LEVEL II

QUALITATIVE MAINTENANCE EXPERIENCE HANDBOOK

20 OCTOBER 1975

(12) 567

(15) N00156-74-C-0159 new

Issued by:
Maintenance Policy and Engineering Division
Naval Air Systems Command
Washington, D. C. 20361

Prepared by:
Maintainability Engineering Group
Logistics Engineering Division
LTV Aerospace Corporation
Dallas, Texas

QUALITATIVE MAINTENANCE EXPERIENCE HANDBOOK

INTRODUCTION

PURPOSE:

The Qualitative Experience Handbook presents an assessment of the qualitative maintainability features of selected component installations in Navy fighter and attack airplanes. Rather than being an evaluation of the different airplanes, this survey identifies desirable and undesirable features evident in the various installations of the same component. In essence, it offers an opportunity to review the design treatment of components with significant maintenance histories. This data can therefore be used to apply the aggregate experience gained over a spectrum of designs and a broad span of years, when making decisions concerning future designs of similar components. It represents the qualitative impact of installation design on the man who must maintain the airplane.

SCOPE:

The handbook addresses only qualitative assessment of each component installation. No quantitative factors such as failure frequency have been considered. Rather than acknowledging installation trade-offs routinely made on the basis of maintenance frequency, the observers evaluated each component as if they were to replace all components in the airplane one time.

The components reviewed were limited to those items that had demonstrated significant maintenance requirements in the past. Survey of certain components was deferred because the tasks could be better evaluated by demonstration at a later date. The survey was limited to current Navy fighter and attack airplanes in fleet service.

IDENTIFICATION OF CANDIDATE COMPONENTS:

Maintenance data from the 3M data collection system was collected for the period of September 1973 through February 1974. This data was sorted against two parameters; frequency of maintenance and elapsed maintenance time. The top 80% of both lists were judged to be significant in both frequency and effort and, therefore, primary contributors to overall maintenance manpower costs. A total of 106 components were selected by the screening. Some of these items could not be evaluated adequately because of the configuration of the aircraft available at the survey sites. These items, including engines, engine mounted accessories and components, and ordnance items, were deferred for evaluation at a later date.

SITE SELECTION:

The survey was conducted at cognizant NARFs for each airplane. Selection of the NARFs as the site of the survey was dictated by the fact that the airplane panels are normally open for rework and the survey could be conducted with negligible disruption of maintenance. This survey could not have been conducted in an operational unit without considerable impact on the organization's operational stature. It is apparent, however, that the deferred items should be demonstrated, in the future, at an organizational maintenance unit. It is highly probable that these demonstrations can be done in conjunction with routine maintenance of the equipment and will require no extra effort for the benefit of the team.

CONDUCT OF THE PROGRAM:

A team, made up of two contractor personnel and two NASCREPLANT representatives, visited the NARFs and received assistance during the survey from appropriate NARF personnel. Highly qualified "guides" were assigned by the NARFs to locate components for the team and provide technical information. Observations were made at the airplanes in the rework facility.

Each component was viewed in its location; if possible, with adjacent components installed. If no aircraft with the equipment installed was available, the mounting space and equipment were viewed separately. Removal tasks were described by knowledgable NARF technicians. Since these tasks were merely to define the scope of work, no attempt was made to match the descriptions with procedures contained in the manual. The team was interested in the effort that was involved in each task and the problems presented to the mechanic.

Individual data sheets were initiated on each component observed. Each data sheet includes the analyst's opinions which are a consensus of opinion of all team members. These opinions reflect an evaluation of the installation, specific good or bad points considered relevant, and occasional additional information related to the equipment but not described in the body of the form. Typed copies of these data sheets are included in the handbook.

NARFs VISITED:

Aircraft studied at each NARF were as follows:

NARF Norfolk, Va.: A-6, F-8, F-14
NARF Cherry Point, N.C.: F-4, AV-8
NARF Jacksonville, Fla.: A-7
NARF Pensacola, Fla.: A-4

ARRANGEMENT OF THE HANDBOOK:

The basic information item in the handbook is the component analysis. This consists of a package of individual data sheets on a component for all

aircraft on which that item was observed and a summary sheet with a brief overview and descriptions of desirable and undesirable features found. It must be recognized that the summary is not a grade sheet and the balance between desirable or undesirable features does not indicate the relative merits of the component installation. An acceptable installation actually rates no comment unless it has an unusually meritorious feature. Undesirable features are identified for even acceptable installations. It will be normal, then, that undesirable features will outnumber desirable features. Identification of aircraft in the summaries is made only to describe the installation. Each summary is located at the beginning of a component package with the data sheets immediately behind.

The component packages are arranged in convenient systems groupings to facilitate use. The systems are tabbed for convenience. Edge marking assists in locating specific components.

The handbook is broken into two sections for convenience during use. Section I is the Mechanical Systems. Section II is the Avionics Systems.

TERMS USED IN THE HANDBOOK:

Generally, the terms used are those supplied by the NARF technicians who assisted in the program. Unless a term was otherwise inappropriate or confusing, it was not necessarily translated into standard or generic terms.

QUALITATIVE MAINTENANCE EXPERIENCE HANDBOOK

CONTENTS

SECTION I
MECHANICAL SYSTEMS

QUALITATIVE MAINTENANCE EXPERIENCE HANDBOOK

SECTION I, MECHANICAL SYSTEMS

CONTENTS

Rudder Actuator

TE Flap Actuator

Horizontal Stabilizer/Elevator

LE Flap Assembly

TE Flap Assembly

Aileron

Rudder

Spoiler Assembly

Pilot's Stick Grip

Power Plant Installation

Approach Power Compensator/Computer

Throttle Quadrant

Utility Systems

Cabin Temperature Control

Generator Control/Supervisory Panels

Internal Light Control Panel

Exterior Lights

Reservoir (PC or Flight Control)

Liquid Oxygen Converter

M61A1 Gun/Ammo Drum

AIRFRAME/COCKPIT SYSTEMS

COCKPIT CANOPY [redacted]

RADOME [redacted]

EJECTION SEAT [redacted]

CANOPY ACTUATOR [redacted]

SEAT ACTUATOR [redacted]

AIRFRAME/COCKPIT SYSTEMS

CONTENTS

COMPONENT	A-4	A-6	A-7	F-4	F-8	F-14	AV-8
Cockpit Canopy	11361	11122	12110	111B4	N/A	11111	12110
Radome	11112	11111	11120	11112	11121	11121	11110
Ejection Seat	12110	12110	12210	12230	12260	12111	12210
Canopy Actuator	11365	N/A	12126	12315	12141	12521	12123
Seat Actuator	12111	12142	12261	1223B	N/A	1211H	1221C

SYSTEM: 11 Airframe

NOMENCLATURE: Cockpit Canopy

WUC: A-4: 11361 A-6: 11122 A-7: 12110 F-4: 111B4

F-8: _____ F-14: 11111 AV-8: 12110

GENERAL OBSERVATIONS: The canopy removal and replacement varied in difficulty depending on size and weight as well as the type of egress system involved. All systems require egress safing.

DESIRABLE FEATURES: 1. The AV-8 canopy is very simple and, most of all light in weight. It can readily be removed by hand. 2. The A-6 and F-14 canopies had an excellent installation arrangement that allowed the canopy to be slid off of the track or hinge (respectively) without an additional disconnect step. 3. The A-7 canopy and the aft canopy in the F-4 have sufficient overtravel after disconnect of the actuator to allow seat removal. 4. Use of eccentrics such as in the A-7 simplifies canopy rigging.

UNDESIRABLE FEATURES: 1. The F-4 hinge point fasteners are difficult to reach and requires special positioning of the canopy. Disengagement from the hinges is also a tedious job requiring jockeying about of the canopy. 2. The A-7 canopy removal is a complex task requiring accounting for shims and eccentrics. 3. All canopies except the AV-8 required external access to remove. The A-6 was easiest with only 4 camlocks to open. The others involved 20 to 50 screws.

SYSTEM: 11 Airframe

NOMENCLATURE: Cockpit Canopy

ADDITIONAL REMARKS: 1. Both inflatable and non-inflatable cabin pressure seals are used. The inflatable seals reduce criticality of canopy rigging but are subject to wear and tear. Significant cabin pressure problems result from relatively minor seal damage. The non-inflatable seals require less care but canopy rigging is more critical. 2. The AV-8 aircraft has mild detonating cord (MDC) canopy glass breakers which provide additional hazard in canopy handling. The AV-8 MDC system is totally self contained in the canopy and is mechanically initiated by the seat. This is convenient but proper safing is essential. 3. The AV-8 canopy is interconnected with the lower cockpit step. A step malfunction or "belly-in" condition will prevent canopy opening. The F-8 canopy installation was not observed.

WORK UNIT CODE 11361 ITEM CANOPY AIRCRAFT A-4M

LOCATION: Upper Forward Fuselage

SUPPORT EQUIPMENT: Transportation dolly Nitrogen cart.
Jury strut

ACCESS: Fairings on canopy and on fuselage. Total 19 screws.

