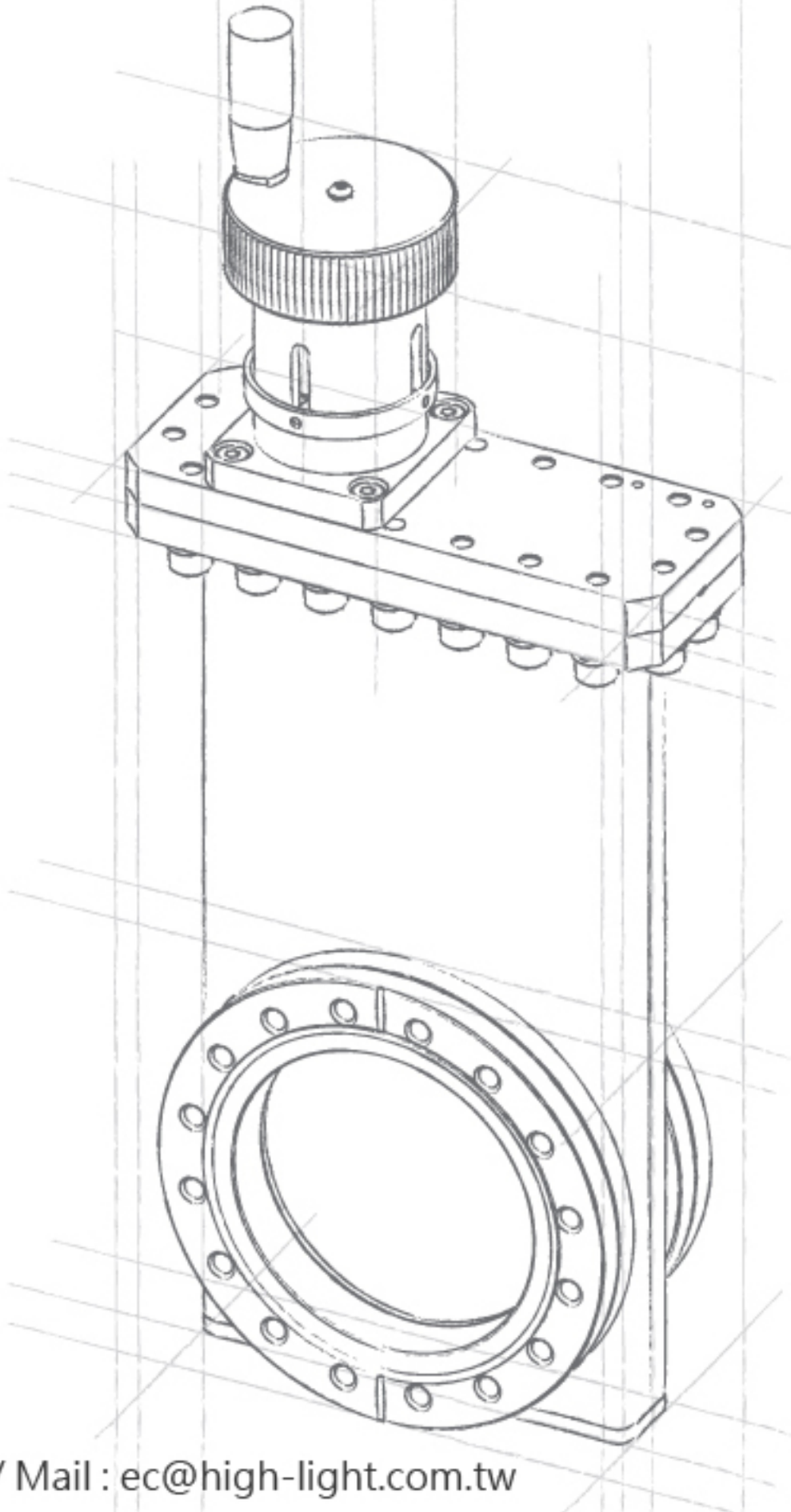
HIGHLIGHT TECH CORP.

