CNLM-1758

PRATT & WHITNEY AIRCRAFT DIVISION
CONNECTICUT OPERATIONS - CANEL

WELDING & BRAZING DEVELOPMENT GROUP
ADVANCED TOOL ENGINEERING

Final Report - Project 1065 May 19, 1959

Weldability of Haynes Alloy #25

Object:

It was desired to determine the fusion welding characteristics of Haynes Alloy #25 as applied to TLJ-100530, Corrosion Loops.

Equipment:

Vacuum Weld Chamber
Plastic Bags
P & H 300 Amp Inert Arc Welder

MASTER

Summary:

Haynes Stellite Alloy #25 is a cobalt-base alloy for corrosion resistant high temperature applications. This material, when welded by the inert gas shielded tungsten arc method, produces sound ductile joints.

The weld joints and adjacent areas should be thoroughly cleaned using solvents and wire brushing. Heavy scale remaining from heat treating operations can be removed by pickling in a solution of dilute aqua regia and hydrogen peroxide, or shot blasting may be used.

Material thicknesses greater than 12 gauge require standard joint preparations, a V joint being preferred up to 1/4 inch and a U joint for greater thicknesses. When sheared material is prepared for welding, the sheared edges should be machined back approximately 1/16 inch to remove any stressed material. Material thinner than 12 gauge may be welded from one side but should be gapped to allow full penetration. Greater care than when working with stainless steel is required to obtain even penetration. A copper backing bar can be used to advantage to obtain more even bead penetration and is beneficial as a chill bar. Welding heat should be kept to a minimum followed by fast cooling. The molten metal is very fluid and may present difficulties when position welding.

2 1

Procedure:

Specimens consisting of .250 O.D. X .030 wall tubing were butt welded both with and without the use of a filler wire. Specimens were welded using argon gas torch coverage, in plastic bags or in vacuum chambers. 1/16 inch sheet specimens were hot rolled from 1/4 stock, solution annealed and shot blasted to clean. These specimens were butt welded using filler wire sheared from the same material. All specimens were submitted for x-ray examination. Representative specimens were metallurgically examined.

Results:

X-ray and metallographic results are shown in the accompanying tables. A tensile test was made on specimen #10 with failure occurring thru the weld zone at 145,000 P.S.I. Several specimens were bent 180° around a 1/32 inch radius with no failure or cracking.

Written by S L Rogers
S. L. Rogers

Approved by C N Peterson
C. N. Peterson

Approved by J S Nimmons
J. S. Nimmons

SLR/bfb

TABLE I

VISUAL & RADIOGRAPHIC RESULTS

Specimen No.	Type Joint	Filler	Argon Atmosphere	Remarks
1	Tube Butt No Gap	None	Plastic Bag	Excess Penetration
2	Tube Butt No Gap	None	Torch	Small Oxide Inclusion and Slight Excess Penetration
3	Tube Butt No Gap	None	Torch	No Defects
4	Tube Butt No Gap	None	Torch	Fine Crater Crack
5	Tube Butt No Gap	None	Torch	No Defects
6	Tube Butt No Gap	None	Torch	No Defects
7	Tube Butt No Gap	None	Drybox	Tendency Toward Excessive Penetration
8	1/16 Sheet Butt No Gap	None	Torch	Low Penetration
9	1/16 Sheet Butt No Gap	None	Torch	Low Penetration
10	1/16 Sheet Butt 1/16 Gap	1/16 Rod	Torch	No Defects
11	Tube Butt No Gap	1/32 Wire	Torch	Incomplete Fusion
12	1/16 Sheet No Gap	1/32 Wire	Torch	Shrinkage Crack 2/3 Length of Weld
13	1/16 Sheet 1/16 Gap	1/32 Wire	Torch	No Defects
14	Tube Butt 1/16 Gap	1/32 Wire	Drybox	No Defects
15	1/16 Sheet 1/16 Gap	1/32 Wire	Drybox	Poor Fusion At One End
16	Tube Butt 1/16 Gap	1/32 Wire	Torch	No Defects

