12. Physical properties of Metal gasket materials

AISI / ASTM	Individual name	Material No.	DIN 17 006	Hardness HB	Tensile strenght [N/mm²]	Tensile strenght [N/mm²](d 0,2)	Temperature [°C]		Density [g/mm²]
							min.	max.	
METAL									
A 570 Gr.36	Lov carbon steel	1.0038	RSt 37-2	100-130	370-450	220	-40	+ 500	7,85
A 619 (100)	Steel sheet	1.0333	Ust 13; St 13; St3	90-120	270-370	250	-40	+ 500	7,85
Soft-Iron	Soft-Iron	1.1003	M2 / Armco	90-110	270-350	190	-60	+ 450	7,85
430	Stainless steel	1.4016	X 6 Cr. 17	130-170	450-600	270	-20	+ 350	7,70
304 (304H)	Stainless steel	1.4301	X 5 CrNi 18 10	130-180	500-700	195	-200	+ 550	7,90
304L	Stainless steel	1.4306	X 2 CrNi 19 11	130-170	460-680	180	-270	+ 550	7,90
316	Stainless steel	1.4401	X 5 CrNiMo 17 12 2	130-180	500-670	205	-200	+ 550	7,95
316L	Stainless steel	1.4404	X2 CrNiMoTi 17 13 2	120-170	490-690	190	-200	+ 550	7,95
316L	Stainless steel	1.4435	X2 CrNi 18 14 3	120-170	490-690	190	-200	+ 550	7,98
321	Stainless steel	1.4541	X 6 CrnITi 18 10	130-190	500-730	205	-270	+ 550	7,90
347	Stainless steel	1.4550	X 6 CrNiNb 18 10	130-190	510-740	205	-200	+ 550	7,90
316Ti	Stainless steel	1.4571	X 6 CrNiMoTi 17 12 2	130-190	500-730	215	-270	+ 550	7,98
309	Stainless steel	1.4828	X 15 CrNiSi 20 12	130-220	500-750	230	-110	+ 800	7,90
B 408, B 409	Incoloy 800	1.4876	X 10 NiCrAlTi 32 20	130-220	500-750	210	-110	+ 850	8,00
NON-METAL									
-	Cooper	2.0090	SF-C U	55-65	200-250	90	-270	+ 400	8,94
Brass	Messing Ms 63	2.0321	CuZn 37	60-80	290-370	140	-200	+ 350	8,44
-	Plumbum 99,9	2.3040	Pb 99,9	4	12	-	-250	+ 200	11,50
-	Nickel 99,6	2.4060	Ni 99,6	100-150	340-400	140	-60	+ 600	8,90
B 162, alloy 200	Nickel 99,2	2.4066	Ni 99,2	100-150	380-450	160	-60	+ 600	8,90
B 127, alloy 400	Monel 400	2.4360	NiCu 30 Fe	100-130	450-580	200	-60	+ 500	8,88
B 168, alloy 600	Inconel 600	2.4816	NiCr 15 Fe	140-200	550-800	200	-60	+ 600	8,42
-	Aluminium 99,5	3.0255	Al 99,5	20-25	70-80	509	-250	+ 350	2,70
-	Aluminium alloy	3.3315	AlMg 1	25-35	90-110	60	-250	+ 300	2,70
B 348 Gr.1	Titan I	3.7025	Ti	110-140	290-410	180	-60	+ 300	4,50
B 348 Gr.2	Titan II	3.7035	Ti	120-160	390-540	250	-60	+ 350	4,50

