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SMITHS INDUSTRIES INC CLEARWATER FL AVIATION DIV F/G 14/2
RELIABILITY AND MAINTAINABILITY IMPROVEMENT PROGRAM FOR THE AV—ETC(U)
MAY 80 R W LOWRIE N00019-77-A-0350

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NADC-78080-60-VOL-2

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FINAL REPORT
DISPLAY SET CONTROL
C10626/AVQ-30(V)

CDRL SEQUENCE #C001

Prepared By
Smiths Industries, Inc.
Aviation Division
Clearwater, Florida

Prepared For
Naval Air Systems Command
Washington, D.C.

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Report NADC-78080-60 Volume 2

Reliability and Maintainability Improvement Program for the AV-8A/TAV-8A
Harrier Head-Up Display Set, Modifications to Display Set Control,
C10626/AVQ-30(V)

Smiths Industries Inc.
Aviation Division
Clearwater, Florida

1 May 1980
Final Report

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Prepared for
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18. SUPPLEMENTARY NOTES This report (Volume 2) covers the DSC portion of the work done under the contract. Other reports (Volume 1 and Volume 3) cover the DDI and SDC portions respectively, of other tasks.			
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) (U) Head-up Display (U) V/STOL Aircraft (U) Displays			
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Modifications were made to the pilots control unit for the head-up display on the AV-8A aircraft, to improve reliability. The modifications consisted of a new toggle switch designed to resist breakage or bending of the toggle arm, and new assembly instructions to prevent loosening or loss of push button covers or threaded components.			

ENCLOSURE (1)

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S/N 0102-LF-014-6601

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ABSTRACT

This final report summarizes the modification performed on the Display Set Control (DSC), C10626/AVQ-30(V) a weapons replaceable assembly (WRA) in the Digital Data Display Set (DDDS), in the AV-8A/TAV-8A aircraft. Improvements in reliability are predicted through replacement of control toggle switches. Recommendations have also been provided for improved maintenance procedures.

Two DSC units have been successfully modified and tested as defined in 1st Article Test Report CDRL Sequence #C009, dated 7 February, 1980. Recommendations have been approved to retain the two modified units at the contractor's location for future flight tests.

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1. BACKGROUND/FUNCTION

- 1.1 The DSC, C10626/AVQ-30(V), mfg part no. 50-100-01, (Figure 1) is an integral WRA within the DDDS, AN/AVQ-30(V), part of the avionics aboard the AV-8A and TAV-8A aircraft. The DSC is a modification of the pilots control panel (PCP), 603CUF/2.
- 1.2 The DSC provides all the manual controls and switches for the Head-Up Display (HUD) Set. In addition, it contains five preset controls for the Digital Display Indicator (DDI) IP-1351/AVQ-30(V), and two switches for using the Built-In-Test features of the HUD set. These controls and switches are mounted on the rear of the metal front panel, and housed in a fiberglass rear cover.
- 1.3 The contract under which this work was done (#N00019-77-A-0350, Work Order WW04) has been closed out and certain work and data items transferred to Work Order WW07. This report is submitted under WW07 although it covers all of the work done on the DSC under WW04.
- 1.4 Considerable effort was expended in searching for an improved switch, with the criteria being form-fit-function, and greater strength of the toggle to resist bending. No U.S. sources were found after a thorough survey. The only source found was APEN in France, whose address is given in 2.2.

1.5 PURPOSE OF CONTRACT

- 1.5.1 The purpose of Contract Number N00019-77-A-0350-WW04 was to improve the reliability and maintainability of the DSC unit and DDDS System by increasing the unit's MTBF.

The current MFHBF* for the PCP is 400 hours. The predicted MFHBF for the modified PCP, designated DSC, is 1400 hours, an improvement factor of 3.42.

*Mean Flight Hours Before Failure

2. MODIFICATION OUTLINE

2.1 Modification of the existing Pilot's Control Panel (PCP) consisted of replacement of six toggle switches with an improved switch design. The new switches are electrically, environmentally, and mechanically interchangeable with the old switches, but contain a stronger (about 50%) non-rotating lever. The old lever bent easily and with rotation, was both unreliable in operation and ambiguous as to the toggle position. Two PCP's were modified under this contract.

The DSC is a form, fit, and functional replacement for the existing PCP.

