HAYNES International

Corrosion-Resistant Alloys

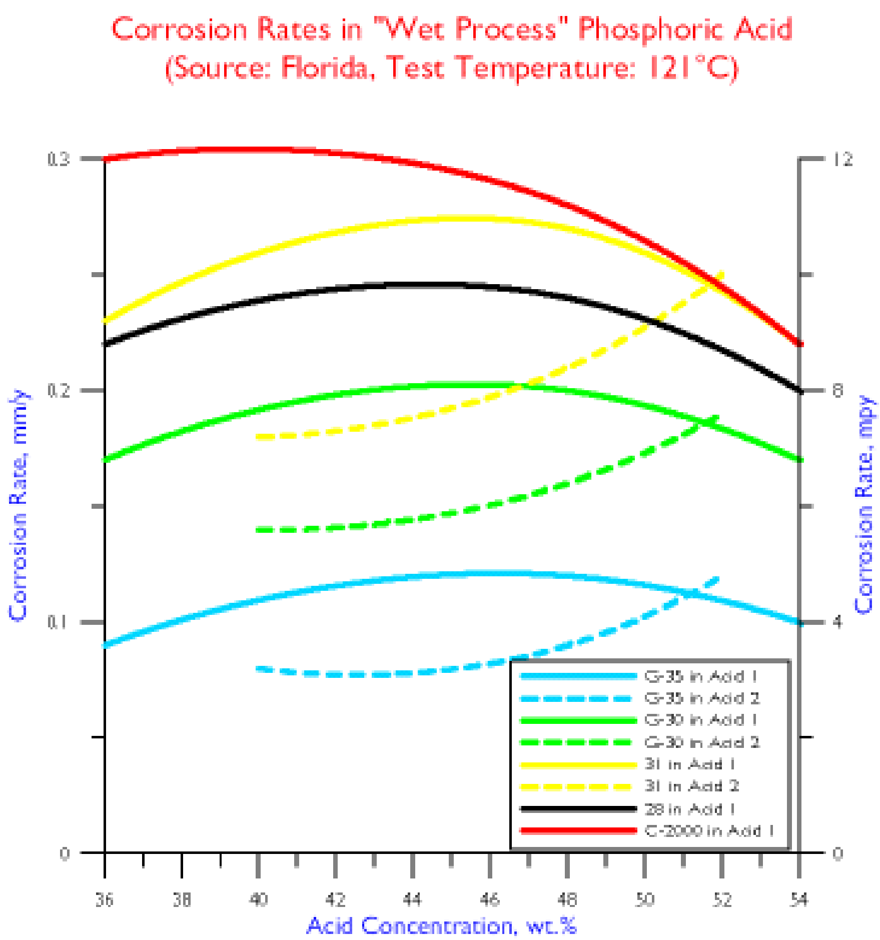
HASTELLOY® G-35® alloy

A nickel alloy with outstanding corrosion resistance to "wet process" phosphoric acid, other oxidizing acids, alkalis, and chloride-bearing media.

Contents

H-2121

Assembly of a "wet process" phosphoric acid evaporator, the primary application of HASTELLOY® G-35® alloy.



This chart illustrates the performance of several alloys in "wet process" phosporic acid from two separate locations in Florida at 121°C (the approximate upper limit for metallic materials). From the first location (Acid 1), concentrations of 36, 48, and 54% were supplied. From the second location (Acid 2), concentrations of 40, 48, and 52% were supplied. The data indicate that Acid 1 is the more corrosive and that G-35 alloy is considerably more resistant to "wet process" phosphoric acid than G-30® alloy and alloys 28 and 31, two high-chromium stainless steels which have been used in phosphoric acid evaporators.

PRINCIPAL FEATURES

Corrosion Performance

HASTELLOY® G-35® alloy* was designed to resist "wet process" phosphoric acid, which is widely used in the production of fertilizers. Tests indicate that it is far superior to HASTELLOY® G-30® alloy and stainless steels, in this chemical. It was also designed to resist localized attack in the presence of chlorides, since under-deposit attack is a potential problem in evaporators used to concentrate "wet process" phosphoric acid.

As a result of its high-chromium content, G-35 alloy is extremely resistant to other oxidizing acids, such as nitric, and mixtures containing nitric acid. It possesses moderate resistance to reducing acids, as a result of its appreciable molybdenum content, and, unlike other nickel-chromium-molybdenum alloys, it is very resistant to "caustic dealloying" in hot sodium hydroxide.

Finally, G-35 alloy is much less susceptible to chloride-induced stress corrosion cracking than the high-chromium stainless steels and nickel-chromium-iron alloys traditionally used in "wet process" phosphoric acid.

