PENFLEX

ENGINEERING BULLETIN #137

H Grade May Be Specified, but You Might Not Need It

While we use stainless steels for their resistance to corrosion and strength at high temperatures, we know that all stainless steels are not created equal.

Most Penflex hose and braid products are made with 304, 304L, 316, 316L and/or 321 stainless steel as these are the most common austenitic steels. These iron-chromium-nickel steels are among the most corrosion resistant of all stainless steels thanks in large part to their chromium content.

Chemical Composition Requirements (%)
ASTM A240

Type	Carbon	Chromium	Nickel	Molybdenum	Nitrogen	Titanium
304	.08	18 - 20	8 - 10.5	---	.10	---
304L	.03	18 - 20	8 - 12	---	.10	---
304H	.04 - .10	18 - 20	8 - 10.5	---	---	---
316	.08	16 - 18	10 - 14	2 - 3	.10	---
316L	.03	16 - 18	10 - 14	2 - 3	.10	---
316H	.04 - .10	16 - 18	10 - 14	2 - 3	---	---
321	.08	17 - 19	9 - 12	---	.10	5 x (C+N) min, .70 max
321H	.04 - .10	17 - 19	9 - 12	---	---	4 x (C+N) min, .70 max

Carbon hardens iron and thus its primary role in these ferrous alloys is to increase material strength. In general, the strength and therefore the pressure rating of metal hose decreases as the temperature increases. Thus, as the operating temperature of a metal hose assembly increases, the maximum allowable working pressure (MAWP) of the assembly decreases.

WHEN H GRADE STAINLESS STEELS ARE SPECIFIED

In Engineering Bulletin #112, we discussed how to calculate MAWP of an assembly at operating temperatures above 70°F [21°C], but special considerations must be taken into account when operating temperatures exceed 1000°F [540°C].

In these instances, ASTM A240 specifies the use of “H grade” alloys (i.e. 304H, 316H, 321H) for ASME applications. H grades have a higher carbon content than the standard and L grades of their corresponding alloys which ensures increased strength at elevated temperatures. They must also have a grain size of ASTM No. 7 or something even more coarse.

ALTERNATIVE ALLOYS

Alternatively, in ASME applications where service temperature exceeds 1000°F—as our 321 and 316L hose and 304L braid alloys are not H grade—we move up to an alloy even better for high temperatures and that is Inconel 625.

The maximum service temperature of Inconel, a superalloy with nickel as its primary metal, far supersedes that of most austenitic stainless steels. For example, the maximum service temperature of Inconel 625 is 1800°F [982°C].

To compare the maximum service temperatures of austenitic steels and other common metals, take a look at Engineering Bulletin #106.

If you have any questions about the materials best suited for your applications, please contact us.