REMOVAL:
1. Open canopy, install jury strut
2. Remove fairing from canopy
3. Remove fairing from aircraft
4. Disconnect seat/canopy interlock cable
5. Disconnect electrical line cannon plug
6. Disconnect canopy seal line
7. Bleed pressure from bungee cylinder
8. Disconnect cylinder rod from canopy (1 bolt)
9. Detach hinge fittings (2 bolts)
10. Remove canopy and jury strut

INSTALLATION:
1. Reverse of installation
2. Service bungee cylinder

FUNCTIONAL CHECK: Latch engagement
Canopy seal and line for leaks
Cabin pressurization check

TEST EQUIPMENT: Cabin pressure checker

CLOSE UP: Reinstall fairings

ANALYST'S OPINION: This is a good installation. Tasks are simple with good access. The use of an inflatable canopy seal requires special care in handling to prevent puncturing of the seal. An inflatable seal reduces criticality of canopy positioning but requires additional maintenance to replace worn/punctured seals.

WORK UNIT CODE 11122 ITEM Cockpit Canopy AIRCRAFT A-6

LOCATION: Forward Fuselage Over Cockpit

SUPPORT EQUIPMENT: Canopy sling.
Overhead hoist.
Transportation dolly.

ACCESS: 2 Panels (2 camlock fasteners each)

REMOVAL:
1. Remove one $\frac{1}{4}$ inch screw from top of canopy center line.
2. Remove one electrical connector.
3. Open right canopy access by loosening two camlock fasteners.
4. Pull "T" handle to remove pip pin securing actuator rod end to canopy.
5. Install sling and support weight of canopy with crane.
6. Pull canopy aft on track until it slides off track.
7. Remove canopy with sling and replace on dolly.

INSTALLATION: Reverse of removal.

FUNCTIONAL CHECK: Cycle canopy with external test stand, handpump, or by running engine. Perform pressurization check.

TEST EQUIPMENT: External hydraulic power
Cabin pressure checker

CLOSE UP: Reinstall panels.

ANALYST'S OPINION: Except for the requirement for the support equipment sling, this canopy is very easy to remove. The $\frac{1}{4}$ inch screw is removed to allow inserting screw which is a part of the sling. When the "PIP PIN" is removed, canopy can be supported with sling and merely slid back off of the track and removed from the aircraft.

WORK UNIT CODE 12110 ITEM CANOPY ASSEMBLY AIRCRAFT A-7

LOCATION: Upper Forward Fuselage

SUPPORT EQUIPMENT: 40° support strut
Canopy sling
Hoist
Nitrogen supply (installation only)
Workstand

ACCESS:
Counterbalance access panel (50 screws) (restricted panel)

REMOVAL:
1. Open canopy, install strut.
2. Deservice counter balance cylinder.
3. Close canopy.
4. Remove access.
5. Disconnect actuator & bungee (1 bolt)
6. Remove pivot nuts (2), strikers (2), washers and spacers (Keep track of location of washers and spacers).
7. Install sling.
--Caution--Do Not Disturb Eccentrics When Removing Pivot Bolts.
8. Remove pivot bolts and washers (Note: Bolts serialized).
9. Lift canopy.

INSTALLATION:
1. Reverse removal process.
2. Trim canopy as needed

(See continuation sheet)

FUNCTIONAL CHECK: Open, close, and latch check
Cabin pressurization check

TEST EQUIPMENT:
Cabin pressure checker

CLOSE UP: Replace access panel.

ANALYST'S OPINION: Canopy replacement is rather complex. Too may loose parts have to be preserved in the order or orientation of removal. Canopy latch rigging is critical. The airconditioning seal is difficult to position. The canopy eccentrics make adjustment of the canopy to the airframe easier than many canopy installations. Ammodrum access panel must be installed before the counterbalance access panel is removed.

CONTINUATION SHEET:

WORK UNIT CODE 12110 ITEM CANOPY ASSEMBLY AIRCRAFT A-7

INSTALLATION: (Continued)

3. Adjust & rig canopy latching mechanism
4. Adjust airconditioning "donut" seals
5. Reservice counterbalance cylinder

WORK UNIT CODE 111B4 ITEM Moveable Canopy AIRCRAFT F-4

LOCATION: Top of fuselage two canopies one for each cockpit

SUPPORT EQUIPMENT: Sling and hoist
Safety strut

ACCESS: Aft canopy requires removal of 2 panels (25 screws each)

REMOVAL:

FWD:

1. Open canopy and install strut
2. Remove canopy interlock block (1 ball lock pin)
3. Remove electrical connector (AFC 506)
4. Remove nuts from hinge point
5. Install sling, remove safety strut
6. Disconnect actuator attachments (2 nuts, bolts, and bushings)
7. Place selector in "close" to retract actuator
8. Lower canopy about 20° and remove hinge bolts
9. Remove canopy

(See continuation sheet)

FUNCTIONAL CHECK: Raise and lower canopy
Cockpit pressurization check

TEST EQUIPMENT: Cockpit pressurization checker

CLOSE UP: Aft: install accesses

ANALYST'S OPINION: This is a rather difficult installation. Access to the hinge nuts is hard in both forward and aft locations. The canopy must be positioned specifically to allow this access. Removal from the hinge points is tedious and requires jockeying of the canopy, actuation of the canopy to disengage the actuator is not desirable from the standpoint of expenditure of air, hazard to personnel, and the extra task.

CONTINUATION SHEET:

WORK UNIT CODE 111B4 ITEM Moveable Canopy AIRCRAFT F-4

REMOVAL: (Continued)

AFT:
3. Remove strut, actuate canopy closed
4. Remove accesses
5. Open canopy, install sling
6. Disconnect actuator
7. Retract actuator
8. Lower canopy to gain access to hinge nuts and cotter pins
9. Remove hinge nuts
10. Remove bolts
11. Remove canopy

INSTALLATION:
1. Reverse of removal
2. Rig latches

WORK UNIT CODE 11111 ITEM Canopy Assy. AIRCRAFT F-14

LOCATION: Forward, Top fuselage

SUPPORT EQUIPMENT: Sling
Hoist
Dolly

ACCESS: 1 access (19 stress panel fasteners)

REMOVAL:
1. Remove 2 lanyards (2 screws; 1 bolt)
2. Disconnect canopy seal quick disconnect
3. Install sling
4. Disconnect pneumatic actuator (1 bolt)
5. Raise canopy to 60° angle - releases itself
6. Remove canopy

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Cabin pressurization check
Operate canopy

TEST EQUIPMENT: Cabin pressure checker

CLOSE UP: Install access

ANALYST'S OPINION: This is a good installation. Canopy removal is simple, inhibited only by the weight and size of the canopy. A clever method of connecting the canopy to the hinge allows it to release itself when opened beyond 60°. This not only simplifies removal, but eliminates the complexity of an additional device to release the canopy during ejection. Allowing the canopy to overtravel also allows the canopy actuator to move full stroke. This permits safe disconnect of the actuator without requiring deservice of the airbottle.

WORK UNIT CODE 12110 ITEM Cabin Hood Assembly AIRCRAFT AV-8

LOCATION: Forward Fuselage Top Side

SUPPORT EQUIPMENT: Work Stand

ACCESS: Open canopy

REMOVAL:
1. Release 3 cables (hooks ea. side, cotter pin in rear)
2. Remove 2 bolts (one ea. side)
3. Roll canopy back and remove

INSTALLATION:
1. Reverse of removal
2. Adjust air conditioning seal
3. Rig canopy brake

FUNCTIONAL CHECK: Cabin pressurization check

TEST EQUIPMENT: Cabin pressure checker

CLOSE UP: Close canopy

ANALYST'S OPINION: This is a lightweight, simple installation. The detonating cord system is totally contained in the canopy requiring no disconnects during removal. The lower cockpit step extends automatically during canopy opening and a step malfunction will likewise prevent canopy opening.

SYSTEM: 11 Airframe

NOMENCLATURE: Radome

WUC: A-4: 11112 A-6: 11111 A-7: 11120 F-4: 11112

F-8: 11121 F-14: 11121 AV-8: 11110

GENERAL OBSERVATIONS: Generally, the radomes are large and high off the ground. In most cases, a jury strut is required to support the radome when open. The largest radomes on the A-6, F-4, and F-14 have slings to help removal because of bulk and weight. In some cases, antennas or other components are mounted in the radome.

DESIRABLE FEATURES: 1. In most cases, latching mechanisms are simple and quickly opened. The F-14 single latch is excellent. 2. Except for the AV-8, removal tasks are kept simple and require no additional access. 3. Slings are provided when size dictates the need for extra help. 4. The A-6 radome is hydraulically opened and has several alternate methods of power to accommodate the maintenance situation. 5. The A-7 jury strut is attached permanently to the radome.

