HIGH STRENGTH, DUCTILE WIDE GAP BRAZE JOINTS FOR STATIONARY TURBINE COMPONENT REPAIRS

by

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ABSTRACT

Wide cracks in land-based Ni- or Co-base superalloy turbine components are difficult to repair successfully using conventional welding or brazing techniques. This project examined the feasibility of liquid phase diffusion brazing using novel Ni- and Co-base braze alloys containing Hf or Zr as melt point depressant for the repair of wide cracks in turbine components. An optimized braze cycle was developed and the joints were evaluated using various metallographic techniques and mechanical tests (elevated temperature tensile tests, creep rupture tests and low cycle fatigue tests). Microstructural examination revealed the presence of Hf- or Zr-rich intermetallic phases (most likely Ni₇Hf₂ or Ni₅Zr) in Ni-base braze joints. These intermetallic compounds were, however, observed to be significantly softer than the boride phases routinely found in commercially available braze alloys with boron as melt point depressant. As a result, the novel wide gap brazed joints displayed excellent mechanical properties (ranging from 80% to 100% of the base metal’s properties). The low cycle fatigue properties of wide gap braze joints performed using a combination of MarM247 superalloy powder and Ni-Cr-Hf or Ni-Cr-Zr braze filler metals were found to be superior to those of the widely used Ni-Cr-B braze filler metals. Wide gap braze repair of FSX-414 Co-base superalloy using novel MarM509/MarM509B and MarM509/Co-Hf braze alloys resulted in high temperature tensile properties equivalent to those of weld repairs in the same parent material (using Nozzalloy filler metal). The creep rupture and low cycle fatigue (LCF) properties of the braze joints were superior to those of welds performed using MarM918 filler metal.
TABLE OF CONTENTS

CHAPTER 1 – LITERATURE SURVEY
THE APPLICATION OF BRAZING, WIDE GAP BRAZING AND LIQUID PHASE SINTERING IN THE REPAIR OF NICKEL-BASE SUPERALLOY COMPONENTS FOR GAS TURBINE ENGINES

1.1 Introduction p. 1
1.2 The brazing of superalloys and the influence of brazing parameters on joint quality p. 3
1.3 Characterization of the eutectic phases that form in brazed joints p. 14
1.4 Repair of turbine components using brazing p. 20
1.5 Wide gap diffusion brazing p. 23
1.6 Sintering of Ni-base superalloys using braze filler metals p. 32

CHAPTER 2 – OBJECTIVES
LIQUID PHASE DIFFUSION BONDING OF NICKEL-BASE SUPERALLOY COMPONENTS USING NOVEL BRAZE FILLER METALS

2.1 Background p. 37
2.2 Objectives p. 37

CHAPTER 3 – EXPERIMENT 1
MICROSTRUCTURAL EXAMINATION OF NOVEL BINARY EUTECTIC Ni-Hf AND Ni-Zr BRAZE ALLOYS

3.1 Introduction p. 39
3.2 Experimental procedure p. 40
3.3 Results and discussion p. 41
   3.3.1 Optimization of the braze temperature p. 41
   3.3.2 Microstructures of the Ni-Hf and Ni-Zr joints after brazing at 1230°C for 40 minutes p. 42
   3.3.3 Microstructures of the Ni-Hf and Ni-Zr joints after brazing at 1230°C for 18 hours p. 46
3.4 Conclusions p. 53

CHAPTER 4 – EXPERIMENT 2
CHARACTERIZATION OF THE MICROSTRUCTURE AND MECHANICAL PROPERTIES OF LIQUID PHASE DIFFUSION BONDS USING EUTECTIC Ni-Hf AND Ni-Zr BRAZE ALLOYS AFTER SHORT PROCESSING TIMES (40 MINUTES)

4.1 Introduction p. 54
4.2 Experimental procedure p. 54
4.3 Results and discussion p. 55
   4.3.1 Microstructural investigation p. 55
   4.3.2 Tensile test results p. 63
4.4 Conclusions p. 66

CHAPTER 5 - EXPERIMENT 3
CHARACTERIZATION OF THE MICROSTRUCTURE AND MECHANICAL PROPERTIES OF LIQUID PHASE DIFFUSION BONDS USING EUTECTIC Ni-Hf AND Ni-Zr BRAZE ALLOYS AFTER LONGER PROCESSING TIMES (4 HOURS)
CHAPTER 6 - EXPERIMENT 4
CHARACTERIZATION OF THE MICROSTRUCTURE AND MECHANICAL PROPERTIES
OF LIQUID PHASE DIFFUSION BONDS USING EUTECTIC Ni-Hf AND Ni-Zr BRAZE
ALLOYS AFTER EXTENDED BRAZING TIMES (12 HOURS)

6.1 Introduction p. 79
6.2 Experimental procedure p. 79
6.3 Results and discussion p. 80
   6.3.1 Microstructural investigation p. 80
   6.3.2 Creep rupture test results p. 88
6.4 Conclusions p. 93

CHAPTER 7 - EXPERIMENT 5
CHARACTERIZATION OF THE MICROSTRUCTURE AND MECHANICAL PROPERTIES
OF LIQUID PHASE DIFFUSION BONDS USING EUTECTIC Ni-Hf AND Ni-Zr BRAZE
ALLOYS AFTER BRAZING FOR 12 HOURS, FOLLOWED BY SOLUTION ANNEALING
AND HOT ISOSTATIC PRESSING

7.1 Introduction p. 95
7.2 Experimental procedure p. 95
7.3 Results and discussion p. 96
   7.3.1 Microstructural investigation p. 96
   7.3.2 Tensile test results p. 100
   7.3.3 Creep rupture test properties p. 106
7.4 Conclusions p. 107

