

4.3 Material – Chemical Resistance

The engineering polymers used in the creation of Smart Band are specifically chosen because of their outstanding resistance to organic and inorganic substances. They are not affected by, nor do they affect, lubricating oils, greases, aliphatic and aromatic hydrocarbons including conventional fuels. **PA11 (Nylon 11)** and **POM (Acetal)** are particularly resistance to sea water with minimal water uptake and so are suitable for highly demanding applications in the oil and gas industry.

PP (Polypropylene) is more resistant to acid than the other polymers.

The following table features the resistance of the polymers to main chemical reagents. In the case of **PA11 (Nylon 11)** this is after 18 months exposure. The figures for **PA11 (Nylon 11)** are the same for **PA11GF (Nylon 11 Glass Filled)**.

Table 4.3.1

Chemical Agent	Concentration ¹ (100%)	PP (Polypropylene) Performance		Concentration ¹ (100%)	PA66 (Nylon 6.6.) Performance		PA11 (Nylon 11) Performance				Concentration ¹ (100%)	POM (Acetal) Performance			
		20°C (68°F)	60°C (140°F)		Temp°C	PA6.6††	20°C (68°F)	40°C (104°F)	60°C (140°F)	90°C (194°F)		unknown °C	23°C (73.4°F)	49°C (120.2°F)	82°C (179.6°F)
Mineral Acids															
Boric acid	Sat. Sol.	G	G	7%	24	P							G		
Carbonic acid	Sat. Sol.	G	G	10%	24	G							G		
Chloroacetic acid	Sol	L	P	10%	24	P							P		
Chlorosulphonic acid	Tg-s	P	P	10%	24	P							P		
Chromic acid	40%	L	L	10%	24	P	10%	P	P	P	P	10%	P		
Hydrochloric acid	10%	G	G	2.5%	23	G	1%	G	L	P	P	20%	G		
	30%	G	G	5%	77	P						37%	G		
	Gaseous	G		10%	25	P						100%	G		
Nitric acid	10%	G	P	10%	23	P	10%	G	L	P	P			P	
	65%	G	P				10%	P	P	P	P	5-10%		P	
	100%	P	P									50%	P		
Perchloric acid	20%	G		10%	24	P							G		
Phosphoric acid	30%	G	G	5%	98	P	5%	G	L	P	P		P		
	90%	G	G	50%			50%						P		
Sulphur dioxide	Gaseous, Dry	G			38	P		L	P	P	P		G		
	Gaseous, Wet	L													
Sulphuric acid	10%	G	G	1%			1%	G	L	L	P	3%		G	
	50%	L	P	3%			10%	G	L	L	P	30%		P	
	80%	L	P	10%											
	98%	L	P	30%	23	P									
Sulphurous acid		L	P	10%	23	P							G		
Mineral Salts															
Aluminium hydroxide	Sat. Sol.	G	G	10%	23	L						10%		G*	G*
				10%	52	P									
Alumina sulphate	Sat. Sol.	G	G	Sat. Sol.			Concentrated	G	G	G	G		p		
				10%	23	L	or boiled								
				10%	52	P	solutions								
Ammonium carbonate	100%	G	G	10%	23	L							P		
Ammonium chloride	100%	G	G	10%	52	P							G		
Ammonium hydroxide	10%	G	G	10%	23	G**							G		
	28%	G	G		70	P**									
	100%	L													
Ammonium sulphate	Sat. Sol.	G	G	Sat. Sol.			Concentrated	G	G	L			G		
	100%	L					or boiled								
Antimony trichloride	Sat. Sol.	G	G	10%	24	P									
Barium chloride	Sat. Sol.	G	G	Sat. Sol.			Concentrated	G	G	G	G		G		
				10%	24	P	or boiled								
Barium sulphate	Sat. Sol.	G	G	10%	24	G							G		
Barium Sulphide	Sat. Sol.	G	G	10%	24	L							G		
Calcium arsenate	Sat. Sol.	G	G				Concentrated	G	G	G					
							or boiled								
							solutions								
Calcium chloride	Sat. Sol.	G	G	Sat. Sol.			Concentrated	G	G	G	G		P		
				5%	60	P	or boiled								
							solutions								
Calcium hypochlorite	Sat. Sol.	G	L	Sat. Sol.	35	P							P		
Calcium thiocyanate				50%		P									
Copper chloride	Sat. Sol.	G	G	10%	24	P							G		
Copper sulphate	Sat. Sol.	G	G	Sat. Sol.			Concentrated	G	G	G	G		P		
															or boiled
							solutions								
Copper sulphite	Sat. Sol.	G	G	10%	24	P									
Di-ammonium phosphate	Sat. Sol.	G	G	Sat. Sol.			Concentrated		G	G	L				
							or boiled								
							solutions								
Hydrogen sulphide	Gaseous, Dry	G	G	Sat. Sol.	23	P							G		
Magnesium chloride	Sat. Sol.	G	G	50%			50%	G	G	G	G		G		
Potassium carbonate	Sat. Sol.	G	G	50%									G		
				20%	98°C	G									
Potassium chloride	Sat. Sol.	G	G	90%	23	G						G			
Potassium hydroxide	Sat. Sol.	G	G	30%	98	L							G		
Potassium nitrate	Sat. Sol.	G	G	Sat. Sol.			Concentrated	G*	L*	P	P		G		
															or boiled
							solutions								

