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MILITARY POTENTIAL TEST, COMPATIBILITY OF THE AUTOMATIC CLOSED---ETC(U)
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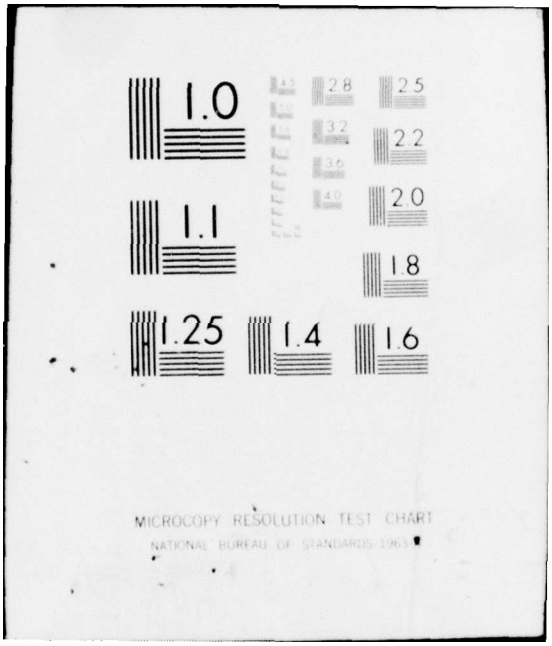
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DEPARTMENT OF THE ARMY
UNITED STATES ARMY AVIATION TEST BOARD
Fort Rucker, Alabama 36360

STEBG-TD (9) (6) JUN 28 1968

SUBJECT: (9) Final Report of Test, 'Military Potential Test, Compatibility of the Automatic Closed-Circuit Refueling System for CH-47( ) Helicopters,' USATECOM Project No. 4-7-0100-02

(11) 28 Jun 68

SEE DISTRIBUTION (12) 13p.

(16) USATECOM-4-7-0100-02

1. REFERENCES

a. Letter, STEBG-TD, US Army Aviation Test Board, 7 July 1966, subject: "Letter Report, 'Military Potential Test of Automatic Closed Circuit Refueling System for UH-1 Model Helicopter,' RDT&E Project No. _____, USATECOM Project No. 4-7-0100-01."

b. Letter, AMSAV-EAC/3-34, Headquarters, US Army Aviation Materiel Command, 10 March 1967, subject: "Military Potential Test, Compatibility of the Automatic Closed-Circuit Refueling System for CH-47 Aircraft," with 1st Indorsement, AMSTE-BG, Headquarters, US Army Test and Evaluation Command, 30 March 1967.

c. Letter, AMSAV-EAC/7-102, Headquarters, US Army Aviation Materiel Command, 31 July 1967, subject: "USATECOM Project No. 4-7-0100-01, Military Potential Test, Compatibility of the Automatic Closed-Circuit Refueling System for CH-47 Aircraft," with 1st Indorsement, AMSTE-BG, Headquarters, US Army Test and Evaluation Command, 4 August 1967.

d. Message, AMSAV-EAC-12-1301, Commanding General, US Army Aviation Materiel Command, 1 December 1967, subject: "USATECOM Project 4-7-0100-01, Military Potential Test, Compatibility of the Automatic Closed-Circuit Refueling System for CH-47 Aircraft."

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SUBJECT: Final Report of Test, "Military Potential Test, Compatibility of the Automatic Closed-Circuit Refueling System for CH-47( ) Helicopters," USATECOM Project No. 4-7-0100-02

e. Letter, STEBG-TD, US Army Aviation Test Board, 11 December 1967, subject: "Interim Report, 'Military Potential Test, Compatibility of the Automatic Closed-Circuit Refueling System for CH-47 Helicopter,' USATECOM Project No. 4-7-0100-02."