Product Forms

G-35 alloy is available in the form of plate, sheet, strip, billet, bar, wire, covered electrodes, pipe, and tubing.

Potential Applications

- "Wet process" phosphoric acid evaporators.
- Pickling in nitric and hydrofluoric acids.
- Chemical process industry systems involving nitric and chlorides.
- Caustic neutralizing systems.
- Systems requiring resistance to high temperature corrosion at 800-1200°F.

Field Test Program

Samples of G-35 alloy are available for field trials. Furthermore, samples can be weighed prior to delivery, and then reweighed after test by the customer and reports provided on corrosion rates and other observations. For samples, please contact one of the Haynes International Service Centers listed on the back of this brochure.

Specifications

G-35 alloy is covered by ASME, ASTM, and DIN specifications. A listing of these is provided on page 14.

CHEMICAL COMPOSITION, wt. %

Ni	Cr	Mo	Fe	Si	Mn	Al	C
BAL	33	8	2**	0.6**	0.5**	0.4**	0.05**

*Covered by U.S. Patent 6,740,291
** Maximum

PHYSICAL PROPERTIES

Physical Property	Metric Units		British Units	
Density	RT	8.22 g/cm.^{3}	RT	0.297 lb/in.^{3}
Electrical Resistivity	RT	1.18 µohm.m	RT	46.5 µohm.in
	100°C	1.19 µohm.m	212°F	46.9 µohm.in
	200°C	1.20 µohm.m	392°F	47.2 µohm.in
	300°C	1.21 µohm.m	572°F	47.6 µohm.in
	400°C	1.22 µohm.m	752°F	48.0 µohm.in
	500°C	1.24 µohm.m	932°F	48.8 µohm.in
	600°C	1.25 µohm.m	1112°F	49.2 µohm.in
Thermal Conductivity	RT	10 W/m.°C	RT	70 btu.in/h.ft^2.°F
	100°C	12 W/m.°C	212°F	85 btu.in/h.ft^2.°F
	200°C	14 W/m.°C	392°F	95 btu.in/h.ft^2.°F
	300°C	16 W/m.°C	572°F	110 btu.in/h.ft^2.°F
	400°C	18 W/m.°C	752°F	125 btu.in/h.ft^2.°F
	500°C	19 W/m.°C	932°F	135 btu.in/h.ft^2.°F
	600°C	23 W/m.°C	1112°F	160 btu.in/h.ft^2.°F
Mean Coefficient of Thermal Expansion	21-100°C	12.3 µm/m.°C	70-212°F	6.8 µin/in.°F
	21-200°C	12.6 µm/m.°C	70-392°F	7.0 µin/in.°F
	21-300°C	13.2 µm/m.°C	70-572°F	7.3 µin/in.°F
	21-400°C	13.4 µm/m.°C	70-752°F	7.5 µin/in.°F
	21-500°C	13.6 µm/m.°C	70-932°F	7.6 µin/in.°F
	21-600°C	14.1 µm/m.°C	77-1112°F	7.8 µin/in.°F
Thermal Diffusivity	RT	0.028 cm^2/s	RT	0.11 ft^2/h
	100°C	0.031 cm^2/s	212°F	0.12 ft^2/h
	200°C	0.034 cm^2/s	392°F	0.13 ft^2/h
	300°C	0.038 cm^2/s	572°F	0.15 ft^2/h
	400°C	0.042 cm^2/s	752°F	0.16 ft^2/h
	500°C	0.045 cm^2/s	932°F	0.17 ft^2/h
	600°C	0.048 cm^2/s	1112°F	0.19 ft^2/h
Specific Heat	RT	450 J/kg.°C	RT	0.11 btu/lb.°F
	100°C	470 J/kg.°C	212°F	0.11 btu/lb.°F
	200°C	490 J/kg.°C	392°F	0.12 btu/lb.°F
	300°C	510 J/kg.°C	572°F	0.12 btu/lb.°F
	400°C	530 J/kg.°C	752°F	0.13 btu/lb.°F
	500°C	530 J/kg.°C	932°F	0.13 btu/lb.°F
	600°C	600 J/kg.°C	112°F	0.14 btu/lb.°F
Dynamic Modulus of Elasticity (Young's Modulus)	RT	204 GPa	RT	29.6 x 10^6 psi
	316°C	189 GPa	600°F	27.4 x 10^6 psi
	427°C	183 GPa	800°F	26.5 x 10^6 psi
	538°C	177 GPa	1000°F	25.7 x 10^6 psi
	649°C	170 GPa	1200°F	24.7 x 10^6 psi
Melting Range	1332 - 1361°C		2430 - 2482°F	

