

HAYNES[®] 556[®] alloy

Oxidation Resistance

HAYNES[®] 556[®] alloy exhibits good resistance to both air and combustion gas oxidizing environments, and can be used for long-term exposure at temperatures up to 2000°F (1095°C). For exposures of short duration, 556[®] alloy can be used at higher temperatures.

Comparative Oxidation Resistance in Flowing Air*

Comparative Oxidation Resistance in Flowing Air*, 1008 Hours								
Alloy	1800°F (980°C)				2000°F (1095°C)			
	Average Metal Affected**		Metal Loss		Average Metal Affected**		Metal Loss	
	mils	µm	mils	µm	mils	µm	mils	µm
X	1.5	38	0.2	5	4.4	112	1.3	33
601	1.7	43	0.4	10	3.8	97	1.3	33
556 [®]	2.3	58	0.4	10	6.9	175	1.5	38
446 SS	2.3	60	1.3	35	14.4	366	13.0	330
RA330	3.0	76	0.3	8	6.7	170	0.8	20
800HT	4.1	104	0.5	13	11.6	295	7.6	193
304 SS	8.1	206	5.5	140	> 19.6	> 498	N/A	N/A
316 SS	14.2	361	12.3	312	> 17.5	> 445	N/A	N/A

*Flowing air at a velocity of 7.0 ft/min (213.4 cm/min) past the samples.
Samples cycled to room temperature once per week.

**Average Metal Affected = Metal Loss + Average Internal Penetration

Metallographic Technique used for Evaluating Environmental Tests



1. Metal Loss = (A - B)/2
2. Average Internal Penetration = C
3. Maximum Internal Penetration = D
4. Average Metal Affected = ((A - B)/2) + C
5. Maximum Metal Affected = ((A - B)/2) + D

Comparative Oxidation in Flowing Air 1800°F (980°C) for 1008 Hours

Microstructures shown are for coupons exposed for 1008 hours at 1800°F (980°C) in air flowing 7.0 feet/minute (212.0 cm/minute) past the samples. Samples were descaled by cathodically charging the coupons while they were immersed in a molten salt solution. The black area shown at the top of each picture represents actual metal loss due to oxidation. The data clearly show HAYNES[®] 556[®] alloy to be superior to both RA330[®] alloy and Type 304 stainless steel as well as the other iron-base alloys shown in the table on the previous page.



HAYNES[®] 556[®] alloy
Average Metal Affected
= 2.3 mils (58 µm)



RA330 alloy
Average Metal Affected
= 3.0 mils (76 µm)



Type 304 Stainless Steel
Average Metal Affected
= 8.1 mils (206 µm)

Oxidation Test Parameters

Burner rig oxidation tests were conducted by exposing, in a rotating holder, samples 0.375 inch x 2.5 inches x thickness (9.5mm x 64mm x thickness) to the products of combustion of fuel oil (2 parts No. 1 and 1 part No. 2) burned at a ratio of air to fuel of about 50:1. (Gas velocity was about 0.3 mach). Samples were automatically removed from the gas stream every 30 minutes and fan cooled to less than 500°F (260°C) and then reinserted into the flame tunnel.

Comparative Dynamic Oxidation

Alloy	1600°F (870°C), 2000 h, 30-min cycles				1800°F (980°C), 1000 h, 30-min cycles				2000°F (1090°C), 500 h, 30-min cycles				2100°F (1150°C), 200 h, 30-min cycles			
	Metal Loss		Average Metal Affected		Metal Loss		Average Metal Affected		Metal Loss		Average Metal Affected		Metal Loss		Average Metal Affected	
	mils	µm	mils	µm	mils	µm	mils	µm	mils	µm	mils	µm	mils	µm	mils	µm
188	1.1	28	2.9	74	1.1	28	3.2	81	10.9	277	13.1	333	8	203	9.7	246
230	0.9	23	3.9	99	2.8	71	5.6	142	7.1	180	9.9	251	6.4	163	13.1	333
617	2	51	7.8	198	2.4	61	5.7	145	13.3	338	20.9	531	13.8	351	15.3	389
625	1.2	30	2.2	56	3.7	94	6	152	-	-	Consumed		-	-	-	-
556®	1.5	38	3.9	99	4.1	104	6.7	170	9.9	251	12.1	307	11.5	292	14	356
X	1.7	43	5.3	135	4.3	109	7.3	185	11.6	295	14	356	13.9	353	15.9	404
HR-120®	-	-	-	-	6.3	160	8.3	211	-	-	-	-	-	-	-	-
RA330	2.5	64	5	127	8.7	221	10.5	267	15.4	391	17.9	455	11.5	292	13	330
HR-160®	-	-	-	-	5.4	137	11.9	302	12.5		18.1	460	8.7	221	15.5	394
310SS	6	152	7.9	201	16	406	18.3	465	-	-	-	-	-	-	Consumed	
800H	3.9	99	9.4	239	22.9	582	Through Thickness		-	-	Consumed after 300 h		-	-	Consumed	

Amount of metal affected for high-temperature sheet (0.060 to 0.125") alloys exposed for 360 days (8,640h) in flowing air.*

Alloy	1600°F (870°C)				1800°F (980°C)				2000°F (1090°C)			
	Metal Loss**		Average Metal Affected***		Metal Loss**		Average Metal Affected***		Metal Loss**		Average Metal Affected***	
	mils	µm	mils	µm	mils	µm	mils	µm	mils	µm	mils	µm
230	0.2	5	1.4	36	0.1	3	2.5	64	3.4	86	11	279
HR-120®	0.3	8	1.6	41	0.5	13	3.3	84	18.1	460	23.2	589
188	0.2	5	1.8	46	-	-	-	-	-	-	-	-
556®	0.3	8	1.9	48	0.5	13	6.2	157	15	381	24.1	612
X	0.3	8	2.2	56	0.2	5	2.8	71	17.1	434	26.2	665
800HT	0.4	10	2.9	74	-	-	-	-	-	-	-	-

*Flowing air at a velocity of 7.0 ft/min (213.4 cm/min) past the samples. Samples cycled to room temperature once per month.

** Metal loss was calculated from final and initial metal thicknesses; i.e. ML = (OMT – FMT) /2

***Average Metal Affected is sum of Metal Loss and Average Internal Penetration