



**Aerospace
Systems Division**

APOLLO 14 DRT INSTALLATION
ANOMALY STUDY

NO. ATM-997	REV. NO.
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This ATM is being issued to summarize the results of the anomaly study instigated as a result of the Apollo 14 problem with Dome Removal Tool insertion on the Fuel Cask Body Release Assembly.

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I. STUDY PLAN

- A. Check the design tolerances of the flight and trainer hardware.
- B. Review the training and flight hardware configuration.
- C. Survey the CF² procedures.
- D. Review training sequence versus design intent.
- E. Submit recommendations.

II. FINDINGS

A. Flight and Trainer Design Comparison - The trainer and flight hardware designs were compared and it was found that all dimensional requirements were the same for both models.

B. Trainer and Flight Hardware Configuration

1. KSC Trainer

- a. The dimensional checks that were made are shown in attachment I with the out-of-tolerance item circled.
- b. The spline lock is a metal pin rather than the ceramic bead string.
- c. The GLFC dome holes for alignment of the Body Release Assembly are extremely oversize, elongated and broken out.
- d. The Body Release Assembly had several discrepancies above and beyond those noted on the dimensional check:
 - (1) The assembly is an aluminum construction.
 - (2) The release levers are badly worn.
 - (3) The angle brackets are full slotted per design but are badly worn.
 - (4) The positive stop appears to have rewelded.
 - (5) The angle brackets have been broken off and re-assembled to the bands.
 - (6) The plunger is badly worn and deformed (both internally and externally).
 - (7) As reflected in the dimensional check the spring force is extremely low.



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2. MSC Trainer

- a. The dimensional checks that were made are shown in Attachment II, with the out-of-tolerance items circled.
- b. The Body Release Assembly had several discrepancies above and beyond those noted on the dimensional check:
 - (1) The locking assembly is free to rotate without depressing the plunger.
 - (2) The locking plate is badly worn.
 - (3) The plunger is badly worn and distorted (both internally and externally).
 - (4) As reflected in the dimensional check the spring force is very low.

3. Flight Hardware

- a. All dimensions taken are within print requirements.

C. CF² Procedure Review

1. It was noted during CF² that the Dome Removal Tool appeared to be difficult to install.
2. The tool was returned to Ann Arbor and reworked.
3. During the delta CF² both astronauts performed fit checks using the tool on both the flight and the flight spare cask and found the fit acceptable.

D. Training Exercise Review

1. A Trainer deployment on 22 March 1971 at KSC was witnessed and it was evident that the installation of the DRT was a poor simulation of the flight hardware requirements.



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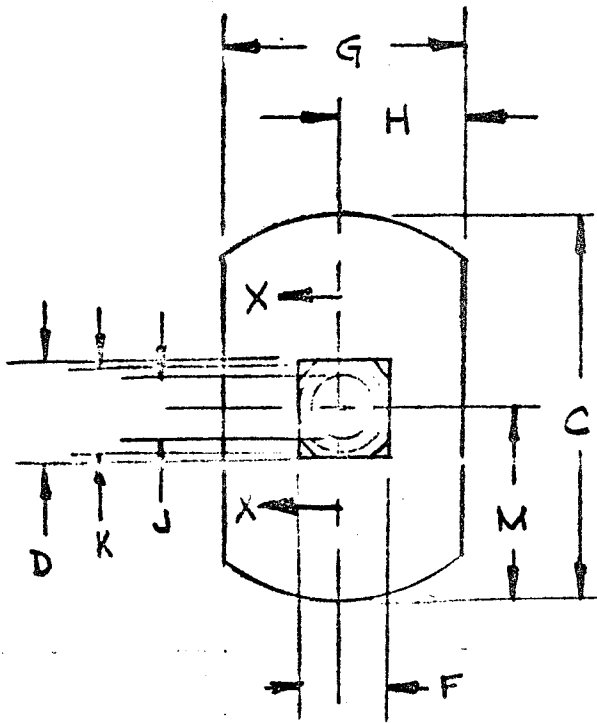
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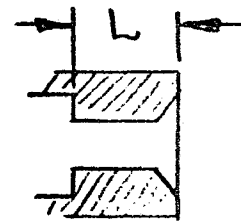
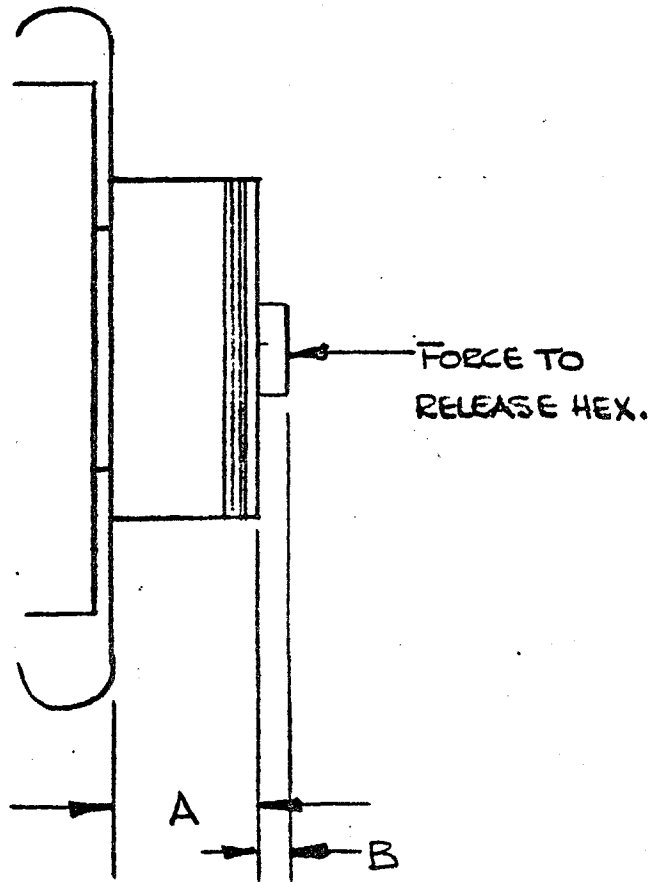
III. RECOMMENDATIONS