TABLE II

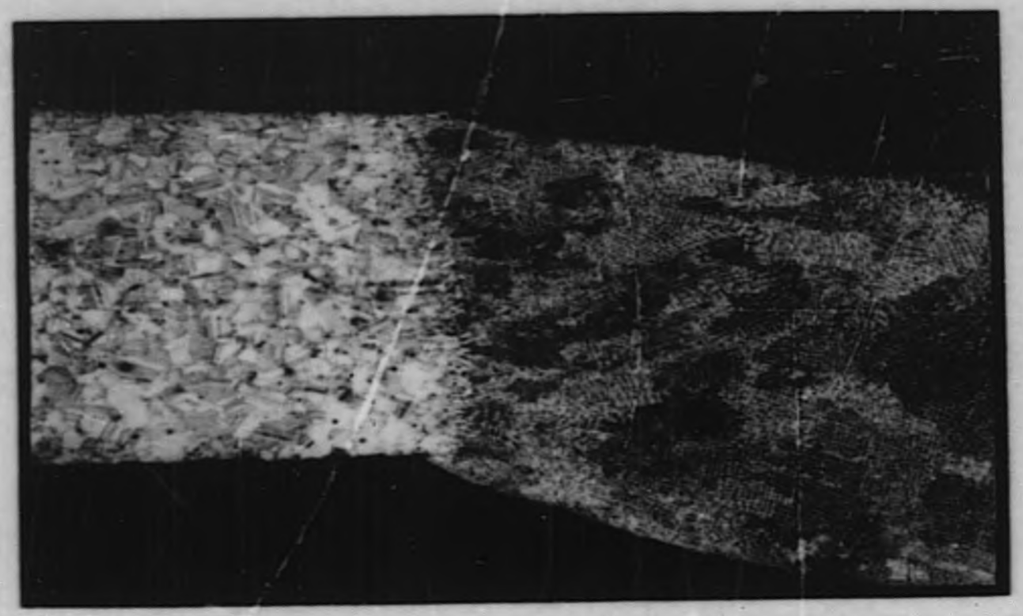
RESULTS OF METALLURGICAL EXAMINATION

Spec. No.	ASTM Grain Size Base	Weld	Hardness Ave. DPH Base	HAZ	400 Weld	Remarks
13	4-5	Cored Structure	260	250	297	Base metal grain size up to weld nugget. Good ductility. 180° Bend No cracks or defects. Some second phase in small spheroidized form. See Fig. 1
15	4-5	Cored Structure	250	264	268	Same as Specimen 13.
11	4-5	Cored Structure	298	279	284	Same as Specimen 13 except one small void in weld nugget. Stringer of inclusions in the base metal. See Fig. 2 & 3.
16	4-5	Cored Structure	306	285	261	Same as Specimen 11.

HAYNES ALLOY #25
CHEMICAL COMPOSITION

Nickel	9.00 - 11.00	Iron	3.00 - Max.	Manganese	1.00 - 2.00
Chromium	19.00 - 21.00	Carbon	.05 - 0.15	Molybdenum	.50 - 1.00
Tungsten	14.00 - 16.00	Silicon	1.00 - Max.	Cobalt	Balance