LOCALIZED CORROSION DATA

Critical Crevice (CCT) and Critical Pitting (CPT) Temperatures in Acidified Ferric Chloride (ASTM G 48, Methods D and C)

	Critical Crevice Temperatures		Critical Pitting Temperatures	
ALLOY	°C	°F	°C	°F
316L	0	32	15	59
254SMO®	30	86	60	140
28	17.5	64	45	113
31	42.5	109	72.5	163
G-30	37.5	100	67.5	154
G-35	45	113	95	203
625	40	104	100	212
C-2000	80	176	>120	>248

Time to Stress Corrosion Cracking in Boiling 45% Magnesium Chloride (ASTM G 36)

ALLOY	Time to Cracking
316L	2 h
254SMO	24 h
28	36 h
31	36 h
G-30	168 h
G-35	No cracking in 1008 h
625	No cracking in 1008 h
C-2000	No cracking in 1008 h

UNIFORM CORROSION DATA (G-35, 625)

Chemical	Conc.	Temperature		Corrosion Rate			
	wt.%	°C	°F	G-35		625	
				mm/y	mpy	mm/y	mpy
Hydrochloric Acid	1	Boiling		0.05	2.1	0.23	8.9
	5	79	175	1.23	48.3	4.65	183.0
	10	38	100	0.17	6.7	0.30	11.9
	20	38	100	0.42	16.6	0.36	14.1
Hydrobromic Acid	2.5	Boiling		<0.01	0.1	<0.01	0.1
	5	93	200	<0.01	0.1	0.60	23.7
	7.5	93	200	<0.01	<0.1	0.93	36.5
	10	79	175	<0.01	<0.1	0.82	32.3
	20	66	150	0.44	17.2	0.65	25.7
Hydrofluoric Acid	1	79	175	0.15	6.0	0.31	12.2
	5	52	125	0.1	4.0	0.70	27.4
	10	52	125	0.24	9.5	2.23	87.8
	20	52	125	3.49	137.5	4.33	170.5
Sulfuric Acid	10	93	200	<0.01	0.1	0.24	9.5
	20	93	200	0.01	0.3	0.58	23.0
	30	93	200	2.62	103.0	0.68	26.9
	40	79	175	<0.01	0.1	0.58	22.8
	50	79	175	2.30	90.7	0.89	35.2
Nitric Acid	20	Boiling		<0.01	0.1	0.01	0.3
	40	Boiling		0.01	0.4	0.14	5.5
	60	Boiling		0.06	2.2	0.46	18.1
	70	Boiling		0.10	3.8	0.58	22.7
Phosphoric Acid	50	Boiling		0.01	0.2	0.02	0.9
	60	Boiling		0.01	0.4	0.16	6.2
	70	Boiling		0.11	4.4	0.89	35.2
	80	Boiling		0.42	16.7	4.90	193.0
Chromic Acid	10	66	150	0.15	5.9	0.13	5.2
	20	66	150	0.85	33.4	1.00	39.3
Acetic Acid	99	Boiling		<0.01	<0.1	<0.01	0.1
Formic Acid	88	Boiling		0.07	2.6	0.24	9.3
ASTM G 28A**		Boiling		0.09	3.7	0.48	18.8

*N/T = not tested

**G 28A = 50%H_2SO_4 + 42g/l $Fe_2(SO_4)_3$

UNIFORM CORROSION DATA (OTHER ALLOYS)

