

ACCURATE BRAZING

And Thermal Processing

CASE STUDY 1.04

2020 INDEPENDENT HIP STUDY

HIP Rejuvenation to Extend the Life of Siemens W501F, Row 2 Blades.

BY WARREN MIGLIETTI, PH.D., FALL 2020



FIGURE 1: Siemens W501F, row 2 blade that was repaired via HIP Rejuvenation

An engine set of blades were received that operated for 2 service intervals. The pressure side and suction side airfoil material endured a 20% and 28% reduction in stress rupture life, when tested at 1550°F/50ksi respectively, as observed in Table 2. The HIP Rejuvenated pressure side airfoil material, when tested at 1550°F/50ksi, showed a 1.75X –2.19X improvement in stress rupture life when compared to the virgin like, as-cast and heat treated material. Similarly, the HIP Rejuvenated suction side airfoil material showed a 1.29X –2.58X improvement in stress rupture life when compared to the virgin like, as-cast and heat treated material; and the root material showed a 1.5X –2.13X improvement in stress rupture life when compared to the virgin like, as-cast and heat treated material. The conclusions gained from the data in Table 2 was that the HIP Rejuvenated blade material had on average increase of 1.9X, which is close to twice the virgin like, as-cast and heat treated stress rupture life. The customer contemplated not only repairing these blades for an additional service interval, but also 2 service intervals.

TABLE 2: Comparison in Stress Rupture life between HIP Rejuvenated Airfoil and Root material from the W501F, row 2 blade compared to Engine Run/Service exposed Airfoil and Root material

Material Type and location specimen removed from blade	Stress in ksi	Temp in °F	Life in hours	Improvement / Reduction in Life	Elongation at failure %	Reduction in Area (RA) %
As received-engine run 2 hot gas path (HGP) service intervals. Pressure side specimen	50	1550	80.0	20% reduction in life	14.7	22.2
As received-engine run- 2 hot gas path (HGP) service intervals. Suction side specimen	50	1550	72	28% reduction in life	16.0	24.1
HIP Rejuvenated material Pressure Side specimen 1	50	1550	174.5	1.75X improvement	8.4	15.9
HIP Rejuvenated material Pressure Side specimen 2	50	1550	219.2	2.19X improvement	5.0	14.5
HIP Rejuvenated material Suction Side specimen 1	50	1550	128.6	1.29X improvement	6.7	13.2
HIP Rejuvenated material Suction Side specimen 2	50	1550	257.5	2.58X improvement	8.0	15.50
HIP Rejuvenated material Root specimen 1	50	1550	212.5	2.13X improvement	6.97	8.8
HIP Rejuvenated material Root specimen 2	50	1550	202.4	2.02X improvement	6.76	9.9
HIP Rejuvenated material Root specimen 3	50	1550	150.0	1.50X improvement	9.74	13.3
HIP Rejuvenated material Root specimen 4	50	1550	164.2	1.64X improvement	9.87	14.4
Virgin Like / Original Casting Material not exposed to engine operation. Baseline	50	1550	100	1.0	5.0	5.0

Now Introducing HIP'ing Services in our South Carolina Location

Accurate Brazing is a full-service vacuum brazing and heat treating enterprise with over 30 years in the business. Over that time, we've become adept at heat treating materials that include stainless steel, super alloys, copper, and refractory materials. Unlike competitors, Accurate Brazing has the unique expertise, capacity, and equipment to take new programs and get them into production quickly.

Due to an increasing need for perfect parts for demanding industries such as aerospace, medical, and casting, Accurate Brazing has recently invested Quintus in Hot Isostatic Pressing (HIP) Technology in our Nadcap certified facility in South Carolina. This will assist our customers with the need to get their components quicker and cheaper.



About the Author

Warren Miglietti, Ph.D. - President and Principal Metallurgical Consultant of Miglietti and Associates, LLC



Dr. Miglietti is currently the President and Principal Metallurgical Consultant of Miglietti and Associates, LLC, a consultancy company based in Kansas City, Missouri. Prior to this he was Director of Repair Technology at ProEnergy and worked for 7 years at PSM-An Alstom Company. In addition he worked for 5 years at GE's Repair Development Center and 5 years for Sermatech International as a process repair engineer and as a component repair engineer respectively. His principal responsibility was the development of novel repair techniques and processes for components, operating in advanced land-based gas turbine engines, such as the Frame 7FA.03, GT24/26 and W501F/M501F engines. He has over 30 years of experience

and expertise in the Welding (GTAW and Laser), Brazing (Narrow and Wide Gap Diffusion), FIC, Acid Stripping and Heat Treatment of Ni and Co-base superalloys. Dr. Miglietti is the outgoing chairman of the Commission XVII – "Brazing and Diffusion Bonding" of the International Institute of Welding (IIW) and was past chairman of the Manufacturing, Materials and Metallurgy Committee of IGTI, an affiliate of ASME. He has authored or co-authored 47 technical papers and has 13 repair technology patents. Today, he has a strong focus on assisting clients with materials characterization and mechanical property evaluation of Additive Manufactured/3D printed components, as well as providing heat treatment information for these components.

The One-Stop Shop
for Brazing, Heat
Treating, and Now,
Hot Isostatic Pressing.

Accurate Brazing Benefits

RAPID COOL

Our HIP furnace quenches (fast cools) after holding at elevated temperature, resulting in a good microstructure; whereas other suppliers of HIP services cannot quench, requiring an additional post HIP heat treatment to achieve the desired microstructure costing you additional time and money.

HIP AND HEAT TREATMENT CAPABILITIES

- Max Pressure: 30,000 psi
- Max Temperature: 2,282°F
- Max Cooling Rate: 390°F
- Gas Chromatograph
- Load capacity 26"dia x 69"

SOUTH CAROLINA

Brent Davis
Vice President
299 B Garlington Road
Greenville, SC 29615

W (864) 213-9310
C (864) 423-6625
brent.davis@accuratebrazing.com

NEW HAMPSHIRE - HQ

Hazen Earle
Northeast Regional Manager
36 Cote Avenue
Goffstown, NH 03045

W (603) 945-3761
C (603) 235-4502
hazen.earle@accuratebrazing.com

CONNECTICUT

Bob Sartori
General/Operations Manager
4 Progress Drive
Manchester, CT 06042

W (860) 432-1840
C (860) 306-3628
bob.sartori@accuratebrazing.com



aalberts.com