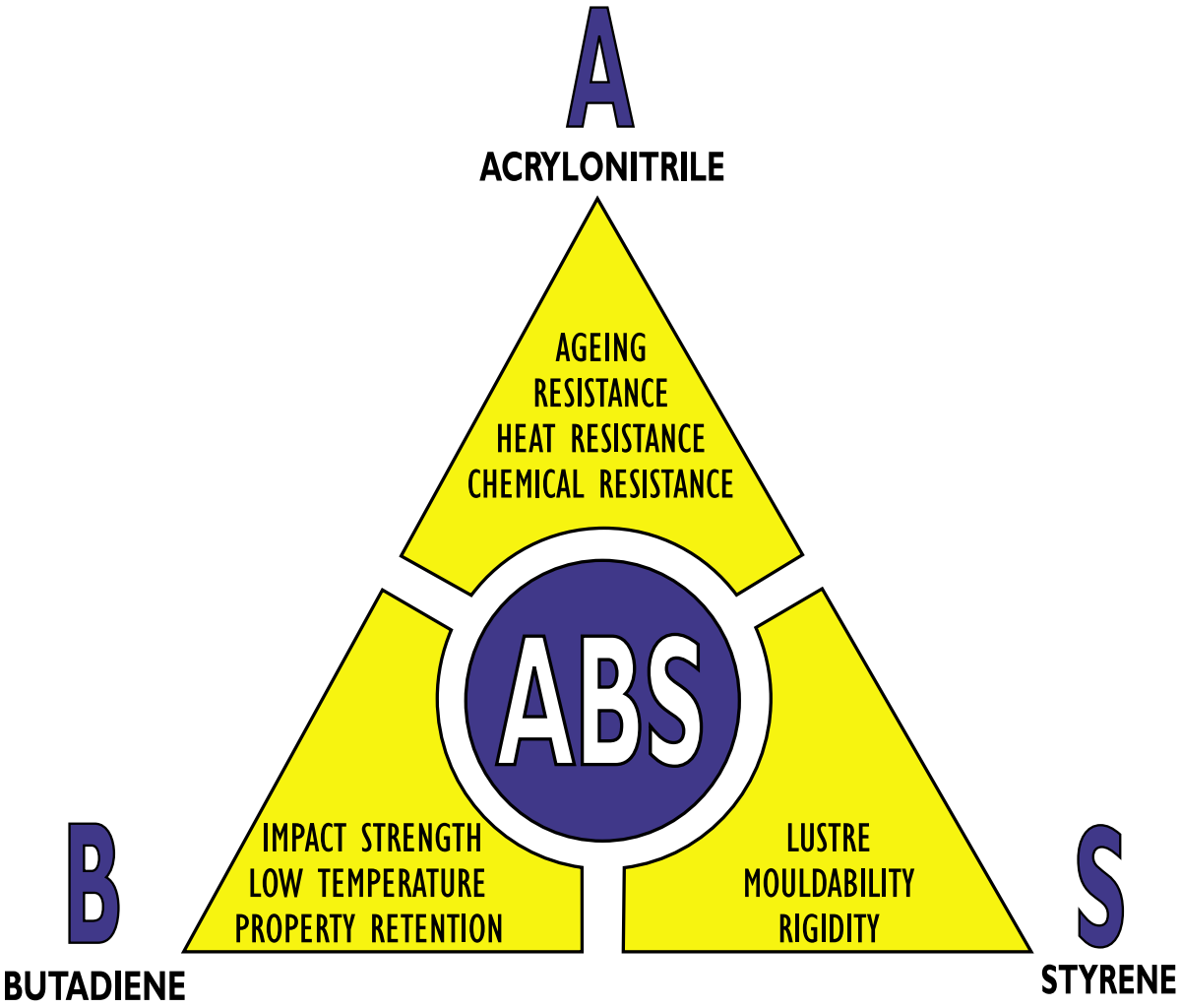
THE MATERIAL

Acrylonitrile - Butadiene - Styrene (ABS) identifies a family of engineering thermoplastics with a broad range of performance characteristics.
The copolymeric system is alloyed to yield the optimum balance of properties suited to the selected end use.