Vacuum Solution

Htc leading the new future for vacuum

2020



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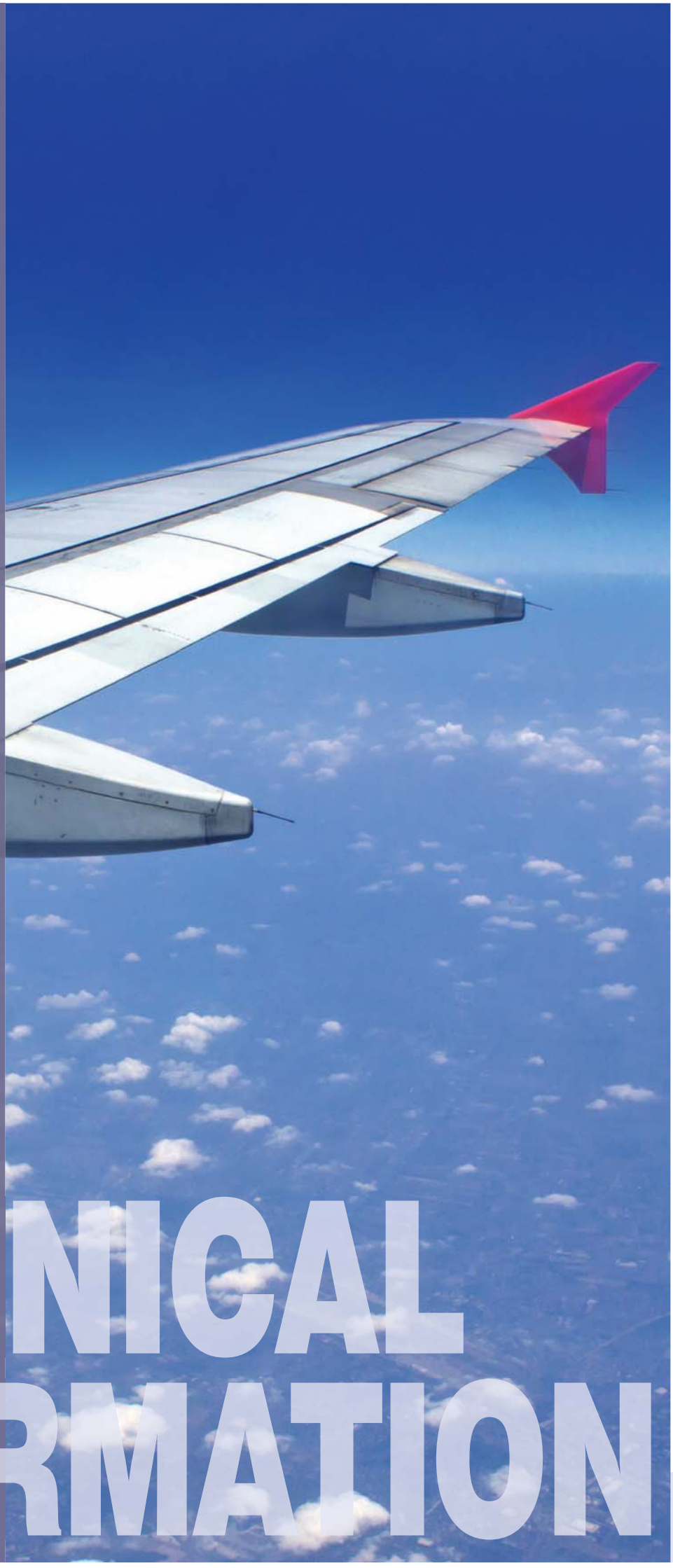
10 TECHNICAL INFORMATION



TECHNICAL INFORMATION

Conversion Table

Pressure

		Pa		torr	micron		psi
	kg_f/cm^2	N/m^2	mbar	mm Hg	mtorr	atm	lb_f/in^2
kg_f/cm^2	1	$9.8x10^4$	$9.8x10^2$	$7.36x10^2$	$7.36x10^5$	$9.68x10^{-1}$	$1.42x10^1$
Pa	$1.02x10^{-5}$	1	$1x10^{-2}$	$7.5x10^{-3}$	7.5	$9.87x10^{-6}$	$1.45x10^{-4}$
mbar	$1.02x10^{-3}$	$1x10^2$	1	$7.5x10^{-1}$	$7.5x10^2$	$9.87x10^{-4}$	$1.45x10^{-2}$
torr	$1.36x10^{-3}$	$1.33x10^2$	1.33	1	$1x10^3$	$1.32x10^{-3}$	$1.93x10^{-2}$
micron	$1.36x10^{-6}$	$1.33x10^{-1}$	$1.33x10^{-3}$	$1x10^{-3}$	1	$1.32x10^{-6}$	$1.93x10^{-5}$
atm	1.03	$1.01x10^5$	$1.01x10^3$	$7.6x10^2$	$7.6x10^5$	1	$1.47x10^1$
psi	$7.03x10^{-2}$	$6.89x10^3$	$6.89x10^1$	$5.17x10^1$	$5.17x10^4$	$6.81x10^{-2}$	1

Example :

$5x10^{-4}$ Pa	$5.1x10^{-9}$	$5x10^{-4}$	$5x10^{-6}$	$3.75x10^{-6}$	$3.75x10^{-3}$	$4.94x10^{-9}$	$7.25x10^{-8}$

Length

	foot	inch	meter	centimeter	millimeter	micron
	ft	in	m	cm	mm	um
foot	1	$1.2x10^1$	$3.05x10^{-1}$	$3.05x10^1$	$3.05x10^2$	$3.05x10^5$
inch	$8.33x10^{-2}$	1	$2.54x10^{-2}$	2.54	$2.54x10^1$	$2.54x10^4$
meter	3.28	$3.94x10^1$	1	$1x10^2$	$1x10^3$	$1x10^6$
centimeter	$3.28x10^{-2}$	$3.94x10^{-1}$	$1x10^{-2}$	1	$1x10^1$	$1x10^4$
millimeter	$3.28x10^{-3}$	$3.94x10^{-2}$	$1x10^{-3}$	$1x10^{-1}$	1	$1x10^3$
micron	$3.28x10^{-6}$	$3.94x10^{-5}$	$1x10^{-6}$	$1x10^{-4}$	$1x10^{-3}$	1

Example :

2m	6.56	78.72	2	$2x10^2$	$2x10^3$	$2x10^6$

Weight

	kg	g	oz	lb
kg	1	$1x10^3$	$3.53x10^1$	2.21
g	$1x10^{-3}$	1	$3.53x10^{-2}$	$2.21x10^{-3}$
oz	$2.84x10^{-2}$	$2.84x10^1$	1	$6.25x10^{-2}$
lb	$4.54x10^{-1}$	$4.54x10^2$	$1.6x10^1$	1

Example :