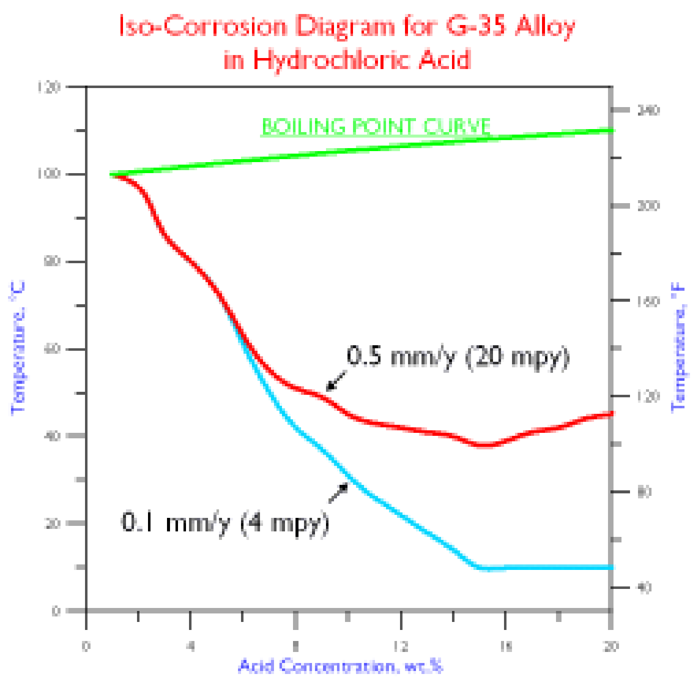
Chemical	Conc.	Temperature		Corrosion Rate					
	wt.%	°C	°F	C-2000		G-30		C-276	
				mm/y	mpy	mm/y	mpy	mm/y	mpy
Hydrochloric Acid	1	Boiling		0.01	0.2	0.01	0.4	0.33	13.0
	5	79	175	<0.01	0.1	2.65	104.5	0.75	29.4
	10	38	100	<0.01	<0.1	0.44	17.5	0.17	6.8
	20	38	100	0.16	6.3	0.3	11.7	0.14	5.4
Hydrobromic Acid	2.5	Boiling		0.01	0.2	N/T	N/T	0.13	5.0
	5	93	200	0.01	0.2	N/T	N/T	0.15	5.8
	7.5	93	200	<0.01	0.1	N/T	N/T	0.73	28.7
	10	79	175	<0.01	<0.1	N/T	N/T	0.51	20.0
	20	66	150	<0.01	<0.1	N/T	N/T	0.37	14.5
Hydrofluoric Acid	1	79	175	0.18	7.0	N/T	N/T	0.40	15.9
	5	52	125	0.09	3.7	N/T	N/T	0.34	13.4
	10	52	125	0.22	8.7	N/T	N/T	0.41	16.0
	20	52	125	0.48	18.8	N/T	N/T	0.48	18.8
Sulfuric Acid	10	93	200	0.02	0.8	<0.01	0.1	0.14	5.5
	20	93	200	0.03	1.0	0.36	14.2	0.40	15.6
	30	93	200	0.04	1.5	0.55	21.7	0.42	16.4
	40	79	175	0.01	0.5	0.04	1.9	0.19	7.5
	50	79	175	0.02	0.7	0.26	10.3	0.26	10.3
Nitric Acid	20	Boiling		0.02	0.7	N/T	N/T	0.66	25.9
	40	Boiling		0.24	9.5	N/T	N/T	4.42	174.0
	60	Boiling		0.94	37.0	0.16	6.2	16.21	638.0
	70	Boiling		1.66	65.4	N/T	N/T	21.55	848.5
Phosphoric Acid	50	Boiling		0.03	1.1	0.01	0.4	0.18	6.9
	60	Boiling		0.08	3.2	0.14	5.4	0.28	11.1
	70	Boiling		0.15	6.0	0.35	13.6	0.13	5.2
	80	Boiling		0.4	15.6	0.61	24.1	0.31	12.3
Chromic Acid	10	66	150	0.1	3.9	0.14	5.7	0.13	5.0
	20	66	150	0.61	24.1	N/T	N/T	0.53	21.0
Acetic Acid	99	Boiling		<0.01	<0.1	0.03	1.0	<0.01	0.1
Formic Acid	88	Boiling		0.01	0.4	0.05	2.1	0.04	1.4
ASTM G 28A**		Boiling		0.67	26.3	0.17	6.8	5.97	235.0