ACRYLONITRILE - imparts chemical resistance and rigidity.

BUTADIENE - endows the product with impact strength, toughness and abrasion resistance.

STYRENE - contributes to the lustre, ease of processing and rigidity.



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MATERIALS PROPERTIES

The formulation used by Eurapipe has been developed in conjunction with polymer manufacturers to optimise performance in respect to tensile strength, chemical resistance, ductility, resistance to weathering, heat stability, low toxicity, taint free and ease of processing from raw material to finished product.
ABS is tough and strong over the recommended temperature range of -30°C to +60°C.

The outstanding properties of ABS are:

✔ High impact strength and ductility, which combine to give exceptional toughness.

✔ Good chemical resistance.

✔ Abrasion resistance.

✔ High strength solvent weld jointing which allows efficient system assembly and modification.

✔ Rubber Ring jointing methods, allowing compatible systems jointing techniques.

✔ Nontoxic and non-taint properties.

✔ Withstands aggressive ground waters.

✔ High strain tolerance for buried applications.

✔ Good resistance to ultraviolet light.

✔ Lower celerity and extreme tolerance to water hammer surges.

Property*	Reference Temperature	S.I.Unit	Other Units
Ultimate tensile strength (strain rate 50mm/min) ASTM D638 Type I	20 °C	40 MPa	5800 lbf/in^2
Elongation at break	20 °C	50%	50%
Instantaneous Flexural Modulus	20 °C	2200 MPa	319 072 lbf/in^2
Compressive strength	20 °C	42 MPa	6100 lbf/in^2
Izod impact strength (notched) ASTM D256 (method A)	23 °C	340 J/m notch	6.4 ft lb/in notch
Specific gravity		1.05 x 10^3 Kg/m^3	65.5 x 10^{-3} lb/ft^3
Vicat softening point ASTM D1525		95 °C	203 °F
Coefficient of thermal expansion		10.1 x 10^{-5} m/m°C	5.6 x 10^{-5} ft/ft°F
Maximum operating temperature		60 °C	140 °F
Poisson's ratio		0.35	
Thermal conductivity		0.2 W/m°C	1.3 BTU/ft^2/in/°F
Specific heat		1.47 KJ/Kg°C	0.35 BTU/lbm/°F
Volume resisitivity		3.5 x 10^{16} Ω cm	
Dielectric constant		3.20 @ 60 Hz 3.12 @ 10^3 Hz 2.90 @ 10^6 Hz	

*Test pieces machined from moulded specimens yielded to the above mentioned typical properties

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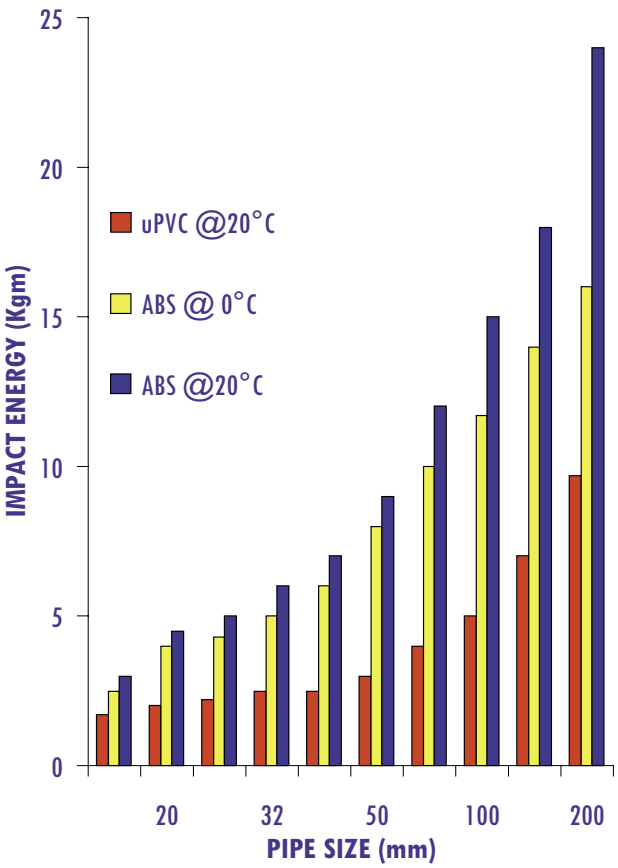
IMPACT STRENGTH

