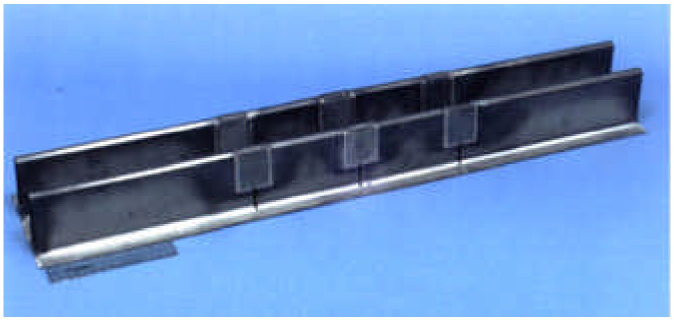
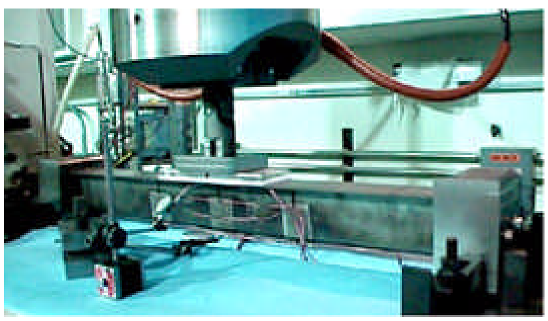
Benchmark Testing of the Largest Titanium Aluminide Sheet Subelement Conducted



Double corrugated titanium aluminide divergent flap subelement.

To evaluate wrought titanium aluminide (γTiAl) as a viable candidate material for the High-Speed Civil Transport (HSCT) exhaust nozzle, an international team led by the NASA Glenn Research Center at Lewis Field successfully fabricated and tested the largest γTiAl sheet structure ever manufactured. The γTiAl sheet structure, a 56-percent subscale divergent flap subelement, was fabricated for benchmark testing in three-point bending. Overall, the subelement was 84-cm (33-in.) long by 13-cm (5-in.) wide by 8-cm (3-in.) deep. Incorporated into the subelement were features that might be used in the fabrication of a full-scale divergent flap. These features include the use of (1) γTiAl shear clips to join together sections of corrugations, (2) multiple γTiAl face sheets, (3) double hot-formed γTiAl corrugations, and (4) brazed joints.



Benchmark test of titanium aluminide subelement (load at 340 kg).

The structural integrity of the γTiAl sheet subelement was evaluated by conducting a room-temperature three-point static bend test. The maximum beam deflection was approximately 2 mm (0.075 in.) at 340 kg (750 lb). Subelement failure occurred shortly after reaching 385 kg (850 lb). This is 93-percent higher than the predicted failure load.

The subelement failed at the center shear clip edge within the stress concentration area.

Pretest finite element analysis (FEA) results accurately predicted the measured corrugation strains and stresses. Corrugation stresses were within 4 percent of predicted stresses. The pretest FEA results illustrated that the tools and methodology to design components with this new material were in hand. Posttest FEA using a failure load of 850 lb (385 kg) showed that the stress at the failure location was 520 MPa (75 ksi). Since this is within 5 percent of the γ-sheet's ultimate tensile strength of 550 MPa (80 ksi), it proved that the fabrication process of hot-forming and brazing did not affect the material's structural capability.

This successful effort showed the tremendous potential of the γTiAl sheet for advanced aerospace propulsion systems. Present interests in this material technology include a metallic thermal protection system for the VentureStar (Lockheed Martin Corporation) program, hot ducts and acoustic tiles for the Joint Strike Fighter program, and nozzle elements in the F119 propulsion system program.

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Programs/Projects: HSR, VentureStar, JSF, F119 propulsion system