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17-DEC-1990

From: FNAL::JBS
To: BOSSERT,CARSON,GREGG,KERBY,MANTSCH,TNICOL,PEWITT,JOHNZ
CC: MYSELF
Subj: Nitronic 33 for end clamp filler laminations

Nitronic 33 looks to me to be at least as good a material for the end clamp filler laminations as Kawasaki steel. The idea in using high Mn steel was to get a closer match to the thermal contraction of iron than is achieved with standard stainless steel. The Nitronic 33 data sheet shows an integrated thermal contraction from 293 to 89 K of 0.215%. Assuming that it scales to 4 K by the same fraction as 304 and 316, the integrated contraction to 4 K would be 0.24%. This is 0.03% more than iron, while the Kawasaki steel is 0.04% less than iron. If, as Tom Nicol quotes Tom Reed, the thermal contraction is linear in the Manganese content, the "ideal" material would have about 20% Manganese, very close to the Carpenter Technology 18-18 Plus which Tom says in unavailable in sheet or plate.

The permiability of Nitronic 33 is 1.002 from 293 down to LN temperatures (as far as the Armcol data sheet goes). This is somewhat smaller than Armco quotes for Nitronic 40: 1.005 at 77 K. This is certainly small enough for the end laminations where the only restriction is that the field at the conductors in the end not be enhanced.

I see no technical reason to choose one of Kawasaki KHMN30L or Armco Nitronc 33 over the other. If Nitronic 33 is more readily available then we should use it.

Fermilab

Fermi National Accelerator Laboratory
Technical Support / Engineering
P.O. Box 500 - Batavia, Illinois - 60510
FAX: (708) 840-8036

December 15, 1990

To: Distribution

From: T. Nicol

Subject: Domestic high-Mn steel sources

I spent a few hours this past week looking into the possibility of locating a source for high-Mn steel in the U.S. Below is a summary of my findings.

I first contacted Dick Reed at NIST (formerly NBS) in Boulder. Dick has just completed a consulting job for BNL and General Dynamics in which he was looking for high-Mn steel for some x-ray lithography magnets. He steered me to Armco, U.S. Steel, and Allegheny Ludlum.

Armco makes the nitronic series with which most of us are familiar. U.S. Steel at one time made something called 'Tenelon' which had about 15% Mn, but is said to be out of that business. Allegheny Ludlum at one time made something called '18-18 Plus' (18% Mn), but has since licensed that recipe to Carpenter Technology, a specialty steel house. Carpenter makes two high-Mn alloys; '15-15 LC' with 16% Mn (*sic*) and '18-18 Plus'. Unfortunately, Carpenter's alloys are only made in bar form, not sheet or plate. The reference material, Kawasaki 'KHMN30L' is 28-30% Mn.

In my initial talk with Dick Reed he confirmed that the high Mn content is what yields the low permeability and low coefficient of thermal expansion of Mn alloy steels. He also estimates that the difference in thermal expansion between alloys, to first order, varies linearly with the Mn content.

My feeling from the sum total of these contacts is that the closest we're going to get in a readily available alloy is 'Nitronic-33' (13% Mn) from Armco. Assuming the linear variation in thermal expansion is right, 'Nitronic-33' should yield about 2.2 mils/inch shrinkage from 300K to 4K based on values of 2.6 and 1.7 for 316L stainless and 'KHMN30L' respectively. The number for iron is about 2.1. I have a product data sheet for 'Nitronic-33' in my office if you're interested. Armco's information gives data for shrinkage of 2.15 mils/inch over the range from 293K to 89K so I suspect the above estimate of 2.2 is pretty close.

There may be other sources that I haven't found, but it seems likely we would have run across them by now. Low demand for the material is compounded by the fact that manganese is evidently really nasty stuff in the manufacturing process. In any case, Dick Reed will be here this coming week for the design review. I'm sure he would be glad to expound upon his knowledge and experience if anyone has further interest.

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