CONCEPT ALLOYS

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Technical Data Sheet

Alloy 126

The following data compare Concept Alloys' Alloy 126 (formerly Hoskins Manufacturing Co. Alloy 126) with Haynes® 230® and Haynes® 214®. These competitive alloys are often used in applications for which Alloy 126 was designed.

Haynes 214 is chemically similar to our Alloy 126. In most cases, where direct performance data is not available, it can be assumed that the data for Alloy 126 would be similar to Haynes 214. It should be noted, however, that Alloy 126 is softer than Haynes 214. This is due to the lower aluminum and carbon content of the Alloy 126. Alloy 126 is, therefore, easier to fabricate.

COMPOSITION:

	Haynes 230	Alloy 126	Haynes 214
Boron	0.015*	--	--
Carbon	0.10	0.02*	0.05
Aluminum	0.3	4.	4.5
Silicon	0.4	0.10*	0.2*
Sulfur	--	0.003*	--
Calcium	--	0.015	--
Chromium	22.	20.	16.
Manganese	0.5	0.10*	0.5*
Iron	3.*	2.5	3.
Cobalt	5.*	--	--
Nickel	bal	bal	bal
Yttrium	--	0.04	0.01
Zirconium	--	0.06*	0.1*
Molybdenum	2.	--	--
Lanthanum	0.02	--	--
Tungsten	14.	--	--

* denotes maximum

TYPICAL PHYSICAL PROPERTIES:

	Haynes 230	**Alloy 126**	**Haynes 214**
Density (lb. / in.^{3}) (g / cm^3)	.324 8.97	.2988 8.27	.291 8.05
Resistivity (ohm circ. mils / foot) (ohm sq. mils / foot) (microhm-centimeters)	752 591 125	770 605 128	817 642 135.9
Thermal Expansion Coef. (1 / °C) (20 to 1000°C)	16.1×10^{-6}	15×10^{-6}	17.6×10^{-6}
Recommended Upper Temp. Limit (for continuous use)	2100°F	2300°F	2300°F
Nominal Tensile Strength, psi (at 20°C; cold worked and annealed)	125,000	115,000	144,000
Nominal Yield Strength, psi (at 20°C; cold worked and annealed)	57,000	60,000	88,000
Nominal Elongation, % (at 20°C; cold worked and annealed)	48	37	37

FABRICATION AND HEAT TREATMENT:

Concept Alloys 126:

Alloy 126 was developed to be chemically compatible with nickel base thermocouple alloys while providing the best possible protection at high temperatures in oxidizing environments. It is typical of other aluminum containing nickel base alloys in that it forms a gamma prime second phase when exposed in the temperature range of 1100°F to 1700°F.

Formation of the gamma prime phase causes low ductility in the intermediate and low temperature ranges. This can cause fabrication problems if the material is under stress and restrained when heated through the intermediate temperature range of 1100°F to 1700°F. Gamma prime formation is eliminated or reduced by solution treating above 2000°F and rapidly cooling. Annealing (above 2000°F) and rapid cooling during processing can retain good room temperature ductility. It is recommended that exposure time between 1100°F and 1700°F be minimized during heating and cooling to limit the formation of the gamma prime phase.

This alloy can be satisfactorily TIG or MIG welded. Filler wire of Alloy 126 is recommended.

Haynes 230:

Haynes 230 was developed to have a combination of high temperature strength and good resistance to oxidation. It can be hot worked after thoroughly heating at 2150°F. It is supplied in a solution treated condition obtained by heating in the range of 2150°F to 2275°F followed by rapid cooling. After cold working, the material should be annealed above the solution treating temperature and rapidly cooled to avoid carbide precipitation. It can be TIG or MIG welded.

Haynes 214:

Haynes 214 is similar in composition and properties to Alloy 126. It has a somewhat higher aluminum content that results in a greater tendency for the precipitation of gamma prime in the temperature range of 1000°F to 1700°F. The higher carbon content of Haynes 214 causes greater precipitation of grain boundary carbides than in Alloy 126 when exposed to temperatures below the solution treating temperature. The formation of either grain boundary carbides of gamma prime reduces the ductility of the alloy. Other fabrication recommendations above for Alloy 126 would also apply to Haynes 214.

APPLICATIONS:

Thermocouple Sheathing:

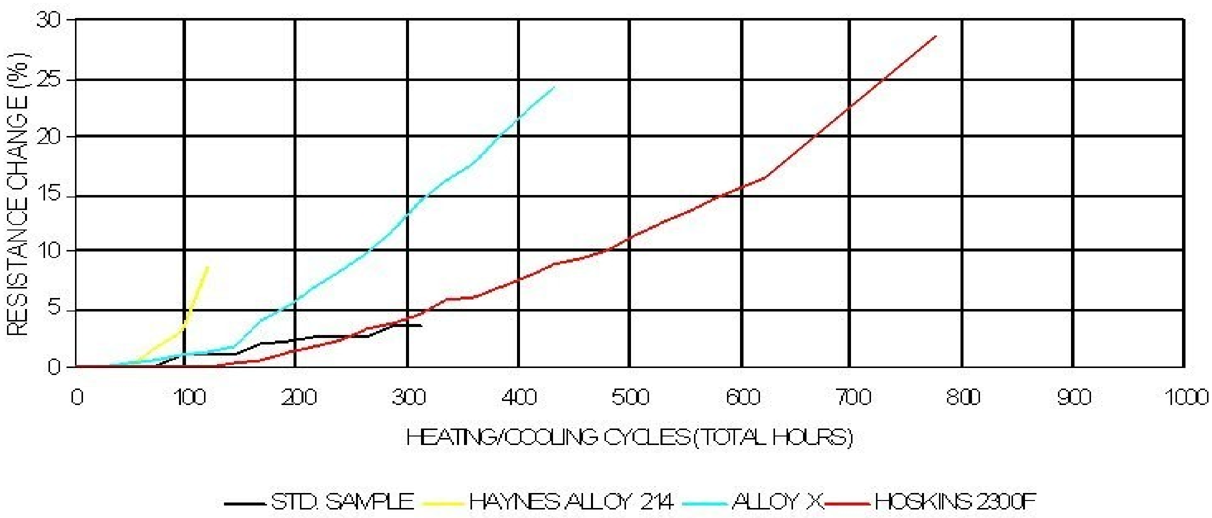
Alloy 126 was designed to be a protective sheath material for Hoskins 2300MI mineral insulated thermocouple cable. It was originally produced in strip form. The strip was continuously welded and filled with magnesium oxide powder and thermocouple wires to produce long lengths of cable. With this application in mind, it was important to design an alloy that would have excellent oxidation resistance, good fabricability, and would be chemically compatible with the thermocouple alloys that would be used inside.