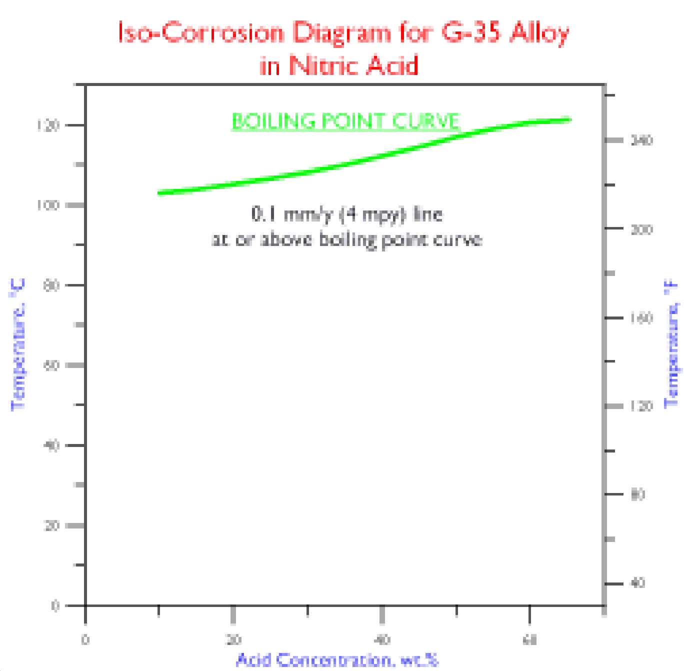
*N/T = not tested

**G 28A = 50%H_2SO_4 + 42g/l $Fe_2(SO_4)_3$

ISO-CORROSION DIAGRAMS

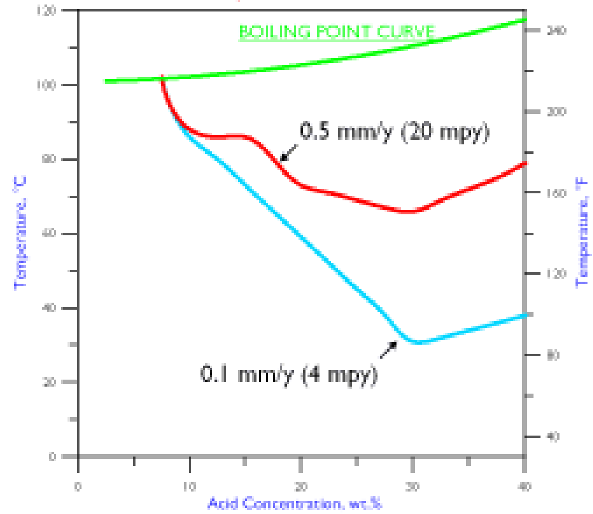
Each of these iso-corrosion diagrams was constructed using numerous corrosion rate values, generated at different acid concentrations and temperatures. The blue line represents those combinations of acid concentration and temperature at which a corrosion rate of 0.1 mm/y (4 mils per year) is expected, based on laboratory tests. Below the line, rates under 0.1 mm/y are expected. Similarly, the red line indicates the combinations of acid concentration and temperature at which a corrosion rate of 0.5 mm/y (20 mils per year) is expected. Above the red line, rates of over 0.5 mm/y are expected. Between the blue and red lines, corrosion rates are expected to fall between 0.1 and 0.5 mm/y.



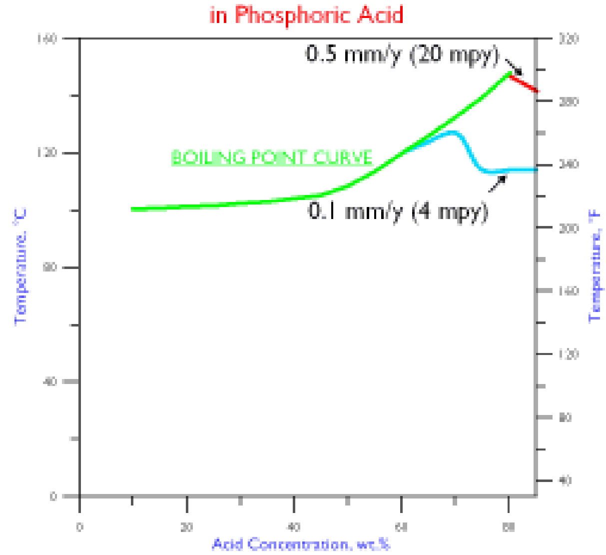


ISO-CORROSION DIAGRAMS

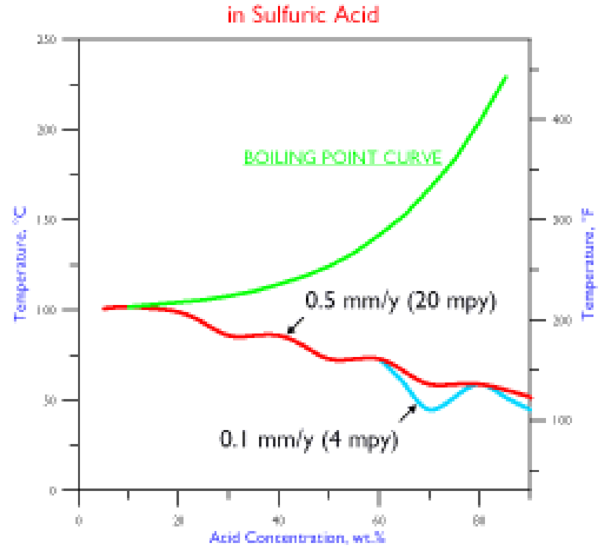
Iso-Corrosion Diagram for G-35 Alloy
in Hydrobromic Acid



Iso-Corrosion Diagram for G-35 Alloy
in Phosphoric Acid



Iso-Corrosion Diagram for G-35 Alloy
in Sulfuric Acid



MECHANICAL PROPERTIES

Room Temperature Tensile Data

Form	Annealing Temperature		Thickness/ Diameter		0.2% Offset Yield Strength		Ultimate Tensile Strength		Elongation
	°C	°F	mm	in	MPa	ksi	MPa	ksi	%
Sheet	1135	2075	3.2	0.125	348	50.5	745	108.0	59.0
Plate	1121	2050	6.4	0.25	344	49.9	703	102.0	66.0
Plate	1121	2050	12.7	0.5	318	46.1	689	100.0	72.0
Bar	1121	2050	25.4	1.0	319	46.3	710	103.0	66.0
Bar	1121	2050	63.5	2.5	338	49.0	689	100.0	68.0