2.2 The new switches used in the DSC are identified below:

SI Part No.*	Manufacturer's Part No.**	Description	Qty. per WRA
40-611-579	5636AD2-KG-30-X443	SPST switch	5
40-611-4021	5646AD2-KG-30-X443	DPDT switch	1

* Copies of the Smiths Industries drawings are included for reference.

**These switches are manufactured by APR/APEN, B.P. 1 Route de Toulouse, 82300 Caussade, France.

2.3 In addition to the above modification, a change was made to the assembly drawing of the DSC (50-100-01) to cement in place the built-in-test (BIT) switch covers and provide a thread locking compound for threaded components.

3. TESTING (Refer to First Article Test Report, CDRL Sequence #C009; Issue Date: 15 November, 1979; Revision Date: 7 February, 1980)

- 3.1 Tests and analyses performed on the two DSC units are defined in Data Item CDRL Sequence #C007, "Test Procedures"; Revision "A" Date: 2 October, 1979.

Part I: Performance and GSE Compatibility Tests Under Laboratory Conditions

Part II: Burn-In; not required because of original manufacture burn-in; also because units have already seen fleet service.

Part III: Performance Tests Under Simulated Environmental Conditions

Part IV: Interference Tests

A summary of the test results are given in Report CDRL Sequence #C009. All tests were completed satisfactorily.

- 3.2 Flight tests were run at NATC, 22-30 August 1979, with the SDC, DDI, and DSC installed. Eight flights were made totaling 7.7 hours with operation up to 35,000 ft., up to mach 0.85, with 7.5 g turns, and hovering. The performance of the DSC was fully satisfactory during these flights.

4. SUMMARY OF IMPROVEMENTS

- 4.1 The DSC switches are stronger, resist bending, and the toggle does not rotate.
- 4.2 The BIT switch covers are cemented in place to prevent accidental removal and loss.
- 4.3 The screws are secured with a thread locking compound to prevent loosening.
- 4.4 There is no change in weight, size, form, fit, or function.
- 4.5 The reliability of the DSC is improved from a performance, based on operating data, of 400 hours MFHBF to a predicted 1400 hours MFHBF.

5. CONCLUSIONS AND RECOMMENDATIONS

- 5.1 The DSC portion of the contract has been successfully completed by performing the modifications required to improve system reliability factors.

All unit testing has been satisfactorily completed and documented.

Recommendations have been made and approved to retain the two modified DSC units at SI Inc. for future laboratory, system, and flight tests of the HUD system.