12. Physical properties of Metal gasket materials

	Brass	Lead	Copper	Aluminium	Monel	Low-Carbon Steel	AISI 304, 321	AISI 316, 316 Ti
SIMPLE AND COMBINED AROMATIC HYDROCARBONS								
Aniline, $C_6H_5NH_2$	1	2	3	3	1	1	1	1
Citrit acid, $C_6H_8O_7\ H_2O$	3	1	1	1	1	3	1	1
Nitrobenzene, $C_6H_5NO_2$		2	1	2	2	1	2	1
Toluene, $C_6H_5CH_3$		1	2	1	1	1	2	2
OTHER COMPOUNDS AND ORGANIC ELEMETS								
Bromine, Br	2	3	3	2	2	3	3	3
CO_2 or carbon anhydride, dry		1	1	1	1	1	1	1
CO_2 or carbon anhydride, wet		3	1	1	1	1	1	1
CO, hot	3	2	3	2	2	1	1	1
Glue		2	1	1	1	1	1	1
Chlorine, Cl_2, dry	2	1	1	1	1	1	1	1
Chlorine, Cl_2, wet	3	1	3	3	3	3	3	2
Oxygen, O_2, at temp. below 260°C		3	1	1	1	1	1	1
Oxygen, O_2, at temp. between 260°C and 535°C		3	3	2	1	1	1	1
Oxygen, O_2, at temp. over 535°C		3	3	3	3	3	3	3
Creosote	2	2	1	1	1	1	1	1
Oxide, cold		1	1	1	1	1	1	1
Ozone, O_3		2	2	2	2	2	2	2
Steam, O_2, at temp. below 260°C	1	2	1	1	1	1	1	1
Steam, at temp.260°C and 535°C	3	3	2	2	2	1	1	1
Steam, O_2, at temp. over 535°C	3	2	3	3	3	3	1	1
Gas, lean		1	2	1	1	1	2	2
Gas, natural		1	2	1	1	1	1	1
Gas, coke gas		2	1	2	1	1	2	1
Hydrogen (gas), H_2 cold		1	1	1	1	1	1	1
Hydrogen (gas), H_2 hot		3	3	2	1	1	1	1
Air	1	1	1	1	1	1	1	2
Mercury, Hg	3	2	3	3	1	1	1	1
Sulphur, S	3	2	3	1	3	1	1	1
Sulphur chloride, S_2Cl_2	3	1	3	2	2	2	2	2
BASES, ACIDS AND INORGANIC SALTS								
Aluminium fluoride, AlF_3	3	2	2	3	2	2	2	2
Aluminium chloride, $AlCl_3$	3	3	1	3	1	1	3	3
Al-sulphate, $Al_2(SO_4)_3$	3	1	1	1	1	3	1	1
Ammonia vapour, NH_3, cold	3	1	2	1	1	1	1	1
Ammonia vapour, NH_3, hot	3	3	2	1	2	1	1	1
Ammonium monobas. phosph.$(NH_4)H_2PO_4$	2	1	1	3	2	3	1	1
Ammonium dibasic phosph.$(NH_4)_2HPO_4$	3	1	1	1	1	1	1	1
Ammonium tribasic phosph.$(NH_4)_3PO_4$	3	1	1	1	1	1	1	1
Ammonium hydroxide, NH_4OH	3	1	3	1	2	1	1	1
Ammonium chloride, NH_4Cl	3	1	3	3	1	2	1	1
Ammonium nitrate, NH_4NO_3	3	3	3	1	2	1	1	1
Ammonium sulphate, $(NH_4)_2SO_4$	3	1	1	2	1	1	1	1
Barium hydroxide, Ba (OH)$_2$		3	3	3	2	2	1	2
Barium chloride, $BaCl_2$	1	2	2	3	2	2	1	1
Barium sulphide, BaS		1	3	2	1	2	1	1
Borax, Na2B4O7 10H2O	1	2	1	1	1	1	1	1
Boric acid, H_3B0_3	3	1	1	1	1	3	1	1
Bromidic acid, HBr	3	2	2	3	2	3	2	2
Hydrocyanic acid, HCN	3	2	2	2	1	2	1	1
Fluosilicic acid	3	1	2	2	2	3	3	3
Phosphoric acid, H_3PO_4, crude	3	2	3	3	3	2	2	2
Alum, KCr (SO4)2 12H2O	3	1	1	1	1	3	1	1
Calcium bisulphite, Ca $(HSO_3)_2$	3	1	3	2	3	2	1	1
Calcium hydroxide, Ca $(OH)_2$	3	2	2	2	1	1	1	1
Calcium hypochlorite, $CaOCl_2\ 4H_2O$	3	3	2	3	2	2	2	2
Calcium chlorite, $CaCl_2$	3	3	1	2	1	1	2	2
Chromic acid, $H_2\ CrO_4$	3	1	3	3	1	2	2	1
Carbon bisulphide, CS_2	3	2	3	1	1	1	1	1
Hydrochloric acid, HCl, below 65°C	3	1	3	3	2	3	3	3
Hydrochloric acid, HCl, over 65°C	3	3	3	3	2	3	3	3
Iron chloride, $FeCl_3$	3	3	3	3	3	3	3	3
Iron sulphate, $Fe_2(SO_4)_3$	3	1	3	3	3	3	1	1
FUELS, FLUIDS, LUBRICANTS								
Asphalt		2	1	2	1	1	1	2
Petrol, with sulph. compounds	3	1	2	2	1	2	2	1
Petrol, refined	1	1	1	1	1	1	1	1
Benzoline	1	1	1	1	1	1	1	1
Cellulose paints and solvents		2	2	1	1	2	1	1
Ether, $C_2H_5OC_2H_5$	1	1	1	1	1	1	2	2
Vinegar, CH_3COOH, 5%	3	2	2	2	1	2	1	1
Milk	2	2	2	1	1	1	2	1
Naphta	1	1	1	1	1	1	1	1
Fuel oil	1	1	1	2	1	1	1	2
Linseed oil		1	1	1	1	1	1	1
Lubricant oil, unrefined		1	2	2	1	2	2	2
Lubricant oil, refined		1	1	1	1	1	1	2
Mineral oil	1	1	1	1	1	1	1	1
Castor oil		2	2	1	1	1	1	2
Crude oil, at temp. below 260°C	1	2	2	1	2	1	1	1
Crude oil, at temp. between 260°C and 535°C	1	3	3	1	3	1	1	1
Crude oil, at temp. over 535°C	1	3	3	3	3	3	2	2
Tar		2	2	1	2	1	1	2
Turpentine	1	1	2	1	1	2	1	1
Water, H_2O distilled	3	3	3	1	2	3	1	1
Sea water, H_2O	3	1	2	3	1	2	1	1
Mineral water, H_2O with oxidizing salts	2	2	2	2	3	3	1	1
Mineral water, H_2O without oxidizing salts	1	2	2	1	1	2	2	3
Drinking water, H_2O	1	1	1	1	1	2	1	1

