Stainless / temperature / strength

Table 1
Short Term Tensile Strength vs Temperature
(in the annealed condition except for 410)

Temperature	304 & TS ksi	316 YS ksi	309 & TS ksi	309S YS ksi	310 & TS ksi	310S YS ksi	410* TS ksi	YS ksi	430 TS ksi	YS ksi
Room Temp.	84	42	90	45	90	45	110	85	75	50
400°F	82	36	80	38	84	34	108	85	65	38
600°F	77	32	75	36	82	31	102	82	62	36
800°F	74	28	71	34	78	28	92	80	55	35
1000°F	70	26	64	30	70	26	74	70	38	28
1200°F	58	23	53	27	59	25	44	40	22	16
1400°F	34	20	35	20	41	24	---	---	10	8
1600°F	24	18	25	20	26	22	---	---	5	4

* heat treated by oil quenching from 1800° F and tempering at 1200° F

Table 2
Generally Accepted Service Temperatures

Material	**Intermittent Service Temperature**	**Continuous Service Temperature**
Austenitic		
304	1600°F (870°C)	1700°F (925°C)
316	1600°F (870°C)	1700°F (925°C)
309	1800°F (980°C)	2000°F (1095°C)
310	1900°F (1035°C)	2100°F (1150°C)
Martensitic		
410	1500°F (815°C)	1300°F (705°C)
420	1350°F (735°C)	1150°F (620°C)
Ferritic		
430	1600°F (870°C)	1500°F (815°C)

It may seem to be illogical that the “continuous” service temperature would be higher than the “intermittent” service temperature for the 300 series grades. The answer is that intermittent service involves “thermal cycling”, which can cause the high temperature scale formed to crack and spall. This occurs because of the difference in the coefficient of expansion between the stainless metal and the scale. As a result of this scaling and cracking, there is a greater deterioration of the surface than will occur if the temperature is continuous. Therefore the suggested intermittent service

temperatures are lower. This is not the case for the 400 series (both ferritic and martensitic grades). The reason for this is not known.