2kg	2	$2x10^3$	$7.06x10^1$	4.42

Force

	kg_f	N	oz_f	lb_f
kg_f	1	9.81	$3.53x10^{1}$	2.21
N	$1.02x10^{-1}$	1	3.6	$2.25x10^{-1}$
oz_f	$2.83x10^{-2}$	$2.78x10^{-1}$	1	$6.25x10^{-2}$
lb_f	$4.54x10^{-1}$	4.45	$1.6x10^{1}$	1

Example :

10N	1.02	10	36	2.25

Torque

	kg_f-m	N-m	oz_f -in	lb_f -ft
kg_f-m	1	9.81	$1.38x10^{3}$	7.23
N-m	$1.02x10^{-1}$	1	$1.41x10^{2}$	$7.38x10^{-1}$
oz_f-in	$7.25x10^{-4}$	$7.09x10^{-3}$	1	$5.21x10^{-3}$
lb_f-ft	$1.38x10^{-1}$	1.36	$1.92x10^{2}$	1

Example :

8 lb_f-ft	1.104	10.88	$1.54x10^{3}$	8

Flow Rate

	gpm	gps	l/m	l/s
gpm	1	$1.67x10^{-2}$	3.79	$6.31x10^{-2}$
gps	6x10	1	$2.27x10^{2}$	3.79
l/m	$2.64x10^{-1}$	$4.4x10^{-3}$	1	$1.67x10^{-2}$
l/s	1.59x10	$2.64x10^{-1}$	$6x10^{1}$	1

Example :

4gpm	4	$6.68x10^{-2}$	$1.52x10^{1}$	$2.52x10^{-1}$

Leak Rate

	pa.l/s	mbar.l/s	torr.l/s	std.cc/s
pa.l/s	1	$1x10^{-2}$	$7.5x10^{-3}$	$9.87x10^{-3}$
mbar.l.s	$1x10^{2}$	1	$7.5x10^{-1}$	$9.87x10^{-1}$
torr.l/s	$1.33x10^{2}$	1.33	1	1.32
std.cc/s	$1.01x10^{2}$	1.01	$7.6x10^{-1}$	1

Example :

$1x10^{-7}$std.cc/s	$1.01x10^{-5}$	$1.01x10^{-7}$	$7.6x10^{-8}$	$1x10^{-7}$

Dimension in mm unless otherwise noted

Graphic Symbols for Important Comonents Used in Vacuum Technology.(Extract from DIN 28 401 Std. Spec.)

Vacuum Pumps


Cryo pump


Diffusion pump


Getter pump

Piston vacuum pump

Roots vacuum pump


Rotary plunger vacuum pump


Suptter-ion pump


Diaphragm vacuum pump


Ejector vacuum pump


Liquid ring vacuum pump


Radial flow pump


Rotary piston vacuum pump (e.g. trochoid pump)


Sliding vane rotary vacuum pump

Subimation (evaporation) pump


Turbine vacuum pump, general


Turbomolecular pump


Vacuum pump, general

Accessories


Baffle, general


Cold trap, general


Cold trap with coolant reservoir


Cooled baffle

Condensate trap, general


Condensate trap with heat exchange (e.g. cooled)


Filtering apparatus, general


Gas filter, general


Sorption trap

Vacuum Chamber

Vacuum chamber

Isolating Devices

Butterfly valve

Gate valve

Isolating valve, Straight-throught valve

Non-return valve

Right-angle stop-cock

Right-angle valve

Safety shut-off valve

Shut-off device, general

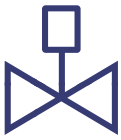
Stop-cock

Three-way stop-cock

Valve Actuation

Electric motor operation

Electromagnetic operation



Hydraulic or pneumatic operation

Manual operation

Variable-leak valve

Weight-operated

Dimension in mm unless otherwise noted

Connections / Tubes

Branch-off point

Change in the cross-section of a duct

Clamped flange connection

Coooection of ducts

Cross-over of two ducts without connection

Flange connection bolted

Flange connection general

Flexible connection (e.g. bellows, flexible tubing)

Liner motion leadthrough, flange-mounted

Small flange connection

Threaded tube connection

Intersection of two ducts with connection

(Subject to international provision still to be agreed on, a contact point may be inserted for improved clearness)

Gauges

Vacuum gauge

Vacuum gauge control unit

Measurement of throughput
(This symbol must be used only in the position shown)

General Symbol

General symbol for vacuum
(This symbol must be used only in the position shown)