UNDESIRABLE FEATURES: 1. Jury struts are not integral with the radome or mating structure in several cases. Loss of struts occurs and they are often tricky to install. A radome latch open mechanism would be preferable. 2. Mounting of other antennas or unassociated components in the radome causes extra maintenance effort and risk. These items should be airframe mounted and the radome function only as a fairing. 3. The AV-8 radome is unsatisfactory. It requires a special

SYSTEM: 11 Airframe

NOMENCLATURE: Radome

UNDESIRABLE FEATURES: (Cont.)

wrench to open, has pitot/static lines routed through it as well as several other components mounted in it, and requires prior removal of 7 access panels. The nose reaction nozzle is in the way of removal and it must be positioned properly with the control stick.

ADDITIONAL REMARKS: It was noted that the F-4 radome had a sharp metal point which is quite effective in reducing rain erosion, one of the more common causes of radome removal. Blunt noses such as the A-7 and A-6 are more vulnerable to rain damage. All radomes are designed to serve their function of covering the radar dish and, except for the AV-8, provide quick access to components mounted inside. Radome maintenance is complicated by the electrical transparency requirements which make them a more complex problem than is obvious on observation.

WORK UNIT CODE 11112 ITEM RADOME AIRCRAFT A-4M

LOCATION: Nose of Aircraft

SUPPORT EQUIPMENT: Work stand

ACCESS: No access required

REMOVAL:
1. Open radome- 2 latch fittings
2. Remove attaching bolts from pivot at top of radome
3. Lift off

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Check mechanical alignment

TEST EQUIPMENT: None

CLOSE UP: None required

ANALYST'S OPINION: This is a good installation. The radome is easy to remove. However, it is sufficiently high enough to require the average worker to use a workstand which is considered a drawback. Other than this, it is a good design.

WORK UNIT CODE 11111 ITEM Radome AIRCRAFT A-6

LOCATION: Nose of Aircraft

SUPPORT EQUIPMENT: Sling to hold and support radome. Jury strut.
Transportation dolly.
Overhead crane.

ACCESS: None

REMOVAL:
1. Remove 2 bolts on each side of radome.
2. Release radome latch.
3. Open radome (can be opened by electrically driven pump, handpump in wheel well, or handpump in cockpit.)
4. Install jury strut.
5. Attach sling to radome.
6. Remove rod end attach bolt securing actuator to radome.
7. Remove bolts from hinge torque tube.
8. Remove radome with sling.
9. Place radome on transportation dolly.

INSTALLATION:
1. Reverse of removal.
2. Check fits of radome.

FUNCTIONAL CHECK: Cycle radome with hydraulic system.

TEST EQUIPMENT: None

CLOSE UP: None

ANALYST'S OPINION: Radome should have mechanical lock open latch in addition to the hydraulic lock to hold the canopy open. A latch would eliminate the need for a jury strut. The jury strut was not stowed in the radome, but should have provisions for storing one. Alternate sources of opening radome are convenient to have especially when the nose wheel well hand pump handle gets lost. This redundancy, however, does add weight because of the additional plumbing required. The handpump handle in the nose wheel should possibly be made a permanent part of the handpump assembly.

WORK UNIT CODE: 11120 NEW Redome AIRCRAFT A-7

LOCATION: Nose of Aircraft Above Engine Inlet Duct

SUPPORT EQUIPMENT: Work stand to reach radome.

ACCESS: None

REMOVAL:

1. Release or loosen one dzus fastener on each side securing cver center latch handle in the stowed position.
2. Open each handle aft until handle latches to open position.
3. Rotate locked handle forward so that oval shaped eyebolt disengages hook in radome.
4. Raise radome and rotate curved jury strut from radome. and align jury strut clevis with fitting located on fuselage frame.
5. Install pip pin to attach jury strut to frame so that radome will be held in open position.
6. Remove 3 radome hinge compression springs.
7. Remove 3 nuts, washers, and bolts holding hinge pin halves together.
8. Remove pip pin securing jury strut and lower radome.
9. "Jockey" assembly to one side or the other so that hinge pin will slide in slots of fuselage hinge half so that one or the other hinge pin half can be disengaged.

(See continuation sheet)

FUNCTIONAL CHECK: None

TEST EQUIPMENT: None

CLOSE UP: None

ANALYST'S OPINION: Radar hinge arrangement is functionally simple, but requires manipulation both to engage or disengage hinge pin halves with radome and fuselage hinge halves. The consequences are possible damage to radome during removal and installation. Also, when radar dish is present, there is a very good chance that something on the dish could be damaged. This is because the technician has to stand on the work stand directly in front of the dish. Removal during gusting winds will necessitate having additional assistance from other personnel to preclude losing a radome to the wind. The jury strut fitting attached to the radome is attached to a fiberglass channel which appears to flex readily if care is not

(See continuation sheet)

CONTINUATION SHEET:

WORK UNIT CODE 11120 ITEM Radome AIRCRAFT A-7

REMOVAL: (Continued)

10. Disengage other hinge pin and remove radome.

INSTALLATION: Reverse of removal.

ANALYST'S OPINION: (Continued)

exercised when stowing or unstowing the strut. Strut swivels at radome attach fitting which allows jury strut rotation for stowing and unstowing. In the stowed position, the pip pin attached to the clevis end of strut is used to lock strut in stowed position. Pip pin is hard to engage in stowed position, but quite possibly gets looser with usage. The radome overcenter latch requires a double action to disengage the attach hook on radome. If, for example, the dzus fastener either fails or is inadvertently not secured, the latch handle will remain closed in the stowed position; or, in worst case, only unstow in flight. Total disengagement requires that handle be rotated forward. This feature seems like a good redundant safety feature.

WORK UNIT CODE 11112 ITEM Radome AIRCRAFT F-4

LOCATION: Nose

SUPPORT EQUIPMENT: Sling and hoist

ACCESS: None

REMOVAL:
1. Open radome ($\frac{1}{4}$ sq drive jacking bolt - 4 places)
2. Install sling and support weight
3. Remove pitot line (1 connector)
4. Disconnect coax lead (1 connector)
5. Remove hinge pins and radome

INSTALLATION:
1. Reverse of removal
2. Trim new radome to get proper seal fit

FUNCTIONAL CHECK: Pitot static check
Check APN-154

TEST EQUIPMENT: Electrical power
Pitot static checker

CLOSE UP: None

ANALYST'S OPINION: This is a very large radome and requires a sling for handling. A bulb seal is used at the contact point with the fuselage requiring a critical trimming during installation of a new radome. Mounting the APN-154 antenna in the radome requires disconnect of the coaxial cable and additional checkout tasks.

WORK UNIT CODE 11121 ITEM Radome AIRCRAFT F-8J

LOCATION: Nose of Aircraft

SUPPORT EQUIPMENT: Work stand.

ACCESS: None

REMOVAL:
1. Fully open radome.
2. Install jury strut.
3. Disconnect pitot heat line.
4. Pull quick release pin.
5. Remove radome.

INSTALLATION: Reverse of removal.

FUNCTIONAL CHECK: None required.

TEST EQUIPMENT: None required.

CLOSE UP: None

ANALYST'S OPINION: Radome opens upward requiring that jury strut be installed to hold radome open. Jury strut has to be removed from stowed position in radome and installed in hole in radome and nose structure to hold radome open and removed and stowed in radome when it is closed. The jury strut frequently gets misplaced or lost and is a nuisance from this standpoint. Future designs on radomes this size should incorporate a latch or locking device to hold radome in open position. If a jury strut is used, it should not be separable from the radome so that it will not be lost.

WORK UNIT CODE 11121 ITEM Radome AIRCRAFT F-14

LOCATION: Nose

SUPPORT EQUIPMENT: Sling and hoist
Jury Strut

ACCESS: None

REMOVAL:
1. Unlatch (handle under nose) radome
2. Push radome up, install jury strut
3. Install sling
4. Remove actuator (1 bolt)
5. Open coax connector
6. Remove hinge bolts (2)
7. Remove radome

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: None

TEST EQUIPMENT: None

CLOSE UP: None.

ANALYST'S OPINION: Except for size, this radome is easily removed. It has the disadvantage of being 6 feet off the ground. The radome latching mechanism includes a single large latching handle conveniently located on the right hand side of the nose. If the radome is not latched, the handle cannot be stowed and serves as a very obvious signal to that fact. The requirement to disconnect the coax cable introduces a risk to a system that is not involved in the maintenance being performed.

WORK UNIT CODE 11110 ITEM Nose Cone Section Structure AIRCRAFT AV-8

LOCATION: Nose

SUPPORT EQUIPMENT: Special spanner wrench

ACCESS: 1 Panel (9 screws)
4 Panels (2 screws)
1 Panel (8 screws)
1 Panel (11 scews)

REMOVAL:
1. Disconnect pitot and static lines
2. Remove cannon plug (1)
3. Disconnect 4 special mount bolts
4. Pull back on stick in cockpit to position reaction nozzle shutter to clear
5. Remove radome

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Pitot/Static check
Camera function check

TEST EQUIPMENT: Pitot/Static Checker
Electrical Power

CLOSE UP: Install panels

ANALYST'S OPINION: This is definitely a bad installation. In spite of its small size, which should make removal easy, it has been complicated by the inclusion of several components mounted to the radome interior. Further, routing of pitot/static lines to the radome requires disturbance of an essential instrument system. Too many access panels must be removed (seven panels held on with 36 screws). A man is required to move the stick to position the nozzle to clear the canopy during removal. Finally, it is hard to justify requiring a special wrench to perform the removal task. Overall, this has to be considered the worst radome installation among the aircraft surveyed.