HAYNES ALLOY NO. 25
1/16 SHEET BUTT WELD



MAGNIFIED: 50X

2-5

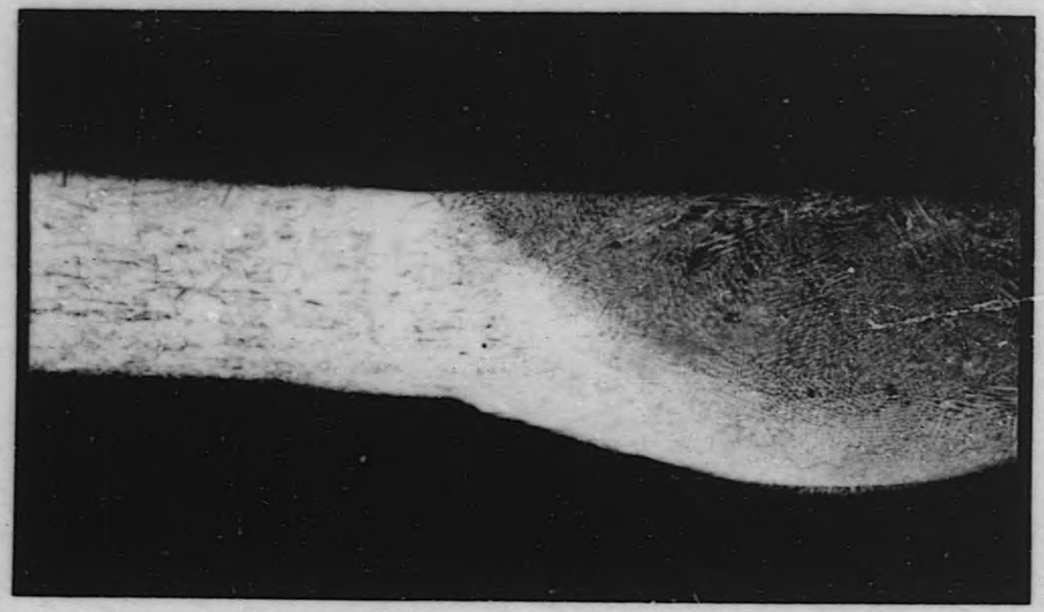
PROJ - 1065

FIG 1

C-13-1

HAYNES ALLOY NO. 25

TUBE BUTT WELD



MAGNIFIED: 50X

PROJ - 1065 — FIG 2 — C-13-2

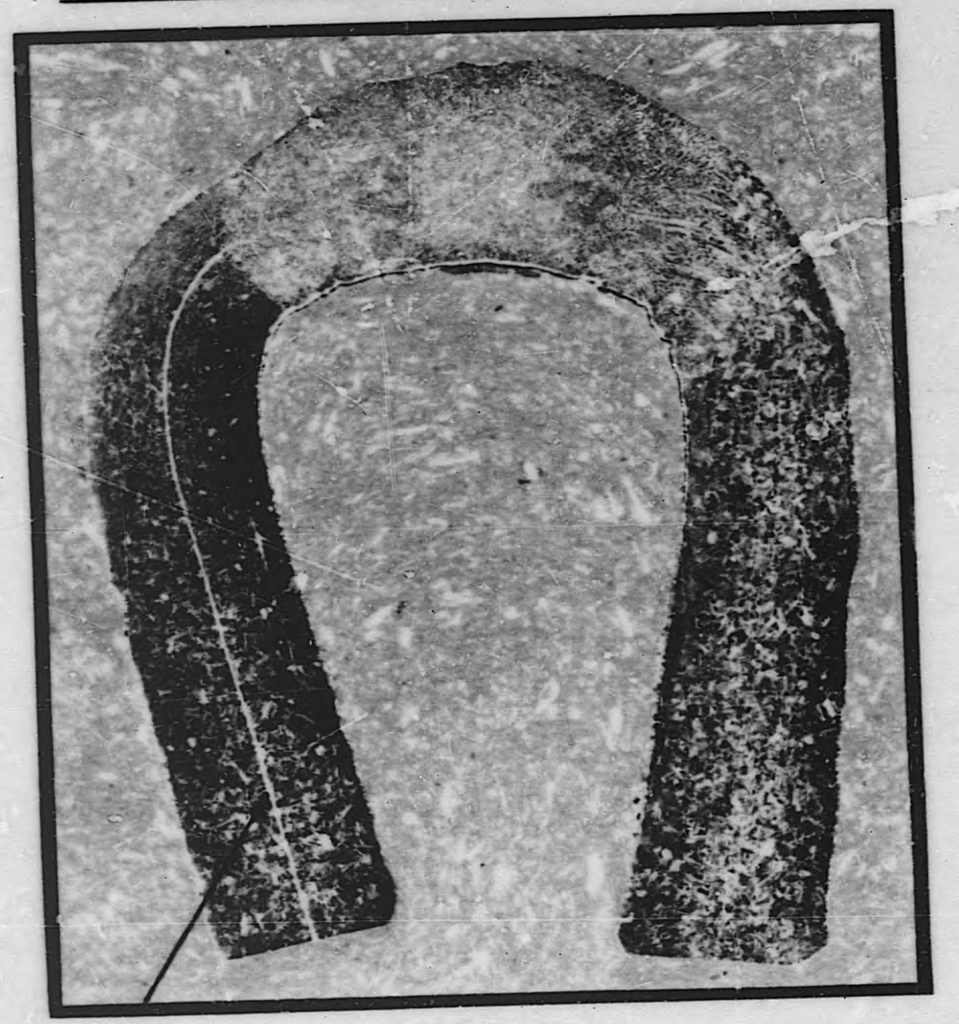
PROJ - 1065

8A5903

FIG 3

HAYNES ALLOY NO. 25

TUBE BUTT WELD SHOWING BEND THRU JOINT



STRINGER OF
INCLUSIONS
IN BASE METAL

MAGNIFIED: 35X

END