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The Fabrication of an Expansion Joint
with an Inconel "X" Bellows

By

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March 31, 1952

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The Fabrication of an Expansion Joint
with an Inconel "X" Bellows

Summary

This report describes the details found necessary to produce leak tight expansion joints with Inconel "X" bellows. Attention to small details of the welding procedure was necessary to produce leak tight welds.

Introduction

This report covers the fabrication of an expansion joint with an Inconel "X" bellows. It is written for the purpose of:

- 1- Reviewing the difficulties in the making of the welds and recording the corrective steps.
- 2- Re-emphasizing the importance of mechanical details in producing satisfactory welds.

The Inconel "X" bellows which was to be fabricated into a leak tight expansion joint had to be welded to heavy members (plunger and guide) made from type-347 stainless steel (K-6A3377). Previous attempts to fabricate an expansion joint with Inconel "X" bellows had failed, and so it became evident that more than the usual attention to details of the fabrication process was necessary.

1. The Welding of the Filler Band

Procedure: The edge welding of the thin filler band (type-347 stainless steel) to the Inconel "X" bellows was done by melting down the edges with an inert gas shielded tungsten arc.

As the preliminary weld becomes part of the final weld preparation, it had to be made carefully to avoid defects, which even though small, may cause a leak or crack in the final weld.

The first precaution observed was the careful cleaning of the joint before welding by degreasing and wire brushing.

Originally, welding-grade argon was used. The weld was rough, with a considerable overhang and crown and badly oxidized (Fig. 1 - Photo No. 1105806). The shape of the weld was not acceptable as it did not allow close fitting to the structural parts and the crown produced a steep angle which was not bridged by the final weld. Thus a notch was created which led to the initiation of a crack in the final weld (Photo No. 1784).

To overcome this difficulty an 80% argon-20% hydrogen mixture, utilized originally by KAPL in the welding of nickel fuel rods, was used together with a 1% thoriated tungsten electrode. This process produced a satisfactory edge weld (Fig. 2 - Photo No. 1105806).

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2. The Final Weld

To assure that a satisfactory assembly was produced, several precautionary measures were taken.

First, the weld preparation on the guide and plunger were machined to fit snugly into the bellows, so that no slag would be trapped which could give off gasses during solidification of the weld and lead to a leak.

Second, the weld preparations on the guide and plunger as well as the preliminary weld were tested with a fluorescent penetrating oil to detect possible defects.

Third, the three parts (plunger, bellows, guide) were held tightly during welding to make sure the completed expansion joint was correctly aligned.

The assembly was rotated horizontally while it was being welded. The welding sequence is shown in Drwg. K-6A3377. The electrode was held at an angle of 20 degrees from the vertical pointing away from the bellows. Every crater produced by a stop was ground out. In the multipass weld, each pass was ground to remove the tightly adherent slag.

The International Nickel electrode No. 132 (3/32" diam.) producing an inconel deposit was used with a current of 50 to 55 amps. Although the Nickel Company recommended that the electrode be baked for 2 to 4 hours at 475-525°F prior to use, it was found in preliminary testing that the baking resulted in porosity in the deposit. Consequently, the electrode was used in the "as-received" condition.

Conclusion: To fabricate an expansion joint with an Inconel "X" bellows it was found necessary to insist on some details in addition to those usually employed in good welding practice.

- 1- Cleanliness including freedom from oil and grease film for both the preliminary and final weld.
- 2- A reducing atmosphere in the making of the inert gas shielded arc weld.
- 3- Tight fit between component parts.
- 4- Component parts held rigidly assembled during the final weld.

K-6A3377

EXPANSION JOINT

REVISIONS

PRINTS TO

1	EM Frowbridge	7/15/52	P. 3
GENERAL CHANGES			

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ISSUEDR. S. Howell
March 25, 1952
March 26, 1952KAPL
SCHENECTADYDIV
WORKS

K-6A3377

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Fig. 1
with Welding Grade
Argon Gas

Fig. 2
with 80% Argon - 20% Hydrogen
Mixture

Edge Weld

Inconel X to Type-347 Stainless Steel

605-85

Final
Weld

Preliminary
Weld

Photo No. 1784
Oxalic Electrolytic Etch

Inconel "X" Weld

Unsatisfactory Edge Weld
May Lead to Cracks in the Final Weld