SYSTEM: 12 Fuselage Compartments

NOMENCLATURE: Ejection Seat

WUC: A-4: 12110 A-6: 12110 A-7: 12210 F-4: 12230

F-8: 12260 F-14: 12111 AV-8: 12210

GENERAL OBSERVATIONS: The seat installations depended more on seat design than airframe factors. In most cases, the canopy had to be removed first. Personnel hazard from various munitions items used in seat function and the criticality to pilot safety require specialists in handling of the seat. Seat safing procedures are required on all seats and are not detailed.

DESIRABLE FEATURES: 1. The A-7 seat and rear seat of the F-4 can be removed without prior canopy removal. This reduces task effort considerably. 2. The A-7 seat is light enough to remove without a sling. 3. Generally, attachments and connectors are accessible with a few exceptions in the F-4 and AV-8. 4. The A-4 has a removal procedure decal which is a helpful reminder if it is kept current with changes to the seat or removal procedures.

UNDESIRABLE FEATURES: 1. Except for the A-4 and A-7, the seats are heavy and difficult to handle. This is specially true of Martin-Baker seats. 2. The seat installation in the F-4 and AV-8 have some disconnects that are difficult to reach. 3. Two potential safety hazards exist in the AV-8: difficulty in disconnecting the LOX block can result in energizing the bailout bottle and no safety pin is available for the drogue gun. 4. The F-14 rocket motor is removed with the seat

SYSTEM: 12 Fuselage Compartments

NOMENCLATURE: Ejection Seat

UNDESIRABLE FEATURES: (Cont.)

and must be transferred to the new seat or stored awaiting return of the original seat. A storage and handling problem exists.

ADDITIONAL REMARKS: The ejection seat is a very special item which usually functions only once in the life of the airplane. It should remain undisturbed in the airplane until preventive maintenance is to be performed on it then should be easily and quickly removed. It has several critical interfaces with the rest of the egress system which should be conveniently located. Components of other systems should not be located so that seat removal is required for access. This is not always accomplished in the installations studied. Primarily, however, the details of seat installation and interface are determined by the seat designer who is concerned with proper function rather than the airframe designer who locates it in the cockpit.

WORK UNIT CODE: 12110 ITEM Ejection Seat AIRCRAFT A-4M

LOCATION: Cockpit

SUPPORT EQUIPMENT: Sling
Hoist
Transportation dolly
Jury Strut
Nitrogen servicing equipment

ACCESS: Must remove canopy.

REMOVAL:
1. Install Safety Pins
2. Disconnect Lanyards
3. Remove Parachute and Survival Kit
4. Disconnect Inertial Reel Hose
5. Disconnect Sequencing System Hoses
6. Remove Firing Mechanism Cover
7. Disconnect Seat From Catapult (1 bolt)
8. Attach Sling
9. Lift From Aircraft

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Pull test to check frictional load on seat.

TEST EQUIPMENT: Scale for pull test.

CLOSE UP: Install canopy, service bungee cylinder, test canopy seal.

ADDITIONAL REMARKS: Except for need to remove canopy, this as a good installation. Ejection seat maintenance is so critical to pilot safety that removal and installation should not be inhibited by a major task like canopy removal. It was noted that the A-4 has a decal that lists canopy/seat removal procedures. This is a good memory aid for trained personnel. It can be counterproductive if it is allowed to become noncurrent or if someone tries to substitute it for use of the manual.

WORK UNIT CODE: 12110 ITEM MKGRU5 EJECTION SEAT AIRCRAFT A-6

LOCATION: Cockpit

SUPPORT EQUIPMENT:
- Sling
- Overhead crane
- Transportation dolly
- Hand wheel
- External electrical power

ACCESS: Canopy has to be removed to gain access to ejection seats.

REMOVAL:
1. Remove canopy.
2. Attach sling to seat with four pip pins (two on top and two on bottom)
3. Remove 2 pip pins for the leg restraints.
4. Remove seat ordnance.
5. Remove quick-release for life support equipment.
6. Disconnect electrical disconnects.
7. Install hand wheel to unlock seat from rail.
8. Hoist seat from rail and place on transportation dolly. (Ejection gun remains with aircraft)

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform pull force check on face curtain and handle. Check operation of seat position motors.

TEST EQUIPMENT: Force scale (fish scale type)

CLOSE UP: Replace canopy

ADDITIONAL REMARKS: Seat fore & aft seat adjust motor were reported to be unreliable and hard to remove and replace on one seat. No other undesirable characteristics were noticed.

WORK UNIT CODE 12210 ITEM Ejection Seat Assembly AIRCRAFT A-7

LOCATION: Cockpit

SUPPORT EQUIPMENT: 72° strut
40° strut
DART cover
Spring scale (0-150 lb. ft.)

ACCESS: Open canopy & install 40° strut
(deflate and disconnect counter balance cylinder, remove strikers)
(disconnect radiation shield hoses (2) & microswitch (3 screws)
Install 72° strut

REMOVAL:
1. Gain access and safety seat for removal.
2. Remove parachutes and survival kit.
3. Disconnect DART lanyard quick release pin under forward edge of seat pan
4. Push radiation shield up 6-8 inches to clear seat
5. Remove cover from top of seat (6 screws)
6. * Disconnect seat from rocket (1 bolt on top aft of seat).
7. Lift seat up rails until clear

* Subsequent to ACC 236, remove flex line from top of rocket

INSTALLATION: Reverse of removal procedure

FUNCTIONAL CHECK: Perform go-no go check when rails engaged
Check seat alignment, side play

TEST EQUIPMENT: None

CLOSE UP: Install 40° strut, hookup counterbalance and service, install strikers, hookup radiation shield hoses and microswitch, adjust microswitch

ANALYST'S OPINION: Notable in this installation is the ability to remove the seat without prior removal of the canopy. This saves a great deal of time and effort. The 72° strut holds the canopy securely out of the way and the small investment of effort required to disconnect the counterbalance and radiation shield to allow sufficient motion is more than repaid. Seat removal is fairly normal for ejection seats with the usual cautions and warnings. The seat is comparatively light weight.

WORK UNIT CODE 12230 ITEM MB Rocket Assisted Ejection Seat MK-H7 AIRCRAFT F-4

LOCATION: Forward and aft cockpit

SUPPORT EQUIPMENT: Sling and hoist
Set of special unloading tools (to unload pyrotechnics and explosives)

ACCESS:	Forward	Aft
	Canopy removal required unless seat disassembled in airplane	Canopy removal not required

REMOVAL:
1. Remove 2 leg restraint lines (1 Pip pin each)
2. Remove 2 trip rods (1 nut and bolt each)
3. Remove actuator connector (1)
4. Install starwheel (spec tool)
5. Install sling and remove seat

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Actuator check (raise and lower)

TEST EQUIPMENT: Electrical power

CLOSE UP: Fwd: Install canopy

ANALYST'S OPINION: This is a heavy seat but a good sling is provided. Safety pins are adequate. Trip rod and leg restraint disconnect points are hard to reach. The ability to remove the seat from the aft cockpit without canopy removal is good. The front seat can be disassembled and removed without removing the canopy but this is considered a method to be used only under extraordinary circumstances.

WORK UNIT CODE 12260 ITEM Ejection Seat (Martin Baker MK-F7) AIRCRAFT F-8

LOCATION: Cockpit

SUPPORT EQUIPMENT: "Cherry Picker" or crane. Dolly to support seat.
Special support sling.
Brass hand wheel.

ACCESS: Seat can be removed by either removing canopy or by leaving it in place. With canopy removed, better access is gained at the cost of having to perform cockpit pressurization check after replacing canopy.

REMOVAL:
1. Life support systems have to be disconnected prior to starting removal procedures.
2. Brass hand wheel has to be installed on seat assembly so that seat can be removed from ejection gun.
3. "Cherry Picker" or crane is required to life seat out of aircraft.
4. Removed seat is placed on support or transportation dolly.

INSTALLATION: Reverse of removal.

FUNCTIONAL CHECK: Measured pull checks are made of firing mechanism handles with spring scale.

TEST EQUIPMENT: Spring scale ("fish scale") required to check handle forces.

CLOSE UP: Replace canopy (if removed).

ANALYST'S OPINION: An ejection seat assembly is relatively large and heavy requiring special support equipment to lift and support seat assembly. Some support equipment is necessary due to the size and weight of an ejection seat assembly. This requirement does not seem unreasonable. Removal procedures could possibly be simplified by having a canopy that is removed easily or by having a canopy that has a large enough "canopy open" angle that allows seat removal without removing the canopy.