CHAPTER 8 - EXPERIMENT 6
CHARACTERIZATION OF THE LOW CYCLE FATIGUE PROPERTIES OF LIQUID
PHASE DIFFUSION BONDS USING EUTECTIC Ni-Hf AND Ni-Zr BRAZE ALLOYS
AFTER BRAZING FOR 24 HOURS, FOLLOWED BY SOLUTION ANNEALING, HOT
ISOSTATIC PRESSING AT 1200°C AND A FULL AGING TREATMENT

8.1 Introduction p. 109
8.2 Experimental procedure p. 109
8.3 LCF test results p. 111
8.4 Conclusions p. 112

CHAPTER 9 - EXPERIMENT 7
CHARACTERIZATION OF THE MECHANICAL PROPERTIES OF LIQUID PHASE
DIFFUSION BONDS PRODUCED BY MIXING A SOLID SOLUTION-STRENGTHENED
NICKEL-BASE SUPERALLOY POWDER WITH THE EUTECTIC Ni-Hf AND Ni-Zr
BRAZE ALLOYS

9.1 Introduction p. 114
9.2 Experimental procedure p. 114
9.3 Results and discussion p. 115
   9.3.1 Tensile test results p. 115
   9.3.2 Creep rupture test results p. 119
9.4 Conclusions p. 120
CHAPTER 10 - EXPERIMENT 8
CHARACTERIZATION OF THE MICROSTRUCTURE AND PROPERTIES OF HYPO-EUTECTIC Ni-Cr-Hf AND Ni-Cr-Hf-B ALLOYS

10.1 Introduction p. 122
10.2 Experimental procedure p. 122
10.3 Results and discussion p. 123
   10.3.1 Ternary Ni-Cr-Hf alloys p. 123
   10.3.2 Quaternary Ni-Cr-Hf-B alloys p. 125
   10.3.3 Microhardness measurements p. 125
10.4 Conclusions p. 126

CHAPTER 11 - EXPERIMENT 9
MICROPROBE ANALYSIS OF INTERMETALLIC PHASES

11.1 Introduction p. 128
11.2 Experimental procedure p. 128
11.3 Results and discussion p. 128
   11.3.1 The MarM247/Ni-Hf braze joint produced using Ni-7Cr-31Hf braze filler (as-brazed condition) p. 128
   11.3.2 The MarM247/Ni-Zr braze joint produced using Ni-7Cr-13Zr braze filler (as-brazed condition) p. 136
   11.3.3 The MarM247/Ni-Zr braze joint produced using Ni-7Cr-13Zr braze filler (after an extended diffusion cycle) p. 143
   11.3.4 Repeat: The MarM247/Ni-Zr braze joint produced using Ni-7Cr-13Zr braze filler (after an extended diffusion cycle) p. 152
11.4 Conclusions p. 155

CHAPTER 12 - EXPERIMENT 10
DEVELOPMENT OF COMPLEX Ni-Cr-Hf BRAZE ALLOYS

12.1 Introduction p. 157
12.2 Experimental procedure p. 157
12.3 Results and discussion p. 157
   12.3.1 Alloy PV9020 (Ni-8.5Cr-25Hf) p. 157
   12.3.2 Alloy PV9023 (Ni-7.4Cr-4.7W-1.4Ti-2.3Al-0.03C-25.5Hf) p. 159
   12.3.3 Alloy PV9025 (Ni-8.4Cr-5.4W-1.6Ti-6.1Al-14.5Hf) p. 159
   12.3.4 Alloy PV9024 (Ni-8.3Cr-5.6Co-5.3W-4.3Al-14.2Hf) p. 162
   12.3.5 Alloy PV9026 (Ni-7.9Cr-5.4Co-5W-1.5Ti-4.1Al-0.04C-20.3Hf) p. 163
12.4 Conclusions p. 164

CHAPTER 13 - EXPERIMENT 11
CHARACTERIZATION OF THE MICROSTRUCTURE AND MECHANICAL PROPERTIES OF ADH BRAZE JOINTS IN FSX-414 COBALT-BASE SUPERALLOY NOZZLE SEGMENTS USING NOVEL BRAZE ALLOYS

13.1 Introduction p. 165
13.2 Experimental procedure p. 167
13.3 Results and discussion p. 170
   13.3.1 Mechanical test results p. 170
   13.3.2 Metallurgical examination p. 175
13.4 Conclusions p. 178
LIST OF FIGURES

Figure 1: The cuboidal and spheroidal structure of primary and secondary $\gamma'$ precipitates (10% oxalic acid etch, magnification: 10000X)

Figure 2: Intergranular and intragranular carbide phases (10% oxalic acid etch, magnification: 1000X)

Figure 3: Centreline cracking in a joint brazed with BNi-4 (with a composition of Ni-2B-3.5Si) [5]

Figure 4: Typical joint microstructures in four filler metals. A: BNi-2; B: BNi-3; C: BNi-4; and D: NK10. Magnification: 200X [5]

Figure 5: Variation in microstructure with decreasing gap width. Magnification: 200X [5]

Figure 6: Effect of holding time on the brazed joint microstructure. A: 10 minutes; B: 40 minutes; C: 160 minutes; and D: 640 minutes. Magnification: 200X [5]

Figure 7: Effect of brazing temperature on joint microstructure. A: 1100°C; B: 1150°C; C: 1200°C; and D: 1250°C. Magnification: A, B and C = 200X, and D = 100X [5]

Figure 8: Microstructure of brazed joints with a 0.05 mm gap. A: 1075°C for 10 minutes; B: 1175°C for 10 minutes; C: 1075°C for 30 minutes; and D: 1075°C for 90 minutes [6]

Figure 9: The effect of brazing time and brazing temperature on joint shear strength (brazing foil BNi-1) [7]

Figure 10: Effect of brazing time and brazing temperature on the joint shear strength (brazing foil BNi-2) [7]