Stainless Steel Specification Table

U.S.A.	GERMANY	GERMANY	FRANCE	JAPAN	ITALY
AISI	DIN17 06	W.N. 17007	AFNOR	JIS	UNI
201				SUS 201	
301	X12CrNi177	1.4310	Z12 CN 17-07	SUS 301	X12 CrNi 1707
302	X5CrNi187	1.4319	Z10 CN 18-09	SUS 302	X10 CrNi 1809
303	X10CrNiS189	1.4305	Z10 CNF 18-09	SUS 303	X10 CrNiS 1809
303Se			Z10 CNF 18-09	SUS 303Se	X10 CrNiS 1809
304	X5CrNi1810	1.4301	Z6 CN 18-09	SUS 304	
	X5CrNi1812	1.4303			
304N				SUS 304N1	X5 CrNiN 1810
304H				SUS F304H	X8 CrNi 1910
304L	X2CrNi1811	1.4306	Z2 CN 18-10	SUS 304L	X2 CrNi 1911
	X2CrNi1810	1.4311	Z2 CN 18-10-Az	SUS 304LN	X2 CrNiN 1811
305			Z8 CN 18-12	SUS 305	X8 CrNi 1812
			Z6CNU 18-10	SUS XM7	
309	X15CrNi2012	1.4828	Z15 CN 24-13	SUS 309	X16 CrNi 2314
309S				SUS 309S	X6 CrNi 2314
310	X12CrNi2521	1.4845		SUH 310	X22 CrNi 2520
310S	X12CrNi2520	1.4842	Z12 CN 25-20	SUS 310S	X5 CrNi 2520
314	X15CrNiSi2520	1.4841	Z12 CNS 25-20		X16 CrNiSi2520
316	X5CrNiMo17122	1.4401	Z6 CND 17-11	SUS 316	X5 CrNiMo1712
316	X5CrNiMo17133	1.4436	Z6 CND 17-12	SUS 316	X5 CrNiMo1713
316F	X12CrNiMoS1811	1.4427			
316N				SUS 316N	
316H				SUS F316H	X8 CrNiMo1712
316H					X8 CrNiMo1713
316L	X2CrNiMo17132	1.4404	Z2 CND 17-12	SUS 316L	X2 CrNiMo1712
	X2CrNiMoN17122	1.4406	Z2 CND 17-12-Az	SUS 316LN	X2 CrNiMoN1712
	X2CrNiMo18 143	1.4435	Z2 CND 17-13		X2 CrNiMo1713
	X2CrNiMo17 133	1.4429	Z2 CND 17-13-Az		X2 CrNiMoN1713
	X6CrNiMoTi17122	1.4571	Z6 CNDT17-12		X6 CrNiMoTi1712
	X10CrNiMo1812	1.4573			X6 CrNiMoTi1713
	X6CrNiMoNb17122	1.4580	Z6 CNDNb17-12		X6 CrNiMoNb1712
	X10CrNiMoNb1812	1.4583			X6 CrNiMoNb1713
317				SUS317	X5 CrNiMo1815
317L	X2CrNiMo18164	1.4438	Z2 CND19-15	SUS317L	X2 CrNiMo1815
317L	X2CrNiMo18164	1.4438	Z2 CND19-15	SUS317L	X2 CrNiMo1816
330	X12CrNiSi3616	1.4864	Z12 NCS35-16	SUH303	
321	X6CrNiTi1810	1.4541	Z6 CNT18-10	SUS321	X6 CrNiTi1811
	X12CrNiTi189	1.4878			

Dimension in mm unless otherwise noted

U.S.A.	SWEDEN	U.K.	U.E.	SPAIN	RUSSIA
AISI	SIS	BSI	EURONORM	UNE	GOST
201					
301	2331	301S21	X12 CrNi177	X12CrNi17-07	
302	2331	302S25	X10 CrNi189	X10CrNi18-09	12KH18N9
303	2346	303S21	X10 CrNiS189	X10CrNiS18-09	
303Se		303S41		X10CrNiS18-09	12KH18N10E
304	2332	304S15	X6CrNi 1810	X6CrNi19-10	08KH18N10
		304S16			06KH18N11
304N					
304H				X6CrNi19-10	
304L	2352	304S11	X3CrNi 1810	X2CrNi19-10	03KH18N11
	2371				
305	2333	305S19	X8CrNi 1812	X8CrNi 18-12	
			X6CrNiCu18104Kd		
309		309S24	X15CrNi 2313		
309S			X6CrNi 2213		
310		310S24			20KH23N18
310S	2361		X6CrNi 2520		10KH23N18
314			X15CrNiSi2520		20KH25N20S2
316	2347	316S31	X6CrNiMo 17122	X6CrNiMo17-12-03	
316	2343	316S33	X6CrNiMo 17133	X6CrNiMo17-12-03	
316F					
316N					
316H				X5CrNiMo17-12	
316H				X6CrNiMo17-12-03	
316L	2348	316S11	X3CrNiMo 17122	X2CrNiMo17-12-03	03KH17N14M2
	2353	316S13	X3CrNiTi 17133	X2CrNiMo17-12-03	03KH16N15M3
	2375				
	2350	320S31	X6CrNiMoTi 17122	X6CrNiMoTi17-12-03	08KH17N13M2T
					10KH17N13M2T
		320S33	X6CrNiMoTi17133	X6CrNiMoTi17-12-03	08KH17N13M2T
					10KH17N13M2T
			X6CrNiMoNb17122		08KH16N13M2B
			X6CrNiMoNb17133		09KH16N15M3B
317	2366	317S16			
317L	2367	317S12	X3CrNiMo 18164		
317L	2367	317S12	X3CrNiMo 18164		
330					
321	2337	321S31	X6CrNiTi1810	X6CrNiTi18-11	08KH18N10T

Stainless Steel Specification Table

U.S.A.	GERMANY	GERMANY	FRANCE	JAPAN	ITALY
AISI	DIN17006	W.N. 17007	AFNOR	JIS	UNI
321H				SUS321H	X8 CrNiTi1811
329	X8CrNiMo275	1.4460		SUS329J1	
347	X6CrNiNb1810	1.4550	Z6CNNb 18-10	SUS347	X6 CrNiNb1811
347H				SUS F 347H	X8 CrNiNb1811
904L		1.4939	Z12CNDV 12-02		
	X20CrNiSi254	1.4821			
UNS31803	X2CrNiMoN225	1.4462			
UNS32760	X3CrNiMoN257	1.4501	Z3CND25-06Az		
403	X6Cr13	1.4000	Z12C13	SUS403	X12Cr13
	X10Cr13	1.4006			
	X15Cr13	1.4024			
405	X6CrAl13	1.4002	Z6CA13	SUS405	X6CrAl13
	X10CrAl7	1.4713	Z8CA7		
	X10CrAl13	1.4724			X10CrAl12
	X10CrAl18	1.4742			
409	X6CrTi18	1.4512	Z6CT12	SUS409	X6CrTi12
					X2CrTi12
410	X6Cr13	1.4000	Z10C13	SUS410	X12Cr13
	X10Cr13	1.4006	Z12C13		
	X15Cr13	1.4024			
410S	X6Cr13	1.4000	Z6C13	SUS410S	X6Cr13
414					

