

Internal Letter



Rockwell International

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TO: (Name, Organization, Internal Address)

D. L. Fulton
D596, AC17

FROM: (Name, Organization, Internal Address, Phone)

Materials Design
D539/166, AC10
2340

Subject: Weekly Progress Report

SSME

PROBLEM

Nozzle Tube Failure: Materials & Processes analysis of tube failures from Test 179 on Nozzle Unit 9005 has concluded that the tubes failed from overheating in the range of 2200 to 2400F. This indicates a tube coolant pressure of 50 to 500 psig, and places the time of failure very late in the shutdown sequence.

HPFTP 2202R2 Fishmouth Seal Failure: In-place blade inspection of HPFTP U/N 2202R2 after 1289 seconds and 6 starts revealed a segment missing from the outer fishmouth seal lip of the first rotor forward seal (P/N RS007588). The missing piece was approximately 1-1/2 inches long. The seal was new at the last pump build. Visual examination indicates the segment separated as one piece. The fragment was formed when a circumferential crack that initiated on the inside of the fishmouth connected with two axial cracks in the outer lip. The final crack propagation of the circumferential crack was by fatigue. The failure investigation will continue to attempt to define the mechanism for initiation of the circumferential crack and the cause of the axial cracks.

LS-14

PROBLEM

Module Plate Unit #4 - Inspection: A thorough visual examination at 12 to 50X magnification was conducted on the failed flexure. The location of various types of damage, (i.e., cracks, braze fillet separation, etc.) were recorded. A map of these discrepancies will be analyzed for correlation with possible vibration drivers. Initial evaluation shows a random rather than patterned distribution. At present, the only evidence of fatigue cracks in the flexure is the leak check; penetrant and X-ray inspections were inconclusive.

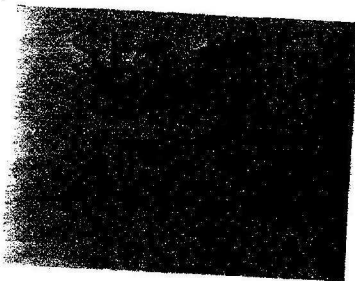
EB braze/weld samples were made to simulate repair of the cracked flexure. Micro examination shows that it is possible to seal the leaks; however, penetration of more than .005 is not too realistic, and there is no inspection method to verify anything other than a leak free joint.

Baffle Nozzle Array No. 3: Dye penetrant indications on the end of one baffle to array joint were locally blended. After 10 mils (total) of EDNi, removal break through at two locations - one over the manifold area and one over the nozzle blade feed slot - was noted. This condition is being investigated for Engineering disposition. Re-dye penetrant inspection of all joints will be conducted prior to any additional rework.



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Diffuser Vanes: Two diffuser vanes were noted to have unbonded nickel while the parts were at Dunlap & Abbott Mfg. Co. for machining. The vanes were EDNickel plated by Metal Surfaces, Inc., to repair some under-tolerance surface conditions. The unbond condition is possibly due to the activation procedure for electrolytic nickel plating on electroless nickel. An investigation is currently being conducted. Meanwhile, a disposition to strip and reprocess the defective vanes was made.

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ACHIEVEMENT

Specification Coordination: The release of Materials & Processes Specifications is progressing with sign-off scheduled this date for three documents. The remaining specifications are in various stages of typing (ATS) and coordination. M&P will continue to assist in and monitor their orderly progression.

SSME

INFORMATION

HPOTP LOX Inlet Castings: The metallurgical evaluation of the four HPOTP LOX inlet castings (Inconel 718) recently produced by TRW foundry has been completed. Results indicate that the present gating and risering system, plus HIP, results in acceptable quality. The penetrant inspection indications originally rejected in all four castings have been found to be minor and of "surface" nature. The only remaining area that needs some foundry improvement is a localized surface roughness (on the wax side of the pattern) that is probably caused by improper "dipping" of the wax-ceramic pattern assembly. The complete results of this analysis are scheduled to be discussed with TRW foundry on 26 February 1980.