Figure 11: Effect of brazing time and brazing temperature on the joint shear strength (brazing foil BNi-3) [7]

Figure 12: Influence of joint gap on (a) tensile strength, and (b) percentage elongation of copper brazed alloy steel joints [8]

Figure 13: Influence of gap width on the tensile strength (TS) and proof stress (PS) of copper brazed mild steel joints. MS1 and MS2 are the yield points of mild steel [8]

Figure 14: The influence of gap width on the fracture toughness, as characterized by $\delta_c$ (the crack tip opening displacement), for copper brazed mild steel joints [8]

Figure 15: Dependence of impact strength on joint clearance for Inconel 625 brazed with Au-6 (Ni-20.5Au-5.6Cr-2.3Fe-3.4Si-2.3B) filler metal [9]

Figure 16: Fatigue behavior of brazed joints (tested at room temperature, $R = 0.1$).
- brazing at 1190°C for 5 minutes, followed by aging at 710°C for 16 hours.
- brazing at 1190°C for 5 minutes and 1100°C for 10 hours, followed by aging at 710°C for 16 hours [10]

Figure 17: Hardness profiles across brazed joints in Inconel 625

Figure 18: Typical microstructure of a joint brazed with BNi-5 [11]

Figure 19: (a) Microstructure of a joint brazed with Nicrobraz 150 at 1125°C; and (b) a magnified view showing the details of the ternary eutectic component [11]

Figure 20: (a) The constituents and component phases in a joint brazed with BNi-4; and (b) details of the ternary eutectic and nickel silicide precipitates in the joint centreline [11]

Figure 21: (a) Microstructure of a joint brazed with BNi-1 at 1125°C; and (b) a magnified view showing the details of the eutectic phases [11]

Figure 22: Brazed joint of BNi-2 with 4 phases present. Magnification: 200X (reduced 50% on reproduction) [12]

Figure 23: Brazed joint of BNi-4 with 3 phases present. Magnification: 200X (reduced 50% on reproduction) [12]

Figure 24: Brazed joint of BNi-4 with 2 phases present. Magnification: 200X (reduced 50% on reproduction) [12]
Figure 25: Brazed joint of BNi-4 with 1 phase present. Magnification: 200X (reduced 50% on reproduction) [12]

Figure 26: Boride particles in the steel parent metal (BNi-4 braze). Magnification: 500X (reduced 50% on reproduction) [12]

Figure 27: Boride particles in the steel parent metal (BNi-4 braze). Magnification: 2000X (reduced 50% on reproduction) [12]

Figure 28: Brazed joints in two nickel-base superalloys produced with BNi-3 filler metal at 1040°C for 3 hours [14]

Figure 29: Cracks in new and repaired vanes after engine testing [17]

Figure 30: Tensile properties (UTS: ultimate tensile strength, and 0.2% YS: 0.2% proof stress) of activated diffusion bonded butt joints in Rene 80, compared with those of the base metal [21]

Figure 31: Creep rupture properties of activated diffusion bonded joints in Rene 80, compared with those of the base metal and conventional brazed joints [21]

Figure 32: High cycle fatigue strengths of activated diffusion bonded butt joints in Rene 80 at 760°C [21]

Figure 33: In the ADH repair process, a superalloy is “cast” into the crack using a lower melting point bonding alloy [22]

Figure 34: Creep rupture curves for different width ADH joints in Rene 80 base metal [22]

Figure 35: Tensile strength data at 870°C (1600°F) for the parent metal and brazed joints in Rene 80 base metal. (‘Oxidised’ refers to a simulated engine run; ‘Strip’ refers to chemical stripping simulating the removal of the aluminide coating; and ‘FIC’ refers to fluoride ion cleaning) [22]

Figure 36: Creep rupture tests performed at 850°C (base material is In738 and the wide gap braze is a proprietary material referred to as Elniment 100) [25]

Figure 37: Elniment 10 wide gap braze, as-brazed without subsequent heat treatment. The borides have an oblong shape [25]

Figure 38: Elniment 10 wide gap braze, as-brazed with annealing heat treatment. The borides appear more rounded [25]

Figure 39: Percentage porosity as a function of braze alloy content [26]

Figure 40: SEM micrographs of a brazed joint produced from a mixture containing 40 wt.% Microbraz 150: (a) blocky boride phase (magnification: approximately 270X), and (b) Ni-Ni3B eutectic (N). The arrow highlights the blocky boride phase precipitated within the metal powder particles (magnification: approximately 1800X) [26]

Figure 41: SEM micrographs of a brazed joint produced from a mixture containing 40 wt.% DF4B: (a) blocky boride phase (magnification: approximately 350X), and (b) darker γ’ phase. The arrow highlights the blocky boride phase precipitated within the metal powder particles (magnification: approximately 1750X) [26]

Figure 42: SEM micrographs of a brazed joint produced from a mixture containing 40 wt.% BRB: (a) blocky boride phase (magnification: approximately 225X), and (b) darker γ’ phase. The arrow highlights the blocky boride phase precipitated within the metal powder particles (magnification: approximately 1325X) [26]

Figure 43: Braze joint of 1.25 mm clearance using sinter filler metal S1 and braze filler metal B1 (as shown in Table 7) [28]

Figure 44: Tensile strength as a function of temperature for the base metal, and for sintered and brazed joints with 0.5 mm clearance [27]