ABS is a relatively ductile thermoplastic, which exhibits very high impact strength compared to other thermoplastics such as uPVC particularly at low temperatures. It is for this reason ABS is used in demanding applications requiring exceptionally high impact strength material such as construction site safety helmets.

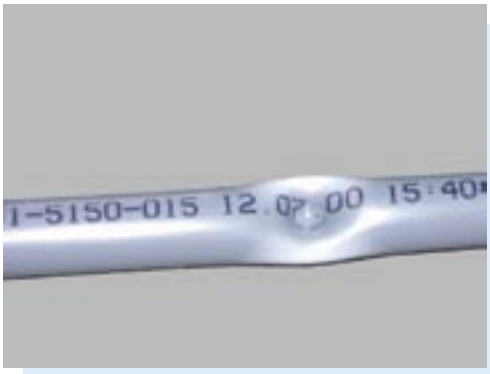
As part of the Eurapipe Quality Assurance programme, sample lengths of pipe are routinely impact tested at 0˚C as required by AS 3518.

ABS is unique in retaining high levels of impact strength at sub zero temperatures and is significantly superior to most other thermoplastics used in pipe systems.

The graph shows the relatively small reduction in impact strength of ABS between 20°C and 0°C compared with another thermoplastic pipe systems.



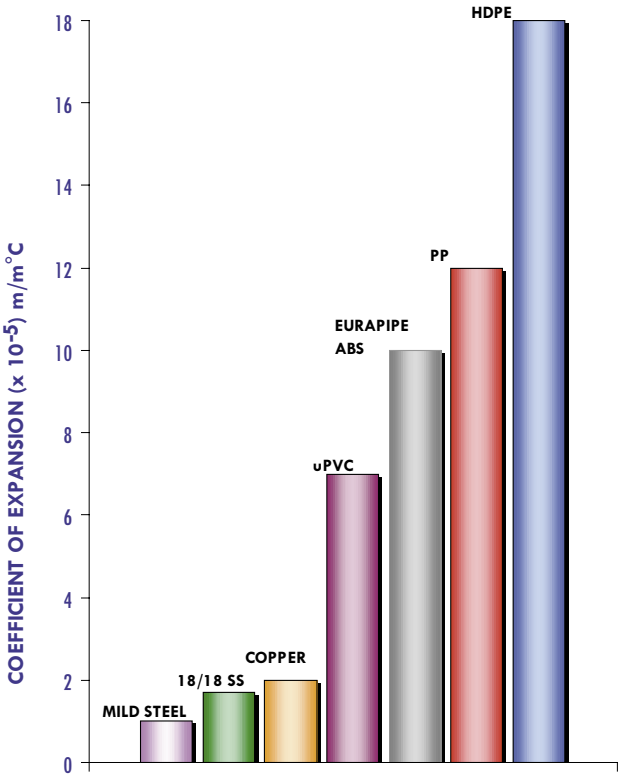
MODE OF FAILURE



ABS is a relatively ductile material and the mode of failure resembles that of soft copper. Failure is by ductile distortion and tearing, the localised nature minimising the loss of pipe contents.

In contrast, crack propagation and hazardous material fragmentation accompany the failure of brittle material.

