High Chromium Fusion Braze Alloys Ideal for Automotive Applications

The Situation

In the past two decades, many automotive components previously fabricated from carbon steels are now fabricated from stainless steels. This fact, in itself, has necessitated changes from the previous methods and braze filler metals used to join steel components, to furnace brazing using high temperature nickel-based filler metals, such as AWS BNi-2 and BNi-5.

The design complexity and the demand for service reliability of components such as EGR coolers, catalytic converters and heat exchangers have continually increased. At the same time, so has the need for more cost-efficient and reliable manufacturing methods. These requirements underscore several shortcomings for the currently used braze alloys.

The Solution

Fusion has introduced a new family of high-chromium, boron-free braze filler metals that can be used advantageously by automotive component manufacturers.

Fusion A-250, Fusion A-251, and Fusion A-252 each have a minimum of 23% chromium by weight to produce strong, corrosion resistant braze joints for steel, stainless steel and superalloy components. Phosphorous in these filler metals acts as a boron-free alternative to reduce the braze temperature range and improve ductility for improved burst strength in heat exchangers. In Fusion A-251 and Fusion A-252, iron replaces some or most of the nickel content reducing the cost and the impact from increasing nickel prices.

Fusion Paste Brazing Alloys are available in a variety of packaging choices

The service life of components brazed with BNi-2 can be reduced as a result of the boron contained in this braze filler metal, which diffuses into grain boundaries.

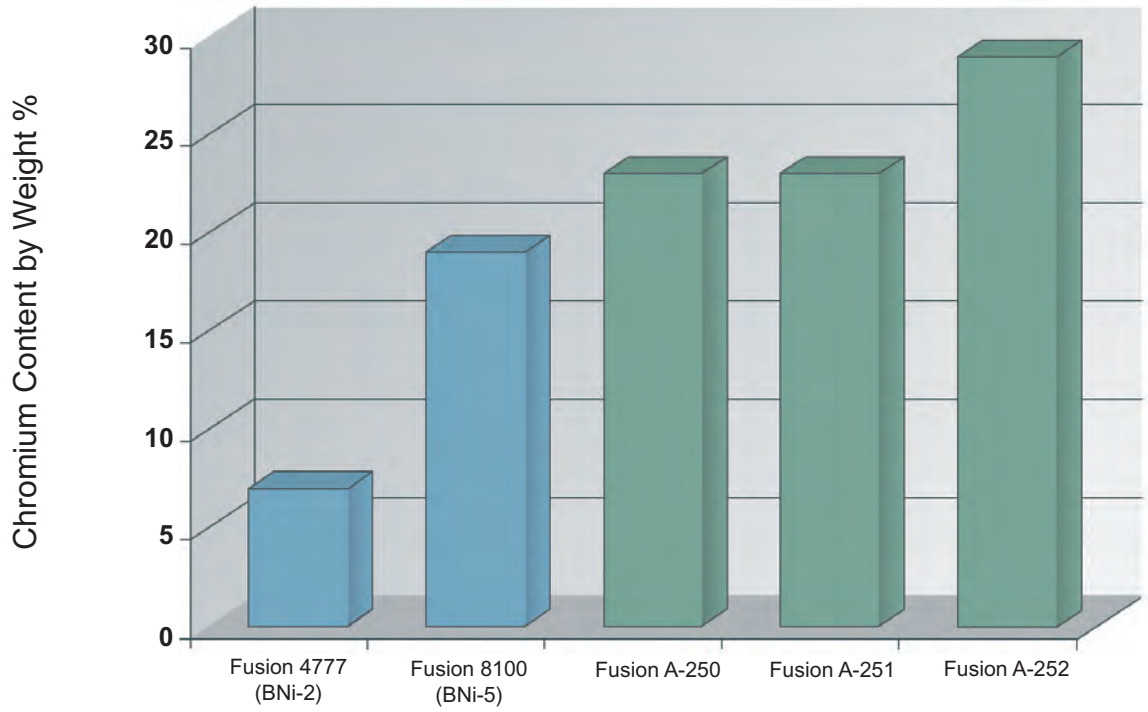
BNi-5 (NiCrSi) has a high braze temperature range of 1150 to 1200°C (2100 to 2200°F), which is above the feasible temperature range for many components.

Braze joints of BNi-5 are brittle, therefore, burst strength requirements for components such as heat exchangers cannot always be achieved.

All nickel-based braze alloys are subject to the escalating cost of nickel – an issue that many manufacturers would like to eliminate to achieve component manufacturing cost targets.