WORK UNIT CODE 12111 ITEM MKGRU7/( ) Ejection Seat AIRCRAFT F-14

LOCATION: Cockpit - front & rear

SUPPORT EQUIPMENT: Hoist, Sling
Lockout Handle
Seat Dolly
External Electrical Power

ACCESS: Remove canopy

REMOVAL:
1. Raise seat
2. Disconnect oxygen line (quick disconnect)
3. Disconnect leg straps (2 ball lock pins)
4. Disconnect seat position electrical plug
5. Disconnect 2 rods at back of seat (2 bolts ea.)
6. Install hoist
7. Lock detent with lockout handle
8. Hoist seat, place on dolly
9. Remove rocket rack

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Check positioning
check oxygen hookup

TEST EQUIPMENT: External Electrical Power

CLOSE UP: Install canopy

ANALYST'S OPINION: This assembly also includes a ballistics mechanism that remains in the airplane during removal. The rocket mechanism also is removed and installed on the new seat. Although this eliminates the hazard of transporting and handling of the rocket in the shop, it is an additional significant task and presents a storage problem if the replacement seat is not immediately available. Normally, canopy removal would be considered a deficiency. In this case, the removal is so simplified that it can't be faulted. Any canopy has to be overextended for seat removal. The F-14 requires only the additional task of lifting it free and placing it out of the way.

WORK UNIT CODE 12210 ITEM Ejection Seat AIRCRAFT AV-8

LOCATION: Cockpit

SUPPORT EQUIPMENT: Set of special tools to unload pyrotechnics and explosives
Sling & hoist

ACCESS: Remove canopy

REMOVAL:
1. Disconnect leg restraint lines (2 ball lock pins)
2. Remove trip rod (1 ball, lock pin)
3. Disconnect IFF switch (1 ball lock pin)
4. Disconnect lower LOX block (1 quick disconnect)
5. Install star wheel (special tool)
6. Install sling
7. Remove seat
8. Complete pyrotechnics from seat

INSTALLATION: Reverse of removal
NOTE: Hook up electrical disconnect for actuator during installation (automatic release during removal).

FUNCTIONAL CHECK: Seat actuator check

TEST EQUIPMENT: Electrical power

CLOSE UP: Install canopy

ANALYST'S OPINION: The seat is quite heavy and it is difficult to get to some disconnects, particularly the LOX Block (can actuate bottle) and actuator cannon plug. Leg restraint pins are difficult to reach - not much room available in small cockpit. The sling is locally manufactured. NARF personnel say none is available.
*** Safety Note: A safety pin is needed for drogue gun. Provisions are in the gun but no pin is available. NARF uses pip pin from trip rod. Without the pin,

(See continuation sheet)

CONTINUATION SHEET:

WORK UNIT CODE 12210 ITEM Ejection Seat AIRCRAFT AV-8

ANALYST'S OPINION: (Continued)

the drogue can be fired by a pull on the trip rod.

SYSTEM: 11 Airframe/12 Fuselage Compartments

NOMENCLATURE: Canopy Actuator

MUC: A-4: 11365 A-6: _____ A-7: 12126 F-4: 12315

F-8: 12141 F-14: 12521 AV-8: 12123

GENERAL OBSERVATIONS: The method of assisting the pilot to open the canopy varies considerably from one airplane to another and does not lend itself very well to comparison. The AV-8, A-4, A-7 and F-8 have assists to manual opening while the F-4, A-6, and F-14 have powered canopies. Canopy size and weight dictate complexity and associated maintainability problems. The A-6 and AV-8 canopies slide aft to open. The others are aft hinged "clamshell" types. Significant differences in type and location of actuators results.

DESIRABLE FEATURES: 1. The simpler assist methods are easier to get to usually and are smaller. The AV-8 is the simplest consisting of two simple bungee cords which if not broken are quite easily replaced. 2. Jury struts are used to support the "clamshell" type canopies during actuator removal. The F-8 strut is also used as a reference in rigging. 3. The F-14 actuator uses different connectors on each pneumatic line to prevent improper hookup. 4. The A-4 actuator is the most accessible with no requirement to remove any panel or component for access. 5. The F-8 uses a locknut rather than a cotter pin.

UNDESIRABLE FEATURES: 1. Powered canopies have large actuators and in the case of the F-4 and F-14 access requires seat removal. Access in the F-4 is especially bad. 2. Access on the F-8 canopy deck is difficult. This was overcome in the A-7 by adding a 50 screw access panel.

SYSTEM: 11 Airframe/12 Fuselage Compartments

NOMENCLATURE: Canopy Actuator

UNDESIRABLE FEATURES: (Cont.)

3. The AV-8 bungee cord, if broken, requires removal of several components to thread the new cord around the sheaves.

ADDITIONAL REMARKS: The AV-8 bungee cord is located in the nose wheel well and connected to the canopy by cables. A very simple system made possible by a light canopy. Of the assisted canopies, the AV-8 is the simplest, the A-4 is the easiest to remove, the F-8 is the most difficult, and the A-7 requires the most access effort but is fairly easy to remove. The powered canopies of the F-14 the best and the F-4 the hardest to remove, but both are less accessible than the assist actuators. The A-6 was not observed.

WORK UNIT CODE 11365 ITEM Canopy Encl Bungee Assy AIRCRAFT A-4M

LOCATION: Aft of seat - topside

SUPPORT EQUIPMENT: Jury strut
Nitrogen Servicing Equipment

ACCESS: Open canopy

REMOVAL:
1. Open canopy
2. Install jury strut
3. Release Nitrogen pressure
4. Remove canopy attach bolt
5. Disconnect canopy jettison actuating line
6. Remove lower attach bolt
7. Lift out of aircraft

INSTALLATION:
1. Reverse of removal
2. Service Bungee cylinder

FUNCTIONAL CHECK:
Actuate to insure proper operation

TEST EQUIPMENT: None

CLOSE UP: Close canopy

ANALYST'S OPINION: This is a good installation. Access is good with no access panel removal required. Tasks are simple and easily performed.

WORK UNIT CODE 12126 ITEM Canopy Counterbalance Cylinder AIRCRAFT A-7

LOCATION: Cockpit, aft of seat

SUPPORT EQUIPMENT: 40° strut
Nitrogen Servicing Equipment
Workstand

ACCESS: Access panel (50 screws) (restricted panel)

REMOVAL:
1. Open canopy, install strut, deflate counter balance cylinder
2. Close canopy, remove access
3. Remove upper and lower bolts - keep shims.
4. Remove counter balance cylinder

INSTALLATION:
1. Reverse removal procedure
2. Re-service counterbalance cylinder

FUNCTIONAL CHECK: Check canopy by opening and closing

TEST EQUIPMENT: None

CLOSE UP: Install panel

ANALYST'S OPINION: Ammo drum access panel must be installed if counterbalance panel is off with counterbalance serviced. Access is good except for the 50 screws required in the access panel. Tasks are fairly simple.

WORK UNIT CODE 12315 ITEM Retract Cylinder (Canopy Actuator) AIRCRAFT F-4

LOCATION: Behind Seat, Each Cockpit

SUPPORT EQUIPMENT: Canopy Safety Strut (Aft Canopy)
Nitrogen Servicing Equipment

ACCESS: Forward: Remove canopy, seat, and radar scope and rack in aft cockpit

Aft: Remove seat and 1 access panel (48 screws)

REMOVAL: Aft: (Seat removed)

1. Install strut
2. Bleed three pneumatic bottles (1 in radome, 1 LOX compt, 1 behind door #23)
3. Remove canopy damper (2 bolts)
4. Disconnect canopy actuator pressure lines and stow inside door
5. Remove sound proofing on access panel (glued on)
6. Remove access panel
7. Remove lower attach bolt, bushing
8. Remove upper attach bolt, bushing
9. Remove actuator

(See Continuation Sheet)

FUNCTIONAL CHECK: Leak check pneumatic system
Operate canopy

TEST EQUIPMENT: None, however additional pneumatic service may be required on completion.

CLOSE UP: Install removed items

ANALYST'S OPINION: This is a difficult installation. NARF personnel indicate that removal can be accomplished in the aft cockpit without removing the seat but they consider it too hazardous to do routinely. Working position is awkward. The glued on sound proofing over the aft access panel is bad. The requirement to remove the radar scope rack during removal of the forward actuator is worse.

CONTINUATION SHEET:

WORK UNIT CODE 12315 ITEM Retract Cylinder (Canopy Actuator) AIRCRAFT F-4

REMOVAL: (Continued)

Forward: (Canopy, Seat Removed)

1. Bleed pneumatic bottles (same as aft)
2. Disconnect actuator pressure lines at canopy shuttle valve
3. Remove radar scope rack, aft seat
4. Remove lower attach bolt, bushing
5. Remove actuator

INSTALLATION: (Both Cockpits)

1. Reverse of removal
2. Service pneumatic bottles

WORK UNIT CODE 12141 ITEM CANOPY ACTUATOR CYLINDER/DAMPER AIRCRAFT F-8

LOCATION: Aft canopy deck behind ejection seat.

SUPPORT EQUIPMENT: Canopy jury strut and normal hand tools.