ABS Material



THERMAL EXPANSION

All thermoplastics expand at a greater rate than metals as shown in the diagram above.
Expansion need not cause undue concern in design or installation of an ABS piping system provided that due recognition is taken at the design stage. The reduced flexural modulus of ABS over that of steel results in reduced loads on supports and equipment arising from thermal strains.
The linear coefficient of thermal expansion of ABS is 10.1 x 10^{-5} m/m °C.

TOXICITY AND TAINT

ABS is **free** from heavy metal stabilisers such as **lead** which are often used in the processing of other thermoplastic materials. Therefore, there is **no** possibility of any toxic heavy metals substances being leached from the ABS pipe material into the fluid being conveyed by the pipe.
Eurapipe ABS conforms to AS4020 and has been safely used for many years with potable water, grade I distilled water for medical use, renal dialysis fluid and many foods and beverages.
ABS is regarded as taint free and has been used for conveying potable water, beer, soft drinks, caramel, wines, sauces, chocolate, custard cream and other similar products. It is recommended that food and drink manufacturers test for taste tainting on their own product before installation commences.

RIGIDITY AND STIFFNESS

ABS is classified as a rigid thermoplastic over its working temperature range -30°C to +60°C.
With increased temperature, pipe rigidity decreases thus necessitating more frequent support.

ABS Material

WEATHERING

Eurapipe ABS piping systems are suitable for external installation under extreme conditions without additional surface protection.
When ABS products are exposed to the weather, they will suffer some minor degradation of the exposed surface. The degradation results in a reduction of surface gloss, and shift in surface colour to light grey. The degradation is confined to the exposed surface only.
The effect of long-term exposure to sunlight over prolonged periods has minimal effect on the physical properties of ABS systems.
Because of the relatively high flexural modulus of ABS, the stresses induced in a component whilst in service result in smaller strains, therefore minimising the possibility of environmental stress cracking of the exposed surface.

This resistance to failure is further improved by the inherently high impact strength of ABS, particularly at low temperatures, and the ability of the polymer to withstand long term heat exposure with little change to physical properties.

ABRASION RESISTANCE

ABS piping systems have long been successfully employed in applications where abrasion resistance is the prime consideration. The conveying of slurries in the mining, food, power generation and waste water industries is a typical example where ABS has been demonstrated to outlast steel and stainless steel pipes previously employed.
The chemical resistance of ABS combined with impact resistance makes it an ideal choice for such corrosive and erosive environments.
It is these conditions which lead to reduced life of metal pipe systems.
The rubber-like butadiene phase in ABS provides this piping material with outstanding resistance to abrasive media.
Eurapipe sales engineers have the experience to advise on the suitability of ABS pipe for slurry or abrasive applications.
For gravity flow systems the long term low surface roughness enables less steep slopes to be used. Lower slopes can mean reduced building heights which has a great effect on capital costs. Additionally, lower slopes reduce transport velocity, which in turn reduces the wearing of the piping material.

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CHEMICAL RESISTANCE

The information given on the following pages is based on the recommendations of the manufacturers of the polymers, field experience and subsequent tests by Eurapipe.
The chemical resistance information has been obtained from numerous sources and it is primarily based on plastic material test specimens that have been immersed in the chemical (not combination of chemicals) and on field experience. Under no circumstances is to be assumed that a mixture of individually acceptable chemicals may be safely used with ABS or any other product.

The effect of the combination of chemicals on the ABS components has to be assessed in conjunction with other factors that have a significant impact upon the lifecycle of the system i.e. temperature, internal pressure, flexural stresses, cyclic loads etc. Any chemical attack is increased when temperature or stress are increased or when temperature or stress are varied.
It is the design engineers responsibility to assess the materials and the exposure under such conditions.
Specific data on industrial chemical applications of ABS can be given by the Eurapipe organisation. Such enquiries are invited for applications not shown here.
Under no circumstances is it to be assumed that a mixture of individually acceptable chemicals may be safely used with ABS or any other product.
Absence of notation indicates the substance has not been tested.