Figure 45: Room temperature tensile strength as a function of joint clearance for sintered and brazed joints and for the joints containing no sinter powder [27]
Figure 47: Larson Miller plot for wide gap joints produced by the Liburdi solid state sintering process [28]
Figure 48: Liquid phase diffusion sintering: general description of diffusion solidification [29]
Figure 49: Binary Ni-Hf phase diagram [2]
Figure 50: Binary Ni-Zr phase diagram [2]
Figure 51: Optical micrograph of a Ni-Hf brazed joint in In738 parent metal after brazing at 1230°C for 40 minutes. Magnification: 50X
Figure 52: Optical micrograph of a Ni-Hf brazed joint in In738 parent metal after brazing at 1230°C for 40 minutes. Magnification: 100X
Figure 53: Optical micrograph of a Ni-Hf brazed joint in In738 parent metal after brazing at 1230°C for 40 minutes. Magnification: 200X
Figure 54: Optical micrograph of a Ni-Zr brazed joint in In738 parent metal after brazing at 1230°C for 40 minutes. Magnification: 50X
Figure 55: Optical micrograph of a Ni-Zr brazed joint in In738 parent metal after brazing at 1230°C for 40 minutes. Magnification: 100X
Figure 56: Optical micrograph of a Ni-Zr brazed joint in In738 parent metal after brazing at 1230°C for 40 minutes. Magnification: 200X
Figure 57: Optical micrograph of a Ni-Zr brazed joint in In738 parent metal after brazing at 1230°C for 40 minutes. Magnification: 500X
Figure 58: Optical micrograph of a Ni-Hf brazed joint in In738 parent metal after brazing at 1230°C for 18 hours. Magnification: 50X
Figure 59: Optical micrograph of a Ni-Hf brazed joint in In738 parent metal after brazing at 1230°C for 18 hours. Magnification: 100X
Figure 60: Optical micrograph of a Ni-Hf brazed joint in In738 parent metal after brazing at 1230°C for 18 hours. Magnification: 200X
Figure 61: Optical micrograph of a Ni-Hf brazed joint in In738 parent metal after brazing at 1230°C for 18 hours. Magnification: 500X
Figure 62: Optical micrograph of a Ni-Zr brazed joint in In738 parent metal after brazing at 1230°C for 18 hours. Magnification: 50X
Figure 63: Optical micrograph of a Ni-Zr brazed joint in In738 parent metal after brazing at 1230°C for 18 hours. Magnification: 100X
Figure 64: Optical micrograph of a Ni-Zr brazed joint in In738 parent metal after brazing at 1230°C for 18 hours. Magnification: 200X
Figure 65: Optical micrograph of a Ni-Zr brazed joint in In738 parent metal after brazing at 1230°C for 18 hours. Magnification: 500X
Figure 66: Optical micrograph of a Ni-Zr brazed joint in In738 parent metal after brazing at 1230°C for 18 hours. Magnification: 500X
Figure 67: SEM micrograph of the Ni-Hf braze, showing the phases identified as γ (labelled “grain boundary particle”) and Ni₅Hf₂ (labelled “grain boundary film”)
Figure 68: SEM micrograph of the Ni-Zr braze, showing the phases identified as γ (labelled “grain boundary particle”) and Ni₅Zr (labelled “grain boundary film”)
Figure 69: Configuration of tensile and creep rupture specimens: Dₜ = 4.6 mm; Lₜ = 18.3 mm; Lₕ = 21.8 mm; Lₛ = 46.5 mm; Rₜ = 3.2 mm; L₀ = 9.5 mm; and Dᵣ = 8 mm
Figure 70: Ni-Hf braze dispersed between MarM247 powder particles after brazing at 1230°C for 40 minutes. Magnification: 50X
Figure 71: Ni-Hf braze dispersed between MarM247 powder particles after brazing at 1230°C for 40 minutes. Magnification: 100X
Figure 72: Ni-Hf braze dispersed between MarM247 powder particles after brazing at 1230°C for 40 minutes. Magnification: 200X
Figure 73: Ni-Hf braze dispersed between MarM247 powder particles after brazing at 1230°C for 40 minutes. Magnification: 200X
Figure 74: Ni-Hf braze dispersed between MarM247 powder particles after brazing at 1230°C for 40 minutes. Magnification: 500X
Figure 75: Ni-Hf braze dispersed between MarM247 powder particles after brazing at 1230°C for 40 minutes. Magnification: 50X
Figure 76: Ni-Zr braze dispersed between MarM247 powder particles after brazing at 1230°C for 40 minutes. Magnification: 100X
Figure 77: Ni-Zr braze dispersed between MarM247 powder particles after brazing at 1230°C for 40 minutes. Magnification: 200X
Figure 78: Ni-Zr braze dispersed between MarM247 powder particles after brazing at 1230°C for 40 minutes. Magnification: 500X
Figure 79: Ni-Zr braze dispersed between MarM247 powder particles after brazing at 1230°C for 40 minutes. Magnification: 500X
Figure 80: SEM micrograph of the Ni-Hf braze, showing the phases identified as $\gamma$ (labelled “grain boundary particle”) and Ni$_7$Hf$_2$ (labelled “grain boundary film”)
Figure 81: SEM micrograph of the Ni-Zr braze, showing the phases identified as $\gamma$ (labelled “grain boundary particle”) and Ni$_5$Zr (labelled “grain boundary film”)
Figure 82: The tensile strength (UTS) and yield strength (YS) of the Ni-Hf and Ni-Zr braze joints and the MarM247 parent metal as a function of the test temperature (each data point shown represents the average of three tests)
Figure 83: The ductility of the Ni-Hf and Ni-Zr braze joints and the MarM247 parent metal expressed as % elongation and % reduction in area (RA) as a function of the test temperature (each data point shown represents the average of three tests)
Figure 84: Ni-Hf braze dispersed between MarM247 powder particles after brazing at 1230°C for 4 hours. Magnification: 50X
Figure 85: Ni-Hf braze dispersed between MarM247 powder particles after brazing at 1230°C for 4 hours. Magnification: 100X
Figure 86: Ni-Hf braze dispersed between MarM247 powder particles after brazing at 1230°C for 4 hours. Magnification: 200X
Figure 87: Ni-Hf braze dispersed between MarM247 powder particles after brazing at 1230°C for 4 hours. Magnification: 500X
Figure 88: Ni-Hf braze dispersed between MarM247 powder particles after brazing at 1230°C for 4 hours. Magnification: 50X
Figure 89: Ni-Zr braze dispersed between MarM247 powder particles after brazing at 1230°C for 4 hours. Magnification: 100X
Figure 90: Ni-Zr braze dispersed between MarM247 powder particles after brazing at 1230°C for 4 hours. Magnification: 200X
Figure 91: Ni-Zr braze dispersed between MarM247 powder particles after brazing at 1230°C for 4 hours. Magnification: 500X
Figure 92: Ni-Zr braze dispersed between MarM247 powder particles after brazing at 1230°C for 4 hours. Magnification: 500X
Figure 93: SEM micrograph of the Ni-Hf braze, showing the phases identified as $\gamma$ (labelled “grain boundary particle”) and Ni$_7$Hf$_2$ (labelled “grain boundary film”)
Figure 94: SEM micrograph of the Ni-Zr braze, showing the phases identified as $\gamma$ (labelled “grain boundary particle”) and Ni$_5$Zr (labelled “grain boundary film”)
Figure 96: The tensile strength (UTS) of the Ni-Hf and Ni-Zr braze joints and the MarM247 parent metal as a function of the test temperature and braze time (each data point shown represents the average of three tests)

