

VERTOL AIRCRAFT CORPORATION

TEST MEMORANDUM REPORT

*P. J. ...*  
(2)

DATE: 2-12-57  
REF. NO.: TMR 293  
DATE OF TEST: October 1957  
November 1957

SUBJECT: Fire Test of Components, H-21 Self-Sealing Oil Tank, for CAA Certification

- REFERENCE:
- A) EMD 00-38 Fire Test of Materials and Components Required for CAA Certification - Model H-21.
  - B) CAA Safety Regulation Release No. 259 dated 26 August 1947.
  - C) Civil Aeronautics Regulation Parts 6.384 & 6.482 Rotorcraft Airworthiness.
  - D) Vertol Aircraft Corporation Dwg. 42P3013 Tank Assembly, Self-Sealing Oil.
  - E) Vertol Aircraft Corporation Report 42-P-02 "Fire Protection Proposal, Engine Compartment - VERTOL Model 42".

- ENCLOSURES:
- Fig. 1 Tabulation of Tests & Results.
  - Fig. 2 Typical Test Setup, Detail Specimens (Photo Neg. No. 40868)
  - Fig. 3 WE3001-130 Oil Tank Shutoff Valve, Painted with ALB159, After 5 Min. of Testing (Photo Neg. No. 40990).
  - Fig. 4 Segregator Divorter Valve & Sump, Test Set up (Photo Neg. No. 40970).
  - Fig. 5 Burning 42P3031-1 Cell Assembly (Photo Neg. No. 40979).
  - Fig. 6 42P3013-1 Oil Tank Assembly After Test (Photo Neg. No. 40972).
  - Fig. 7 Fire Test of 42P3031-1 Cell Assembly, Test Setup (Photo Neg. No. 40971).
  - Fig. 8 Results of Testing 42P3031-1 Cell Assembly (Photo Neg. No. 40967)

PURPOSE: Testing was conducted to demonstrate the ability of the H-21 self-sealing oil tank and components to retain oil if there were a fire in the engine compartment. (Ref. B & C).

DATE: 1-12-57  
 REF. NO.: TMR 293  
 DATE OF TEST: October 10-  
 November 20, 1956

DESCRIPTION OF TEST SPECIMEN:

The following oil tank assembly parts were fire tested.

ITEM NO.	TEST SPECIMEN	SPECIMEN CONFIGURATION
1	USAF 49F9798-65 Drain Valve (Auto Valve)	Standard Valve
2		Standard Valve Painted with ALBI 99
3	35951-2 Drain Valve (Koehler)	Standard Valve
4		Standard Valve Painted with ALBI 99
5		Standard Valve, Aluminum handle replaced with steel handle. Painted with ALBI 99
6	WE 4801-1 $\frac{1}{2}$ Oil Tank Shut Off Valve (Wm. R. Whittaker Co.)	Standard Valve
7		Standard Valve Painted with ALBI 99
8	Modified 22P3063 Adapter	Same as 22P3063-1 adapter but with .180" min. wall thickness.
9		Same as 22P3063-1 adapter but with .180" min. wall thickness. Painted with ALBI 99.
10	22P3063 - Adapter	Standard Adapter (.080 wall thickness) Painted with ALBI 99.
11	475C-65T Drain Valve (Auto Valve)	Standard Valve. Stainless steel construction.
12	U-5410-4D - Segregator Diverter Valve (United Aircraft Products Co.)	Standard Valve
	22P3078-2 - Sump	Standard Sump
13	42P3031-1 - Cell Assembly	Standard cell except for lack of redundant nylon strap installation. (See Ref. E).

DATE: 2-12-57  
REF. NO.: TMR 293  
DATE OF TEST: October 10 -  
November 20, 1956

PROCEDURE:

Requirements for fire testing of H-21 oil system components, located in the engine compartment, essential to functioning of the helicopter were obtained from CAA Regulations. Questions concerning procedure were discussed with CAA representatives.

The detail parts, Items 1 thru 11, were installed on a steel tank, Fig. 2, partially filled with 5 gal. of MIL-L-6082 1100 engine oil. The test installation simulated a typical helicopter installation. All valves were checked for operation after installation.