QUICK REFERENCE CHEMICAL RESISTANCE	
Chemical	**Resistance**
Weak acids	Good resistance
Strong acids	Limited resistance
Weak alkalis	Good resistance
Strong alkalis	Good resistance
Aggressive soils	Excellent resistance
Metal salts	Good resistance
Sea water	Excellent resistance
Aromatic hydrocarbons	Poor resistance
Organic solvents	Poor resistance

Unless stated, all concentrations are 100% or saturated aqueous solution. Reference to saturated solutions is at 20°C.

Resistance Key Information

1. RESISTANT=Little or no attack

2. CONDITIONAL RESISTANCE=Some attack, however may still be suitable when used with a higher pipe class or reduced service life.

3. NOT RECOMMENDED=Little or no resistance. Not suitable for use with ABS pipe.

4. REFER TO EURAPIPE

The information given here is based upon various sources available at the time this manual was created. We reserve the right to revise this information from time to time in the light of subsequent research and experience. The information is to be used as a general guide and there is no warranty or representation, either expressed or implied, that this data is free from errors.
We shall not be liable for any damages of any kind that may result from the use of this data.

ABS Material

Chemical or Agent	Formula	Concentration (%W/V)	Working temperature	
			20°C	50°C
Acetamide	CH_3CONH_2	%	1	
Acetic Acid	CH_3COOH	Up to 10 10-20 Over 20 (including Glacial)	1 2 3	1 3
Acetone	CH_3COCH_3		3	3
Acetyl Chloride	CH_3COCl		3	3
Alcohols:				
Allyl	$CH_2=CHCH_2OH$		3	3
Amyl	$CH_3(CH_2)_3CH_2OH$		3	3
Benzyl	$C_6H_5CH_2OH$		3	3
Butyl (Butanol)	$CH_3(CH_2)_2CH_2OH$		3	3
Ethyl (Ethanol)	CH_3CH_2OH	Up to 50% aq. soln.	1	1
Ethyl (Ethanol)	CH_3CH_2OH	95% aq. soln.	3	3
Furfuryl	$C_4H_3OCH_2OH$		3	3
Methyl (Methanol)	CH_3OH		3	3
Iso Propyl (propanol)	$(CH_3)_2CHOH$		3	3
Alum	$Al_2(SO_4)_3K_2SO_4.H_2O$		1	1
Aluminium Chloride	$AlCl_3$		1	1
Aluminum Sulphate	$Al_2(SO_4)_3$		1	1
Ammonia Solution	NH_4OH	35%	1	1
Ammonium Carbonate	$(NH_4)_2CO_3$		1	1
Ammonium Molybdate	$(NH_4)_6Mo_7O_2.H_2O$		1	1
Ammonium Nitrate	NH_4NO_3		1	1
Ammonium Sulphate	$(NH_4)_2SO_4$		1	1
Ammonium Thiocyanate	NH_4SCN		1	1
Amyl Acetate	$Ch_3COO(CH_2)_4CH_3$		3	3
Aniline	$C_6H_5NH_2$		3	3
Aromatic Hydrocarbons			3	3
Barium Bromide	$BaBr_2$		1	1
Barium Carbonate	$BaCO_3$		1	1