ACCESS: Cylinder/damper is hard to get to because of angle (approximately 45°) formed by open canopy and canopy deck. Canopy angle and location of cylinder rod end make access to bolt securing cylinder rod end to canopy difficult.

REMOVAL:
1. Install jury strut
2. Secure canopy firing mechanism and remove canopy firing mechanism.
3. Remove locknut and bolt securing actuator rod end to canopy.
4. Disconnect canopy hook release arm.
5. Remove bolt and nut securing actuator lug end to canopy deck, and remove actuator.

INSTALLATION: Cylinder is a prerigged assembly, but rod end may require adjustment when installed. Jury strut supporting canopy acts as a rigging tool for adjusting the rod end, if required.

Reverse of removal

FUNCTIONAL CHECK: Open and close canopy and check for proper damping action.

TEST EQUIPMENT: None

CLOSE UP: None

ANALYST'S OPINION: Bolt and nut securing rod end of cylinder/damper to canopy is difficult to remove because of having to work behind and above the ejection seat in a relatively hidden area. A locknut and bolt are used to secure the rod end. This eases the removal tasks by not having to work at removing a cotter key. Improved access to cylinder/damper rod end would improve remove and replace capability.

WORK UNIT CODE 12521 ITEM Canopy Actuator AIRCRAFT F-14

LOCATION: Behind rear seat, aft cockpit

SUPPORT EQUIPMENT: Nitrogen Servicing Equipment

ACCESS: Remove canopy and rear seat

REMOVAL:
1. Relieve pneumatic bottle (NLG well)
2. Disconnect 2 pneumatic lines (B-nuts)
3. Disconnect gas generator
4. Retract piston manually
5. Disconnect lower support (1 bolt)
6. Remove actuator
7. Remove gas generator from actuator (clamp)

INSTALLATION:
1. Reverse of removal
2. Reservice pneumatic bottle

FUNCTIONAL CHECK: Operate canopy

TEST EQUIPMENT: None

CLOSE UP: Install canopy & seat

ANALYST'S OPINION: A good job of "de-murphying" has been done by using different connectors on the pneumatic lines to prevent improper hookup. It is not desireable to require seat removal to work on this actuator. Access time exceeds task time by a substantial margin.

WORK UNIT CODE 12123 ITEM Plastic Cord (Canopy Actuator) AIRCRAFT AV-8

LOCATION: Nose Wheel Well (one cord on each side of well)

SUPPORT EQUIPMENT: Hydraulic Power and Servicing Equipment (RH only)
Small Work Stand

ACCESS: LH: Linkage plate (10 screws) (linkage need not be disconnected)
RH: Remove forward nose steering accumulator

REMOVAL:
1. Disconnect bungee at cable (pin)
2. Remove pulley (1 bolt)
3. Disconnect bungee at airframe (hooked)

INSTALLATION:
1. Reverse of removal
2. Adjust cable tension
3. Reservice and bleed nose gear steering (RH bungee) after re-installation

FUNCTIONAL CHECK: Operate canopy
Check nose gear steering

TEST EQUIPMENT: Hydraulic Power

CLOSE UP: LH: Re-install linkage plate
RH: Re-install accumulator

ANALYST'S OPINION: Very uncomplicated device. The bungee cord is adequate for the job and requires no servicing. The airframe attachment point is very high in the nosewheel well and assistance is needed to reach it. The procedure outlined presumes a broken cord and is not good because of the disturbance of other systems while gaining access to the pulley so a new cord can be threaded through. If the cord is merely worn, it can be hooked to the new one and used to pull the new cord into position. This installation also emphasizes the extreme overuse of the nose

(See Continuation Sheet)

CONTINUATION SHEET:

WORK UNIT CODE 12123 ITEM Plastic Cord (Canopy Actuator) AIRCRAFT AV-8

ANALYST'S OPINION: (continued)

wheel well for component installation. It is very crowded. This can be partially excused by the small airframe size and requirement for light weight. Investment in some judiciously placed exterior access panels (which was done so well in other areas of the airplane) would help tremendously. This area is narrow, very deep at the aft end, and the open fairing doors do not provide sufficient easy access to overcome the difficulties involved in working here.

SYSTEM: 12 Fuselage Compartments

NOMENCLATURE: Seat Actuator

WUC: A-4: 12111 A-6: 12142 A-7: 12261 F-4: 1223B

F-8: _____ F-14: 1211H AV-8: 1221C

GENERAL OBSERVATIONS: Except for the A-6, this component requires seat removal. In most cases, the actuator is part of the seat and is a shop removal item. This item is the most common cause of unscheduled seat maintenance and should be removable in the airplane without prior seat removal.

DESIRABLE FEATURES: 1. The A-6 actuator is accessible without removing the seat. 2. Except for the A-6 and F-14, removal and installation is simple once access has been gained.

UNDESIRABLE FEATURES: 1. Except for the A-6, the seat must be removed to gain access to the actuator. 2. The F-14 actuator requires accurate shimming to avoid interference with the frame. 3. The A-6 requires cutting and splicing of wires, a disconnect plug is required. 4. The A-6 also requires spreading of the motor support frame to free the motor.

ADDITIONAL REMARKS: The A-6 actually has two actuators: the tilt motor discussed here and the fore and aft actuator discussed in the comments on the ejection seat (WUC 12110) data sheet. Looking at recent seat designs indicates a trend to allow removal of the actuator with the seat installed. This should be encouraged.

WORK UNIT CODE 12111 ITEM SEAT ACTUATOR AIRCRAFT A-4M

LOCATION: Attached to Lower Section of Canted Bulkhead in Cockpit Behind Ejection Seat

SUPPORT EQUIPMENT: None

ACCESS: Must remove canopy and ejection seat to gain access.

REMOVAL:
1. Disconnect electrical line
2. Remove attach bolts (2)
3. Lift out

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK:
Height trend
Parallel alignment
Operate seat

TEST EQUIPMENT: External electrical power

CLOSE UP: Re-install seat and canopy and make appropriate functional checks

ANALYST'S OPINION: It is a shame that what is a 3 step, 15 minute job should require several hours to gain and close access. Removal of seat and canopy to replace this actuator is not acceptable in future designs. It can be avoided. Other than this, the installation is excellent.

WORK UNIT CODE 12142 REV EJECTION SEAT TILT MOTOR AIRCRAFT A-6

LOCATION: Cockpit aft of seat

SUPPORT EQUIPMENT: External electrical power

ACCESS: Open canopy

Left tilt motor is accessible, but right side is not as accessible.

REMOVAL:
1. Adjust seat full forward
2. Remove 1 bolt securing screw jack to seat tilt "A" frame.
3. Cut electrical wires at slice zone.
4. Remove fasteners on motor support frame and spread frame in order remove tilt motor.
5. Support tilt motor, remove tilt motor trunnion from supporting structure
6. Remove tilt motor

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Cycle seat with at least a 175 lb. man sitting in seat.

TEST EQUIPMENT: External electric power

CLOSE UP: Close canopy

ANALYST'S OPINION: Sometimes a new tilt motor will not lift the weight of a 175 lb. man sitting in the seat. Some motors would stall out and not lift the combined weight of a man and the seat. A motor of larger capacity should have been used to do the job. Instead of cutting and splicing the tilt motor electric wires, a connector should have been used which would reduce the time necessary to replace an actuator by not having to splice the electrical connections. Another arrangement should have been devised that would have not required loosening or removing some of the frame support hardware so that the frame could be spread enough to take motor out of frame.

WORK UNIT CODE 12261 ITEM Seat Adjust Actuator AIRCRAFT A-7

LOCATION: Cockpit

SUPPORT EQUIPMENT: None

ACCESS: Open canopy and install 40° strut
(deflate and disconnect counter balance cylinder, remove strikers)
(disconnect radiation shield hoses (2) and microswitch (3 screws)
Install 72° strut and remove ejection seat.

REMOVAL:
1. Remove rocket (4 bolts) (prior to AFC 321/ACC 236 remove 2 flex lines).
2. Disconnect plug and two (2) clamps
3. Remove two (2) bolts, nuts and washer
4. Remove actuator

INSTALLATION:
1. Reinstall in reverse order of removal

FUNCTIONAL CHECK: Perform operational check of seat adjustment actuator.

TEST EQUIPMENT: External electric power

CLOSE UP: Install ejection seat

ANALYST'S OPINION: Requirement to remove seat to gain access is unfortunate. This is a case where access effort greatly exceeds task time and requires the services of specially trained personnel. Actual removal tasks are quite simple. It would be worth increasing complexity of the installation to produce a design that allows removal without prior seat removal.

WORK UNIT CODE 1223B ITEM Seat Positioning Actuator AIRCRAFT F-4

LOCATION: Behind Seat Bucket, Both Seats

SUPPORT EQUIPMENT: None

ACCESS: Remove seat

REMOVAL:
1. Disconnect guillotine hose
2. Disconnect actuator cable
3. Remove override pin (QD)
4. Remove actuator lower attach pin
5. Remove bucket
6. Remove inertia reel (2 bolts and gas line)
7. Remove actuator (1 bolt)

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Rocket check
Actuator check

TEST EQUIPMENT: Special jig and gages to check rocket angle

CLOSE UP: Install seat

ANALYST'S OPINION: This work is done in the seat shop. A better installation would allow replacement at the airplane.