A "David Bradley Multi-Purpose Torch and Weed Burner", burning kerosene produced a 2300°F. maximum flame temperature approximately 5 inches in diameter and 12 inches long. The burner was positioned so that the 2000°F. portion of the flame enveloped the test specimen. The temperature at the specimen was adjusted by moving the burner near or away from the specimen. All items tested were enveloped in flame from the side that would be exposed in case of fire.

A chromel-alumel thermocouple, used in conjunction with a portable potentiometer, was positioned in the path of the flame to indicate an average temperature across the test specimen.

One burner was used for the small specimens, two burners for the WE 4801-1½D oil tank shut off valve and three burners were used to test the U-5410-4D segregator diverter valve and 22P3078-2 sump combination.

All specimens using ALBI 99 fire resistant paint were coated to an approximate thickness of .015".

The U-5410-4D segregator diverter valve, 22P3078-2 sump and 42P3031-1 cell assembly were assembled into a 42P3013-1 self-sealing oil tank assembly. The 42P3066-1 hopper assembly was not installed. The oil tank was partially filled with 15 gal. of MIL-L-6082 1100 engine oil. The flame was directed at the sump and segregator diverter valve. (See Fig. 4)

Flame temperatures on the test specimens were 2000°F plus/minus 75°. Temperatures were kept on the high side of this range for most of the testing.

Upon completion of the sump and segregator testing the flames on the 42P3031-1 cell assembly were fanned out or allowed to die out. A flame of 2000°F plus 150° minus 100° was impinged on the aft end of the 42P3031-1 cell assembly above the oil level in the tank, for 15 min. (See Fig. 7).

DATE: 2-12-57  
REF. NO.: TMR 293  
DATE OF TEST: October 10 -  
November 20, 1956

### DISCUSSION OF RESULTS:

ALBI 99 fire resistant paint was used for protection of some test specimens. Application of heat causes the ALBI 99 to rise up into a multi-cellular structure that acts as an insulator, thus prolonging the life of the specimen.

Two USAF 49F9798-65 drain valves were tested. The standard valve failed after 2.5 min. as a result of warpage of the front plate. The second valve painted with ALBI 99 showed signs of seepage, that was not measurable, after 6 minutes of testing. (See Fig. 1)

Three 35951-2 drain valves were tested. The handle failed on the first valve after 45 sec. of testing, allowing the valve to open and drain the tank. The second valve painted with ALBI 99 failed in a similar manner after 2½ minutes. The third valve had the aluminum handle replaced with a steel handle. The valve was then painted with ALBI 99. No leaks or seepage was noted after 5 min. of testing. (See Fig. 1)

Two WE 4801-1½D oil tank shut-off valves were tested. The test installation consisted of a modified 22P3063-1 adapter, wall thickness increased from .084" min. to .180" min., WE 4801-1½D valve and a 42P3001-7 hose assembly. The valve was closed successfully after one minute of testing. The valve and -7 hose assembly failed after 2.2 minutes of testing. The second modified 22P3063-1 adapter and WE 4801-1½D valve were painted with ALBI 99. The WE 4801-1½D valve was successfully closed after 1 min. of testing. The -7 hose assembly started to burn 1.5 minutes after the oil flow was stopped. After consulting with CAA representatives it was decided that the testing of the WE 4801-1½D valve could be continued with the -7 hose removed from the test set-up. The valve opening was blocked with a blank flange and the test continued for 2.75 minutes for a total fire time of 5.25 minutes. No seepage was noted around the valve or adapter after the test. (See Fig. 3).

A 22P3063-1 adapter painted with ALBI 99 was tested for 5 min. No seepage or damage to the specimen was noted at the end of the test.

A 475C-65T stainless steel drain valve, intended as a possible substitute for the USAF 49F9798-65 valve, was tested for 5 min. Slight seepage, not measurable, was noted at the valve opening upon completion of the test.