Banding Products – Technical Booklet

Chemical Agent	Concentration† (100%)	PP (Polypropylene) Performance		Concentration† (100%)	PA66 (Nylon 6.6.) Performance		Concentration† (100%)	PA11 (Nylon 11) Performance				Concentration† (100%)	POM (Acetal) Performance			
		20°C (68°F)	60°C (140°F)		Temp°C	PA6.6††		20°C (68°F)	40°C (104°F)	60°C (140°F)	90°C (194°F)		unknown °C	23°C (73.4°F)	49°C (120.2°F)	82°C (179.6°F)
Potassium sulphate	Sat. Sol.	G	G	Sat. Sol.			Concentrated or boiled solutions	G	G	G	G		G			
Potassium thiocyanate	Sat. Sol.	G	G	Sat. Sol.		P										
Sodium carbonate	Sat. Sol.	G	G	Sat. Sol.	2% 20%	35°C	G	Concentrated or boiled solutions	G	G	L	P	2% 2% 20%	G		G
Sodium chloride	Sat. Sol.	G	G	Sat. Sol.	10%	23°C	G	Saturated 10%	G	G	G	G	Saturated 10%	G		G*
Sodium hydroxide	Sat. Sol.	G	G		1% 10% 10% 60%	70°C	P**						1% 10% 10% 60%	G G		G* G*
Sodium nitrate	Sat. Sol.	G	G	5%	24°C		G							G		
Sodium sulphate	Sat. Sol.	G	G	90%	24°C		G							G		
Sodium sulphide	Sat. Sol.	G	G	90%	24°C		G	Concentrated or boiled solutions	G	G	L					
Sodium thiosulphate	Sat. Sol.	G	G	25%									25%	G		G
Stannic chloride	Solution	G	G	10%	24°C		P**						G			
Stannic sulphate	Solution	G	G	10%	24°C		P									
Tricresyl Phosphate					66°C		G									
Trisodic phosphate				Sat. Sol.				Concentrated or boiled solutions	G	G	G	G				
Zinc chloride	Sat. Sol.	G	G	Sat. Sol.				Saturated	G	G	L	P		G		
Mineral bases																
Ammonia	Gaseous, Dry	G	G	Sat. Sol.	-33°C 24°C		G	Concentrated	G	G	G	G		P		
Ammonia solution	100%	G	G	Liquid or gas	10%	24°C	P	Liquid or gas	G	G						
Potassium carbonate								50%	G	L	P	P		G		
Sodium bicarbonate	Sat. Sol.	G	G	50%	24°C		G	50%	G	L	P	P		G		
Other mineral bodies																
Agricultural spray solution									G	G						
Bleach (sodium hypochlorite)	10%	G	G	5%	23°C		L	L	P	P	P	P	5%		P	
Bromine	Tg-g	P	P		24°C		P	P	P					P		
Bromine water	Tg-l	P	P	25%	23°C		G**									