Chromium Content

The chromium content of the new Fusion filler metals was designed for excellent corrosion resistance and strength in applications such as heat exchangers and catalytic converters. These alloys contain much higher amounts of chromium than most other nickel-based braze alloys.



Corrosion Resistance

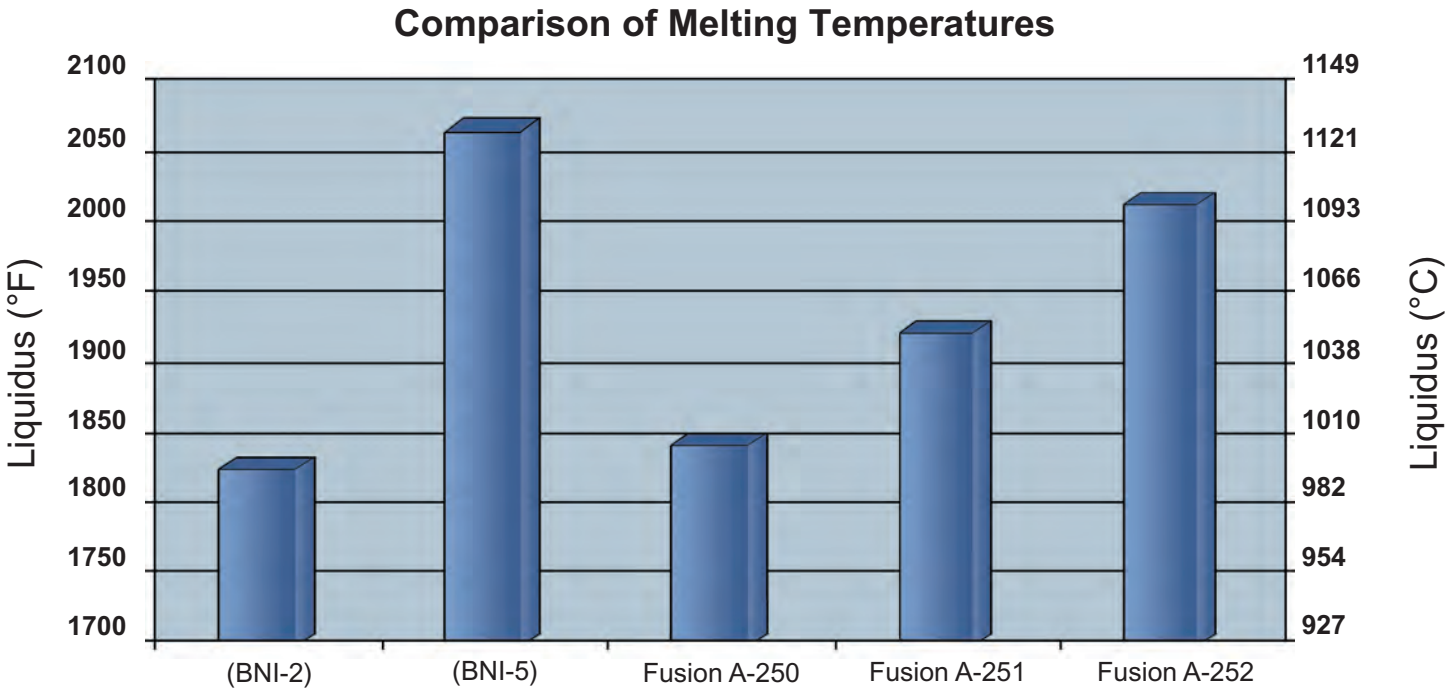
Corrosion and high temperature oxidation tests were performed on brazed samples of Fusion A-250, Fusion A-251, and Fusion A-252, and compared to BNi-2 and BNi-5 control samples.

In each case, the results revealed excellent corrosion resistance for the samples brazed with Fusion A-250, Fusion A-251, and Fusion A-252.