- 5 -

DATE: 2-12-57  
REF. NO.: TMR 293  
DATE OF TEST: October 10 -  
November 20, 1956

### DISCUSSION OF RESULTS (Continued)

The test of the U-5410-40 segregator diverter valve and 22P3078-2 oil tank sump was conducted for 5 minutes. Seepage was noted on the fwd. end between the sump and segregator valve. There was seepage between the sump and 42P3031-1 cell assembly on the fwd. end, inboard side and the aft end of the sump. (See Fig. 6). The oil accumulated in a 5 min. period from the seepage on the fwd. end and inboard side of sump segregator combination was 1.8 cu. in. The seepage at the aft end of the sump was not measurable.

As a result of testing the sump and segregator diverter valve, the nylon tire chord exterior of the 42P3031-1 cell assembly caught fire. (See Figs. 4, 5 & 6). The flames progressed from the base of the cell assembly toward the top. When the test was complete the flames on the tank, to a large extent, could be extinguished by fanning. The oil tank scupper in the path of the flames showed no signs of distress. (See Fig. 5). There was no noticeable deformation of the tank as a result of the nylon chord exterior burning.

A fire test was conducted on the aft end of the 42P3031-1 cell assembly for 15 min. The temperature was 2000°F and over for 90% of the test. At the start of the test the outer layers of nylon tire chord burnt away revealing the fibreglass portion of the cell assembly. (See Fig. 7). The flame did not burn through the layers of fibreglass. Separation of plies occurred on the other side of the fibreglass but no leaks were noted as a result of this test.

### CONCLUSIONS:

1. The USAF 49F9798-65 drain valve, WE 4801-1½D oil tank shutoff valve and 22P3063-1 adapter painted with approximately .015" ALBI 99 passed the 5 minute requirement. A 35951-2 drain valve modified with a suitable steel handle and painted with approximately .015" ALBI 99 passed the 5 minute requirement.
2. The seepage noted around the 22P3078-2 sump and U-5410-40 segregator diverter valve was not sufficient to aggravate or sustain an existing fire. Therefore, the sump and segregator diverter valve installation is satisfactory for the 5 minute requirement. It is felt that the useful life and reliability of the sump and segregator diverter valve may be extended beyond 5 minutes by painting them with approximately .015" ALBI 99.

- 6 -

DATE: 2-12-57  
REF. NO.: TMR 293  
DATE OF TEST: October 10 -  
November 20, 1956

CONCLUSIONS (Continued)

3. It is recommended that an approved fire-resistant electrical plug and wire should be used with the WE 4801-1½" oil tank shut-off valve installation.
4. The results of testing the aft end and sump area of the 42P3031-1 cell assembly indicate that the cell assembly is capable of performing its functions under the most severe conditions of fire and duration likely to be encountered. The burning of the cell assembly exterior had no effect on the integrity of the cell. After the burners were removed, these flames were easily extinguished by fanning.

TEST OBSERVED BY:

S. Ross	CAA
P. Lynahan	VERTOL
P. Christiansen	VERTOL
I. Shapiro	VERTOL

PREPARED BY Jack W. Cotton

APPROVED BY E. Roeser

APPROVED BY E. Dretz

cc:

J. Diamond (3)  
K. Gillmore (1)  
P. Lynahan (1)  
W. Flemming (1)  
E. Roeser (1)

JC:ddl  
February 8, 1957  
Ext. 355

VERTOL AIRCRAFT CORPORATION

REPORT NO. TMR-293  
MODEL NO.

