Table H.1 — Material classes for pump parts

PART	Full compliance materials[b]	Material classes and abbreviations													
		I-1	I-2	S-1	S-3	S-4	S-5	S-6	S-8[l]	S-9[l]	C-6	A-7	A-8	D-1[j]	D-2[j]
		CI[a]	CI	STL	STL	STL	STL	STL	STL	STL	12 % CHR	AUS	316 AUS	Duplex	Super Duplex
		CI	BRZ	CI	NI-RESIST	STL	STL 12 % CHR	12 % CHR	316 AUS	Ni-Cu Alloy	12 % CHR	AUS[c, d]	316 AUS[d]	Duplex	Super Duplex
Pressure casing	Yes	Cast iron	Cast iron	Carbon steel	Carbon steel	Carbon steel	Carbon Steel	Carbon Steel	Carbon Steel	Carbon Steel	12 % CHR	AUS	316 AUS	Duplex	Super Duplex
Inner case parts: (bowls, diffusers, diaphragms)	No	Cast iron	Bronze	Cast iron	Ni-Resist	Cast iron	Carbon Steel	12 % CHR	316 AUS	Ni-Cu Alloy	12 % CHR	AUS	316 AUS	Duplex	Super Duplex
Impeller	Yes	Cast iron	Bronze	Cast Iron	Ni-Resist	Carbon steel	Carbon Steel	12 % CHR	316 AUS	Ni-Cu Alloy	12 % CHR	AUS	316 AUS	Duplex	Super Duplex
Case wear rings[k]	No	Cast iron	Bronze	Cast Iron	Ni-Resist	Cast iron	12 % CHR Hardened	12 % CHR Hardened	Hard-faced 316AUS[e]	Ni-Cu Alloy	12 % CHR Hardened	Hard-faced AUS[e]	Hard-faced 316 AUS[e]	Hard-faced Duplex[e]	Hard-faced Super Duplex[e]
Impeller wear rings[k]	No	Cast iron	Bronze	Cast Iron	Ni-Resist	Cast iron	12 % CHR Hardened	12 % CHR Hardened	Hard-faced 316AUS[e]	Ni-Cu Alloy	12 % CHR Hardened	Hard-faced AUS[e]	Hard-faced 316 AUS[e]	Hard-faced Duplex[e]	Hard-faced Super Duplex[e]
Shaft[d]	Yes	Carbon steel	Carbon steel	Carbon steel	Carbon steel	Carbon steel	AISI 4140	AISI 4140[f]	316 AUS	Ni-Cu Alloy	12 % CHR	AUS	316 AUS	Duplex	Super Duplex
Throat bushings[k]	No	Cast iron	Bronze	Cast iron	Ni-Resist	Cast iron	12 % CHR Hardened	12 % CHR Hardened	316 AUS	Ni-Cu Alloy	12 % CHR Hardened	AUS	316 AUS	Duplex	Super Duplex
Interstage sleeves[k]	No	Cast iron	Bronze	Cast iron	Ni-Resist	Cast iron	12 % CHR Hardened	12 % CHR Hardened	Hard-faced 316AUS[e]	Ni-Cu Alloy	12 % CHR Hardened	Hard-faced AUS[e]	Hard-faced 316 AUS[e]	Hard-faced Duplex[e]	Hard-faced Super Duplex[e]
Interstage bushings[k]	No	Cast iron	Bronze	Cast iron	Ni-Resist	Cast iron	12 % CHR Hardened	12 % CHR Hardened	Hard-faced 316AUS[e]	Ni-Cu Alloy	12 % CHR Hardened	Hard-faced AUS[e]	Hard-faced 316 AUS[e]	Hard-faced Duplex[e]	Hard-faced Super Duplex[e]
Case and gland studs	Yes	Carbon steel	Carbon steel	AISI 4140 steel	AISI 4140 Steel	AISI 4140 Steel	AISI 4140 Steel	AISI 4140 Steel	AISI 4140 Steel	Ni-Cu Alloy Hardened[i]	AISI 4140 Steel	AISI 4140 Steel	AISI 4140 Steel	Duplex[i]	Super Duplex[i]
Case gasket	No	AUS, Spiral wound[g]	AUS, Spiral wound[g]	AUS, Spiral wound[g]	AUS, Spiral wound[g]	AUS, Spiral wound[g]	AUS, Spiral wound[g]	AUS, Spiral wound[g]	316 AUS Spiral wound[g]	Ni-Cu Alloy, Spiral wound, PTFE filled[g]	AUS, Spiral wound[g]	AUS, Spiral wound[g]	316 AUS Spiral wound[g]	Duplex SS Spiral wound[g]	Duplex SS Spiral Wound[g]