	Brass	Lead	Copper	Aluminium	Monel	Low-Carbon Steel	AISI 304, 321	AISI 316, 316 Ti
ALCOHOLS, ETHERS, ACIDS, ESTERS, ANHYDRIDES AND KETONES								
Acetone, CH_3COOH_3,						1	1	1
Amyl acetate, CH3COOC5H10,	2	2	1	1	1	2	1	1
Amyl alcohol, C5H11OH		2	1	2	1	2	2	2
Acetic anhydride, $(CH_3CO)_2O$	3	3	3	1	1	2	1	1
Cupric chloride, $CuCl_2$	3	1	2	3	1	3	1	1
Cupric sulphate, $CuSO_4$	3	1	2	3	1	1	3	3
Butyl alcohol, C_4H_9OH		2	1	2	1	1	2	2
Butyl acetate, $CH_3COOC_4H_9$,	1	2	1	1	2	2	1	1
Zinc chloride, $ZnCl_2$	3	1	3	3	1	2	3	3
Zinc sulphate, $ZnSO_4$		2	3	2	1	2	1	1
Nitric acid, HNO_3, crude	3	3	3	2	3	3	2	2
Nitric acid, HNO_3, diluted	3	3	3	3	3	3	1	1
Nitric acid, HNO_3, concentrated	3	3	3	1	3	3	1	1
Ethyl acetate, $CH_3COOC_2H_5$,		2	1	1	1	1	1	1
Ethyl cellulose		2	2	2	1	2	2	2
Ethylene chloride, $(CH_2Cl)_2$,	1	2	1	2	1	1	1	1
Ethylenglycol, $(CH_2OH)_2$,	1	1	1	1	1	1	1	1
Phenol, C_6H_5OH	2	1	3	1	1	2	1	1
Formaldehyde, HCHO	1	3	1	1	1	1	1	1
Phosphoric acid, H_3PO_4								
- with concentr. below 45%	3	1	1	2	1	3	1	1
- cold, concentr.over 45%	3	1	1	3	1	3	1	1
- hot, concentr.over 45%	3	3	2	3	2	3	3	2
Hydrofluoric acid, HF								
- cold, concentr.below 65%	3	1	2	3	1	3	3	3
- cold, concentr.over 65%	3	2	1	3	1	1	3	3
- hot, concentr.below 65%	3	3	3	3	2	3	3	3
- hot, concentr.over 65%	3	3	1	3	1	2	3	3
Glycerine, $(CH_2OH_2)CHOH$	1	1	1	1	1	1	1	1
Glucose		2	1	1	1	1	1	1
Potash, K	3	3	3	3	1	2	1	1
Potassium cyanide, KCN	3	3	3	3	1	1	1	1
Potassium chloride, KCl	3	1	1	2	1	1	1	1
Potassium sulphate, K_2SO_4	1	1	1	1	1	1	1	1
Stannic chloride, $SnCl_2$	3	2	3	3	3	2	2	2
Chloroacetic acid, $CH_2ClCOOH$		3	3	3	2	3	3	3
Cresylic acid	1	2	1	1	1	1	2	1
Magnesium hydroxide, $Mg(OH)_2$	1	2	3	3	1	1	1	1
Magnesium chloride, $MgCl_2$	3	3	1	3	1	1	1	1
Magnesium sulphate, $MgSO_4$	1	2	1	2	1	1	1	1
Methyl alcohol methanol, CH_3OH	1	1	1	1	1	1	1	1
Sodium cyanide, NaCN	3	3	3	3	1	1	2	1
Sodium phosphate, Na_3PO_4								
12H2O , monobasic		2	2	1	1	2	2	1
Sodium phosphate, Na_2HPO_4, dibasic		2	1	1	1	2	2	1
Sodium phosphate, NaH_2PO_4, tribasic		1	3	3	1	1	2	1
Sodium hydroxide, NaOH	3	1	3	3	1	1	1	1
Sodium hypochlorite, NaOCl	3	3	2	3	2	3	3	3
Sodium carbonate, Na_2CO_3	1	1	2	3	1	1	1	1
Sodium chloride, NaCl	3	1	1	3	1	1	1	1
Sodium metaphosphate, $NaPO_3$		1	2	1	1	2	1	2