Figure 97: The yield stress of the Ni-Hf and Ni-Zr braze joints and the MarM247 parent metal as a function of the test temperature and braze time (each data point shown represents the average of three tests)

Figure 98: The % elongation measured for the Ni-Hf and Ni-Zr braze joints and the MarM247 parent metal as a function of the test temperature and braze time (each data point shown represents the average of three tests)

Figure 99: The % reduction in area measured for the Ni-Hf and Ni-Zr braze joints and the MarM247 parent metal as a function of the test temperature and braze time (each data point shown represents the average of three tests)

Figure 100: Ni-Hf braze dispersed between MarM247 powder particles after brazing at 1230°C for 12 hours, followed by solution heat treatment at 1230°C for 4 hours and quenching. Magnification: 50X

Figure 101: Ni-Hf braze dispersed between MarM247 powder particles after brazing at 1230°C for 12 hours, followed by solution heat treatment at 1230°C for 4 hours and quenching. Magnification: 100X

Figure 102: Ni-Hf braze dispersed between MarM247 powder particles after brazing at 1230°C for 12 hours, followed by solution heat treatment at 1230°C for 4 hours and quenching. Magnification: 200X

Figure 103: Ni-Hf braze dispersed between MarM247 powder particles after brazing at 1230°C for 12 hours, followed by solution heat treatment at 1230°C for 4 hours and quenching. Magnification: 500X

Figure 104: Ni-Zr braze dispersed between MarM247 powder particles after brazing at 1230°C for 12 hours, followed by solution heat treatment at 1230°C for 4 hours and quenching. Magnification: 50X

Figure 105: Ni-Zr braze dispersed between MarM247 powder particles after brazing at 1230°C for 12 hours, followed by solution heat treatment at 1230°C for 4 hours and quenching. Magnification: 100X

Figure 106: Ni-Zr braze dispersed between MarM247 powder particles after brazing at 1230°C for 12 hours, followed by solution heat treatment at 1230°C for 4 hours and quenching. Magnification: 200X

Figure 107: Ni-Zr braze dispersed between MarM247 powder particles after brazing at 1230°C for 12 hours, followed by solution heat treatment at 1230°C for 4 hours and quenching. Magnification: 500X

Figure 108: SEM micrograph of the Ni-Hf braze, showing the phases identified as γ and Ni$_7$Hf$_2$

Figure 109: SEM micrograph of the Ni-Hf braze, showing islands of intergranular Ni$_7$Hf$_2$ intermetallic compound

Figure 110: SEM micrograph of the Ni-Zr braze, showing the phases identified as γ and Ni$_5$Zr

Figure 111: SEM micrograph of the Ni-Zr braze, showing islands of intergranular Ni$_5$Zr intermetallic compound

Figure 112: Larson-Miller plot at 845°C for creep rupture tests performed at three applied stress levels: 345 MPa (50 ksi), 276 MPa (45 ksi) and 228 MPa (33 ksi) (where: $T$ is temperature (°F) and $t$ is time (hours))

Figure 113: Larson-Miller plot at 900°C for creep rupture tests performed at three applied stress levels: 242 MPa (35 ksi), 186 MPa (27 ksi) and 152 MPa (22 ksi) (where: $T$ is temperature (°F) and $t$ is time (hours))
Figure 114: Larson-Miller plot at 980°C for creep rupture tests performed at three applied stress levels: 138 MPa (20 ksi), 104 MPa (15 ksi) and 76 MPa (11 ksi) (where: $T$ is temperature (°F) and $t$ is time (hours))

Figure 115: Larson-Miller plot for the In738 base metal, the MarM247/Ni-Zr joint and the MarM247/Ni-Hf braze joints in the solution annealed condition

Figure 116: Ni-Hf braze dispersed between MarM247 powder particles after brazing at 1230°C for 12 hours, followed by solution heat treatment at 1230°C for 4 hours and a HIP cycle at 1080°C for 4 hours. Magnification: 50X

Figure 117: Ni-Hf braze dispersed between MarM247 powder particles after brazing at 1230°C for 12 hours, followed by solution heat treatment at 1230°C for 4 hours and a HIP cycle at 1080°C for 4 hours. Magnification: 100X

Figure 118: Ni-Hf braze dispersed between MarM247 powder particles after brazing at 1230°C for 12 hours, followed by solution heat treatment at 1230°C for 4 hours and a HIP cycle at 1080°C for 4 hours. Magnification: 200X

