

Sulfidation & Chlorine Environment Resistance of High-temperature Alloys

Corrosion Resistance in Aggressive Industrial Environments

Sulfidation Resistance

The following test results were generated by exposing alloy coupons in a gas mixture consisting of 5% hydrogen, 5% carbon dioxide, 1% carbon monoxide, 0.15% hydrogen sulfide, and the balance argon. Exposures were at the temperatures and for the times shown. Average metal affected was determined metallographically by adding the observed metal loss, or thinning, to the observed average depth of internal sulfide penetration. This is a severe test, with sulfur partial pressures ranging from 10⁻⁶ to 10⁻⁷, and oxygen partial pressures between 10⁻¹⁷ and 10⁻²².

Alloy	Average Metal Affected							
	1400°F (760°C)		1600°F (870°C)				1800°F (980°C)	
	mils	µm	215 h		500 h		mils	µm
-				mils	µm	mils		
6B	1.5	38	2.5	64	3.1	79	4.2	107
HR-160[®]	1.1	28	3.8	97	4.7	119	-	-
25	1.8	46	1.4	36	8.4	213	1.8	46
188	3.3	84	2.9	74	14.9	378	1.9	48
150	4.2	107	6.3	160	22.1	561	-	-
556[®]	3.8	97	11.7	297	31.9	810	2.0	51
617	10.8	274	8.7	221	-	-	>21.7	>550
RA333	5.6	142	10.0	254	-	-	-	-
310	9.1	231	13.5	343	-	-	7.4	188
HR-120[®]	-	-	17.0	432	-	-	-	-
800H	11.2	284	19.2	488	-	-	23.2	589
625	12.6	320	>24.5*	>620*	-	-	-	-
230[®]	12.6	320	>21.7	>550	-	-	-	-
214[®]	16.7	424	>17.7	>450	-	-	>17.7	>450
600	>21.7	>550	>21.7	>550	-	-	>21.7	>550
X	>29.5	>750	>21.7	>550	-	-	>21.7	>550
601	>29.5	>750	>21.7	>550	-	-	>21.7	>550
S	>29.5	>750	>29.5	>750	-	-	-	-

Values shown as "greater than" indicate samples were consumed in the test. *Partially consumed

Hot Corrosion Resistance

The following results were generated for standard burner rig low-velocity hot corrosion tests. No.2 fuel oil containing approximately 0.4% sulfur was combusted at an air:fuel ratio of 35:1, with synthetic sea salt (conforming to ASTM D1141- 52) injected at a level of 50 parts per million. Samples were exposed to the combustion gas at 1650°F (900°C) for 1000 hours in a rotating carousel, which was cycled out of the gas stream once-an-hour, and cooled by forced air to less than 400°F (205°C). Samples were evaluated metallographically to determine the extent of metal loss, or thinning, and the average depth of internal penetration. Average metal

affected is the sum of these two quantities.

Alloy	Average Metal Affected	
	mils	mm
188	3.2	81
230 [®]	4.4	112
150	5.2	132
625	>33.9	>861
25	>39.7	>1008
X	>46.0	>1168
S	>70.3	>1786

Chlorine-Contaminated Oxidizing Environment

Results were generated by exposing coupons to a gas mixture consisting of argon, 20% oxygen and 0.25% chlorine for 400 hours at various temperatures shown. Samples were cycled to room temperature every 50 hours and removed from the gas mixture for weighing. The average metal affected after 400 hours was determined metallographically, and is the sum of the metal loss, or thinning, and the average depth of internal penetration.

Alloy	Average Metal Affected							
	1400°F (760°C)		1560°F (850°C)		1650°F (900°C)		1800°F (980°C)	
-	mils	µm	mils	µm	mils	µm	mils	µm
214 [®]	2.4	61	2.6	66	5.9	150	2.0	51
310	-	-	-	-	6.0	152	9.7	246
556 [®]	2.0	51	3.1	79	6.0	152	11.8	300
800H	1.8	46	3.8	97	7.5	191	16.7	424
263	-	-	-	-	7.6	193	16.7	424
X	-	-	-	-	8.6	218	17.1	434
R-41	-	-	-	-	9.5	241	18.0	457
600	3.4	86	5.2	132	9.9	251	15.2	386
601	-	-	-	-	10.4	264	11.6	295
625	-	-	-	-	10.7	272	17.2	437
C-276	2.8	71	6.9	175	12.6	320	17.7	450
S	5.9	150	10.1	257	13.9	353	18.6	472
188	-	-	-	-	>14.0	>355	-	-

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