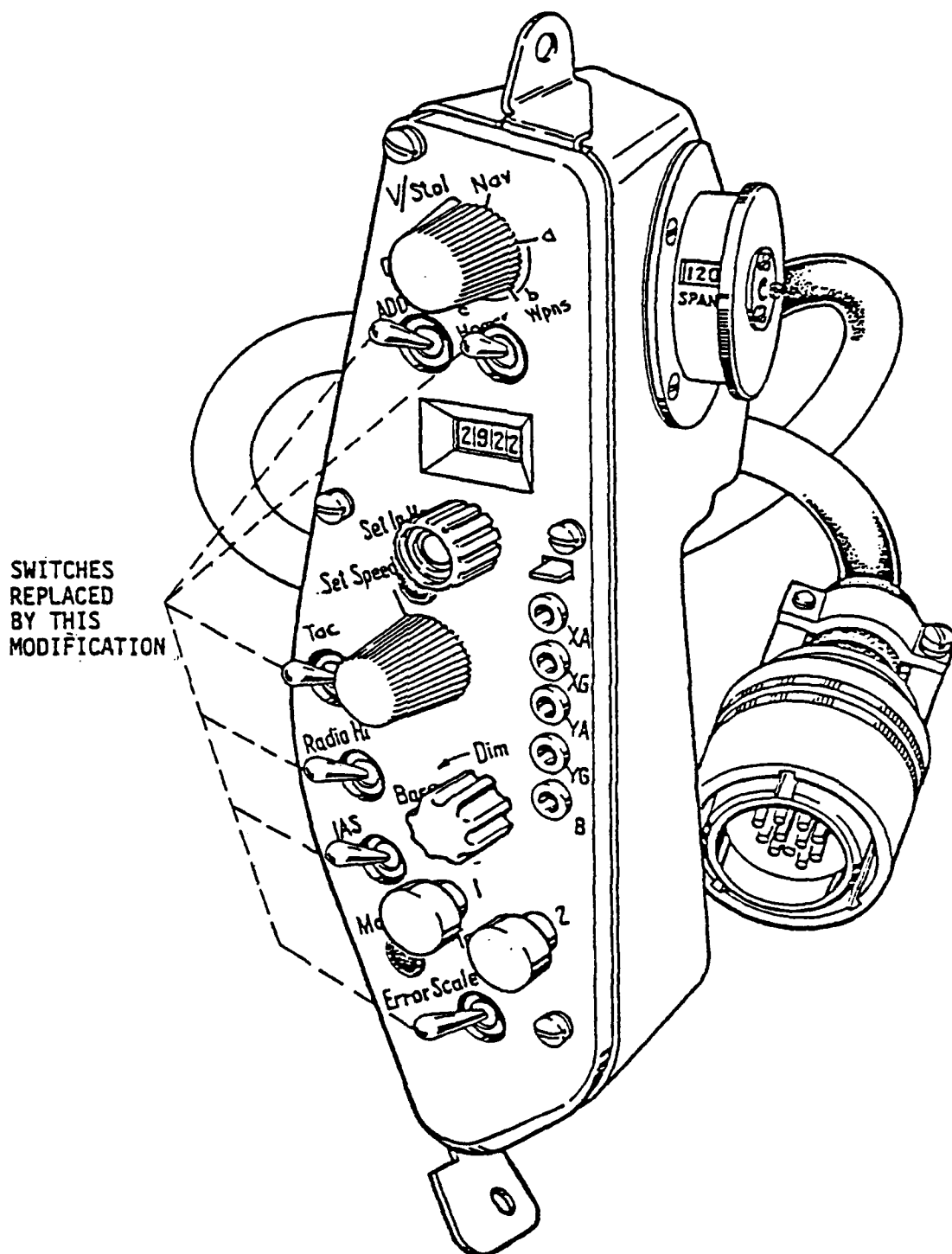


Figure 1. Display Set Control, Part No. 603 CUF/1
Redesignated as C10626/AVQ-30(V) When Modified



Figure 2. Stanley Set Control, #C10626, 7Q-30(V)

*INITIAL CONTACT RESISTANCE	10 m Ω MAX
DIELECTRIC STRENGTH	1K Vrms BETWEEN TERMINALS 2K Vrms BETWEEN TERMINALS & FRAME
*CURRENT/VOLTAGE RATING	10 μ A 5 Vdc, LOW LEVEL 300 mA, 30 Vdc, MAX 10 mA, 50 mVdc, MIN
LIFE EXPECTANCY WITH NOMINAL RESISTIVE LOAD	50,000 OPERATIONS (TYP)
MECHANICAL LIFE	100,000 OPERATIONS (TYP)
TEMPERATURE RANGE	-40 $^{\circ}$ C to +85 $^{\circ}$ C
STORAGE RANGE	-55 $^{\circ}$ C to +125 $^{\circ}$ C
OPERATING FORCE	0.2kg TYP
FUNCTION	ON - ON
INSULATION RESISTANCE	1,000 m Ω MIN @ 500 Vdc

***NOTES:**

1. OPERATION IS NOT GUARANTEED BELOW THE MIN AND LOW LEVEL CURRENT/VOLTAGE RATINGS.
2. FIGURES FOR INITIAL CONTACT RESISTANCE AND MIN/LOW LEVEL CURRENT/VOLTAGE ARE GUARANTEED PROVIDED THE MAX CURRENT/VOLTAGE RATING IS NOT EXCEEDED. (ABOVE THIS RATING THE GOLD FLASHING MAY BE DESTROYED).
3. IF LOW LEVEL OPERATION IS UNIMPORTANT, MAX RATING IS 3A 250 VAC/6A, 125 VAC.

SWITCH TOGGLES & DOLLIES SHALL BE MADE FROM A NON-MAGNETIC MATERIAL.