2. BACKGROUND

a. Open refueling is used for CH-47( ) helicopters. Refueling in this manner is hazardous because the fuel is subject to contamination, and fuel vapors emanating from the filler neck may become ignited. A suitable closed-circuit refueling system could provide safer refueling, eliminate contamination from external sources during refueling, and preclude the necessity of engine shutdown, thus, minimizing ground time.

b. The US Army Aviation Laboratories (USAAVLABS) developed a closed-circuit refueling system for the UH-1( ) helicopter. The US Army Aviation Test Board (USAAVNTBD) tested this system in FY 1967, found that it had military potential, and recommended that development be continued (reference 1a). USAAVLABS modified the helicopter-mounted components of the system to fit the CH-47( ) helicopter. On 30 March 1967, the US Army Test and Evaluation Command directed the USAAVNTBD to conduct a military potential test to determine compatibility with the CH-47( ) helicopter (reference 1b). The system was received for test on 3 May 1967. In July 1967, an automatic refueling nozzle assembly of different design than that used previously was received and incorporated into the test program (reference 1d).

3. DESCRIPTION OF MATERIEL The automatic closed-circuit refueling system consists of four units: filler-neck flange assembly, automatic shut-off nipple assembly, automatic shut-off refueling nozzle assembly with quick-disconnect socket, and conventional refueling nipple assembly. The first two items are installed on the helicopter. The automatic shut-off refueling nozzle is attached to the fuel supply hose and used on aircraft equipped with the closed-circuit system. The conventional refueling nipple assembly attaches to the automatic shut-off

refueling nozzle for use on aircraft or equipment which do not have the closed-circuit system installed. (A photograph of the system is attached as inclosure 1.)

4. OBJECTIVE To determine the compatibility of the automatic closed-circuit refueling system with the CH-47( ) helicopter and the maintainability and reliability of the new refueling nozzle.

5. SCOPE AND METHOD The USAAVNTBD conducted this Category II test at Fort Rucker, Alabama, from 5 May 1967 to 19 February 1968. Two refueling units were installed on one CH-47A Helicopter with an additional weight of four pounds and nine ounces. Four units were installed on each of two CH-47B Helicopters with a combined weight of nine pounds and two ounces. The conventional refueling nipple assembly was used to fuel the internal auxiliary tanks. Time to refuel using the closed-circuit refueling system was compared with that using the conventional refueling method. The automatic refueling nozzle assembly (~~reference~~ 1c) was installed on a standard Army 5,000-gallon tanker. To obtain reliability and maintainability data on the new automatic nozzle assembly, one refueling unit was installed on a 55-gallon drum, and the new automatic shut-off refueling nozzle was installed on a standard Army 1,200-gallon tanker. Two thousand five hundred and eighty refueling operations were conducted using the 55-gallon drum. The helicopter accumulated 1,283 flying hours during the test and was refueled 232 times with the closed-circuit system.

6. SUMMARY OF RESULTS

a. Weights and Dimensions. The dimensions and weights of the system components were:

	Length (in.)	Width (in.)	Height (in.)	Weight (lb.)	Weight (oz.)
Flange Assembly	5 5/8	4	4	1	10

	Length (in.)	Width (in.)	Height (in.)	Weight (lb.)	Weight (oz.)
Automatic shut-off nipple assembly	6 5/8	2	2	0	8 3/4
Dust cap	3 11/16	1 13/16	1 13/16	0	1 3/4
Automatic shut-off nozzle assembly	13 3/4	5 1/4	5 1/4	5	
Conventional nipple assembly	11	3 1/2	3 1/2	1	

b. Installation Requirements.

(1) One Multi-Engine Tandem-Rotor Helicopter Repairman (MOS 67U20) using an Aircraft General Mechanic's Tool Set and two eighteen inch pipe wrenches accomplished the installation.

(2) Procedures and time required for installation of one refueling system were:

	Time (man-min)
(a) Detach existing flange from helicopter.	2
(b) Install closed-circuit flange on helicopter.	3
(c) Remove standard nozzle from refueling hose.	2
(d) Install automatic shut-off nozzle on refueling nose.	2
Total	9

Installation instructions were not furnished. The helicopter-mounted flange assembly was marked for proper positioning. However, the assembly had to be turned 90 degrees to the right of its marked position so that, when the automatic shut-off nipple was installed, the sensing tube would be parallel to the fuel cell.

c. Operation Suitability.

(1) On the basis of sixty refueling operations for each, results of the time comparison between the conventional system and the closed-circuit system were:

(a) Conventional system - average 9.6 minutes; gallons pumped, 495.