Figure 119: Ni-Hf braze dispersed between MarM247 powder particles after brazing at 1230°C for 12 hours, followed by solution heat treatment at 1230°C for 4 hours and a HIP cycle at 1080°C for 4 hours. Magnification: 500X

Figure 120: Ni-Zr braze dispersed between MarM247 powder particles after brazing at 1230°C for 12 hours, followed by solution heat treatment at 1230°C for 4 hours and a HIP cycle at 1080°C for 4 hours. Magnification: 50X

Figure 121: Ni-Zr braze dispersed between MarM247 powder particles after brazing at 1230°C for 12 hours, followed by solution heat treatment at 1230°C for 4 hours and a HIP cycle at 1080°C for 4 hours. Magnification: 100X

Figure 122: Ni-Zr braze dispersed between MarM247 powder particles after brazing at 1230°C for 12 hours, followed by solution heat treatment at 1230°C for 4 hours and a HIP cycle at 1080°C for 4 hours. Magnification: 200X

Figure 123: Ni-Zr braze dispersed between MarM247 powder particles after brazing at 1230°C for 12 hours, followed by solution heat treatment at 1230°C for 4 hours and a HIP cycle at 1080°C for 4 hours. Magnification: 500X

Figure 124: SEM micrograph of the Ni-Hf braze, showing the intergranular Ni$_4$Hf$_2$ intermetallic phase and $\gamma'$ precipitates within the MarM247 particles

Figure 125: Higher magnification SEM micrograph of the Ni-Hf braze, showing cuboidal $\gamma'$ precipitates within the MarM247 powder particles

Figure 126: SEM micrograph of the Ni-Zr braze, showing intergranular Ni$_5$Zr intermetallic compound

Figure 127: The tensile strength of the MarM247 base metal, and the MarM247/Ni-Hf and MarM247/Ni-Zr braze joints after brazing for 40 minutes and 4 hours at 1230°C, and after brazing for 12 hours at 1230°C, followed by solution heat treatment and a HIP cycle

Figure 128: The yield stress of the MarM247 base metal, and the MarM247/Ni-Hf and MarM247/Ni-Zr braze joints after brazing for 40 minutes and 4 hours at 1230°C, and after brazing for 12 hours at 1230°C, followed by solution heat treatment and a HIP cycle

Figure 129: The percentage elongation of the MarM247 base metal, and the MarM247/Ni-Hf and MarM247/Ni-Zr braze joints after brazing for 40 minutes and 4 hours at 1230°C, and after brazing for 12 hours at 1230°C, followed by solution heat treatment and a HIP cycle

Figure 130: The percentage reduction in area of the MarM247 base metal, and the MarM247/Ni-Hf and MarM247/Ni-Zr braze joints after brazing for 40 minutes and 4 hours at 1230°C, and after brazing for 12 hours at 1230°C, followed by solution heat treatment and a HIP cycle

Figure 131: Larson-Miller plot for the In738 base metal and the MarM247/Ni-Hf and MarM247/Ni-Zr joints after brazing for 12 hours at 1230°C, followed by solution heat treatment (SHT) and a HIP cycle

Figure 132: In738 plate with a 1.5 mm wide groove machined in the center
Figure 133: Enlarged view of the 1.5 mm wide groove machined in the centre of the In738 plate samples

Figure 134: LCF specimen with the braze joint in the centre of the gauge length

Figure 135: Low cycle fatigue properties of the In738 base metal, the In738/BRB braze joint, and the MarM247/Ni-Zr and MarM247/Ni-Hf braze joints

Figure 136: Tensile strength of Haynes 230, In738, MarM247, the MarM247/Ni-Zr braze joint and the Haynes 230/Ni-Zr braze joint as a function of test temperature

Figure 137: Yield stress of Haynes 230, In738, MarM247, the MarM247/Ni-Zr braze joint and the Haynes 230/Ni-Zr braze joint as a function of test temperature

Figure 138: Percentage elongation of In738, MarM247, the MarM247/Ni-Zr braze joint and the Haynes 230/Ni-Zr braze joint as a function of test temperature

Figure 139: Creep rupture properties of In738, Haynes 230, the MarM247/Ni-Zr braze joint and the Haynes 230/Ni-Zr braze joint

Figure 140: BSE image of the Ni-13Cr-15 Hf alloy showing primary γ dendrites, and a fine eutectic component consisting of γ phase and the Ni$_7$Hf$_2$ intermetallic compound

Figure 141: BSE image of the Ni-13Cr-20 Hf alloy showing primary γ dendrites, and a fine eutectic component consisting of γ phase and the Ni$_7$Hf$_2$ intermetallic compound

Figure 142: BSE image of the Ni-13Cr-25 Hf alloy showing primary Ni$_7$Hf$_2$, and a fine eutectic component consisting of γ phase and the Ni$_7$Hf$_2$ intermetallic compound

Figure 143: BSE image of the Ni-13Cr-25 Hf-1B alloy showing the Ni$_7$Hf$_2$ phase (white), Ni-rich γ (dark gray), chromium borides (black) and a possible ternary eutectic component consisting of γ phase, Cr boride, and the Ni$_7$Hf$_2$ intermetallic compound

Figure 144: Secondary (a) and backscatter (b) electron images of the MarM247/Ni-7Cr-31Hf joint in the as-brazed condition

Figure 145: (a) Secondary electron image of the Ni-Cr-Hf alloy in the as-brazed condition
(b) Enlarged view of the secondary electron image of the Ni-Cr-Hf braze shown in Figure 145(a), highlighting the location of three spot chemical analyses of the intermetallic compound within the braze

Figure 146: EMPA maps displaying the distribution of Al, C, Ni and Cr within the MarM247/Ni-Cr-Hf braze microstructure (as-brazed condition)

Figure 147: EMPA maps displaying the distribution of Zr, Hf and Si within the MarM247/Ni-Cr-Hf braze microstructure (as-brazed condition)