1=RESISTANT 2=CONDITIONAL RESISTANCE 3=NOT RECOMMENDED 4=REFER TO EURAPIPE

ABS Material

Chemical or Agent	Formula	Concentration (%W/V)	Working temperature	
			20°C	50°C
Barium Chloride	$BaCl_2$		1	1
Barium Hydroxide	$Ba(OH)_2$		1	1
Battery Acid	H_2SO_4		1	1
Benzene	C_6H_6		3	3
Benzoic Acid	B_6H_5COOH		3	3
Boric Acid	H_3BO_3		1	1
Brake Fluids			3	3
Brine	$NaCl_H2O$	Saturated	1	1
Bromic Acid	$HbrO_3$		1	1
Bromine (Gas + Liquid)	Br_2		3	3
Butane Gas	C_4H_{10}		1	1
Butyric Acid	C_3H_7COOH	20% aqueous	3	3
Calcium Compounds	Refer to respective sodium compound			
Carbon Dioxide	CO_2	40% aq. soln.	1	1
Carbon Disulphide	CS_2	95% sq. soln.	3	3
Carbon Monoxide	CO		1	1
Carbon Tetrachloride	CCl_4		3	3
Castor Oil			1	1
Chlorine Gas Dry	Cl_2		2	3
Chlorine Wet			3	3
Chlorine Aqueous Solution		Up to 3% free chlorine	1	1
		Over 3% free chlorine	4	4
Chlorobenzene	C_6H_5Cl		3	3
Chloroform	$CHCl_3$		3	3
Chromic Acid	CrO_3+H_2O	10% 25%	2 3	3 3
Citric Acid	$HOC(COOH)(CH_2COOH)_2H_2O$		1	1
Cresols	$C_6H_4(OH)CH_3$		3	3
Copper Chloride	$CuCl_2$		1	1
Copper Fluoride	CuF_2		1	1
Copper Sulphate	$CuSO_4$		1	1

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ABS Material

Chemical or Agent	Formula	Concentration (%W/V)	Working temperature	
			20°C	50°C
Creosote			3	3
Cyclohexane	C_6H_{12}		3	3
Detergents			4	4
Dextrose	$C_6H_{12}O_6H_{12}$		1	1
Dichloroethane	CH_2ClCH_2Cl		3	3
Dichloromethane	$CHCl_2$		3	3
Diethylamine	$(C_2H_5)_2NH$		3	3
Diethyl Ether	$C_2H_5OC_2H_5$		3	3
Ethylene Glycol	$HOCH_2CH_2OH$		1	1
Ferric Chloride	$FeCl_3$		3	3
Ferric Nitrate	$Fe(NO_3)_3$		1	1
Ferrous Chloride	$FeCl_2$	Saturated	1	2
Ferrous Sulphate	$FeSO_4$	40% aqueous	1	1
Formaldehyde (Formalin)	HCHO ($+H_2O$)	10%	1	1
Formic Acid	HCOOH	3%	1	3
Freon	R11, R12, R22, R113, R114		4	4
FruitJuices			1	2
Gelatine			1	1
Glucose	$C_6H_{12}O_6$		1	1
Glycerine	$HOCH_2$-CHOH-CH_2OH		1	1
Hydrochloric Acid	HCl HCl HCl	0-10% 10-30% 30%-37% >37%	1 1 1 3	1 1 3 3
Hydrofluoric Acid	HF HF	0-10% >10%	1 3	2 3
Hydrofluorosilicic Acid	H_2SiF_6		3	3
Hydrogen	H_2		1	3
Hydrogen Peroxide	H_2O_2	1% 3% 5% 10% (30 vol)	1 1 1 3	1 2 3 3

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ABS Material

Chemical or Agent	Formula	Concentration (%W/V)	Working temperature	
			20°C	50°C
Iodine Solution in KI	I_2		1	3
Kerosene			3	3
Ketones			3	3
Lanolin			1	1
Lead Acetate	$Pb(CH_3OO)_2$		1	1
Linseed Oil			1	3
Magnesium Compounds	Refer to respsective sodium compound			
Mesityl Oxide	$(CH_3)_2C=CHCOCH_3$		3	3
Methane	CH_4		1	3
Methoxyethanol	$CH_3OCH_2CH_2OH$		3	3
Methyl Acetate	CH_3COOCH_3		3	3
Methyl Cyclohexanone	$C_6H_9CH_3O$		3	3
Methyl Ethyl Ketone	$CH_3COCH_2CH_3$		3	3
Methyl Methacrylate	$CH_2C(CH_3)COOCH_3$		3	3
Methylated Spirits			3	3
Milk			1	1
Mixed Acids Limited resistance Dependent on Concentrations			4	4
Molasses		Commercial	1	1
Nickel Sulphate	$NISO_4$	1%	1	1
Nitric Acid	HNO_3	1% 5%	1 2	3 3
Nitrogen	N_2	3	1	1
Oleic Acid	C_8H_{17}-CO=CH-		1	3
Oxalic Acid	HO_2CCO_2H		1	4
Oxygen	O_2		1	1
Ozone	O_3	20PPM Solution Saturated Solution Gaseous	1 3 3	1 3 3