Alloy 126 satisfies all of these conditions.

To evaluate the performance of Alloy 126 under oxidizing conditions it was compared to Haynes 214 using an accelerated life test (ASTM B76) designed for resistance heating elements. This test involves electrically (resistance) heating the sample in a cycle of two minutes on and two minutes off. The increase in resistance of the sample is indicative of a reduction in cross section due to oxidation.

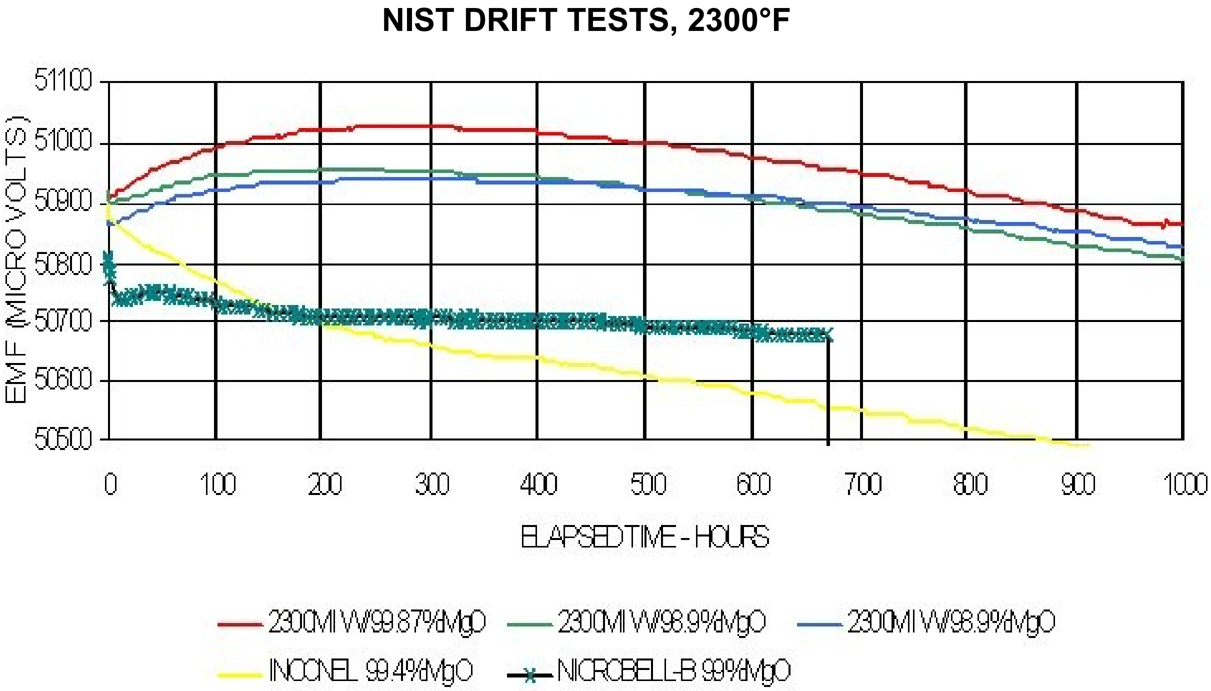
Using this test at a temperature of 2150°F the Alloy 126 was compared to Haynes 214 and Alloy X (an earlier version of Alloy 126). The results are shown on the following graph:

ACCELERATED LIFE TEST, 2150°F



The resistance increase, caused by surface oxidation, clearly shows the superior performance of Alloy 126 compared to Haynes 214 and Inconel (the "Std." sample). The improved performance of Alloys 126 over its' predecessor, Alloy X, is also apparent.

At the request of Hoskins, the National Institute of Standards and Technology (NIST) tested several 1/8TH inch diameter samples of Hoskins 2300MI thermocouples against competitive materials with sheaths of Inconel and Nicrobell. The data from these tests is below:



While the Nicrobell sheathed sample showed good stability after an initial shift in output, it failed after about 650 hours at temperature. The Inconel sheath exhibited continuous drift throughout the test, changing more than 400 microvolts (about 20°F) in less than 900 hours. All three samples of Hoskins 2300MI, with the Alloy 126 sheath, lasted the full 1000 hours, closely paralleled each other with regard to drift, and shifted a maximum of less than 120 microvolts (about 6°F) from the starting value.

SUMMARY:

The primary advantages gained when using Alloy 126 as a thermocouple sheath are:

- Excellent oxidation resistance
- Compatibility with nickel-base thermocouple alloys
- Easy fabrication compared to competitive materials

AVAILABILITY:

Concept Alloys is the exclusive owner of the several U.S. and foreign patents covering the composition of Alloy 126.