

H-1

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Info given to: *W. Marshall*
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MEMORANDUM FOR RECORD

December 6, 1966

From: *Arthur W. Thompson*
(MSFC) - I/IB-SI/IB-969-66

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Subject: Meeting held December 1, 1966 to Review Problems with
the H-1 Engines on S-IB-7 and S-IB-8

Marshall, Chrysler and Rocketdyne management and technical personnel convened in the IO Conference Room on December 1, 1966 and reviewed three recent problems. Mr. Lowrey of Chrysler and Mr. Johnson of Rocketdyne presented their findings regarding the discovery of 12 pieces of Teflon behind the injector plates of the engine in position #4 on the S-IB-7 Stage. Mr. Lowrey read the letter which Chrysler had transmitted to the Government stating the action taken and the results of their investigation. Of special interest was that the S-IB-7 propulsion subsystem had been specially inspected (in the nature of a quality spot check) to verify workmanship and the flight worthiness of the components. Chrysler had composed a best fit of the 12 pieces of Teflon which were found to make (with reasonable fit considering the environment to which the Teflon had been subjected) a single piece of Teflon about two square inches in area.

Mr. Johnson described Rocketdyne's efforts, which had been quite extensive on the part of the Neosho plant, toward locating the source of the material. He also presented data on the S-IB-7 engines which indicated that the engine in position #4 had performed slightly differently during static than it had in previous tests and that the position #8 engine had performed similarly. Chrysler had presented a stage LOX system schematic which showed that, if a single piece of Teflon had been in the LOX system and had broken into parts prior to leaving the LOX sump from LOX tank #1, some of the pieces could have gotten into the position #5 engine. Rocketdyne had learned of a fiberoptics tool which could be used to inspect the area behind the injector plate of an engine with good confidence of finding any foreign material. It was agreed that the engines in positions #5 and #8 were suspects and would be opened for inspection.

NOTE: Subsequent to the meeting, Solar has provided Chrysler with three pieces of the Teflon which is used to protect the lines from clamps during welding. These three pieces are of the same general size and shape and have the same markings as the Teflon found in the engine. Review of the flex joints in the line revealed that the Teflon could have been lodged in such a

manner that considerable turbulence in the LOX would have been required to dislodge it. This establishes the source of the Teflon and, since the lines are not common with any other engine, it has been decided not to inspect the other lines as agreed in the subject meeting.

The next subject discussed was the discovery of steel filings in the FABU screen on engine # 6 after the short-duration firing of S-IB-8. A study of the LOX system revealed that the filings could have come from the ground system or stage components. Effort is continuing to establish the source of the filings. It was concluded that the steel filings in the engine did not contribute to the other trouble encountered with the engine turbine which was discussed next.

The turbine failure of the position # 6 engine on the S-IB-8 Stage was the third subject discussed. Mr. Cox of Chrysler described the problem, a frozen turbine shaft, and the effort to unfreeze the shaft. The presentation revealed a lack of conformance to written procedures by field personnel and illustrated the need for more thorough processing of Defective Material Notices (DMN's), especially those relating to Government furnished equipment. In this occurrence, a torque of 800 in. /lbs. was applied to the turbine shaft when the applicable quality control specification allows for a torque of only 150 in. /lbs. to be applied.

Personnel from Chrysler field test, Test Laboratory, Rocketdyne, and IO were present at a meeting held prior to the short-duration static test of S-IB-8 at which the recommendation was made to go ahead with the static test. All concerned were agreeable to continuing with the firing prior to authorization to go ahead by the S-IB Stage Project Manager. It was confirmed that an earlier report that Chrysler, Rocketdyne and Test Laboratory personnel were opposed to conducting the short-duration static firing was in error. Actions have been initiated to improve the operational aspects of static testing and also the pre-launch checkout operations.

Mr. Johnson confirmed a previous report that a stainless steel material had been used to manufacture certain turbine blades, including some 42 of those on the engine which failed. Data pertaining to this problem were limited at the time of the meeting, partly because it was not confirmed until very late on November 29 that stainless steel had been used in the blades, and partly because a strike at Haynes Stellite (a division of Union

Carbide) in Kokomo, Indiana, prevented rapid access to knowledgeable personnel. Pending definitive data, all H-1 engine turbines, Thor engine turbines, and Atlas engine turbines are suspect. Rocketdyne has established that X-rays exist for the individual blades as well as the turbine assemblies used in all H-1 engines. These X-rays, originally made for weld inspection, are being reviewed because stainless steel shows up more dense in X-rays than does the Haynes Stellite 21 material which should have been used. This procedure is indicative of bad turbines when both materials are used in the same wheel; it may not be indicative if all blades on a turbine are made of the same material. It was agreed to further study the existing X-rays and to evaluate their actual confidence factor for the investigation.

Rocketdyne was to continue a comprehensive investigation of the problem, with support from the Government to meet with Haynes Stellite personnel and obtain records even though they are on strike. P&VE will investigate the validity of the X-ray technique. Special action items which resulted from the meeting are:

1. An investigating team, with Qual Lab (Mr. E. Mintz) leadership, will visit Rocketdyne and Chrysler (unannounced) at the working level to investigate procedures, and compliance to these procedures, regarding the handling of the engines. Areas to be investigated include the packaging procedures for the engines and the protection provided during transportation, especially regarding access to the engines by unauthorized personnel. The experience of the inspectors who were on the job at the time the problems developed will also be checked. (Subsequent data regarding the source of the Teflon requires that this action be extended to Solar's operations.)
2. A boroscope inspection will be made of the region behind the injector plates for engines # 5 and # 8 on S-IB-7. (This action has been satisfied by the determination of the source of the Teflon.)
3. The Engine Office will evaluate the incorporation of a screen at the engine inlet ducts to keep foreign matter out of the engines.
4. The handling of procedures and DMN's at Static Test will be reviewed and/or brought into line with Michoud requirements.
5. Future DMN's prepared by Chrysler will contain their recommendation for a fix.

6. Chrysler will institute a system for logging the time critical propulsion subsystem feed line joints are open and also log the name of the man responsible for the operation.
7. Rocketdyne will review other engine performance data which could indicate a variation in engine performance due to foreign matter in the system.
8. Chrysler will investigate possible sources of the stainless steel filings from both the ground system and from the stage.
9. The data requirements for the engine log books will be reviewed.
10. A study of criteria for the torque testing of the turbine shaft will be made and new values established if required.
11. The Engine Office will continue to investigate the stainless steel turbine blade problem and develop a position for corrective action within one week.

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cc:

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