Elevated Temperature Tensile Data (Averaged for Plates and Bars)

Temperature		0.2% Offset Yield Strength		Ultimate Tensile Strength		Elongation
°C	°F	MPa	ksi	MPa	ksi	%
93	200	313	45.4	692	100.3	69.3
149	300	278	40.3	656	95.1	68.2
204	400	248	36.0	623	90.3	69.5
260	500	232	33.7	600	87.0	67.9
316	600	219	31.8	583	84.6	68.8
371	700	217	31.5	570	82.7	72.3
427	800	215	31.2	561	81.3	72.8
482	900	204	29.6	543	78.7	71.0
538	1000	194	28.2	521	75.5	72.7
593	1100	185	26.8	501	72.7	72.0
649	1200	184	26.7	483	70.0	70.2

Room Temperature Charpy V-Notch Impact Data (19.1 mm/0.75 in Plate, Annealed at 1107°C/2025°F)

Condition	Impact Strength	
	J	ft.lbf
Annealed	>358	>264
Annealed then Aged for 2000 h at 427°C/800°F	>358	>264
Annealed then Aged for 2000 h at 482°C/900°F	>358	>264
Annealed then Aged for 2000 h at 538°C/1000°F	>358	>264
Annealed then Aged for 2000 h at 593°C/1100°F	>358	>264
Annealed then Aged for 2000 h at 649°C/1200°F	104	77

WELDING AND FABRICATION

Welding

The weldability of G-35 alloy is similar to that of C-276 alloy. To weld G-35 alloy, three processes are commonly used. For sheet welds and plate root passes, gas tungsten arc (GTAW) welding is favored. For plate welds, the gas metal arc (GMAW) process is preferred. For field welding, the shielded metal arc process, using coated electrodes, is favored. Submerged arc welding is not recommended as this process is characterized by high heat input to the base metal and slow cooling of the weld. To minimize the precipitation of second phases in regions affected by the heat of welding, a maximum interpass temperature of 93°C (200°F) is recommended for G-35 alloy. Also, welding of cold-worked materials is strongly discouraged, since they sensitize more quickly and induce residual stresses. A full solution anneal, followed by water quenching, is recommended for cold-worked structures, prior to welding.

Base Metal Preparation

The joint surface and adjacent area should be thoroughly cleaned before welding. All grease, oil crayon marks, sulfur compounds, and other foreign matter should be removed.

Filler Metal Selections

For gas tungsten arc and gas metal arc welding, G-35 filler wire is suggested. For shielded metal arc welding, G-35 covered electrodes are suggested.

Tensile Data for Weldments

Welding Process	Form	Test Temperature		0.2% Offset Yield Strength		Ultimate Tensile Strength		Elongation
		°C	°F	MPa	ksi	MPa	ksi	%
Gas Tungsten Arc Welding (GTAW)	Transverse Sample from Welded Plate of Thickness 12.7 mm/0.5 in	RT	RT	438	63.5	696	101.0	44.0
		260	500	310	44.9	545	79.0	40.0
		538	1000	249	36.1	448	65.0	37.0
Synergic Gas Metal Arc Welding (GMAW)	Transverse Sample from Welded Plate of Thickness 12.7 mm/0.5 in	RT	RT	459	66.5	724	105.0	31.5
		260	500	335	48.6	555	80.5	43.0
		538	1000	246	35.7	501	72.7	51.0
	All Weld Metal Sample of Diameter 12.7 mm/0.5 in from Cruciform	RT	RT	486	70.5	696	101.0	43.0
		260	500	336	48.8	538	78.0	46.0
		538	1000	302	43.8	441	64.0	42.0

Charpy V-Notch Impact Data for Weldments

Welding Process	Form	Notch Position	Test Temperature		Impact Strength	
			°C	°F	J	ft.lbf
Synergic Gas Metal Arc Welding (GMAW)	Transverse Sample from Welded Plate of Thickness 12.7 mm/0.5 in	Mid-Weld	RT	RT	273	201
			-196	-320	207	153
		Heat Affected Zone	RT	RT	>358	>264
			-196	-320	>358	>264

WELDING AND FABRICATION

Room Temperature Charpy V-Notch Data for Aged Weldments (Synergic Gas Metal Arc Welding, Transverse Samples from Welded 12.7 mm Plate)