Sodium nitrate, $NaNO_3$	1	1	1	1	1	1	1	1
Sodium perborate, $NaBO_3\ 4H_2O$		2	2	1	1	2	1	1
Sodium peroxide, Na_2O_2		2	2	1	1	2	1	1
Sodium silicate, $Na_2SiO_3K_2SiO_3$	2	3	2	3	1	1	2	1
Sodium sulphate, Na_2SO_4	1	1	1	2	1	1	1	1
Sodium sulphite, Na_2SO_3	3	1	3	3	1	1	1	1
Sodium thiosulphate, $Na_2S_2O_3$	3	1	3	3	2	2	1	1
Nickel sulphate, $NiSO_4$	3	2	3	3	2	2	1	1
SIMPLE AND COMBINED ALIPHATIC HYDROCARBONS								
Acetylene, C_2H_2	3	1	2	1	1	1	1	1
Butane, C4H10		2	2	1	1	1	2	1
Freon, $CHClF_2$	1	1	1	1	1	2	2	2
Methyl chloride, CH_2Cl_2	1	1	1	2	1	1	2	2
Lactic acid, $CH_3CHOHCOOH$, cold	3	2	2	2	1	3	2	1
Lactic acid, $CH_3CHOHCOOH$, hot	3	2	2	3	2	3	2	2
Fromic acid, HCOOH	3	3	1	3	2	3	1	1
Acetic acid, CH_3COOH, unrefined	3	3	1	1	1	3	2	1
Acetic acid, CH_3COOH, pure	3	1	1	1	1	3	1	1
Acetic acid, CH_3COOH, vapour	3	3	1	2	1	3	1	1
Acetic acid, CH_3COOH, at 10 bar and 2000C	3	3	1	2	1	3	2	1
Oxalic acid, $(COOH)_2$	3	3	2	1	1	2	2	2
Oleic acid, C17H33COOH	3	3	3	1	1	2	1	1
Palmitic acid, C15H31COOH	1	1	1	1	1	1	1	1
Molten picric acid, $(NO_2)C_6H_2OH$	3	3	3	1	3	1	1	1
Aqueous solution of picric acid $(NO_2)C_6H_2OH$	3	3	3	3	2	2	1	1
Propane, C_3H_8		1	2	2	1	1	1	1
Stearic acid, C17H35COOH	2	1	2	2	1	2	1	1
Carbon tetrachloride, CCl_4	3	1	2	2	1	2	2	2
Solvents based on chlorine, dry		1	1	1	1	1	1	2
Solvents based on chlorine, wet		1	3	3	1	3	2	2
Trichloroethylene, C_2HCl_3	1	1	2	2	1	2	2	2
Nickel chloride, $NiCl_2$	3	2	3	3	2	2	1	1
Sodium bicarbonate, Na_2CO_3	1	1	2	3	1	2	1	1
Hydrogen peroxide, H_2O_2		1	3	1	1	3	1	1
Mercury chloride, $HgCl_2$	3	2	3	3	3	2	3	3
Sulphurous acid, H_2SO_3	3	1	2	2	3	1	3	2
Sulphuric acid, H_2SO_4								
- cold, with concentr.up to 10%	3	1	2	2	2	3	1	1
- hot, with concentr.up to 10%	3	1	3	2	2	3	3	1
- cold, concentr. 10-75%	3	1	3	2	2	3	3	1
- hot, concentr. 10-75%	3	1	3	3	2	3	3	1
- cold, concentr. 75-95%	3	1	3	2	2	2	1	1
- hot, concentr. 75-95%	3	1	3	3	2	1	3	3
- steaming. concentr. 75-95%	3	1	3	2	3	2	2	1
Hydrogen sulphide, H_2S, dry, cold		2	3	1	1	1	1	1
Hydrogen sulphide, H_2S, dry, hot		2	3	1	3	3	2	2
Hydrogen sulphide, H_2S, wet, cold		2	3	1	1	2	1	1
Hydrogen sulphide, H_2S, wet, hot		2	3	1	3	3	2	2

1 -recommended

2 -recommendation depends on operating conditions

3 -not recommended