

Welding Filler Metal Information

The following charts were developed to give general guidance for welding high performance alloys used in a wide variety of corrosion- and heat-resistant applications. Information concerning both filler metal specifications and filler metal selections for welding similar and dissimilar alloys are included.

Table 1, *Applicable Welding Product Specifications*, references both American Welding Society (AWS) and Aerospace Material Specifications (AMS). In addition, identification as corrosion (C) or high temperature (HT) alloys, nominal compositions, and product descriptions are given.

The Filler Metal Selection Guide (Table 2) lists, in most cases, three alternative filler metal choices. The numbers listed in Table 2 are referenced in Table 1 as *alloy class*.

The selection of filler materials, for dissimilar welding applications, should be based upon three design criteria. Those design criteria are:

1. The base metals and filler metal should be metallurgically compatible. That is, the as-deposited weld metal should not form a deleterious microstructure or contain deleterious phases which might promote hot cracking, embrittlement, or other metallurgical problems.
2. The as-welded joint should possess mechanical strength and toughness (at room temperature, low temperatures and elevated temperatures) appropriate for the intended service.
3. The as-welded joint should possess aqueous or high-temperature corrosion resistance, depending upon the anticipated environment, which is at least equivalent to one of the base materials.

The above design criteria were applied in all cases during the development of the chart. It should be recognized that these dissimilar selections are based upon experience and engineering judgment. In many cases, the particular joint combination has not been tested and the selection has been made based upon engineering judgment. It is the responsibility of the organization performing the welding to establish proper welding practice. Therefore, it is strongly recommended that welding procedure qualification be performed to assure that the particular dissimilar joint is appropriate for the intended service.