These are austenitic grades
These are ferritic grades
These are ferritic-austenitic grades (otherwise known as Duplex and Superduplex)

Dimension in mm unless otherwise noted

U.S.A.	SWEDEN	U.K.	U.E.	SPAIN	RUSSA
AISI	SIS	BSI	EURONORM	UNE	GOST
321H		321S20		X7CrNiTi 18-11	12KH18N10T
329	23 24				
347	23 38	347S31	X6 CrNiNb 18 10	X6CrNiNb18-11	08KH18N12B
347H				X7CrNiNb 18-11	
904L					
UNS31803					
UNS32760					
403	23 02	403S17	X10Cr13 X12Cr13	X6Cr 13	12Kh13
405		405S17	X16CrAl13 X10CrAl7 X10CrSiAl18	X6CrAl 13	10Kh13SYu 15Kh18SYu
409		409S19	X5CrTi12		
410	23 02	410S21	X12Cr13	X12Cr13	12Kh13
410S	23 01	403S17	X6Cr13		08Kh13
414					

These are austenitic grades
These are ferritic grades
These are ferritic-austenitic grades (otherwise known as Duplex and Superduplex)

Stainless steel grade chart

Grade	Chemical analysis (%) specified								
	C	Si	Mn	P	S	Cr	Mo	Ni	Other
Austenitic stainless steels									
253MA	0.05-0.10	1.1-2.0	0.8	0.040	0.030	20.0-22.0			N 0.14-0.20 Ce 0.03-0.08
301	0.15	0.75	2.0	0.045	0.030	16.0-18.0			N 0.10
302HQ	0.03	1.00	2.0	0.045	0.030	17.0-19.0		8.0-10.0	Cu 3.0-4.0
303	0.15	1.00	2.0	0.20	0.15	17.0-19.0		8.0-10.0	
304	0.08	0.75	2.0	0.045	0.030	18.0-20.0		8.0-10.5	N 0.10
304L	0.030	1.00	2.0	0.045	0.030	18.0-20.0			N 0.10
304H	0.04-0.10	0.75	2.0	0.045	0.030	18.0-20.0			N 0.10
309S	0.08	1.00	2.0	0.045	0.030	22.0-24.0			
310	0.25	1.5	2.0	0.045	0.030	24.0-26.0		19.0-22.0	
316	0.08	0.75	2.0	0.045	0.030	16.0-18.0	2.0-3.0	10.0-14.0	N 0.10
316L	0.030	0.75	2.0	0.045	0.030	16.0-18.0	2.0-3.0	10.0-14.0	N 0.10
317L	0.030	0.75	2.0	0.045	0.030	18.0-20.0	3.0-4.0	11.0-15.0	N 0.10
321	0.08	0.75	2.0	0.045	0.030	17.0-19.0		9.0-12.0	N 0.10 Ti=5x(C+N) min. 0.70 max.
347	0.08	0.75	2.0	0.045	0.030	17.0-19.0		9.0-13.0	Nb 10xC min. 1.0 1.0 max.
904L	0.020	1.00	2.0	0.045	0.035	19.0-23.0	4.0-5.0	23.0-28.0	Cu 1.0-2.0

Note 1: Single values are maxima unless otherwise stated.

Note 2: Hardness specification limits given are HRB = Rockwell B scale, HRC = Rockwell C scale, HB = Brinell Hardness.

Note 4: Mechanical properties shown are for the commonly available form listed; properties of other forms for the grade may vary.

Dimension in mm unless otherwise noted

Grade	Mechanical properties specified (Note4)					
	Common form	Treatment	Tensile strength MPa (min.)	Yield strength (0.2% offset) MPa (min.)	Elongation % in 50mm (min.)	Hardness (max) (Note 2)
Austenitic stainless steels						
253MA	Plate	Annealed	600	310	40	95HRB
301	Sheet or coil	Annealed 1/4 to full hard	515 860-1275	205 515-965	40 25-9	95HRB
302HQ	Wire 2.5mm dia. and over	Annealed Lightly drawn	605 max. 660 max	-	-	-
303	Bar	Cold finished Condition A				262 HB
304	Plate	Annealed	515	205	40	92 HRB
304L	Plate	Annealed	485	170	40	88 HRB
304H	Plate	Annealed	515	205	40	92 HRB
309S	Bar	Annealed	515	205	40	95 HRB
310	Plate	Annealed	515	205	40	95 HRB
316	Plate	Annealed	515	205	40	95 HRB
316L	Plate	Annealed	485	170	40	95 HRB
317L	Plate	Annealed	515	205	40	95 HRB
321	Sheet	Annealed	515	205	40	95 HRB
347	Plate	Annealed	515	205	40	92 HRB
904L	Plate	Annealed	490	220	35	70-90 NRB typical

Note 1: Single values are maxima unless otherwise stated.

Note 2: Hardness specification limits given are HRB = Rockwell B scale, HRC = Rockwell C scale, HB = Brinell Hardness.

Note 4: Mechanical properties shown are for the commonly available form listed; properties of other forms for the grade may vary.