- A. It was agreed at a meeting with J. Briley, NASA/MSC that the KSC Trainer should be considered the prime training hardware consisting of the best possible components.
- B. The aluminum body release assembly on the KSC Trainer should be replaced with a new titanium assembly.
- C. The titanium body release assembly on the MSC Trainer should have piece part replacement in the area of the DRT interface.
- D. The non-conforming wire spline lock on the KSC Trainer should be replaced with proper ceramic bead construction.
- E. The Norco lock assembly of the Trainer DRT should be replaced.
- F. An astronaut decal should be added to the DRT to reflect the off-set requirement for engagement.

MODEL No S/N6
FLIGHT

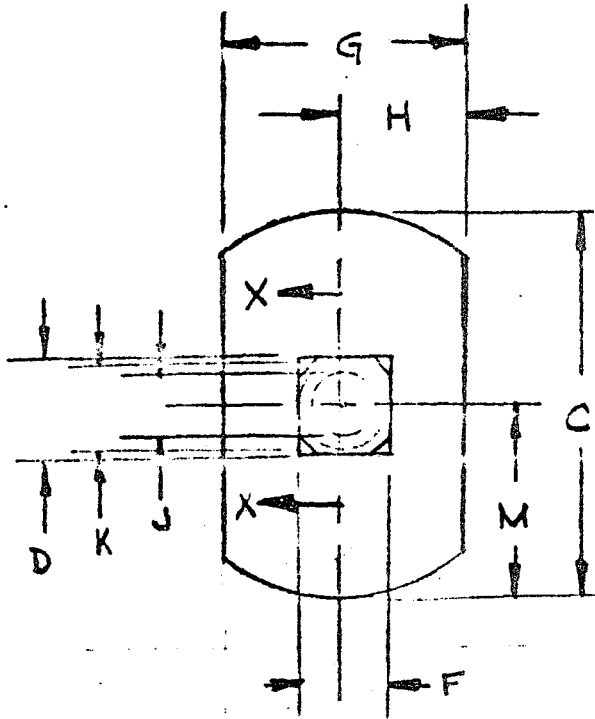


A	<u>.570</u>
B	<u>.120</u>
C	<u>1.526</u>
D	<u>.401</u>
E	<u>N/A</u>
F	<u>.400</u>
G	<u>1.135</u>
H	<u>.534</u>
J	<u>.254</u>
K	<u>.374</u>
L	<u>.306</u>
M	<u>.743</u>
FORCE	<u>7.5-8.0#</u>