WORK UNIT CODE 1211H ITEM Seat Actuator AIRCRAFT F-14

LOCATION: Behind and part of ejection seat

SUPPORT EQUIPMENT None

ACCESS: Remove seat and canopy

REMOVAL: (This task is normally done in the seat shop rather than at the airplane).

1. Disconnect power inertia reel
2. Support seat bucket
3. Remove bolt attaching actuator to main beam (upper)
4. Lower seat bucket
5. Remove bolt, nut, and shims at actuator lower attach point (record number and location of shims)
6. Remove actuator

INSTALLATION: Reverse of removal (ensure proper reinstallation of shims).

FUNCTIONAL CHECK: Raise and lower seat

TEST EQUIPMENT: Electrical power

CLOSE UP: Install seat and canopy

ANALYST'S OPINION: The actuator is the most common source of unscheduled maintenance on the seat. Requiring seat removal and subsequent shop effort to replace this item places an unnecessary burden on maintenance. Further, it does not seem reasonable to have tolerances so close on this device that accurate shimming is required. Certainly, function of the actuator is not that critical. Opening up of clearances with the seat components would improve this immensely.

WORK UNIT CODE 12210 ITEM Seat Raising Assembly AIRCRAFT AV-8

LOCATION: Behind Ejection Seat

SUPPORT EQUIPMENT: None

ACCESS: Remove seat

REMOVAL:
1. Pull 2 ball lock pins at top of seat
2. Disconnect gas line on guillotine (ball lock pin)
3. Pull cable to disconnect harness release from frame
4. Remove 4 bucket mount nuts, remove bucket
5. Disconnect actuator harness (3 bolts) -
6. Remove 2 bolts and actuator

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Check actuator function

TEST EQUIPMENT: Electrical Power

CLOSE UP: Install seat

ANALYST'S OPINION: This is normally performed in the shop. Although this is not a desirable situation, it is a characteristic of the seat rather than the airplane. Since the seat raising assembly is the predominant cause of unscheduled maintenance on the seat, it would be better to provide remove and replace capability with the seat installed.

LANDING GEAR SYSTEM

MLG WHEEL AND TIRE

NLG WHEEL AND TIRE

MLG WHEEL BRAKE

MLG SHOCK STRUT

NLG SHOCK STRUT

NOSE WHEEL STEERING UNIT

ARRESTING HOOK ASSEMBLY

BRAKE CONTROL VALVE

EMERGENCY AIR BOTTLE

LANDING GEAR SYSTEM

CONTENTS

COMPONENT	A-4	A-6	A-7	F-4	F-8	F-14	AV-8
MLG Wheel and Tire	13143	13511	13131	13251	13411	13511	13511
NLG Wheel and Tire	13233	13512	13161	13331	13412	13521	13521
MLG Wheel Brake	13716	13611	13511	13440	13511	13811	13716
MLG Shock Strut	13121	13111	13121	13211	13121	13111	13111
NLG Shock Strut	13221	13211	13151	13313	13221	13511	13216
Nose Wheel Steering Unit	N/A	13724	13612	13342	13311	13921	N/A
Arresting Hook Assembly	1382J	13811	13810	13520	13811	13A15	N/A
Brake Control Valve	N/A	N/A	1352A	13411	N/A	13821	13726
Emergency Air Bottle	N/A	13451	13311	1315.	N/A	13712	13415

SYSTEM: 13 Landing Gear

NOMENCLATURE: Main Landing Gear Wheel and Tire Assembly

MUC: A-4: 13143 A-6: 13511 A-7: 13131 F-4: 13251

F-8: 13411 F-14: 13511 AV-8: 13511

GENERAL OBSERVATIONS: Good access in all observed aircraft. Tasks are similar in nature with minor differences in task difficulty. It was noted that high wing airplanes tend to provide better working space around the wheel. Wheel bearings are cleaned and relubricated during wheel change on all aircraft.

DESIRABLE FEATURES: 1. Most wheels with anti-skid devices required no special effort except reasonable care to avoid damage. 2. All aircraft but one required standard tools to accomplish tasks. 3. The novel arrangement of the AV-8 with the bearings in the strut and an axle that turns with both wheels should provide optimum bearing maintenance by divorcing its frequency of lubrication from unscheduled tire removal. 4. The F-14 false axle is another good method of simplifying the task.

UNDESIRABLE FEATURES: 1. One aircraft (A-6) includes anti-skid drive in the hubcap which could be aligned improperly resulting in degraded anti-skid function. 2. All aircraft with dual or multiple disc brakes have problems holding the discs in alignment during wheel change. The F-4 solves this by tieing the emergency brake. 3. The A-7 inner wheel bearing is difficult to remove for cleaning and repacking. The F-4

SYSTEM: 13 Landing Gear

NOMENCLATURE: Main Landing Gear Wheel and Tire Assembly

UNDESIRABLE FEATURES: (Cont.)

inner bearing is part of the brake. 4. The AV-8 right and left wheels are not interchangeable because of the anti-skid exciter being only on the right.

ADDITIONAL REMARKS: 1. Wheels should be designed so that no critical alignment tasks are required. Anti-skid devices should be assembled into the wheel to avoid separate alignment step. Disc brakes should be designed to hold alignment after removal of wheel (i.e. method of locking brakes to hold discs, etc.). 2. Tire changes are frequent tasks and nearly always accomplished as unscheduled maintenance, special tools should be avoided. 3. Wheel bearings should be designed to avoid difficulties in removal. Bearing damage or inadequate lubrication can be minimized if bearings are easily removed without using tools.

WORK UNIT CODE 13143 ITEM MLG Wheel & Tire AIRCRAFT A-4M

LOCATION: MLG Strut

SUPPORT EQUIPMENT: Wheel Jack
Tire Servicing Equipment

ACCESS: No access required.

REMOVAL:
1. Jack Landing Gear Strut
2. Deflate Tire
3. Remove Lockring and Cover
4. Remove Retainer Nut and Washer
5. Remove Wheel

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: None

TEST EQUIPMENT: None

CLOSE UP: None Required

ANALYST'S OPINION: Low wing reduces working space around wheel. Otherwise, installation is good, simple to work on.

WORK UNIT CODE: 13511 ITEM: MLG WHEEL & TIRE ASSY AIRCRAFT: A-6

LOCATION: MLG SHOCK STRUT

SUPPORT EQUIPMENT: Aircraft jacks. Strut or wing jacks. Special Wrench for axle nut. Nitrogen servicing bottle.

ACCESS: No access required.

REMOVAL:
1. Jack landing gear strut
2. Deflate tire.
3. Remove spring locking device securing hub cap and remove hub cap.
4. Remove axle nut security device
5. Use special wrench to back of axle nut and remove nut.
6. Remove washer and pull wheel off axle.

INSTALLATION:
1. Align brake discs before installing wheel.
2. Install wheel and tighten axle nut to seat bearing and back off to nearest hole.
3. Install axle nut security device.
4. Align hub cap so that anti-skid drive key is aligned and install lock ring.
5. Inflate tire to specified value.
6. Remove jack.

FUNCTIONAL CHECK: None

TEST EQUIPMENT: None

CLOSE UP: None required

ANALYST'S OPINION: Hub cap excluded contaminants and provides drive for the anti-skid system. An alignment key is provided, but NARF NORVA indicates that hub cap can be installed incorrectly. Another key indexing device is required that will eliminate installing hub cap with key not engaged. Consequences of installing hub cap incorrectly can result in anti-skid system malfunctions.

WORK UNIT CODE 13131 ITEM MLG Wheel & Tire Assy AIRCRAFT A-7

LOCATION: Below Center Fuselage

SUPPORT EQUIPMENT: Wheel Jack
Tire Servicing Equipment

ACCESS: No access required.

REMOVAL:
1. Jack Strut
2. Bleed Air From Tire
3. Remove Lockbolt, nut
4. Remove Retaining Nut, Washer, Bearing
5. Remove Wheel & Tire Assy

INSTALLATION:
1. Align Brake Discs
2. Install in Reverse of Removal
3. Torque Retaining Nut

FUNCTIONAL CHECK: None

TEST EQUIPMENT: None

CLOSE UP: None Required

ANALYST'S OPINION: Requires alignment of brake discs and torquing of retaining nut during installation of wheel. Both of these require additional effort. High wing with landing gear in fuselage provide excellent working space. The inner wheel bearing is exceedingly difficult to remove for cleaning. Frequent damage to bearing occurs.