Stainless steel grade chart

Grade	ASTM standard and product use						
	A167 A240 A666 sheet, coil, strip, plate	A312 A358 A409 pipe	A213 A249 A269 A554 tube	A403 buttweld fittings	A276 A582 bar and shapes	A313 A493 A580 wire	A182 flanges pressure fittings
Austenitic stainless steels							
253MA							
301							
302HQ							
303					Also UGIMA		
304					Also UGIMA		
304L							
304H							
309S							
310							
316					Also UGIMA		
316L							
317L							
321							
347							
904L							

Note 1: Single values are maxima unless otherwise stated.

Note 2: Hardness specification limits given are HRB = Rockwell B scale, HRC = Rockwell C scale, HB = Brinell Hardness.

Note 4: Mechanical properties shown are for the commonly available form listed; properties of other forms for the grade may vary.

Dimension in mm unless otherwise noted

Grade	Properties and typical applications
	Austenitic stainless steels
253MA	Excellent resistance to scaling and useful creep strength at temperatures up to 1150˚C.
301	Combination of strength and ductility to withstand severe forming methods. Corrosion resistance comparable to 302. Rail cars, automotive components.
302HQ	Wire for severe cold heading such as the manufacture of cross recess screws. Corrosion resistance at least equivalent to type 304.
303	Free machining grade. Domestic and mild industrial environment. Water low in chlorides. Nuts and bolts, shafts, fittings. Corrosion resistance lower than 304.
304	Good resistance to corrosion, good for malleability and weldability. Most commonly used grade. Wine storage, laundry and kitchen products, water, food, architectural, cryogenic and high temperature applications. UGIMA 304 – improved machinability bar with same properties.
304L	Corrosion resistance as for 304. Low carbon variation for heavy gauge welded sections.
304H	Corrosion resistance as for 304. High carbon gives improved high temperature strength.
309S	Excellent resistance to corrosion, particularly attack by hot sulphur compounds in oxidising gases. Sulphite liquors and acids such as acetic, citric, lactic and nitric. Welding wire for joining dissimilar steels.
310	Excellent corrosion resistance at normal temperatures. Good resistance to oxidisation and carburising atmospheres in high temperatures over 850˚C to 1100˚C. Welding wire for joining dissimilar steels.
316	High corrosion resistance to the complex sulphur compounds used in pulp and paper processing. Also resists attack by marine and corrosive industrial atmospheres. Suitable for mild seacoast atmosphere, pulp and paper, heat exchangers, propeller shafts, dying equipment. UGIMA 316 improved machinability bar, with same properties.
316L	Corrosion resistance as for 316. Low carbon variation, suitable for heavy gauge welding.
317L	Improved corrosion resistance over type 316. Often successfully applied where type 316 has given only moderate performance. Applications such as acetic acid distillation, pulp and paper machinery, ink and dying processes. 317L is a variation of 317 suitable for heavy gauge welding.
321	Excellent corrosion resistance, equivalent to 304 in the annealed condition and superior if the application involves service in 425˚C-870˚C range. Typical applications include expansion joints, furnace parts, aerospace and power industries, heat exchangers and steam generators.
347	This grade is resistant to chromium carbide precipitation. Most commonly found as a consumable for welding 321.
904L	Super austenitic' grade with very high corrosion resistance, especially to strong acids and chlorides. Frequently used in sulphuric acid service.

Note 1: Single values are maxima unless otherwise stated.

Note 2: Hardness specification limits given are HRB = Rockwell B scale, HRC = Rockwell C scale, HB = Brinell Hardness.

Note 3: 3CR12 generally conforms with both ASTM A240 grade S41003 and with EN 10088 Parts 1 and 2, grade 1.4003. Properties quoted are from EN 10088.2.

Note 4: Mechanical properties shown are for the commonly available form listed; properties of other forms for the grade may vary.

Stainless steel grade chart

Grade	Chemical analysis (%) specified								
	C	Si	Mn	P	S	Cr	Mo	Ni	Other
Ferritic stainless steels									
3CR12 (Note 3)	0.03	1.00	1.50	0.040	0.015	10.5-12.5			N 0.03
409	0.08	1.0	1.0	0.045	0.030	10.5-11.75			Ti 6xC min. 0.75 max.
430	0.12	1.0	1.0	0.04	0.030	16.0-18.0			
430F	0.12	1.0	1.25	0.06	0.15 min	16.0-18.0			
434	0.12	1.0	1.0	0.04	0.03	16.0-18.0	0.75-1.25		
Ferritic/Austenitic (Duplex) stainless steels									
2205	0.030	1.00	2.0	0.030	0.020	21.0-23.0	2.5-3.5	4.5-6.5	N 0.08-0.20
UR52N+	0.030	0.80	1.50	0.035	0.020	24.0-26.0 4.0	3.0	5.5-8.0 Cu 0.5-2.0	N 0.20-0.35
Martensitic stainless steels									
410	0.15	1.00	1.00	0.040	0.030	11.5-13.5		0.75	
420	0.15 min	1.00	1.00	0.040	0.030	12.0-14.0			
431	0.20	1.00	1.00	0.040	0.030	15.0-17.0		1.25-2.50	
Precipitation hardening steel									
630			1.00	0.040	0.030	15.0-17.0		3.0-5.0	Cu 3.0-5.0 Nb+Ta 0.15-0.45

Note 1: Single values are maxima unless otherwise stated.

Note 2: Hardness specification limits given are HRB = Rockwell B scale, HRC = Rockwell C scale, HB = Brinell Hardness.