Test Parameters	Duration	Results
10% H_2SO_4 Aqueous Solution	150 hours	Microscopic examination did not reveal any corrosive attack of the braze joint
10% HCl Aqueous Solution	150 hours	Microscopic examination did not reveal any corrosive attack of the braze joint
10% NaCl Aqueous Solution	150 hours	Microscopic examination did not reveal any corrosive attack of the braze joint
810°C (1500°F) Air Atmosphere Furnace	24 hours	No reduction in weight compared to the pre-oxidation test sample weight

Braze Temperature Comparison

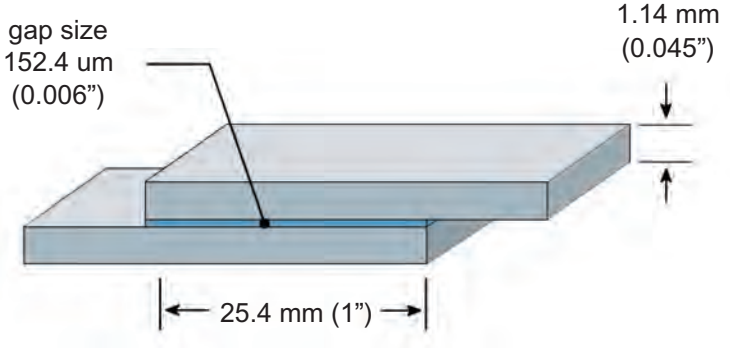
Fusion A-250, Fusion A-251, and Fusion A-252 braze in the same temperature range as the alloys currently used in heat exchangers, catalytic converters and EGR coolers. For applications where a lower braze temperature is desirable, Fusion A-250 is an excellent choice. To maximize cost efficiencies on components that can tolerate a somewhat higher braze range, Fusion A-252 is recommended.



Flow Data

Those alloys have excellent flow during the brazing process. Standard flow testing of these braze alloys on lap joints indicate they will easily fill a 22T joint.

These braze filler metals are free-flowing and can be used to fill long, narrow gaps.



Lap configuration for flow testing

Typical Applications

Plate type heat exchangers
Coolers
HVAC
Refrigeration

Plate/Fin type heat exchangers
HVAC
Condensers
Automotive pre-coolers
Converters

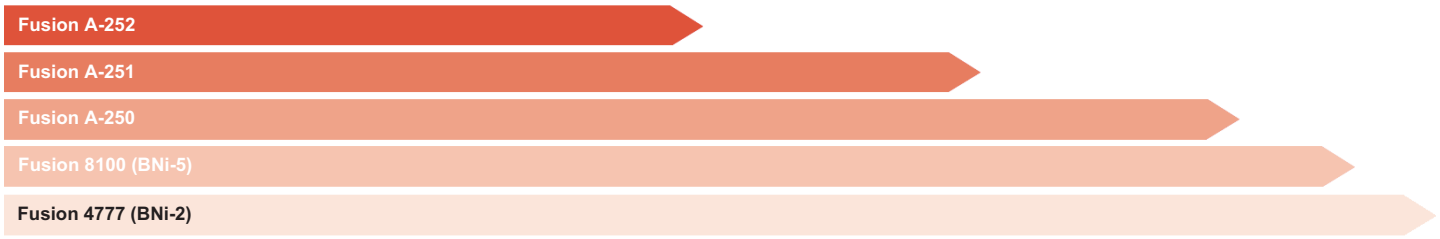
Shell & tube heat exchangers
Boilers/High Pressure applications
Evaporators
Super-heaters

Cost Comparison

The reduced nickel content of these braze materials make them more cost effective than traditional alloys such as BNi-2 and BNi-5.

Fusion A-251, with its greatly reduced nickel content, can be as much as 15% less than traditional nickel-based filler metals. Fusion A-252, being an iron-based filler metal, is the most cost effective at as much as 30% less than nickel-base filler metals, and the material least likely to be affected by fluctuating metal market prices, yet delivers the same braze results.

Material Cost Comparison



Customer Benefits of Fusion A-250, Fusion A-251, and Fusion A-252

Effective:
Produce high quality braze joints with excellent corrosion resistance and strength.
Use on steel, stainless steel and superalloy substrate materials.
Boron-free chemistries improved ductility and helps to ensure component service life.
Low viscosity filler metal can be used for long, narrow gaps.

Fusion A-250:
Very high strength can routinely meet 95.7 kPa (2000 psi) burst strength requirements for heat exchangers.

Fusion A-250 and Fusion A-251:
Low braze temperature range compared to other nickel-base filler metals, which can be used on components that cannot tolerate higher ranges.

Fusion A-252:
Unique iron-based chemistry can reduce typical braze alloy material costs by 30%.
Filler metal costs are not as sensitive to fluctuating metal prices as traditional nickel-based filler metals.

Efficient:
Gas-atomized braze powders clean, dry and have precise and consistent chemistry and particle size for repeatable processing results. Compatible with vacuum brazing and a variety of furnace atmospheres including hydrogen, nitrogen, and argon. Easily replaces traditional braze alloys with little change in processing procedures.

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