Figure 148: EMPA maps displaying the distribution of Ru, Ta, Ti and W within the MarM247/Ni-Cr-Hf braze microstructure (as-brazed condition)

Figure 149: EMPA maps displaying the distribution of Fe and Mo within the MarM247/Ni-Cr-Hf braze microstructure (as-brazed condition)

Figure 150: Secondary (a) and backscatter (b) electron images of the MarM247/Ni-7Cr-13Zr joint in the as-brazed condition (adjacent to the interface)

Figure 151: (a) Secondary electron image of the Ni-Cr-Zr alloy in the as-brazed condition
(b) Enlarged view of the secondary electron image of the Ni-Cr-Zr braze, shown in Figure 151(a), highlighting the location of four spot chemical analyses of the intermetallic compound within the braze

Figure 152: EMPA maps displaying the distribution of Al, C, Ni and Cr within the MarM247/Ni-Cr-Zr braze microstructure (as-brazed condition)

Figure 153: EMPA maps displaying the distribution of Zr and Hf within the MarM247/Ni-Cr-Zr braze microstructure (as-brazed condition)

Figure 154: EMPA maps displaying the distribution of Si, Ta, Ti and W within the MarM247/Ni-Cr-Zr braze microstructure (as-brazed condition)

Figure 155: EMPA maps displaying the distribution of Fe and Mo within the MarM247/Ni-Cr-Zr braze microstructure (as-brazed condition)
Figure 156: Secondary (a) and backscatter (b) electron images of the MarM247/Ni-7Cr-13Zr joint after an extended diffusion cycle (adjacent to the interface)

Figure 157: Secondary electron image of the Ni-Cr-Zr alloy (after an extended brazing cycle). Enlarged view of the secondary electron image of the Ni-Cr-Zr braze, shown in Figure 157(a), highlighting the location of four spot chemical analyses of the intermetallic compound within the braze

Figure 158: EMPA maps displaying the distribution of Al, C, Ni and Cr within the MarM247/Ni-Cr-Zr braze microstructure (after an extended diffusion cycle)

Figure 159: EMPA maps displaying the distribution of Zr and Hf within the MarM247/Ni-Cr-Zr braze microstructure (after an extended diffusion cycle)

Figure 160: EMPA maps displaying the distribution of Si, Ta, Ti and W within the MarM247/Ni-Cr-Zr braze microstructure (after an extended brazing cycle)

Figure 161: EMPA maps displaying the distribution of Fe and Mo within the MarM247/Ni-Cr-Zr braze microstructure (as-brazed condition)

Figure 162: Secondary (a) and backscatter (b) electron images of the MarM247/Ni-7Cr-13Zr joint after an extended diffusion cycle (adjacent to the interface)

Figure 163: Backscatter electron microprobe images of the Ni-8.5Cr-25Hf alloy in the as-cast condition (PV9020)

Figure 164: Backscatter electron microprobe images of the Ni-7.4Cr-4.7W-1.4Ti-2.3Al-0.03C-25.5Hf alloy in the as-cast condition (PV9023). (All compositions given as atomic %)

Figure 165: Backscatter electron microprobe images of the Ni-8.4Cr-5.4W-1.6Ti-6.1Al-14.5Hf alloy in the as-cast condition (PV9025). (All compositions given as atomic %)

Figure 166: Backscatter electron microprobe images of the Ni-8.3Cr-5.6Co-5.3W-4.3Al-14.2Hf alloy in the as-cast condition (PV9024). (All compositions given as atomic %)

Figure 167: Backscatter electron microprobe images of the Ni-7.9Cr-5.4Co-5W-1.5Ti-4.1Al-0.04C-20.3Hf alloy in the as-cast condition (PV9026). (All compositions given as atomic %)

Figure 168: Schematic illustration of the first stage nozzle segment of a Frame7FA+e IGT engine

Figure 169: An example of craze-cracks and large individual thermal fatigue cracks on the outer sidewall of a first stage nozzle segment

Figure 170: The binary Co-Hf phase diagram [2]

Figure 171: The FSX-414 test plate with a 1.5 mm wide groove machined in the centre

Figure 172: Enlarged view of the machined groove in the braze test plate

Figure 173: Photographs of: (a) the MarM509/Co-Hf ADH test plate in the as-brazed condition; and (b) the MarM509/MarM509B ADH test plate in the as-brazed condition

Figure 174: Mechanical test sample machined from the braze test plates. The 1.5 mm wide braze joint is located in the centre of the gauge length

Figure 175: Larson-Miller plot of FSX-414 base metal, the MarM509/MarM509B ADH braze joints, and the Nozzalloy weld

Figure 176: Graphical representation of the LCF data determined for FSX-414 base metal, FSX-414 welded with MarM918 or Nozzalloy filler metal, FSX-414 ADH brazed with MarM509/MarM509B, and FSX-414 ADH brazed with MarM509/Co-Hf

Figure 177: (a) Chromium oxides on the crack surface; and (b) oxide reduction on the sidewalls of the crack after H2 cleaning

Figure 178: Craze-cracks filled with the MarM509/MarM509B braze alloy

Figure 179: Individual crack filled with the MarM509/MarM509B braze alloy

Figure 180: (a) Braze flow in a 7.5 mm deep crack; and (b) braze flow in an 11 mm deep crack

Figure 181: Photomicrograph of the interface between the braze crack repair and the base metal

Figure 182: Microstructure of the fully diffused braze repair of craze-cracks on a nozzle segment

Figure 183: Microstructure of the fully diffused braze repair of craze-cracks on a nozzle segment
LIST OF TABLES