TABULATION OF TESTS AND RESULTS

ITEM NO.	TEST SPECIMEN	SPECIMEN CONFIGURATION	TEST DATE	WITNESSED BY	REQD. TIME	ACTUAL TIME	REMARKS AND TEST RESULTS.
1	USAF 49F 9798-65 Drain Valve	Standard Valve	11-1-56	S. Ross E. Johnson G. Martell P. Lynahan	5	2-1/2	Leakage was noted from valve body and valve outlet after 2-1/2 minutes of testing.
2		Standard Valve Painted with ALBI 99	11-1-56	J. Diamond VERTOL	5	6	Testing was conducted for 6 minutes. Seepage noted on valve face plate but was not measurable.
3	3595L-2 Drain Valve	Standard Valve	11-1-56	S. Ross E. Johnson G. Martell P. Lynahan	5	3/4	Valve failed after 45 sec. of testing. Handle melted off allowing valve to open.
4		Standard Valve Painted with ALBI 99	11-1-56	J. Diamond VERTOL	5	2-1/2	Valve failed after approximately 2-1/2 minutes. Handle started to melt allowing valve to start opening.
5		Standard Valve Aluminum Handle replaced with steel. Painted with ALBI 99	11-20-56	I. Shapiro E. Roeser VERTOL	5	5	There was no seepage after testing for 5 minutes.
6	WE 480L-1-1/2D Oil Tank Shut Off Valve.	Standard Valve	11-8-56	C. Ross G. I. Devore P. Lynahan J. Diamond VERTOL	5	2-1/5	Valve was closed after 1 minute, motor body failed after 1.5 minutes. Valve body started leaking approximately 2.2 minutes after start of test. The 42P3001-7 hose ass'y. failed at the hose after 2.2 minutes of testing.
7		Standard Valve Painted with ALBI 99	11-8-56	J. Diamond VERTOL	5	5	Valve was closed after 1 minute. The -7 hose ass'y. was removed and the opening capped. Test was restarted and continued for 2.75 minutes. There were no indications of leakage during or after the test.

REV

FABULATION OF TESTS AND RESULTS

ITEM NO.	TEST SPECIMEN	SPECIMEN CONFIGURATION	TEST DATE	WITNESSED BY	REQD. TIME	ACTUAL TIME	REMARKS AND TEST RESULTS.
6	Modified 22P3063 Adapter	Same as 22P3063-1 adapter but with .180" wall thickness.	11-8-56		5	2-1/5	Adapter tested in conjunction with WE4801-1-1/2D Valve. Test discontinued due to failure of valve. Adapter showed no signs of failure.
9	Modified 22P3063 Adapter	Same as 22P3063-1 Adapter but with .180" Wall Thickness. Painted with ALBI 99	11-8-56	C. Ross Gill DeVore P. Lynahan J. Diamond VERTOL VERTOL VERTOL	5	5	Adapter tested in conjunction with the Albi'ed WE 4801-1-1/2D Valve. No sign of leakage or failure at end of test.
10	22P3063-1 Adapter	Standard Adapter	11-20-56	I. Shapiro E. Roeser VERTOL VERTOL	5	5	An exchange of burners was required during the test. Total burner time on part 5-1/4 minutes. No oil leakage or damage to the adapter was noted.
11	475C-65T Shut Off Valve (Auto Valve)	Standard Valve (Stainless Steel Construction)	11-20-56		5	5	An exchange of burners was required during the test (1st Burner time 4-1/2 minutes). Total burner time 6-1/2 minutes. A slight seep, not measurable, was noted in valve opening at end of test.
12	U-5410-4D Segregator Diverter Valve	The seg. div. valve was assembled with the sump to a 42P3031-1 cell ass'y. Also installed on the cell was a 42P3009 Scupper Ass'y. & A42P3010 Cover Plate	11-8-56	C. Ross Gill DeVore P. Lynahan J. Diamond VERTOL VERTOL VERTOL	5	5	The cell was filled with 15 gal. of Engine oil. The tire chord on the lower portion of the tank started to burn shortly after test started. The burning continued up the sides of the tank during the test. At the end of the test seepage was noted in 4 places about the sump. One was between the sump & segregator on the fwd. end. The others were between the sump & cell at the fwd. end, fwd. lub. side & aft end. 1.8 cubic in. of oil seepage was collected from the fwd. & lub. side. The seep at the aft end was not measurable.

REV



TABLULATION OF TESTS AND RESULTS

ITEM NO.	TEST SPECIMEN	SPECIMEN CONFIGURATION	TEST DATE	WITNESSED BY	REQD. TIME	ACTUAL TIME	REMARKS AND TEST RESULTS.
13	42P3021-1 Cell Assembly		11-8-56	C. Ross CAA Gill DeVore VERTOL P. Lynahan VERTOL J. Diamond VERTOL	15	15	Test was conducted on 42P3021-1 cell assembly. After comp. of item 12 above, the flame was impinged on the aft end of the tank, above the oil level, for 15 min. The flame did not burn through the fiber glass layers & no seeps or leaks were noted as a result of the test. Separation of plys occurred on the other side of the fiber glass.