Notch Position	Aging Time	Aging Temperature		Impact Strength	
	h	°C	°F	J	ft.lbf
Mid-Weld	2000	427	800	302	223
Mid-Weld	2000	482	900	297	219
Mid-Weld	2000	538	1000	304	224
Mid-Weld	2000	593	1100	169	125
Mid-Weld	2000	649	1200	107	79

Fabrication

Heat Treatment

Wrought forms of HASTELLOY G-35 alloy are furnished in the solution annealed condition, unless otherwise specified. The standard solution annealing treatment consists of heating to 1121°C (2050°F) followed by rapid air-cooling or water quenching. Parts which have been hot formed should be solution annealed prior to final fabrication or installation.

Forming

G-35 alloy has excellent forming characteristics, and cold forming is the preferred method of shaping. The alloy can be easily cold worked due to its good ductility. The alloy is generally stiffer than the austenitic stainless steels; therefore, more energy is required during cold forming. For further information, please consult publication H-2010.

Health and Safety

Welding can be a safe occupation. Those in the welding industry, however, should be aware of the potential hazards associated with welding fumes, gases, radiation, electric shock, heat, eye injuries, burns, etc. Also, local, municipal, state, and federal regulations (such as those issued by OSHA) relative to welding and cutting processes should be considered.

Nickel-, cobalt-, and iron-base alloy products may contain, in varying concentrations, the following elemental constituents: aluminum, cobalt, chromium, copper, iron, manganese, molybdenum, nickel, and tungsten. For specific concentrations of these and other elements present, refer to the Material Safety Data Sheets (MSDS) available from Haynes International, Inc.

Inhalation of metal dust or fumes generated from welding, cutting, grinding, melting, or dross handling of these alloys may cause adverse health effects such as reduced lung function, nasal, and mucous membrane irritation. Exposure to dust or fumes which may be generated in working with these alloys may also cause eye irritation, skin rash, and effects on other organ systems.The operation and maintenance of welding and cutting equipment should conform to the provision of American National Standard ANSI/AWS Z49.1, "Safety in Welding and Cutting". Attention is especially called to Section 4 (Protection of Personnel) and 5 (Health Protection and Ventilation) of ANSI/AWS Z49.1. Mechanical ventilation is advisable and, under certain conditions such as a very confined space, is necessary during welding or cutting operations, or both, to prevent possible exposure to hazardous fumes, gases, or dust that may occur.

MACHINING

The following are guidelines for performing typical machining operations upon G-35 alloy wrought stock. Exact details for specific machining jobs will vary with circumstances of the particular job. Other tool materials not listed here may be suitable for machining G-35 alloy under various conditions. For further information, please consult Haynes publication H-2010.

Recommended Tool Types and Machining Conditions

Operations	Carbide Tools	High Speed Steel Tools
Drilling	C-2 grade not recommended, but tipped drills may be successful on rigid setup of no great depth. The web must be thinned to reduce thrust. Use 135° included angle on point. Gun drill can be used. Speed: 50 sfm. Oil[2] or water-base[3] coolant. Coolant-feed carbide tipped drills may be economical in some setups.	M-33, M-40 series[1] or T-15: Use short drills, heavy web, 135° crank-shaft, grind points wherever possible. Speed: 10-15 sfm. Feed: 0.001 in. rev. 1/8 in. dia. 0.002 in. rev. 1/4 in. dia. 0.003 in. rev. 1/2 in. dia. 0.005 in. rev. 3/4 in. dia. 0.007 in. rev. 1 in. dia. Oil or water-base coolant. Use coolant feed drills if possible.
Normal Roughing; Turning or Facing	C-2 or C-3 grade: Negative rake square insert, 45° SCEA[4], 1/32 in. nose radius. Tool holder: 5° neg. back rake, 5° neg. side rake. Speed: 90 sfm depending on rigidity of set up, 0.010 in. feed, 0.150 in. depth of cut. Dry[5], oil, or water-base coolant.	
Finishing; Turning or Facing	C-2 or C-3 grade: Positive rake square insert, if possible, 45° SCEA, 1/32 in. nose radius. Tool holder: 5° pos. back rake, 5° pos. side rake. Speed: 95-110 sfm, 0.005-0.007 in. feed, 0.040 in. depth of cut. Dry or water-base coolant.	