HAYNES[®] Alloys and other Welding Filler Metal Information

Applicable Welding Product Specifications

Table 1 Bare Filler Wires Coated Electrodes

Alloy Class	Bare Filler Wires				Coated Electrodes				Primary Application*	Alloy Base	Nominal Composition	Notes
	Alloy Name	AWS A5.14	AWS A5.9	AMS	Alloy Name	AWS A5.11	AMS	AMS				
1	HAYNES [®] 625 alloy	ERNiCrMo-3	—	5837	—	—	—	—	C or HT	Ni	21%Cr-9%Mo-Bal Ni	Join 625 & dissimilar alloys
2	HASTELLOY [®] B-2 alloy	ERNiMo-7	—	—	HASTELLOY B-2 alloy	ENiMo-7	—	—	C	Ni	28%Mo-Bal Ni	Join HASTELLOY B-2
3	HASTELLOY B-3 [®] alloy	ERNiMo-10	—	—	HASTELLOY B-3 alloy	ENiMo-10	—	—	C	Ni	28.5%Mo-Bal Ni	Join HASTELLOY B-3 & B-2
4	HASTELLOY C-4 alloy	ERNiCrMo-7	—	—	HASTELLOY C-4 alloy	ENiCrMo-7	—	—	C	Ni	16%Cr-16%Mo-Bal Ni	Join HASTELLOY C-4
5	HASTELLOY C-276 alloy	ERNiCrMo-4	—	—	HASTELLOY C-276 alloy	ENiCrMo-4	—	—	C	Ni	16%Cr-16%Mo-4%W-Bal Ni	Join HASTELLOY C-276
6	HASTELLOY C-22 [®] alloy	ERNiCrMo-10	—	—	HASTELLOY C-22 alloy	ENiCrMo-10	—	—	C	Ni	22%Cr-13%Mo-3%W-Bal Ni	Join HASTELLOY C-22 & C-276 and dissimilar corrosion alloys
7	HASTELLOY C-2000 [®] alloy	ERNiCrMo-17	—	—	HASTELLOY C-2000 alloy	ENiCrMo-17	—	—	C	Ni	23%Cr-16%Mo-1.6%Cu-Bal Ni	Join HASTELLOY C-2000
8	HASTELLOY G-30 [®] alloy	ERNiCrMo-11	—	—	HASTELLOY G-30 alloy	ENiCrMo-11	—	—	C	Ni	30%Cr-15%Fe-5.5%Mo-2.5%W-Bal Ni	Join HASTELLOY G, G-3, G-30
9	HASTELLOY B alloy	ERNiMo-1	—	—	HASTELLOY B alloy	ENiMo-1	—	—	HT	Ni	28%Mo-Bal Ni	Join HASTELLOY B
10	HAYNES 242 [™] alloy	—	—	—	—	—	—	—	HT	Ni	25%Mo-8%Cr-Bal Ni	Join HAYNES 242
11	HASTELLOY W alloy	ERNiMo-3	—	5786	HASTELLOY W alloy	ENiMo-3	5787	—	HT	Ni	24%Mo-5%Cr-Bal Ni	Dissimilar HT filler material
12	HASTELLOY S alloy	—	—	5838	—	—	—	—	HT	Ni	16%Cr-15%Mo-Bal Ni	Join HASTELLOY S & dissimilar HT alloys
13	HASTELLOY X alloy	ERNiCrMo-2	—	5798	HASTELLOY X alloy	ENiCrMo-2	5799	—	HT	Ni	22%Cr-18%Fe-9%Mo-Bal Ni	Join HASTELLOY X
14	HAYNES 230-W [™] alloy	ERNiCrWMo-1	—	5839	HAYNES 230-W alloy	ENiCrWMo-1	—	—	HT	Ni	22%Cr-14%W-Bal Ni	Join HAYNES 230
15	HAYNES HR-160 [®] alloy	ERNiCoCrSi-1	—	—	—	—	—	—	HT	Ni	29%Co-28%Cr-2.75%Si-Bal Ni	Join HAYNES HR-160
16	MULTIMET [®] alloy	—	—	5794	MULTIMET alloy	—	5795	—	HT	Fe	21%Cr-20%Co-20%Ni-Bal Fe	Join MULTIMET & dissimilar HT alloys
17	HAYNES 556 [™] alloy	—	ER3556	5831	—	—	—	—	HT	Fe	22%Cr-18%Co-20%Ni-Bal Fe	Join HAYNES 556 & HR-120 and dissimilar HT alloys
18	HAYNES 25 alloy	—	—	5796	HAYNES 25 alloy	—	5797	—	HT	Co	20%Cr-15%W-10%Ni-Bal Co	Join HAYNES 25 & other cobalt based alloys
19	HAYNES 188 alloy	—	—	5801	—	—	—	—	HT	Co	22%Cr-14%W-22%Ni-Bal Co	Join HAYNES 188
20	HAYNES 214 [™] alloy	—	—	—	—	—	—	—	HT	Ni	16%Cr-4.5%Al-Bal Ni	Join HAYNES 214
21	ULTIMET [®] alloy	—	—	—	ULTIMET alloy	—	—	—	C	Co	26%Cr-9%Ni-5%Mo-Bal Co	Join ULTIMET & weld overlay
22	HAYNES R-41 alloy	—	—	5800	—	—	—	—	HT	Ni	19%Cr-10%Mo-11%Co-1.5%Al-3.1%Ti-Bal Ni	Join HAYNES R-41, precipitation hardening alloy
23	HAYNES 718 alloy	—	—	5832	—	—	—	—	HT	Ni	18%Cr-19%Fe-5%Cb-0.9%Ti-0.5%Al-Bal Ni	Join HAYNES 718, precipitation hardening alloy
24	HAYNES 263 alloy	—	—	—	—	—	—	—	HT	Ni	20%Cr-20%Co-6%Mo-0.6%Al-2.4%Ti-Bal Ni	Join HAYNES 263, precipitation hardening alloy
25	HAYNES Waspaloy alloy	—	—	5828	—	—	—	—	HT	Ni	19%Cr-13%Co-4%Mo-1.5%Al-3%Ti-Bal Ni	Join Waspaloy, precipitation hardening alloy

* C = Corrosion HT = High Temperature

HAYNES[®]

International

HOT LINE: 866-HAS-WIRE

For Commercial Information (sizes, prices, availability) please call:

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Anaheim, CA	800-531-0285	714-978-1775
Houston, TX	800-231-4548	713-937-7597
Kokomo, IN	800-354-0806	765-456-6012
Windsor, CT	800-426-1963	860-688-7771

(additional phone numbers on back cover)

For Technical Information (weldability, compatibility, properties) please call: 765-456-6255

Suggested Filler Metal Selection Guide for both Matching and

Overalloyed Filler Metals

Alloy	Corrosion-Resistant Base Materials										High-Temperature Resistant Base Materials																	
	B-2	B-3	C-4	C-276	C-22	C-2000 G/G-3/G-30	ULTIMET	B	625	N	242	S	X	230	HR-120	556	MULTIMET	HR-160	214	25	188	R-41	718	263	WASPALOY	X-750	Alloy	
HASTELLOY [®] B-2	2-3																											HASTELLOY B-2
HASTELLOY B-3 [®]	3-2	3-2																										HASTELLOY B-3
HASTELLOY C-4	2-3-6-4	3-2-6-4	4-6																									HASTELLOY C-4
HASTELLOY C-276	2-3-6-5	3-2-6-5	6-4-5	5-6																								HASTELLOY C-276
HASTELLOY C-22 [®]	2-3-6	3-2-6	6-4	6-5	6																							HASTELLOY C-22
HASTELLOY C-2000 [®]	2-3-6-7	3-2-6-7	6-4-7	6-7-5	6-7	7-6																						HASTELLOY C-2000
G/G-3/G-30	2-3-6-8	3-2-6-8	6-4-8	6-5-8	6-8	6-7-8	8																					G/G-3/G-30
ULTIMET [®]	2-3-21-6	3-2-21-6	6-21-4	6-21-5	6-21	6-21-7	6-21-8																					ULTIMET
HASTELLOY B	2-3-11-9	3-2-11-9	4-11-9	5-11-9	6-11-9	7-11-9	8-11-9	21-11-9	9-11																			HASTELLOY B
HAYNES [®] 625/625SQ [™]	2-3-6-1	3-2-6-1	6-4-1	6-5-1	6-1	6-7-1	6-8-1	6-21-1	6-1-11-9																			HAYNES 625/625SQ
HASTELLOY N	10-11-2-3	10-11-3-2	10-11-4	10-11-5	10-11-6	10-11-7	10-11-8	10-11-21	10-11-9																			HASTELLOY N
HAYNES 242 [™]	10-2-3	10-3-2	10-4-6	10-6-5	10-6	10-6-7	10-6-8	10-6-21	10-6-11-9																			HAYNES 242
HASTELLOY S	12-11-2-3	12-11-3-2	12-4-6	12-6-5	12-6	12-6-7	12-6-8	12-6-21	12-11-9																			HASTELLOY S
HASTELLOY X	13-2-17	13-3-17	13-4-17	13-5-17	13-6-17	13-7-17	13-8-17	13-21-17	13-11-17-9																			HASTELLOY X
HAYNES 230 [®]	14-2-17	14-3-17	14-4-17	14-5-17	14-6-17	14-7-17	14-8-17	14-21-17	14-11-17-9																			HAYNES 230
HAYNES HR-120 [®]	17-16-2	17-16-3	17-16-4	17-16-5	17-16-6	17-16-7	17-16-8	17-16-21	17-16-11-9																			HAYNES HR-120
HAYNES 556 [™]	17-16-2	17-16-3	17-16-4	17-16-5	17-16-6	17-16-7	17-16-8	17-16-21	17-16-11-9																			HAYNES 556
MULTIMET [®]	16-17-2	16-17-3	16-17-4	16-17-5	16-17-6	16-17-7	16-17-8	16-17-21	16-17-11-9																			MULTIMET
HAYNES HR-160 [®]	17-16-2	17-16-3	17-16-4	17-16-5	17-16-6	17-16-7	17-16-8	17-16-21	17-16-11-9																			HAYNES HR-160
HAYNES 214 [™]	12-17-2	12-17-3	12-17-4	12-17-5	12-17-6	12-17-7	12-17-8	12-17-21	12-17-11-9																			HAYNES 214
HAYNES 25	18-17-2	18-17-3	18-17-4	18-17-5	18-17-6	18-17-7	18-17-8	18-17-21	18-17-11-9																			HAYNES 25
HAYNES 188	19-17-2	19-17-3	19-17-4	19-17-5	19-17-6	19-17-7	19-17-8	19-17-21	19-17-11-9																			HAYNES 188
HAYNES R-41	12-11-2	12-11-3	12-11-4	12-11-5	12-11-6	12-11-7	12-11-8	12-11-21	12-11-9																			HAYNES R-41
HAYNES 718	12-11-2	12-11-3	12-11-4	12-11-5	12-11-6	12-11-7	12-11-8	12-11-21	12-11-9																			HAYNES 718
HAYNES 263	12-11-2	12-11-3	12-11-4	12-11-5	12-11-6	12-11-7	12-11-8	12-11-21	12-11-9																			HAYNES 263
WASPALOY	12-11-2	12-11-3	12-11-4	12-11-5	12-11-6	12-11-7	12-11-8	12-11-21	12-11-9																			WASPALOY
HAYNES X-750	12-11-2	12-11-3	12-11-4	12-11-5	12-11-6	12-11-7	12-11-8	12-11-21	12-11-9																			HAYNES X-750
RA 330/333	17-13-2	17-13-3	17-13-4	17-13-5	17-13-6	17-13-7	17-13-8	17-13-21	17-13-11-9																			RA 330/333
800/800H	17-13-2	17-13-3	17-13-4	17-13-5	17-13-6	17-13-7	17-13-8	17-13-21	17-13-11-9																			800/800H
200/201	2-3	3-2	4-6	5-6	6	7-6	8-6	21-6	1-11-9																			200/201
400	1	1	1	1	1	1	1	1	1																			400
600	2-1	3-1	4-1	5-1	6-1	7-1	8-1	21-1	9-11-1																			600
825	2-6	3-6	4-6	5-6	6	7-6	8-6	21-6	9-11-6																			825
Stainless and Carbon Steels	2-6-1	3-6-1	4-6-1	5-6-1	6-1	7-6-1	8-6-1	21-6-1	9-11-6																			Stainless and carbon steel