Table 1: Nominal chemical compositions (wt.%, balance Ni) of some Ni-base superalloys
Table 2: Influence of heat treatment on the tensile strength (1000°C) of reacting brazed joints
Table 3: Nominal compositions of powders and base metal (wt.%, balance Ni)
Table 4: Chemical compositions of phases in specimens containing 40 wt.% Nicrobraz 150 braze filler metal
Table 5: Chemical compositions of phases in specimens containing 40 wt.% DF4B braze filler metal
Table 6: Chemical compositions of phases in specimens containing 40 wt.% BRB braze filler metal
Table 7: Chemical compositions of the base metal and sinter powders (S1-S4) used in the Chasteen and Metzger investigation
Table 8: Nominal chemical composition of the In738 parent metal used during the course of this investigation (wt.%, balance nickel)
Table 9: Measured chemical compositions (wt.%) of the Ni-Hf and Ni-Zr braze alloys
Table 10: Nominal chemical composition of the MarM247 powder used in this investigation (wt.%, balance Ni)
Table 11: Joint tensile properties measured at 21°C
Table 12: Joint tensile properties measured at 540°C
Table 13: Joint tensile properties measured at 650°C
Table 14: Joint tensile properties measured at 760°C
Table 15: Joint tensile properties measured at 870°C
Table 16: Joint tensile properties measured at 980°C
Table 17: Creep rupture test conditions
Table 24: Creep rupture properties at 845°C of the In738 base metal, and LPDB joints produced with MarM247 superalloy powder and Ni-Hf or Ni-Zr braze alloy. The test samples were produced with a joint gap of 1.5 mm to simulate a worst-case crack repair scenario
Table 25: Creep rupture properties at 900°C of the In738 base metal, and LPDB joints produced with MarM247 superalloy powder and Ni-Hf or Ni-Zr braze alloy. The test samples were produced with a joint gap of 1.5 mm to simulate a worst-case crack repair scenario
Table 26: Creep rupture properties at 980°C of the In738 base metal, and LPDB joints produced with MarM247 superalloy powder and Ni-Hf or Ni-Zr braze alloy. The test samples were produced with a joint gap of 1.5 mm to simulate a worst-case crack repair scenario
Table 27: Joint tensile properties measured at 21°C
Table 28: Joint tensile properties measured at 540°C
Table 29: Joint tensile properties measured at 870°C
Table 30: Joint tensile properties measured at 980°C
Table 31: The influence of a HIP cycle on the creep rupture properties of the In738 base metal and the MarM247/Ni-Hf and MarM247/Ni-Zr joints (1.5 mm joint gap)
| Table 32: | Nominal chemical composition of the Haynes 230 powder used in this investigation (wt.%, balance Ni) |
| Table 33: | Creep rupture test conditions |
| Table 34: | Joint tensile properties measured at 21°C |
| Table 35: | Joint tensile properties measured at 95°C |
| Table 36: | Joint tensile properties measured at 315°C |
| Table 37: | Joint tensile properties measured at 540°C |
| Table 38: | Joint tensile properties measured at 650°C |
| Table 39: | Joint tensile properties measured at 870°C |
| Table 40: | Joint tensile properties measured at 980°C |
| Table 41: | Creep rupture properties of In738, Haynes 230 and the MarM247/Ni-Zr and Haynes 230/Ni-Zr joints (1.5 mm joint gap) |
| Table 42: | Chemical composition (wt.%) of the eutectic component observed in the ternary Ni-Cr-Hf alloys |
| Table 43: | Measured liquidus and solidus temperatures of the ternary Ni-Cr-Hf alloys |
| Table 44: | Measured microhardness values of various phases observed in the ternary and quaternary alloys |
| Table 45: | The chemical compositions of various phases within the ternary and quaternary alloys (all compositions given as wt.%) |
| Table 46: | The results of the EMPA scan of the MarM247/Ni-7Cr-31Hf braze joint in the as-brazed condition. (All compositions given in wt.%) |
| Table 47: | Quantitative EPMA data (taken at 15 keV and 80 nA with a focused spot beam) at three locations (indicated in Figure 145(b)) within the intermetallic phase. (Percentage by weight) |
| Table 48: | The results of the EMPA scan of the MarM247/Ni-7Cr-13Zr braze joint in the as-brazed condition. (All compositions given in wt.%) |
| Table 49: | Quantitative EPMA data (taken at 15 keV and 80 nA with a focused spot beam) at four locations within the intermetallic phase (indicated in Figure 151(b)). (Percentage by weight) |
| Table 50: | The results of the EMPA scan of the MarM247/Ni-7Cr-13Zr braze joint after an extended diffusion cycle. (All compositions given in wt.%) |
| Table 51: | Quantitative EPMA data (taken at 15 keV and 80 nA with a focused spot beam) at four locations within the intermetallic phase (indicated in Figure 157(b)). (Percentage by weight) |
| Table 52: | The results of the second EMPA scan of the MarM247/Ni-7Cr-13Zr braze joint after an extended diffusion cycle. (All compositions given in wt.%) |
| Table 53: | Chemical compositions (wt.%) of the novel “near-eutectic” alloys examined during the course of this investigation |
| Table 54: | EMPA results of the individual phases within the eutectic component observed in alloy PV9020 (wt.%) |
| Table 55: | Nominal chemical compositions of the alloys considered in this investigation (wt.%) |
| Table 56: | Tensile properties at 870°C of FSX-414 base metal, FSX-414 welded with Nozzalloy, FSX-414 brazed with MarM509/MarM509B, and FSX-414 brazed with MarM509/Co-Hf. The test samples were produced with a joint gap of 1.5 mm to simulate a worst-case crack repair scenario |
| Table 57: | Low cycle fatigue (LCF) data for FSX-414 base metal, FSX-414 welded with MarM918, FSX 414 welded with Nozzalloy, FSX-414 ADH brazed with MarM509/MarM509B, and FSX-414 ADH brazed with MarM509/Co-Hf |
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