HEX Tubing Life Demonstration Program: The preliminary test set of tubes containing artificially produced crack-like defects were further evaluated. It was found that geometry and location predictions were accurate within the limits of processing variation. O.D. defects closed up to about .0002" wide, producing a reasonable facsimile of "real" cracks. I.D. defects closed up even more, actually producing areas of friction welding and/or diffusion bonding. It was this condition which precluded their detection by ultrasonic inspection techniques. I.D. defects also produced little or no indications when penetrant inspected. All O.D. defects could be found with penetrant. Only the larger O.D. defects showed up in X-ray.

I.D. EDM notches for the test sample tubes are to be made wider, and consideration is being given to a pre-oxidizing treatment in an attempt to prevent the bonding experienced in the preliminary test set.



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Nozzle Tube Repairs - 0007: Significant leakage was noted during a flush operation that will have to be repaired. This nozzle was proof pressure tested in the annealed condition with only minor leaks then aged. The age may have cracked some repairs and/or flux that prevented gross leak.

Low Pressure Plasma-Sprayed Coatings: Dr. Stan Levine of LeRC, who visited Rocketdyne on February 7th to discuss HPFTP turbine blade coatings, followed up by providing Rocketdyne with two sources who do low-pressure (vacuum) plasma spraying. One is APS in Dayton, Ohio, and the other is Howmet in Whitehall, Michigan. MSFC is currently working with a third source, Metco of New York.

LASERS

INFORMATION

Flexural Fatigue Testing of Brazed Inconel 718: Planning, fabrication and testing of flexural fatigue specimens is being coordinated with Brazing and Laser Support. The tests are intended to partially simulate a brazed joint in an Inconel 718 Intermodule Flexure Assembly which has experienced apparent fatigue failures near a braze joint.

LS-14 Center Axicon Mirror Meeting at UTRC, Florida: The subject meeting to review the machining cracking problem with the flow divider plate (molybdenum sheet) was attended. Four radial cracks up to 1 1/2" long extending in from the periphery of the cone shaped .080" thick detail were discovered the day after completion of the rough machining operation. Stress measurements (X-ray diffraction) on the cracked detail revealed a residual surface machining stress of 62000 psi. This residual stress acting on possible small edge cracks created during breaking off the trim ring appeared to be the cause of the cracks. It is planned to machine the back-up detail using a procedure which in tests only produced a residual surface stress of 6000 psi. The final parting of the trim ring will be performed with an abrasive disk and at a 100°F minimum part temperature to avoid the creation of edge cracks.

Test data on molybdenum sheet was presented by UTRC showing considerably higher strength in the short transverse direction for the annealed re-crystallized heat treat condition than for the stress-relieved heat treat condition. These data were the basis of UTRC decision to use molybdenum in the re-crystallized condition for the mirror details.

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INFORMATION

Injector Castings: A detailed analysis of the just-completed wood mock-up of the very complex internal passages of the A357-T710 aluminum injector revealed that some advancement in the state of the foundry art will be needed to produce the castings. New concepts are presently being formulated.



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Axial Injector Welding: The M&P weld test samples for both the aluminum and CRES injectors were EB welded. The first Workhorse injector fuel rings were EB welded without incident. All of the welding is being performed in the M&P Weld Lab with Manufacturing personnel support. These efforts are demonstrating the excellent cooperation between Manufacturing Engineering and M&P.

Low Density High Silica Nozzle Liner: An investigation is being initiated in finding a substitute for the high silica fabric used in NARMCO 4065 for the axial engine nozzle liner. The baseline fabric designated as C-100-20 is no longer available from Hitco (sole source of fabric) because of process regulation by OSHA. The fabric is so fragile that it cannot withstand the OSHA approved automated leaching process of Hitco. A proposal by Hitco to develop a different fabric which is slightly heavier and stronger is under consideration.