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ABS Material

Chemical or Agent	Formula	Concentration (%W/V)	Working temperature	
			20°C	50°C
Petrol			3	3
Phenol	C_6H_5OH		3	3
Potassium Compounds Refer to respective Sodium compounds				
Propane	C_3H_8		1	1
Pyridine	C_5H_5N	Trace	3	3
Soap solutions (aqueous)			1	1
Sodium Acetates	$Na(CH_3COO)$		1	1
Sodium Borate	$Na_2B_4O_7$		1	1
Sodium Carbonate	$NaCO_3$		1	1
Sodium Chlorate	$NaClO_3$		1	1
Sodium Chloride	NaCl		1	1
Sodium Chromate	Na_2CrO_4		1	1
Sodium Cyanide	NaCN		1	1
Sodium Ferrocyanide	$Na_4F_e(CN)_6$		1	1
Sodium Fluoride	NaF		1	1
Sodium Hydrogen Carbonate	$NaHCO_3$		1	1
Sodium Hydrogen Sulphate	$NaHSO_4$		1	1
Sodium Hydrogen Sulphite	$NaHSO_3$		1	1
Sodium Hydroxide	NaOH	Saturated	1	1
Sodium Hypochlorite	NaOCl	>3% available chlorine	3	3
Sodium Iodide	NaI		1	1
Sodium Nitrate	$NaNO_3$		1	1
Sodium Permanganate	$NaMnO_4$		3	3
Sodium peroxide	Na_2O_2		3	3
Sodium Persulphate	$Na_2S_2O_8$		1	1
Sodium Phosphate	$Na_4P_2O_7$		1	1
Sodium Salicylate	$NaC_7H_5O_3$		1	1
Sodium Silicate	$NaSiOl_{3.9}H_2O$		1	1

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Chemical or Agent	Formula	Concentration (%W/V)	Working temperature	
			20°C	50°C
Sodium Sulphate	Na_2SO_4		1	1
Sodium Sulphite	Na_2SO_3		1	1
Sodium Sulphide	Na_2S		1	1
Sodium Thiosulphate	NaS_2O_4		1	1
Stannic Chloride	$SnCl_4$		1	3
Stannoous Chloride	$SnCl_2$		1	3
Sulphur Dioxide (Gas) Dry Wet	SO_2		 1 1	 2 2
Sulphuric Acid	H_2SO_4	Under 30% 30%-50% 50%+	1 1 3	1 2 3
Toluene	$C_6H_{3=5}CH_3$		3	3
Trichlorobenzene	$C_6H_3Cl_3$		3	3
Trichloroethylene	$Cl_2C=CHCl_3$		3	3
Triethanolamine	$N(CH_2CH_2OH)_3$		1	3
Triethylene Glycol (Trigol)	$HOCH_2O)_2CH_2CH_2OH$		1	2
Turpentine			3	3
Uric Acid	$CO(NH)_2COC_2CO(NH)_2$		1	2
Urine			1	1
Vegetable Oils			1	2
Vinegar			1	2
Water Chlorinated Deionized Distilled Fresh Sea	H_2O		1 1 1 1 1 1	1 1 1 1 1 1
Wines			1	2
Xylene	$C_6H_4(CH_3)_4$		3	3
Zinc Orthophosphate	$Zn_3(PO_4)_2$		2	2
Zinc Stearate	$Zn(C_{18}H_{35}O_2)_2$		1	1

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