CANEL-1729

PRATT & WHITNEY AIRCRAFT DIVISION
CONNECTICUT OPERATIONS - CANEL

WELDING & BRAZING DEVELOPMENT GROUP
ADVANCED TOOL ENGINEERING

Final Report - Project 1325 May 21, 1959

Braze Alloys v.s. Atmospheres

Object:

To compare the compatability of various furnace atmospheres with the contemporary braze alloys commonly used at CANEL and especially to evaluate PMC 2252, an argon 2 1/2 per cent hydrogen gas mixture.

Equipment:

Box Type Furnace
Retort
Braze Alloys
Gas Atmospheres

Summary:

At the time this project was initiated, all brazing had been confined to small retorts of ten cubic feet capacity or less. Larger assemblies were scheduled which required retorts of over 100 cubic feet capacity. Hydrogen atmospheres had given best results, however, there was considerable reluctance to use hydrogen in these large retorts from a safety standpoint. It was thought that thru the use of PMC 2252, an argon - 2 1/2% hydrogen gas atmosphere which is non-explosive, sufficient cleaning action might be attained without the inherent hazards encountered with hydrogen.

An investigation of the argon - 2 1/2% hydrogen gas as a brazing atmosphere was conducted at East Hartford since none of this material was available at CANEL.

Induction brazing is the only application that has been tried with this gas, on installations where it replaced a hydrogen atmosphere.

No comparison has been made with argon or other inert gases but it is believed that the 2 1/2 per cent hydrogen affords some beneficial cleansing action.

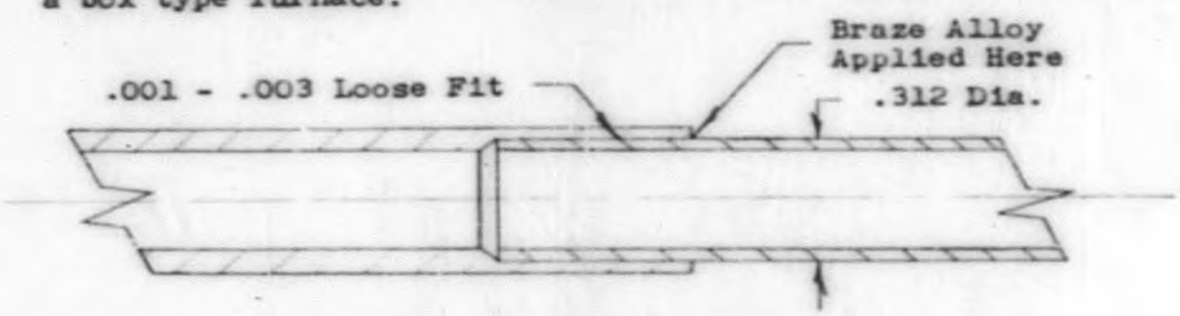
One assembly is currently being completely induction brazed using PMC 2252. Details are of A.I.S.I. type 316 stainless steel and are brazed at approximately 2000° F. using a copper braze alloy. All details are dry hydrogen fired in a humpback furnace prior to assembly. Braze alloy is applied in wire form and the assemblies mounted in induction units. Copper flashing of some details is utilized to promote wetting. Covers are clamped in position using "O" ring seals and the chamber is then purged with PMC 2252 until desired dew point is reached, at which time the induction heating cycle commences. The chamber capacities are approximately two to three cubic feet and purged at a rate of slightly over 400 C.F.H.

Conclusion:

It would appear that an argon - 2 1/2% hydrogen atmosphere would be more desirable than a completely inert gas atmosphere in applications where the hazards of pure hydrogen prohibited its use. This would especially apply to induction work where heating cycles are short. The gas flow rate with retort applications would be extremely high in order to obtain any appreciable cleaning action and would therefore be very uneconomical. The reducing action of hydrogen as a cleaner should not be underestimated, but results of nearly equal quality can be attained with inert gases if a proper precleaning schedule is adhered to.

Procedure:

Braze specimens were dry hydrogen fired. Specimens (a tubing lap joint) were assembled and braze alloy applied. They were then brazed in a horizontal position using a retort in a box type furnace.



Braze Specimen - AISI 316 S.S.

Specimens were sent to Metallurgy for sectioning and examination.

Results:

316 stainless steel assemblies induction brazed in the argon - 2 1/2% hydrogen atmosphere came out clean and bright in joint areas, however, other areas of greater mass and where heat conduction was high, were tarnished a dull blue-gray color. Visually, fillets were good although small and flow appeared to be excellent. Results of specimens brazed in conventional atmospheres are shown in the accompanying table.

Written by S. L. Rogers

Approved by C. N. Peterson

Approved by J. S. Nimmons

SLR/bfb

TABLE I

RESULTS OF SECTIONED BRAZE JOINTS

Spec. No.	Braze Alloy	Atmos.	Temp. ° F.	Coverage %	Diffusion Mils	Max. Dilution Mils	Remarks
1	CM 52	H_2	1910	100	1-2	2	Heavy skulling - Butt Fillet Good - Overlap Fillet Fair.
2	CM 52	H_2	1910	100	1	3	Skulling - Fillets Poor.
3	CM 52	Argon	1910	98	1-2	3	Skulling - Fillets Poor.
4	CM 52	Argon	1910	99	1-2	1/2	Skulling - Fillets Poor.
5	CM 52	HE	1910	90	1-2	2	Moderate to Heavy Skulling Fillets Fair to Poor.
6	CM 52	HE	1910	85	1-2 1/2	1/2	Same as #5.
7	CM 50	H_2	2050	100	1-2	---	Fair to Good Fillets - Good Flow.
8	CM 50	H_2	2050	90	1-2	---	Good Flow - Insufficient Mat'l.to Form Fillets.
9	CM 50	Argon	2050	85	2-2 1/2	---	Fillets Fair to Poor.
10	CM 50	Argon	2050	98	2	---	Fillets Fair to Poor.
11	CM 50	HE	2050	100	1-2	---	2 X 8 Mil Void in Braze Fillets Poor.
12	CM 50	HE	2050	85	1 1/2-2	1/2	Fillets Poor.
13	Au-Ni1	H_2	1815	100	1/2-2	1-1/2	Excellent Fillets
14	Au-Ni1	H_2	1815	100	1	---	Excellent Fillets
15	Au-Ni1	Argon	1815	85	1-2	---	Good Fillets Except for Insufficient Mat'l.
16	Au-Ni1	Argon	1815	97	1-2	---	Fair to Good Fillets
17	Au-Ni1	HE	1815	100	1/2-1	---	Excellent Fillets
18	Au-Ni1	HE	1815	70	1	---	Fillets Good to Excellent 3 Mil Joint Gap.

END