Two other alternatives will also be evaluated. The first one is to investigate the possibility of buying similar high silica fabric from a foreign source (Japan). Quality and delivery are important factors to be considered here. The second alternative is to make a trade-off study to see if using a quartz fabric, similar to C1-100-20, high silica fabric will offer advantages in quality, delivery and performance to offset the cost difference as known at present. However, there is a slight possibility that because quartz fabric is stronger and easier to handle, impregnating cost may be reduced to a point where cost difference will become insignificant. Information is being assembled on this subject for a more detailed review.

Beryllium Machining: Nine air-monitoring samples from the Be machining operation were submitted by Health and Safety for total Be analysis. Results from the monitored air samples ranged from 0 - 0.21 $\mu\text{g Be/cu m}$. (The OSHA limit is 2 $\mu\text{g Be/cu m}$.)

ADVANCED PROGRAMS

INFORMATION

Heat Flux Testing of Nozzle Materials: Test apparatus has been setup to determine backside temperatures on samples made from the H.Q.E. nozzle materials. Initial tests will be performed at a 144 $\text{BTU/ft}^2 - ^\circ\text{F}$ heat flux. Backside temperatures versus time will be measured at the simulated duty cycle of the failed sustainer.

MARINE SYSTEMS

INFORMATION

Dimensional Discrepancies in Thick-Bladed PJ-20 Inducer, R10-0109: Dimensional checks on newly-arrived inducers indicate that the recent tooling changes made by the foundry (TiTech) have not yet corrected the dimensional discrepancies in these castings. In an effort to determine the cause of



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this problem, a member of M & P, along with the pattern-maker, will observe a complete mold assembly operation at the foundry. It is believed that the dimensional discrepancies are a result of deficiencies in either the tooling or the molding/mold assembly process.

SSFL POLLUTION CONTROL

Monday, February 11th, provided the classic example of some of the possibilities that exist to make pollution control at SSFL technically fascinating and administratively nightmarish. The R2A retention pond, the last reservoir before water goes off the property (capacity = 2.5 million gallons of water), had only four inches of freeboard and a rain-storm was on its way. The fluoride was 1.0 ppm, right at the discharge limit. At noon, ESG's PDU experienced a "pressure excursion" such that they dumped several hundred gallons of their sodium carbonated-primordial ooze, laden with boron, oil and grease, chromium and other contaminants, down the spillway at G & 17th streets that heads into the Rocketdyne channel leading to R2A. Maintenance samplers, sighting the rolling greyish waters, picked up samples and submitted them for analysis because COCA was to fire at 3 P.M. and thrust a half a million gallons of reclaim water into R2A. Although the sprinklers had been turned on (to use up some of the R2A) and the reverse-all-pumps technique (to push the water back up to the upstream ponds) was applied full blast, the COCA deluge topped the banks, and the full discharge, as declared by the Environmental Control Specialist, was underway. Meanwhile, back at the ECL range, personnel using FTM, fluorotrinitromethane, a lachrymator (mucous membrane irritant even under a layer of water, and toxic) had a spill while all of this was going on. They released their gallon of trouble into the normal and appropriate place, the line that carries waste to the pond outside their building. (This is hauled off, by a waste disposer, two to three times a week.) However, the polyvinylchloride line was leaking like a sieve and this was also on its way to R2A. Since the FTM decomposes in alkaline solution to harmless entities (nitrate and fluoride, not toxic), as long as the fluoride value was not above 1.0 ppm, as allowed by the discharge permit, the situation was containable and reducible by the excess water shot in from COCA. Subsequent analysis revealed that the overall sample, the official discharge, was at the maximum of, but still within, permissible discharge limits.

On Tuesday, February 12th, drenching rains started late in the afternoon and another full discharge analysis was underway. All results to date have indicated that the NPDES permit limits have not been exceeded in waters leaving the Rocketdyne property.



J. H. Lieb
Manager
Materials Design

JHL/jb



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