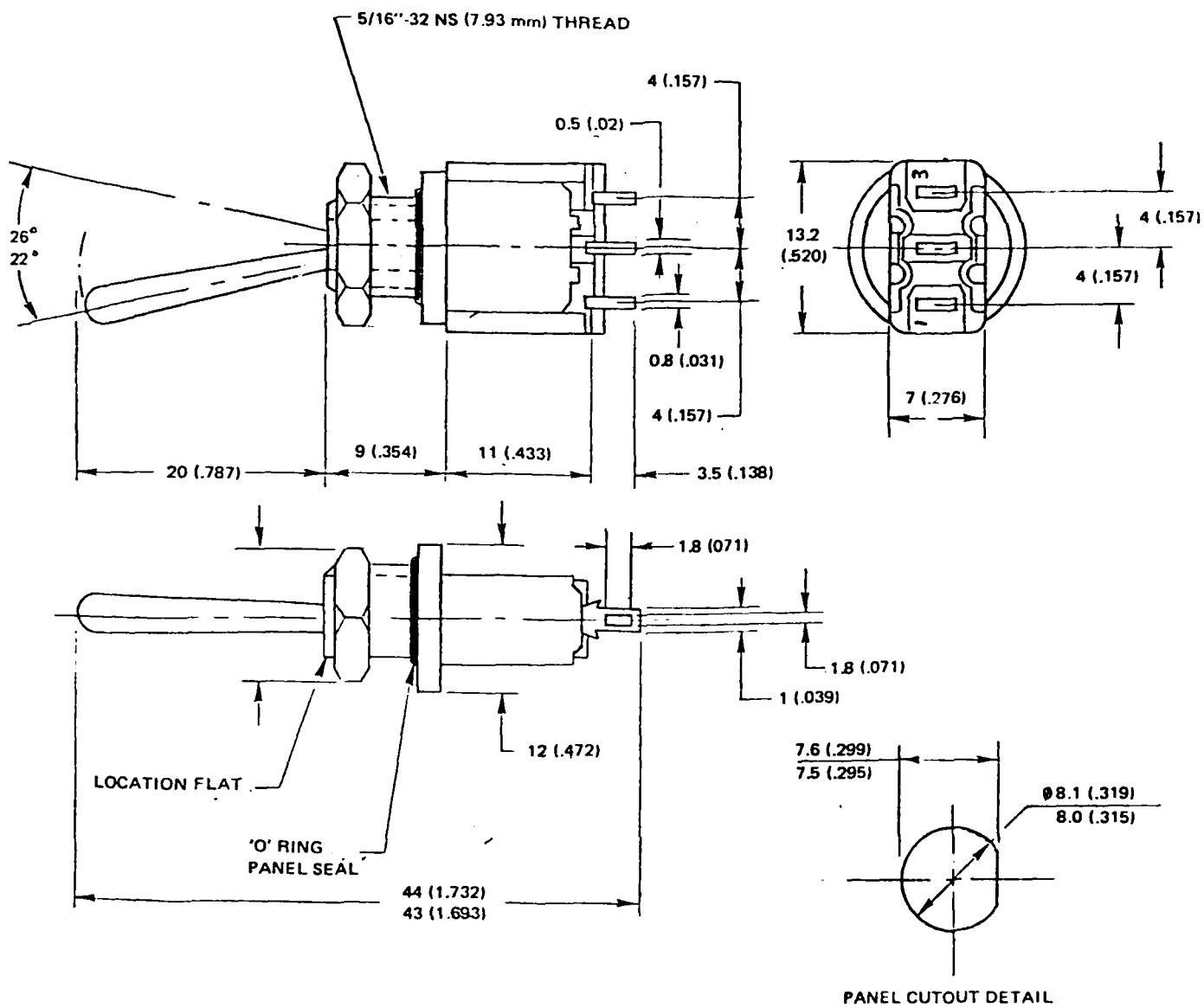
COMMERCIAL EQUIVALENT MANUFACTURED BY:

A.P.E.M.

REF NO. 5636AD2-KG-30-X443

RELEASED TO SMITHS DRAWING 40-611-579

26
22



DIMENSIONS: MM & (INCHES)
FINISH: MATT BLACK
CONTACTS: GOLD FLASH

9086

SWITCH, LEVER S.P., D.T.