(b) Automatic closed-circuit system - average, 10.6 minutes; gallons pumped, 432.

Actual fueling time was nine percent less with the conventional system.

(2) The pressures, flow rates, and whether automatic shut-off was obtained were:

Line Pressure (p.s.i.)	Flow Rate (g.p.m.)	Automatic Shut-Off
10	18	No
60	40	Yes
80	56	Yes

Maximum flow rate was 56 gallons per minute. Automatic shut-off would not function at line pressure of 18 p.s.i. and below.

(3) Fuel leakage did not occur during the connection, refueling, or disconnection during refueling operations.

(4) The position of the tanks and the nearly straight-up fuel tank opening prevented quick disconnect by helicopter lift-off, without notifying the ground crew. (Tests previously conducted on the UH-1( ) for quick break-away and ascents without notifying the ground crew were considered satisfactory.) The only method for quick disconnect and hose removal was for the refueler to actuate the quick-disconnect socket and remove the automatic refueling nozzle with hose from the helicopter.

(5) The automatic closed-circuit refueling system was safer as it eliminated all contamination and fumes emanating from the open filler neck that would occur during conventional refueling.

(6) By eliminating the necessity of engine shut-down, refueling was 40 percent faster with the closed-circuit refueling system than with the conventional system.

(7) Connecting the automatic shut-off refueling nozzle to the automatic shut-off nipple (on the helicopter) was difficult because of the nearly upright design of the fuel tank opening, the height above the ground, and the angle at which the supply hose attached to the refueling nozzle.

(8) If the valve on the refueling nozzle did not lock when opened, it could snap shut and, because of the closeness of the turn-on handle to the nozzle supply inlet, it could pinch fingers badly.

(9) The manual release button located on top of the automatic shut-off refueling nozzle had to be held in the UP position when the valve was opened to assure a positive turn-on and lock.

d. Maintainability and Reliability.

(1) No maintenance or instruction manual was furnished with the system.

(2) No scheduled maintenance was required during the test. Unscheduled maintenance required two man-hours.

(3) The system was easy to maintain, and faults could be located easily.

(4) The system was considered satisfactory from a human factor engineering standpoint with the exception of difficulty encountered in making the connection (paragraphs 6c(8) and 6c(9)).

(5) Repair part usage was as follows:

(a) Four seals, rubber, ring.

(b) One seal, socket assembly to nipple assembly.

(c) One automatic shut-off nipple assembly.

(d) Six sensing tubes.

(6) Maintenance could be performed at the organizational level by a Multi-Engine Tandem-Rotor Helicopter Repairman, MOS 67U20, using an organizational tool kit and one special tool. This tool, locally fabricated, was needed to dismantle and tighten the automatic shut-off nozzle socket assembly. (A sketch of the tool is attached as inclosure 2.)

(7) Four failures occurred in 232 aircraft refueling operations, resulting in a failure rate of one per 58 operations. No failures occurred during 2,580 refueling operations using the 55-gallon drum. The failure rate for the entire test was one per 703 refueling operations.

(8) The four failures required a total of two hours to repair, resulting in a Mean Time to Repair of 0.5 hour.

e. Deficiencies and Shortcomings. One deficiency and four shortcomings were discovered during the test and are listed in inclosure 3.

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SUBJECT: Final Report of Test, "Military Potential Test, Compatibility of the Automatic Closed-Circuit Refueling System for CH-47( ) Helicopters," USATECOM Project No. 4-7-0100-02

7. DISCUSSION During the military potential test of an automatic closed-circuit refueling system for UH-1( ) helicopters (USATECOM Project No. 4-7-0100-01), 20 connects, refueling, and disconnections were accomplished. No contamination from this operation was found.

8. CONCLUSION The automatic closed-circuit refueling system is compatible with CH-47A and CH-47B Helicopters.

9. RECOMMENDATIONS It is recommended that:

a. The deficiencies be corrected.

b. After correction of deficiencies, the automatic closed-circuit refueling system be service tested.

c. The possibility of using this system on other Army aircraft be investigated.

d. The shortcomings listed in inclosure 3 be corrected as technically and economically feasible.