NOTES:
1 M-40 series High Speed Steels include M-41, M-42, M-43, M-44, M-45 and M-46 at the time of writing. Others may be added and should be equally suitable.
2 Oil coolant should be a premium quality, sulfochlorinated oil with extreme pressure additives. A viscosity at 100°F from 50 to 125 SSU.
3 Water-base coolant should be premium quality, sulfochlorinated water soluble oil or chemical emulsion with extreme pressure additives. Dilute with water to make 15:1 mix. Water-base coolant may cause chipping and rapid failure of carbide tools in interrupted cuts.
4 SCEA - Side cutting edge angle or lead angle of the tool.
5 At any point where dry cutting is recommended, an air jet directed on the tool may provide substantial tool life increase. A water-base coolant mist may also be effective.

SPECIFICATIONS

HASTELLOY G-35 alloy (UNS N06035)		Metal No. 2334
ASTM	B 564	Forgings
ASTM	B 574	Rod
ASTM	B 575	Plate, Sheet, and Strip
ASTM	B 619	Welded Pipe
ASTM	B 622	Seamless Pipe and Tubing
ASTM	B 626	Welded Tube
ASTM	B 366	Fittings
ASTM	B 462	Pipe Flanges, Forged Fittings
ASTM	B 472	Billets and Bars for Reforging
ASME	Code Case 2484	All Forms
DIN	17744 No. 2.4643	All Forms
DIN	NiCr33Mo8	All Forms

Material Safety Data Sheets H-2071 and H-1072

TRADEMARKS

HASTELLOY®, C-22®, C-2000®, G-30®, AND G-35® are registered trademarks of Haynes International, Inc. 254SMO® is a registered trademark of Avesta Sheffield.

REFERENCES

H-2010 Fabrication of HASTELLOY Corrosion Resistant Alloys

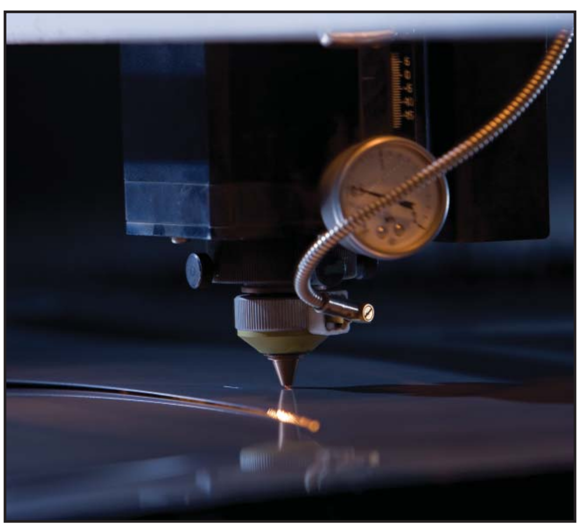
SERVICE CENTER INFORMATION

Service and Availability are Standard at Haynes International.

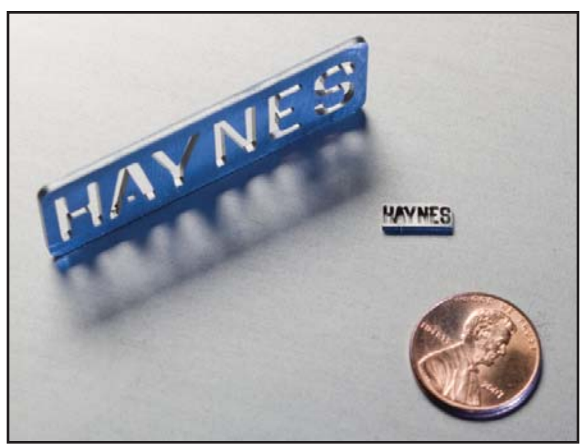
Our global service centers stock millions of pounds of high-performance corrosion-resistant and high-temperature alloys. Whether you need on-demand delivery of finished goods, end-use technical support or a partner with global presence, Haynes International provides value far beyond the alloys themselves.

Corrosion-resistant and high-temperature alloy plate is stocked in several of our global service centers and ready for immediate delivery.

Our LaserQC® equipment accurately maps out parts for duplication.



Our state-of-the art laser is one of many of our specialized equipment that provides precision detail.



Value-added services such as near-net shaped and laser-cut parts can be cut in various sizes to specific drawings and specifications to reduce your labor time and material waste.

STANDARD PRODUCTS

By Brand or Alloy Designation:

HAYNES International

HASTELLOY® Family of Corrosion-Resistant Alloys

B-3®, C-4, C-22®, C-276, C-2000®, C-22HS®, G-30®, G-35®, G-50®, HYBRID-BC1™, and N

HASTELLOY Family of Heat-Resistant Alloys

S, W, and X

HAYNES® Family of Heat-Resistant Alloys

25, R-41, 75, HR-120®, HR-160®, 188, 214®, 230®, 230-W®, 242®, 263, 282®, 556®, 617, 625, 65SQ®, 718, X-750, MULTIMET®, NS-163™, 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

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