Dissimilar Selection Guidelines

In addition to the previously mentioned design criteria, the following general guidelines were used in the selection of filler metals:

1. Only filler metals that are listed in an AWS or AMS specification were used, except for new alloys that have no specification listing.
2. The selections for the category *stainless and carbon steels* are appropriate for joining austenitic, super austenitic, ferritic, and duplex stainless steels, as well as carbon and low alloy steels to HAYNES® and HASTELLOY® alloys.
3. When one base metal was a precipitation hardening alloy and the other base material was a non-precipitation hardening alloy, only non-precipitation hardening filler metals were used. When both metals were precipitation hardening, combinations of hardening and non-hardening filler metals were used.
4. From an aqueous corrosion standpoint, HASTELLOY C-22® alloy was selected as the over-alloyed filler metal of choice. From a high-temperature standpoint, HASTELLOY S, HASTELLOY W, and HAYNES 556™ alloys were selected as filler metals for many applications.

STANDARD PRODUCTS

By Brand or Alloy Designation:

HAYNES
International

HASTELLOY® Family of Corrosion-Resistant Alloys

B-2, B-3®, C-4, C-22®, C-276, C-2000®, D-205™, G-3, G-30®, G-50® and N

HASTELLOY Family of Heat-Resistant Alloys

S, W and X

HAYNES® Family of Heat-Resistant Alloys

25, R-41, 75, HR-120®, 150, HR-160®, 188, 214™, 230®, 230-W™, 242™, 263, 556™, 625, 718, X-750, MULTIMET® and WASPALOY

Corrosion-Wear Resistant Alloy

ULTIMET®

Wear-Resistant Alloy

6B

HAYNES Titanium Alloy Tubular

Ti-3Al-2.5V

Standard Forms:

Bar, Billet, Plate, Sheet, Strip, Coils, Seamless or Welded Pipe & Tubing, Pipe Fittings, Flanges, Fittings, Welding Wire and Coated Electrodes

Properties Data:

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