Carbonated water								G	G	G	G			G		
Chlorine	Tg-g	P	P		23°C		P	P	P	P	P			P		
Chlorine water	100%	P	P													
Chlorine water	2%	G	L	Sol.	23°C		L									
Chlorox				Sat. Sol.	23°C		P									P
Fluorine	Sat. Sol.	G						P	P	P	P			P		
Hydrogen	Tg-g	G						G	G	G	G					
Hydrogen peroxide	3% 10% 30%	G G G	G L L	3% 5%	23°C 43°C		G P	G L					10% 50% 100%	P P P		
Mercury	Tg-l	G	G					G	G	G	G			G		
Ozone								L	P	P	P			G		
Oxygen	Tg-l	G						G	G	G	P					
Potassium permanganate	20%	G	G	5%	23°C		P	5%	P	P				G		
Sea water	100%	G	G					G	G	G	G			G		
Sulphur	100%	G	G					G	G							
Water	100%	G	G					G	G	G	G			G		G**
Organic bases																
Aniline	100%	G	G					Pure	L	P	P	P		Pure		G**,**
Diethanolamine	Tg-l	G						20%	G	G**	G**	L		G		
Pyridine	100%	L	L					Pure	L	P	P	P		G		
Urea	Sat. Sol.	G	G						G	G	L	L		G		
Organic acids and anhydrides																
Acetic acid	10% 60%	G G	G L	5%	23°C		P**	L	P	P	P		5% 20% 80%	G G P		G
Acetic anhydride	Liquid	G						L	P	P	P			P		
Benzoic acid	Sat. Sol.	G	G	10%	23°C		P							G		
Butyric acid				10%	24°C		P							G		
Citric acid	Sat. Sol.	G	G	10%	24°C		P	G	G	L	P		10%	G		G
Formic acid	50% 85%	G G	L L		23		P	G	P	P	P			G		
Glycolic acid	30%	G		70%			P							G		
Lactic acid	10% 50% 90%	G G G	G G G	10%	35		G	G	G	G	L			G		
Oleic acid	Tg-l	G	L					G	G	G	L			G		G
Oxalic acid	Sat. Sol.	G	L					G	G	L	P		Cold	G		
Picric acid	Sat. Sol.	G						L	P	P	P			G		
Stearic acid	100%	G						G	G	G	G			G		
Tartaric acid	100%	G	G					G	G	G	L			G		
Uric acid	Sat. Sol.	G	G					G	G	G	L					
Hydrocarbons																
Acetylene								G	G	G				G		
Benzene	Tg-l	L	P		23		G	G	G**	L	L			G**		
Butane	Tg-g	G						G	G	G				G		
Cyclohexane	Tg-l	G						G	G	L				G		
Decaline	Tg-l	P	P					G	G	G	L					
FORANE® 12								G	G	G						
FORANE® 22								G	G	G						
Heptane	Tg-l	L	L											G		G
Hexadecane	Tg-l	L	L	10%	23		G**									
Methane								G	G	G				G		
Naphthalene	Work. Sol.	G	P					G	G	G	L			G		