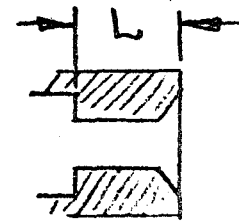
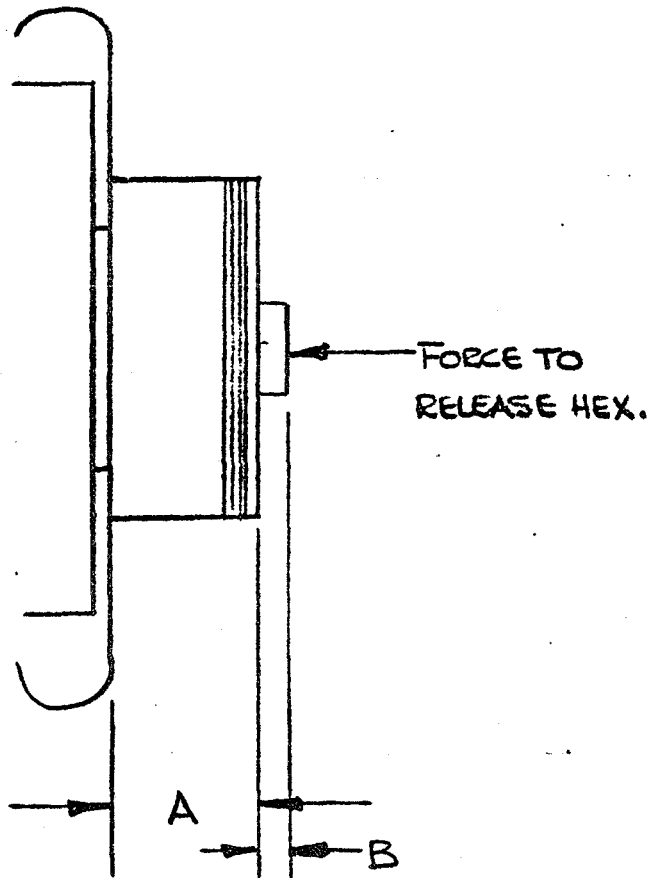


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MODEL No S/N8
FLIGHT SPARE

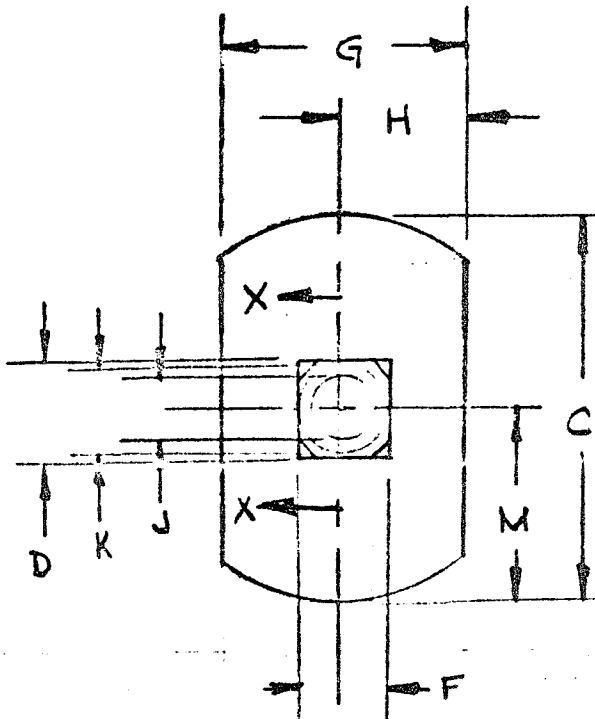


A	<u>.563</u>
B	<u>.128</u>
C	<u>1.509</u>
D	<u>.400</u>
E	<u>N/A</u>
F	<u>.400</u>
G	<u>1.137</u>
H	<u>.557</u>
J	<u>.253</u>
K	<u>.250</u>
L	<u>.282</u>
M	<u>.743</u>
FORCE	<u>7.0-7.2#</u>