Note 3: 3CR12 generally conforms with both ASTM A240 grade S41003 and with EN 10088 Parts 1 and 2, grade 1.4003. Properties quoted are from EN 10088.2.

Note 4: Mechanical properties shown are for the commonly available form listed; properties of other forms for the grade may vary.

Dimension in mm unless otherwise noted

Grade	Mechanical properties specified (Note 4)					
	Common form	Treatment	Tensile strength MPa (min.)	Yield strength (0.2% offset) MPa (min.)	Elongation % in 50mm (min.)	Hardness (max) (Note 2)
Ferritic stainless steels						
3CR12 (Note 3)	Plate	Annealed	450-650	280 (>6mm) 320 (≦ 6mm)	18 (>6mm) 20 (≦ 6mm)	220 HB(≦ 12mm) 250 (>12mm)
409	Tube	Annealed	380	205	20	95 HRB
430	Sheet	Annealed	450	205	22	89 HRB
430F	Bar	Annealed	550	380	25	262 HB
434	Sheet and strip	Annealed	450	240	22	89 HRB
Ferritic/Austenitic (Duplex) stainless steels						
2205	Plate	Annealed	620	450	25	31 HRC
UR52N+	Plate		770	550	25	310 HRB
Martensitic stainless steels						
410	Plate	Annealed	450	205	20	96 HRB
420	Bar	Annealed	655 typical	345 typical	25 typical	241 HB
431	Bar	Annealed	860 typical			285 HRB
Precipitation hardening steel						
630	Bar	Solution treated	1105 typical	1000 typical	15 typical	38 HRC

Note 1: Single values are maxima unless otherwise stated.

Note 2: Hardness specification limits given are HRB = Rockwell B scale, HRC = Rockwell C scale, HB = Brinell Hardness.

Note 3: 3CR12 generally conforms with both ASTM A240 grade S41003 and with EN 10088 Parts 1 and 2, grade 1.4003. Properties quoted are from EN 10088.2.

Note 4: Mechanical properties shown are for the commonly available form listed; properties of other forms for the grade may vary.

Grade	ASTM standard and product use						
	A167 A240 A666 sheet, coil, strip, plate	A312 A358 A409 pipe	A213 A249 A269 A554 tube	A403 buttweld fittings	A276 A582 bar and shapes	A313 A493 A580 wire	A182 flanges pressure fittings
Ferritic stainless steels							
3CR12 (Note 3)							
409							
430							
430F							
434							
Ferritic/Austenitic (Duplex) stainless steels							
2205							
UR52N+							
Martensitic stainless steels							
410							
420							
431							
Precipitation hardening steel							
630							

Note 1: Single values are maxima unless otherwise stated.

Note 2: Hardness specification limits given are HRB = Rockwell B scale, HRC = Rockwell C scale, HB = Brinell Hardness.

Note 3: 3CR12 generally conforms with both ASTM A240 grade S41003 and with EN 10088 Parts 1 and 2, grade 1.4003. Properties quoted are from EN 10088.2.

Note 4: Mechanical properties shown are for the commonly available form listed; properties of other forms for the grade may vary.

Dimension in mm unless otherwise noted

Grade	Properties and typical applications
Ferritic stainless steels	
3CR12 (Note 3)	Useful corrosion resistance particularly in wet abrasion environments. Readily welded and formed into tanks, flues, bins, chutes, rail wagons, etc.
409	Resists atmospheric and automotive exhaust gas corrosion. Extensively used in auto exhaust systems.
430	Good combinations of corrosion resistance, formability and mechanical properties. Typical applications include automotive trims, element supports, cold headed fasteners, refrigerator doors.
430F	430F is a free machining version of 430, suitable for high speed machining. Corrosion resistance is lower than 430.
434	Molybdenum improves the pitting resistance over grade 430. Good for automotive trim components.
Ferritic/Austenitic (Duplex) stainless steels	
2205	2205 microstructure is approximately 50% ferrite and 50% austenitic, which results in the steel possessing high strength and hardness, and resistance to erosion, fatigue, stress corrosion cracking and pitting and crevice corrosion. Applications in marine, chemical and petrochemical industries.
UR52N^{+}	Super Duplex' grade exhibiting exceptional resistance to hot chlorides and sulphides with high strength. Applications in marine, chemical and petrochemical industries.
Martensitic stainless steels	
410	Resists dry atmospheres, fresh water, mild alkalines and acids, steam and hot gases. Must be hardened for maximum heat and corrosion resistance. Typical applications include cold heading, bolts, nuts and screws, pump parts and shafts, steam and gas turbine parts, mine ladder rungs.
420	Good resistance in the hardened condition to the atmosphere. Food, fresh water and mild alkalines or acids. Higher carbon hardenable grade. Typical applications include cutlery, surgical instruments, shear blades, needle valves.
431	Excellent resistance to a wide variety of corrosive media, approaching that of 304. High tensile and torque strength. Pump and boat shafts, nuts, bolts and marine hardware.
Precipitation hardening steel	
630	Precipitation hardening ('aging') treatment after machining gives high strength without distortion. Corrosion resistance similar to type 304. Pump shafts and valve spindles.

Note 1: Single values are maxima unless otherwise stated.

Note 2: Hardness specification limits given are HRB = Rockwell B scale, HRC = Rockwell C scale, HB = Brinell Hardness.

Note 3: 3CR12 generally conforms with both ASTM A240 grade S41003 and with EN 10088 Parts 1 and 2, grade 1.4003. Properties quoted are from EN 10088.2.