FOR THE PRESIDENT:

3 Incls
as

H. R. NUTT
1LT, AGC
Adjutant

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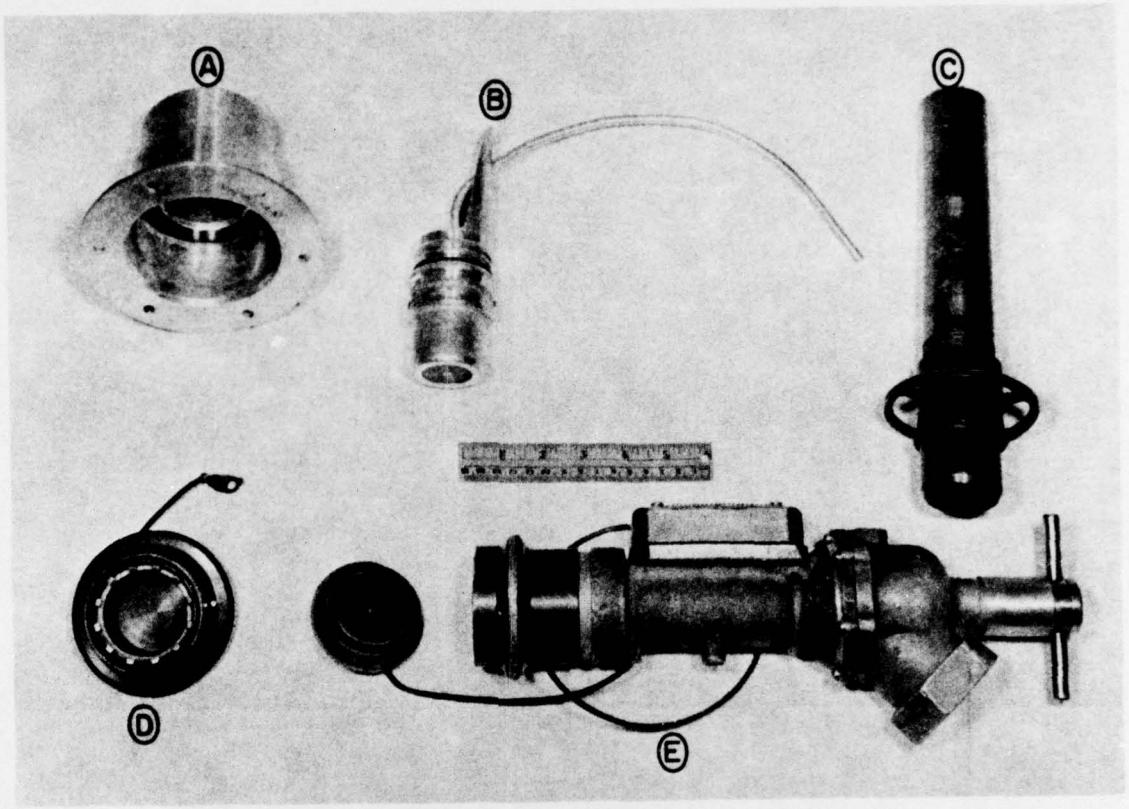
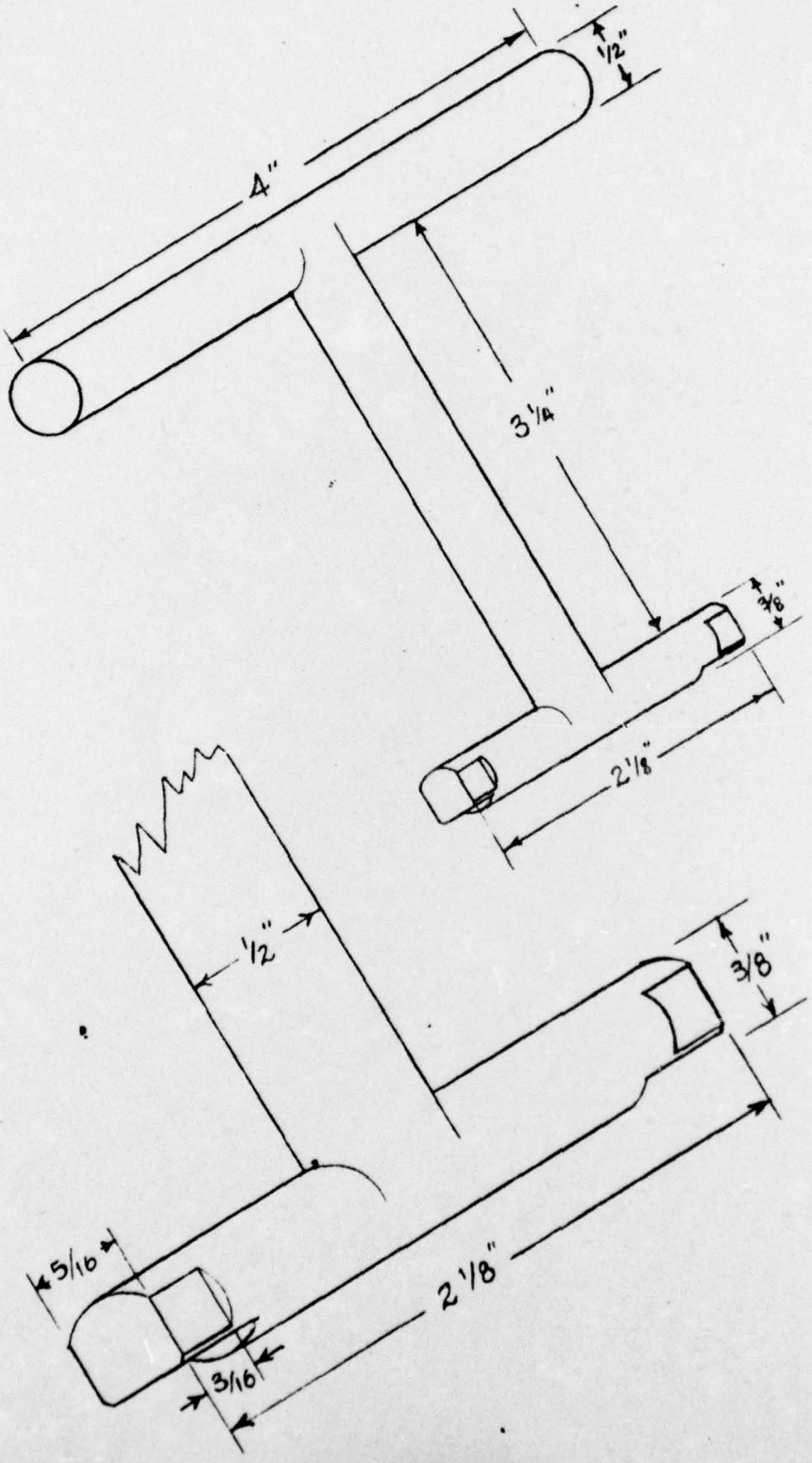