REV

1.01. 10. 15  
TWR AL. 05E  
SADLA W. B-01

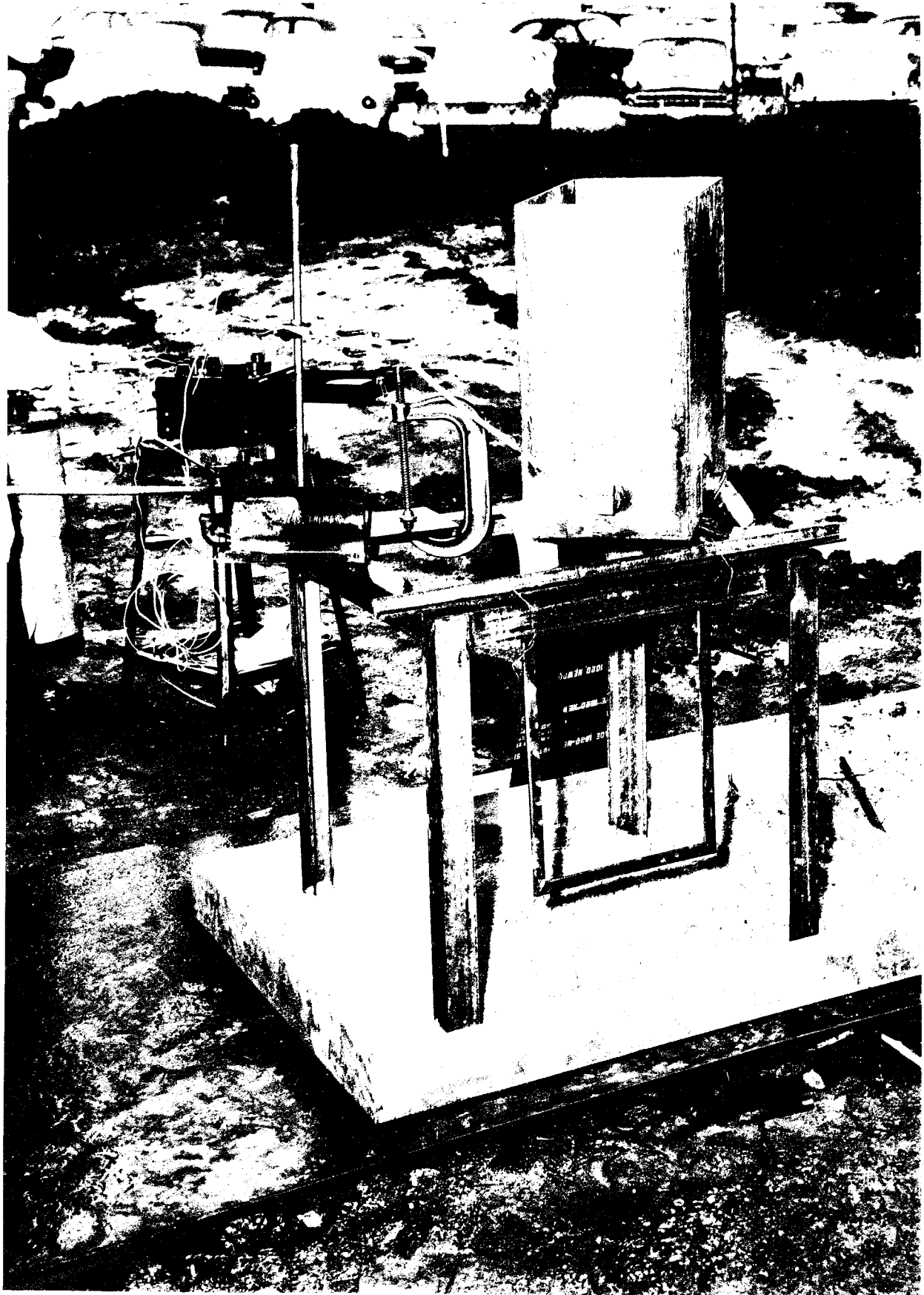


FIGURE 2 PHOTO NO. 10968  
TYPICAL TEST SET-UP, DETAIL SECTION