Note 4: Mechanical properties shown are for the commonly available form listed; properties of other forms for the grade may vary.

Temperature Range of Generic Elastomers

ELASTOMER	TEMPERATURE RANGE
EPICHLOROHYDRIN	- 20°C ~ 120°C
URETHANE	- 40°C ~ 93°C
NEOPRENE	- 54°C ~ 121°C
NITRILE	- 54°C ~ 121°C
HYDROGENATED NITRILE	- 5°C ~ 150°C
ETHYLENE PROPYLENE	- 54°C ~ 150°C
FLUOROSILICONE	- 40°C ~ 177°C
SILICONE	- 50°C ~ 200°C
FKM FLUOROCARBON	- 5°C ~ 204°C
CHEMRAZ PERFLUOROELASTOMER	- 25°C ~ 260°C

Polyurethane (AU)

- Is a very tough, abrasion and wear-resistant elastoplastic material well suited for use as a hydraulic rod or piston seal in heavy duty applications such as construction and lift equipment. Most polyurethane compounds have a service temperature range from -40°C to +93°C.

Neoprene (CR)

- Is a good general purpose polymer with a wide temperature range from -54°C to +121°C. Neoprene exhibits moderate resistance to a broad range of fluids. These attributes account for its wide use as a commercial seal material.

Nitrile (NBR)

- Is a popular polymer with excellent resistance to petroleum-based fluids, a good balance of physical properties and a wide temperature range from-54°C to +121°C. Nitrile is the most widely used polymer in the seal industry today, being the base polymer for most military rubber specifications for fuel and oil-resistant MS and AN materials.

Hydrogenated Nitrile (HNBR)

- Is a newer polymer type similar to nitrile with improved high-temperature capabilities. Also known as HSN(highly saturated nitrile), HNBR is capable of resisting temperatures up to +150°C with excellent resistance to petroleum-based fluid. Available in a variety of automotive rubber specification grades.

Ethylene Propylene (EPDM)

- Is widely specified as a seal material due to its excellent resistance to Skydrol and other phosphate ester based hydraulic fluids. Ethylene propylene has a temperature range from 54°C to +150°C and is suitable for steam service to +204°C. EPDM materials are widely used to seal automotive brake fluids and in aircraft hydraulic systems.

Dimension in mm unless otherwise noted

Silicone (SI)

- As a glass this polymer exhibits exceptional heat and compression set resistance but relatively poor tensile strength, tear and abrasion resistance. Silicones have the advantage of being useful in wide temperature extremes.The maximum recommended temperature for continuous service is +200°C. Silicone is recommended for use in dry heat, high-aniline point oils and chlorinated di-phenyls.

Fluorocarbon (FKM,VITON)

- Is the second most popular seal material after nitrile. Fluorocarbon polymers have wide-spectrum chemical resistance and a very broad temperature range from -29°C to +204°C. Properly formulated, some fluorocarbon materials have been known to seal temperatures as high as +316°C for short periods. Some fluorocarbon compounds can be used in low temperature static sealing applications to -54°C. FKM is widely used in aircraft, aerospace, automotive and other applications requiring maximum resistance to deterioration by environment and/or fluids.

Perfluoroelastomer (FFKM)

- Is a new class of seal material combining the chemical resistance of PTFE with the elastic properties of fluorocarbon. The materials are an excellent choice for use in high-heat applications where harsh chemical environments are present, as in semiconductor processing equipment. FFKM has a temperature range from -25°C to +260°C.

Polyacrylate (ACM)

- Has outstanding resistance to petroleum-based fuels and oils. In addition, this material has good resistance to oxidation, ozone and sunlight, with the ability to resist flex cracking. The temperature range of polyacrylate materials is from -18°C to +150°C. ACM is widely used in the automotive industry for automatic transmission and power steering service.

Butyl (IIR)

- Prior to the introduction of ethylene, butyl polymers were used to seal phosphate ester type hydraulic fluids. Currently butyl finds its widest sealing application in vacuum systems because of its very low gas permeation rates. The temperature range of butyl is -54°C to +107°C.

Fluorosilicone (FVMQ)

- combines the excellent temperature range of silicone with good resistance to petroleum-based fuels and lubricants. Currently, the primary use of fluorosilicone materials is for seals in aircraft fuel systems at temperatures up to +177°C and in applications where high heat environments are combined with potential exposure to petroleum oils and/or hydrocarbon fuels. High-strength fluorosilicone materials with better wear resistance have been developed, and some of these also exhibit much improved resistance to compression set.

Polytetra fluoroethy lene (PTFE)

- Is a very stable polymer with extremely good resistance to almost all known chemicals as well as a very wide temperature range from -268°C to over +288°C. PTFE may be fabricated in its pure state or blended with various fillers to produce a material better suited for a particular application. PTFE has very low friction and is widely used for piston seals and other applications such as valve stem seals where resistance to temperature extremes and harsh chemicals is required.

PEEK

- Is an acronym for polyetheretherketone, a high-temperature-resistant plastic used for backups and other sealing components where extrusion resistance, high-temperature capability and a broad resistance to chemical environments is needed. Available in unmodified or glass-fill formulations, PEEK has a long-term service temperature capability of +232°C.

Nylon

- Is a generic name for a well-known family of plastics used widely in the sealing industry as anti-extrusion devices. Nylon is resistant to a variety of petroleum and phosphate ester hydraulic fluids. Nylon's temperature range is -55°C to +120°C.

Memo

Dimension in mm unless otherwise noted