Automatic Closed-Circuit Refueling System

A. Filler-neck flange assembly.
B. Automatic shut-off nipple assembly.
C. Conventional refueling nipple assembly.
D. Dust cap.
E. Automatic shut-off refueling nozzle assembly.

INCLOSURE 1

DESCRIPTION OF SPECIAL TOOL



INCLOSURE 2

DEFICIENCIES AND SHORTCOMINGS

1. Deficiencies. The following deficiency was discovered during the test:

Deficiency	Suggested Corrective Action	Remarks
Special tool was not provided to remove or tighten the automatic shut-off nozzle socket assembly.	Provide special tool similar to that shown in inclosure 3.	None.

2. Shortcomings. The following shortcomings were discovered during the test:

Shortcoming	Suggested Corrective Action	Remarks
a. No maintenance package was furnished.	Provide maintenance package consisting of technical manuals, parts list, and spare parts.	None.
b. The inlet hose attachment to the automatic shut-off nozzle assembly is too close to the turn-on handle.	Increase the angle between the nozzle turn-on handle and the supply inlet from 45° to 75°.	None.
c. The sensing tube broke when bent to adjust liquid level in fuel tank.	Make the sensing tube from softer aluminum tubing.	None.
d. The manual release button located on top of the nozzle had to be held in the	Redesign the turn-on mechanism so that it will lock when the valve is turned on.	None.

Shortcoming	Suggested Corrective Action	Remarks
UP position while the refueling valve was being opened in order to lock the automatic shut-off nozzle open.		