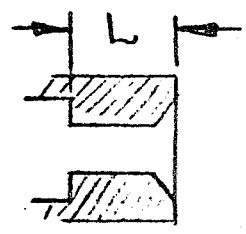
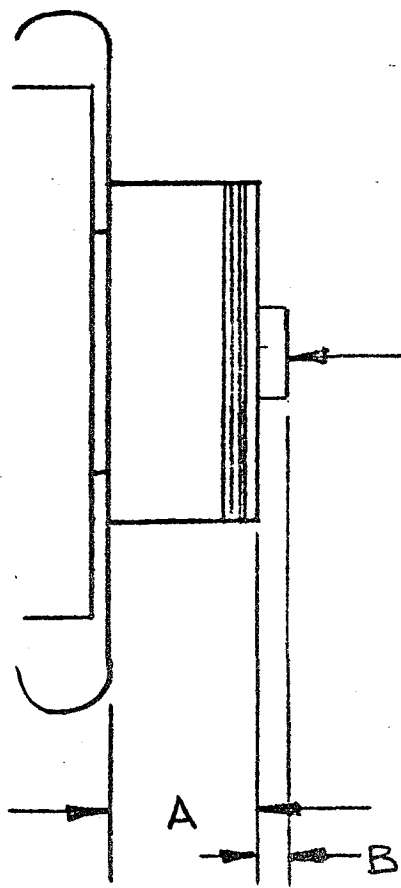


SECTION X-X

MODEL No KSC TRAINER

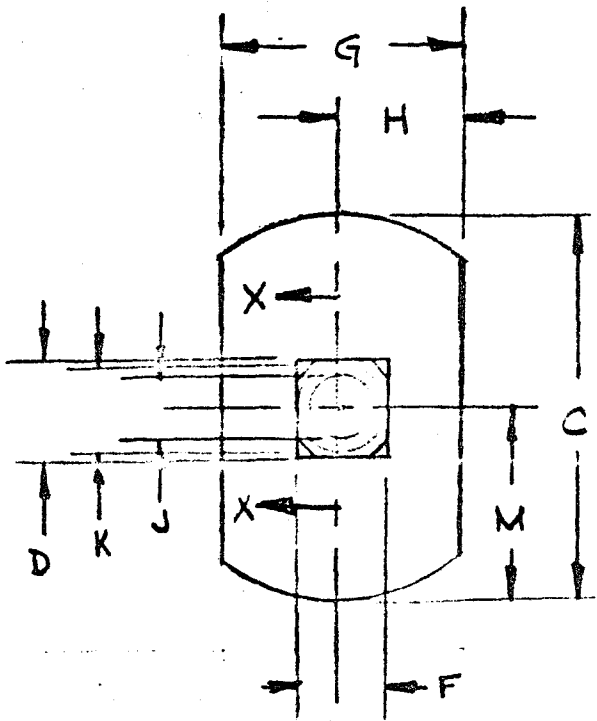


A	.572
B	.120
C	1.503
D	.403-.405
E	N/A
F	.401-.406
G	1.125-1.135
H	.552
J	.255-.257
K	.379
L	.282
M	.743
FORCE	4.5-5.0#

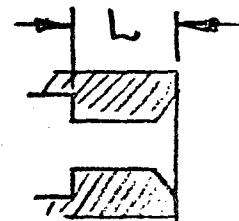
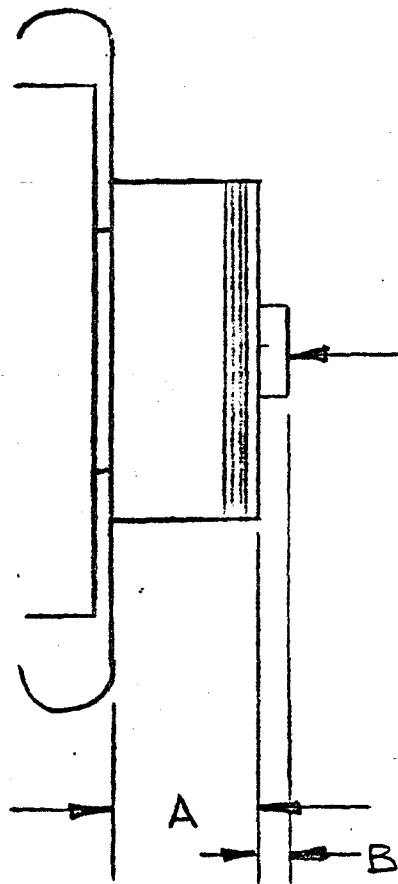


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MODEL No MSC TRAINER



A	<u>.578</u>
B	<u>.112</u>
C	<u>1.508</u>
D	<u>.405</u>
E	<u>N/A</u>
F	<u>.403</u>
G	<u>1.132-1.134</u>
H	<u>.554</u>
J	<u>.253-.257</u>
K	<u>.378</u>
L	<u>.308</u>
M	<u>.746</u>
FORCE	<u>5.2-5.5#</u>



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