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NUJOL					70	G								G		G
Propane	Tg-g	G						G	G	G	Liquified	G				
Styrene								G	G**			G				
Toluene	Tg-l	L	P		50	G		G	G**	L	L		G			G**
Xylene	Tg-l	P	P			G		G	G**	L	L		G			
Alcohols																
Benzyl alcohol	Tg-l	G	L					L	P	P	P					
Butanol	Tg-l	G	L		50	G		G	G	G			G			
Ethanol	100%	G	G		23	G**		G	G	G			G	G**		
					50	G**										
Ethylene glycol	Tg-l	G	G	50%	23	G						50%				P
Glycerin	Tg-l	G	G					G	G	G			G			
Glycol	100%	G	G					G	G	G	P					
Methanol	Tg-l	G			23	G**		G	G	G			G			
Aldehydes and ketones																
Acetone	Tg-l	G			23	G		G	G**	L	P			G**		
					50	G										
Acetaldehyde	Tg-l	G			52	L		G	L	P						
Formaldehyde	40%	G		38%	23	G		G	L	P		40%			G	
												100%	G			
Cyclohexanone	Tg-l	L	L					G	L	P						
Methylethylketone	Tg-l	G	L					G	G	L	P			G		
Methylisobutylketone					23	G		G	G	L	P					
Benzaldehyde	Tg-l	G						G	L	P			G			
Chlorinated solvents																
AROCOR 1242					23	G										
Carbon tetrachloride	Tg-l	P	P		23	G							G	G**		
					50	G										
Dichloroethane	Tg-l	P			66	G										G**
Hexafluoroisopropanol					23	P										
Methyl bromide	Tg-l	G	G					G	P					P		
Methyl chloride	Tg-l	G	G		23	L		G	P					G		
Methyl trichloride	Tg-l	G	G		23	G										
Methylene chloride	100%	L	P		23	L								G		
Tetrafluoropropane						L										
Trichloroethylene	100%	P	P					L	P					P		
Trichloroethane					72	G		L	P	P	P			G		
Perchloroethylene								L	P					G		
Phenols	5%	G	G	5%	23	P		P	P	P	P	5%		G**		
Various organic bodies																
Anethol														G		
Carbon sulphide	Tg-l	P	L					G**	L*	P						
Dibromoethane					50	L										
Dimethyl formamide	Tg-l	G	G											P		
Ethylene oxide								G	G	L	P			P		
Furfural	100%	P	P					G	G**	L	P			G		
Glucose	Sol.	G	G					G	G	G	G			G		
Glycol chlorhydrine	30%	G						P	P							
Nitromethane					23	G								G		
2-Nitropropane					72	G										
Tetraethyl lead														G		
Salts, esters, ethers																
Amyl acetate	100%	L			98	P		G	G	G	L			G		
Butyl acetate	100%	L	P					G	G	G	L			G		
Diethylene glycol	Tg-l	G	G	90%	24	G								G		
Dimethyl ether	100%	P												G**		
Diethyl phosphate								G	G	G	L					
Diethyl phthalate	Tg-l	L						G	G	G						
Ethyl acetate	Tg-l	L	P		50	G		G	G	G				G**	G**	
Fatty acid esters		L						G	G	G	G			G		
Methyl acetate	Tg-l	G	G					G	G	G				G		
Methyl sulphate								G	L							
Sulphuric ether	100%	L						G								
Tributyl phosphate								G	G	G	L					
Tricresyl phosphate					66	G		G	G	G	L			G		
Miscellaneous products																
Antifreeze	Work. Sol.	G	G		104	L										P
Automatic transmission fluid	Work. Sol.	G	L													G
Beer	Work. Sol.	G						G						G		
Brake Fluid	Work. Sol.	G	G											G		G**
Cider	Work. Sol.	G						G						G		
Coal gas								G	G							
Crude oil	Work. Sol.	L	L					G	G	G**						
Detergent	Liquid	G														G*
	Powder	G														
Diesel	Work. Sol.	L														G**
Fruit juice	Work. Sol.	G	G					G	G							
Gasohol	Work. Sol.	P	P											G	G	
Grease	Work. Sol.	G	L					G	G	G	G					G
Kerosene	Work. Sol.	L	L					G	G	G**						G
Lanolin suspension	Work. Sol.	G	L	10%	35	G										
2,4-D Lindane								G								
Linseed Cake	Work. Sol.	G			82	G		G	G	G	G					G
Milk	Work. Sol.	G	G					G	G	G	G			G		
Motor oil	Work. Sol.	G	L													G
Mustard	Work. Sol.	G						G						G		
Naphtha	Work. Sol.	L	L		98	G**		G	G	G**				G		
Oil	Work. Sol.	G	L					G	G	G	G					
Oxyquinoline (agricultural spray)								G								
Premium grade gasoline	Work. Sol.	P	P					G	G	G**						G**
Regular grade gasoline	Work. Sol.	P	P					G	G	G**						G**
Soap Cleanser	100%	G	G					G								G**
Stearine	100%	G						G	G	G						
Turpentine	Tg-l	P	P					G	G	G**						G
Vinegar	Work. Sol.	G	G					G						G		
Wine	Work. Sol.	G	G					G								

*Discolouration occurs. **Swelling action. G = Good. L = Limited. P = Poor. † 100% unless otherwise stated †† Nylon 6.6. including Glass Filled Performance.