

Carburization, Nitriding & Chloride Salt Resistance of High-temperature Alloys

Corrosion Resistance in Industrial Heat-Treating Environments

Carburization Resistance in Mixed Gases

The following test results were generated by exposing alloy coupons in a gas mixture consisting of 5% hydrogen, 5% carbon monoxide, 5% methane, and the balance argon. Exposures were at the temperatures and for the times shown. Carbon absorption values were determined from chemical analyses, performed before and after exposure, and the known specimen surface area. This is a severe test, with conditions representing unit carbon activity and oxygen partial pressures between 10^{-21} and 10^{-22} .

Alloy	Carbon Absorption During Exposure (mg/cm ²)			
	1600°F (870°C) 215 h	1700°F (925°C) 215 h	1800°F (980°C) 215 h	2000°F (1095°C) 215 h
214 [®]	0.1	0.3	0.6	3.4
800H	0.5	1.0	1.0	12.6
556 [®]	0.4	1.0	1.3	14.0
6B	0.2	0.8	1.5	-
671	-	-	1.9	-
S	0.3	1.6	2.1	10.6
230 [®]	0.4	2.0	2.5	10.3
X	0.5	1.8	2.5	10.6
188	0.5	1.1	2.7	8.6
600	0.4	1.3	2.8	9.9
310	2.4	6.4	3.3	-
25	0.1	0.9	4.5	14.4
601	-	1.8	4.8	11.5
617	0.3	2.4	5.0	-
625	0.3	1.1	5.3	9.9
N	0.1	-	5.4	-
150	-	-	8.1	-

* Data for 6,000 hour exposures are indicated with an asterisk

Carburization Resistance in Packed Graphite

The following test results were generated by exposing samples packed in graphite for 500 hours at 1800°F (980°C). Carbon absorption per unit area was determined by chemical analysis before and after exposure. The graphite used was a commercial grade product.

Alloy	Carbon Absorption
HR-120 [®]	0.0
556 [®]	0.0
HR-160 [®]	0.3
X	0.3
800H	0.5

230[®]	0.6
214[®]	0.8
601	1.0
RA330	1.9
310	7.7
253MA	11.6

Nitriding Resistance

Results were generated by exposing samples to 100% ammonia at various temperatures for 168 hours. Nitrogen absorption per unit area was determined by chemical analysis before and after exposure.

Alloy	Nitrogen Absorption		
	1200°F (650°C)	1800°F (980°C)	2200°F (1095°C)
230[®]	0.7	1.4	1.5
HR-160[®]	0.8	2.1	2.9
600	0.8	0.9	0.3
625	0.8	2.5	3.3
601	1.1	1.2	2.6
188	1.2	2.3	2.0
S	1.3	0.9	1.0
617	1.3	1.5	1.9
214[®]	1.5	0.3	0.2
X	1.7	3.2	3.8
825	2.5	4.3	5.2
800H	4.3	4.0	5.5
HR-120[®]	-	5.1	6.5
556[®]	4.9	6.7	4.2
316	6.9	6.0	3.3
310L	7.4	7.7	9.5
304	9.7	7.3	3.5

Molten Chloride Salt Resistance

Data were generated for samples exposed to neutral Ba-K-Na chloride salts at 1550°F (845°C) for 700 hours. Average metal affected reflects the sum of both metal loss, or thinning, and the metallographically determined average depth of internal penetration.

Alloy	Average Metal Affected	
	mils	mm
-		
188	27	0.7
X	38	1.0
S	40	1.0
556[®]	44	1.1
214[®]	71	1.8
304	75	1.9
310	79	2.0

600	96	2.4
601	115	2.9