Table H.1 (*continued*)

PART	Full compliance materials[b]	Material classes and abbreviations													
		I-1	I-2	S-1	S-3	S-4	S-5	S-6	S-8[l]	S-9[l]	C-6	A-7	A-8	D-1[j]	D-2[j]
		CI[a]	CI	STL	STL	STL	STL	STL	STL	STL	12 % CHR	AUS	316 AUS	Duplex	Super Duplex
		CI	BRZ	CI	NI-RESIST	STL	STL 12 % CHR	12 % CHR	316 AUS	Ni-Cu Alloy	12 % CHR	AUS[c, d]	316 AUS[d]	Duplex	Super Duplex
Discharge head/ suction can	Yes	Carbon steel	Carbon steel	Carbon steel	Carbon steel	Carbon steel	Carbon steel	Carbon steel	Carbon steel	Carbon steel	AUS	AUS	316 AUS	Duplex	Super Duplex
Column / bowl shaft bushings	No	Nitrile butadiene[h]	Bronze	Filled carbon	Nitrile butadiene[h]	Filled carbon	Filled carbon	Filled carbon	Filled carbon	Filled carbon	Filled carbon	Filled carbon	Filled carbon	Filled carbon	Filled carbon
Wetted fasteners (bolts)	Yes	Carbon steel	Carbon steel	Carbon steel	Carbon steel	Carbon steel	316 AUS	316 AUS	316 AUS	Ni-Cu Alloy	316 AUS	316 AUS	316 AUS	Duplex	Super Duplex

[a] The abbreviations in the upper part of the second row indicate the case material; the abbreviations in the lower part of the second row indicate trim material. Abbreviations are as follows: BRZ = bronze, STL = steel, 12 %, CHR = 12 % chromium, AUS = austenitic stainless steel, CI = cast iron, 316 AUS = Type 316 austenitic stainless steel

[b] See 5.12.1.4

[c] Austenitic stainless steels include ISO Types 683-13-10/19 (AISI Standard Types 302, 303, 304, 316, 321, and 347).

[d] For vertically suspended pumps with shafts exposed to liquid and running in bushings, the standard shaft material is 12 % chrome, except for Classes S-9, A7, A-8, and D-1. The standard shaft material for cantilever pumps (Type VS5) is AISI 4140 where the service liquid allows (see Annex G, Table G.1).

[e] Unless otherwise specified, the need for hard-facing and the specific hard-facing material for each application is determined by the vendor and described in the proposal. Alternatives to hard-facing may include opening running clearances (5.7.4) or the use of non-galling materials or non-metallic materials, depending on the corrosiveness of the pumped liquid.

[f] For Class S-6, the standard shaft material for boiler feed service and for liquid temperatures above 175 °C (350 °F) is 12 % chrome (see Annex G, Table G.1).

[g] If pumps with axially split casings are furnished, a sheet gasket suitable for the service is acceptable. Spiral-wound gaskets should contain a filler material suitable for the service. Gaskets other than spiral wound, may be proposed and furnished if proven suitable for service and specifically approved by the purchaser.

[h] Alternative materials may be substituted for liquid temperatures greater than 45 °C (110 °F) or for other special services.

[i] Unless otherwise specified, AISI 4140 steel may be used for non-wetted case and gland studs.

[j] Some applications may require alloy grades higher than the Duplex materials given in Table H.2.

"Super Duplex " material grades with pitting resistance equivalency (PRE) values greater than 40 may be necessary.

PRE $\geqslant$ 40, where PRE is based on actual chemical analysis.

PRE = $\%Cr_{free}$ + (3,3 × % molybdenum) + (2 × % copper) + (2 × % tungsten) + (16 × % nitrogen)

= [(% chromium - (14,5 × % carbon)] + (3,3 × % molybdenum) + (2 × % copper) + (2 × % tungsten) + (16 × % nitrogen)

Note that alternative materials such as "super austenitic" may also be considered.

[k] Non-metallic wear part materials, proven to be compatible with the specified process fluid, may be proposed within the applicable limits shown in Table H.4. Also see 5.7.4 c).

[l] The vendor shall consider the effects of differential material expansion between casing and rotor and confirm suitability if operating temperatures are to exceed 95 °C (200 °F).