*INITIAL CONTACT RESISTANCE	10 m Ω MAX
DIELECTRIC STRENGTH	1K Vrms BETWEEN TERMINALS 2K Vrms BETWEEN TERMINALS & FRAME
CURRENT/VOLTAGE RATING	10 μ A 5 Vdc, LOW LEVEL 300 mA, 30 Vdc, MAX 10 mA, 50 mVdc, MIN
LIFE EXPECTANCY WITH NOMINAL RESISTIVE LOAD	50,000 OPERATIONS (TYP)
MECHANICAL LIFE	100,000 OPERATIONS (TYP)
TEMPERATURE RANGE	-40°C to +85 °C
STORAGE TEMPERATURE	-55°C to +125°C
OPERATING FORCE	0.4kg TYP
FUNCTION	ON - ON
INSULATION RESISTANCE	1,000 m Ω MIN @ 500 Vdc

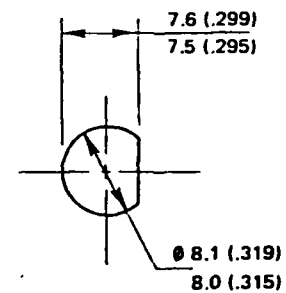
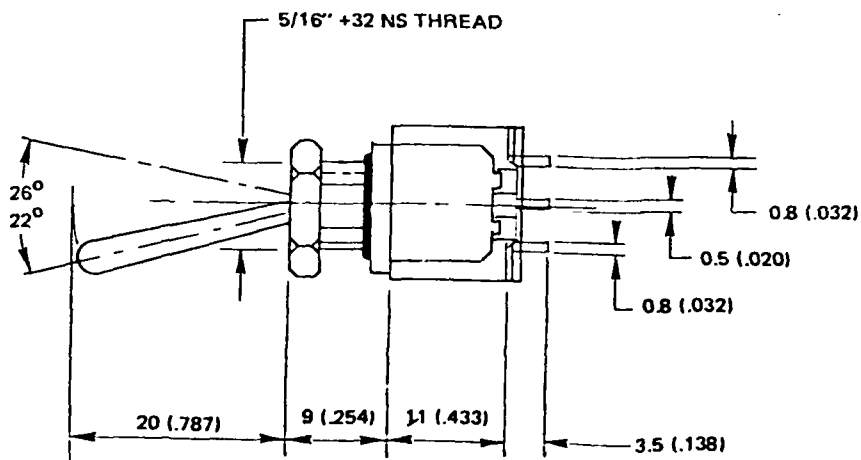
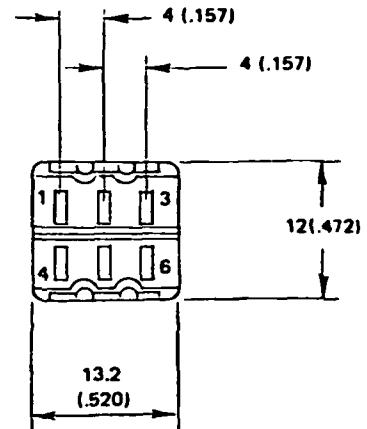
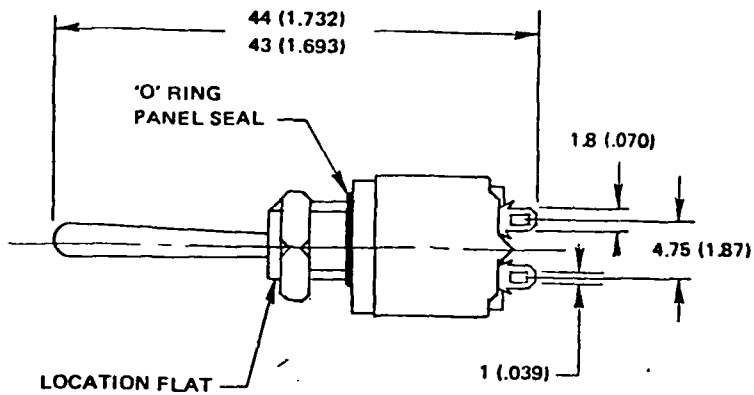
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3. IF LOW LEVEL OPERATION IS UNIMPORTANT, MAX RATING IS 3A 250 VAC/6A, 125 VAC.

SWITCH TOGGLES & DOLLIES SHALL BE MADE FROM A NON-MAGNETIC MATERIAL.

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A.P.E.M.
REF NO. 5646-AD2-KG-30-X443
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PANEL CUTOUT DETAIL

DIMENSIONS: MM & (INCHES)
 FINISH: MATT BLACK
 CONTACTS: GOLD FLASH

9087

SWITCH, LEVER D.P., D.T.