HASTELLOY® W alloy

HASTELLOY® W alloy (UNS N10004) is excellent for welding dissimilar high-temperature alloys. Used extensively in aircraft engine repair and maintenance.

Principal Features

HASTELLOY® W alloy (UNS N10004) is a solid-solution-strengthened super alloy that was developed primarily as a filler metal for welding of dissimilar alloys. It displays excellent dissimilar welding characteristics, and is widely used for that purpose in the gas turbine and aerospace industries. The properties of dissimilar weld joints made with alloy W are dependents upon the alloys joined, but are generally acceptable for a wide variety of combinations. Alloy W is also used as a wrought alloy for a limited number of ring-type applications in older gas turbine engines. HAYNES® 242® alloy is a more modern alloy, and should be considered as a substitute for alloy W in these ring applications (ask for publication H-3079).

Nominal Composition

Weight %

Nickel:	63 Balance
Cobalt:	2.5 max.
Iron:	6
Chromium:	5
Molybdenum:	24
Tungsten:	1 max.
Manganese:	1 max.
Silicon:	1 max.
Vanadium:	0.6 max.
Carbon:	0.12 max.

Stress-Rupture Strength

Bar (AMS 5755)

Test Temperature		**Approximate Initial Stress to Produce Rupture in:**					
		10 h		**100 h**		**1000 h**	
°F	**°C**	**ksi**	**MPa**	**ksi**	**MPa**	**ksi**	**MPa**
1300	705	-	-	34.5	238	27.5	190
1400	760	33.0	228	26.0	179	19.0	130
1500	815	24.8	171	18.0	124	12.4	85
1600	870	17.4	120	12.0	83	8.0	55
1700	925	11.7	81	7.9	54	5.2	36
1800	980	7.9	54	5.2	36	3.2	22

Guided Bend Test Results

1/2 inch (12.7) Plate Weldments (GTAW) Using Alloy W Filler

Base Materials	**Bend Radius**	**Results**
188/ MULTIMET®	2t	No Cracks
625/ 718	2t	No Cracks
304 SS/ Carbon Steel	2t	No Cracks

Heat Treatment

Weld Deposits (A), Wrought Bar (B)

(A) None (B) 2165 °F (1185 °C)/15 minutes/WQ

Physical Properties

Physical Property	British Units		Metric Units	
Density	RT	0.325 lb/in^3	RT	9.00 g/cm^3
Melting Temperature	2350-2510°F	-	1290-1375°C	-
Mean Coefficient of Thermal Expansion	70-800°F	7.3 µin/in -°F	20-500°C	13.2 x 10^{-6}m/m·°C
	70-1000°F	7.4 µin/in -°F	20-600°C	13.2 x 10^{-6}m/m·°C
	70-1200°F	7.4 µin/in -°F	20-700°C	13.5 x 10^{-6}m/m·°C
	70-1400°F	7.8 µin/in -°F	20-800°C	14.2 x 10^{-6}m/m·°C
	70-1600°F	8.2 µin/in -°F	20-900°C	14.8 x 10^{-6}m/m·°C
	70-1800°F	8.4 µin/in -°F	20-1000°C	115.3 x 10^{-6}m/m·°C

Tensile Properties

Bar (AMS 5755):

Test Temperature		0.2% Offset Yield Strength		Ultimate Tensile Strength		Elongation
°F	**°C**	**ksi**	**MPa**	**ksi**	**MPa**	**%**
RT	RT	75.5	520	139.8	965	51.0
1000	538	54.0	370	120.8	835	52.5
1200	649	52.9	365	103.5	715	27.0
1400	760	55.5	385	88.5	610	20.3
1600	871	48.8	335	60.5	415	31.8
1800	982	23.6	165	32.4	225	47.5
2000	1093	10.6	73	17.4	120	79.0

RT=Room Temperature

Typical All-Weld Metal Tensile Properties

Gas Tungsten

Test Temperature

0.2% Offset Yield Strength		Ultimate Tensile Strength		Elongation	Reduction of Area			
	°F	**°C**	**ksi**	**MPa**	**ksi**	**MPa**	**%**	**%**
As-Welded	RT	RT	80	550	120	830	35	27
	1600	871	40	275	43	295	45	53
Aged 1000 h 1200°F (650°C)	RT	RT	115	795	160	1105	14	16
	-	-	-	-	-	-	-	-
Aged 1000 h 1400°F (760°C)	1400	760	64	440	84	580	27	38
	-	-	-	-	-	-	-	-

Gas Metal

Condition	Test Temperature		0.2% Offset Yield Strength		Ultimate Tensile Strength		Elongation	Reduction of Area
	°F	°C	ksi	MPa	ksi	MPa	%	%
As-Welded	RT	RT	80	550	127	875	38	32
	1600	871	42	290	45	310	41	42
Aged 1000 h 1200°F (650°C)	RT	RT	110	760	153	1055	15	16
	-	-	-	-	-	-	-	-
Aged 1000 h 1400°F (760°C)	1400	760	58	400	82	565	30	47
	-	-	-	-	-	-	-	-

Shielded Metal

Condition	Test Temperature		0.2% Offset Yield Strength		Ultimate Tensile Strength		Elongation	Reduction of Area
	°F	°C	ksi	MPa	ksi	MPa	%	%
As-Welded	RT	RT	76	525	110	760	25	22
	1600	871	36	250	38	260	14	15
Aged 1000 h 1200°F (650°C)	RT	RT	108	745	128	885	8	8
	-	-	-	-	-	-	-	-
Aged 1000 h 1400°F (760°C)	1400	760	57	395	77	530	11	14
	-	-	-	-	-	-	-	-

Transverse Tensile Properties for 1/2 incn (12.7mm) Plate Weldments (GTAW) Using Alloy W Filler*

Base Materials	Test Temperature		0.2% Offset		Ultimate Tensile		Elongation	Reduction of Area
-	°F	°C	ksi	MPa	ksi	MPa	%	%
X	RT	RT	58	400	113	780	52	55
	1600	871	33	230	42	290	39	65
188	RT	RT	73	505	128	885	201	301
	1600	871	51	350	58	400	361	601
MULTIMET®	RT	RT	62	425	116	800	49	65
	1600	871	32	220	42	290	28	42
625	RT	RT	69	475	119	820	63	63
	1600	871	35	240	44	305	58	91
718	RT	RT	68	470	125	860	231	311
	-	-	-	-	-	-	-	-
304 SS	RT	RT	48	330	90	620	62	69
	-	-	-	-	-	-	-	-
Carbon Steel	RT	RT	60	415	72	495	14	50
	-	-	-	-	-	-	-	-
188/ MULTIMET®	RT	RT	66	455	117	805	35	64
	1600	871	34	235	47	325	19	19
625/ 718	RT	RT	62	425	131	905	432	422
	1600	871	39	270	48	330	51	95
304 SS/ Carbon Steel	RT	RT	51	350	71	490	17	51
	-	-	-	-	-	-	-	-

*Failures in base metal unless otherwise indicated
[1]Failures in weld [2]Failures in weld and base metal
All values are averages of 2-4 tests

Specifications

Bar Wire	AMS 5786	AWS A5.14 & ASME SFA 5.14 (ERNiMo-3)
Coated Electrodes	-	AWS A5.11 & ASME SFA 5.11 (ENiMo-3)
Bar, Rings and Forgings	AMS 5755	-

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