WORK UNIT CODE 13251 ITEM MIG Wheel and Tire AIRCRAFT F-4

LOCATION: Bottom of Main LG Strut

SUPPORT EQUIPMENT: Jacks
Axle nut wrench
Inner bearing rudder protractor
Brake rotor alignment
Tire inflation equipment

ACCESS: None

REMOVAL:
1. Jack strut
2. Deflate tire
3. Remove 2 safety bolts
4. Remove axle nut
5. Remove wheel - install bearing protector (inner bearing is part of brake assembly)

INSTALLATION: Reverse of removal (brake rotor alignment tool aligns brake - hold with emergency brake. Tied in engage position)

FUNCTIONAL CHECK: Spin check

TEST EQUIPMENT: None

CLOSE UP: None

ANALYST'S OPINION: This wheel is heavy and difficult to handle. Except for the inner bearing, it is a good installation. The inner bearing is part of the brake assembly and requires protection while exposed with the wheel removed. It also is difficult (or impossible) to lubricate during a wheel change. A brake rotor alignment tool is an excellent aid in making a wheel installation. The tool aligns the rotors which are then held by application of emergency brake pressure as the wheel is slipped on.

(See Continutation Sheet)

CONTINUATION SHEET:

WORK UNIT CODE 13251 ITEM MIG Wheel andTire AIRCRAFT F-4

ANALYST'S OPINION: (Continued)

If a replacement wheel is immediately available, however, it would seem reasonable to apply and hold brake pressure before the old wheel is removed. This will prevent losing rotor alignment and eliminate the extra task of using the tool. A method other than tying the emergency brake in the engage position would facilitate this effort.

WORK UNIT CODE: 13411 ITEM: MLG WHEEL/TIRE ASSY AIRCRAFT: F-8

LOCATION: MLG Tension Strut

SUPPORT EQUIPMENT: Tension strut or wing jacks.
Source of dry nitrogen

ACCESS: No access required.

REMOVAL:
1. Jack strut
2. Bleed tire pressure to zero
3. Remove axle nut security device (small bolt and nut)
4. Remove axle nut, spacer, washer, then bearing.
5. Wheel and tire assembly removed by pulling off axle.

INSTALLATION:
1. Align brake discs.
2. Install wheel in reverse of removal.

FUNCTIONAL CHECK: After wheel bearing is seated, axle nut is backed off to nearest notch in axle nut and axle, and axle nut security device is installed. Tire is then rotated to check bearing for freeness.

TEST EQUIPMENT: Air pressure gage and standard tools to remove axle nut.

CLOSE UP: None

ANALYST'S OPINION: The two brake discs, once the wheel is removed, are unsupported requiring that the disc key slots are aligned as the wheel is being installed. This is awkward and could require two men to accomplish the task.

A way of applying brake pressure to hold brake discs in proper position with respect to wheel assembly would be desirable to permit easier wheel and tire installation. A brake design not requiring supporting the brake discs would accomplish the same end result.

WORK UNIT CODE 13511 ITEM MLG WHEEL & TIRE AIRCRAFT F-14

LOCATION: Lower end of Main Landing Gear Strut

SUPPORT EQUIPMENT: Special tool for wheel nut
Jack
Tire inflation equipment

ACCESS: None required

REMOVAL:
1. Jack wheel
2. Remove hubcap (snap ring)
3. Remove cotter pin and wheel nut
4. Remove wheel

INSTALLATION:
1. Reverse of removal.
2. Inflate tire to proper pressure.

FUNCTIONAL CHECK: None

TEST EQUIPMENT: None

CLOSE UP: None

ANALYST'S OPINION: Use of a false axle is very good. Wheel replacement time is reduced and important bearing maintenance is performed in the cleaner shop environment. Antiskid sensing is located in the stub axle and is not disturbed during wheel removal.

WORK UNIT CODE 13511 ITEM Main Undercarriage Wheel and Tire AIRCRAFT AV-8

LOCATION: Beneath Fuselage Midsection, on center line
(Note only one strut, 2 wheels)

SUPPORT EQUIPMENT: Jacks and Cradle
Tire Servicing Equipment

ACCESS: None

REMOVAL:
1. Lock parking brake
2. Jack strut
3. Deflate tire
4. Remove nut retainer plate (2 bolts)
5. Remove nut
6. Remove wheel

INSTALLATION:
1. Reverse of removal (locate and engage master spline)
2. Inflate tire

NOTE: The anti-skid exciter ring is located on the right hand wheel. Care is required to install the proper wheel in the proper position.

FUNCTIONAL CHECK: None

TEST EQUIPMENT: None

CLOSE UP: None

ANALYST'S OPINION: This installation includes an interesting variation of bearing treatment. The bearings are installed at the bottom of the strut and the entire axle turns. The wheels are in turn splined to the axle. A very simple installation results and bearing maintenance as well as associated risks are divorced from tire maintenance. A good design. The parking brake allows locking of the brake discs to maintain their alignment which greatly simplifies wheel installation. A potential maintenance error is included. NARF personnel pointed out that the anti-skid exciter ring is installed only on the right hand wheel and care must be taken to ensure that the proper wheel is installed. In spite of the few ounces of extra weight, it would seem better to have exciter rings on both wheels. Carrying one non-functioning exciter is preferrable to the risk of losing brake function.

SYSTEM: 13 Landing Gear

NOMENCLATURE: Nose Landing Gear Wheel and Tire Assembly

MUC: A-4: 13233 A-6: 13512 A-7: 13161 F-4: 13331

F-8: 13412 F-14: 13521 AV-8: 13521

GENERAL OBSERVATIONS: Wheel and tire replacement is a frequent occurrence and has been designed to facilitate maintenance. Single and dual wheel installations are equally easy to work on. All wheels provide for retention of bearings in the wheel, this eliminating bearing repacking at the airplane.

DESIRABLE FEATURES: 1. "U-Bolts" used in A-4 are simple and effective. 2. The large nut used on the A-6 may provide some protection from loss of wheel if bearing fails. 3. In all aircraft, removal tasks are short and simple. All wheels eliminate bearing maintenance at the airplane.

UNDESIRABLE FEATURES: 1. The A-4 requires a stand under the aft section when the nose wheel is jacked. 2. Although the wheels differ somewhat in method of removal, there exists no particular features that would qualify as "undesirable." 3. The AV-8 requires special jacking fixtures because of the tandem wheel arrangement.

ADDITIONAL REMARKS: 1. Bearings should be kept with wheel and relubricated in shop. 2. Loose parts (spacers, retainers, bolts, etc.) should be minimized in the design. 3. Re-usable retaining devices are preferable to disposable devices (i.e. retaining bolt vs. cotter pin).

WORK UNIT CODE 13233 ITEM NLG Wheel & Tire AIRCRAFT A-4

LOCATION: Nose Section

SUPPORT EQUIPMENT: Nose Jack
Tire Inflation Equipment
Tail Stand

ACCESSIBILITY: No access required

REMOVAL:
1. Place stand under tail
2. Jack nose of aircraft
3. Deflate tire
4. Remove 2 U-bolts
5. Remove wheel and tire assembly

INSTALLATION:
1. Reverse of removal
2. Inflate tire

FUNCTIONAL CHECK: Check wheel rotation

TEST EQUIPMENT: None

CLOSE UP: None

ANALYST'S OPINION: Very simple installation. U-bolts are example of proper application of "think simple" approach. CG location in relation to MLG dictates use of tail stand.

WORK UNIT CODE 13512 ITEM NLG WHEEL & TIRE ASSY. AIRCRAFT A-6

LOCATION: NLG Shock Strut

SUPPORT EQUIPMENT: Nose strut jack or fuselage jack.
Nitrogen servicing cart.
Tire pressure gauge.

ACCESS: No access required.

REMOVAL:
1. Jack strut
2. Remove cotter securing axle nut.
3. Deflate tire.
4. Remove axle nut and washer.
5. Remove wheel and tire assembly.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Rotate wheel and check for smoothness.

TEST EQUIPMENT: None

CLOSE UP: None

ANALYST'S OPINION: The nose wheel axle nut is functionally adequate but looks like it might have come off a piece of heavy equipment. The nut is secured with a cotter key. This comment is merely suggesting that the aesthetics of the installation would be enhanced if this part would look like an aircraft part. Another good design feature of this nut is that the hex seems larger than the wheel half bearing race bore, and would appear capable of retaining the wheel on the axle if a total wheel bearing failure occurred. This in turn might prevent wheel assembly from falling in someones back yard because of a wheel bearing failure.

/..

WORK UNIT CODE 13161 ITEM NLG Wheel & Tire AIRCRAFT A-7

LOCATION: Below Front Fuselage

SUPPORT EQUIPMENT: Nose Jack, Jackpads, Tire Inflation Equipment

ACCESS: None required.

REMOVAL:
1. Jack NLG Assy
2. Bleed air from tire
3. Remove locknut bolt (1)
4. Remove retaining nut from axle
5. Remove wheel and tire assy and two collars

INSTALLATION:
1. Reverse of removal
2. Inflate tire

FUNCTIONAL CHECK: Check for rotation

TEST EQUIPMENT: None

CLOSE UP: None

ANALYST'S OPINION: Collars are saved for installation on new wheel. Wheel change task is simple and easily accomplished.

WORK UNIT CODE 13331 ITEM NLG Wheel and Tire AIRCRAFT F-4

LOCATION: Bottom of nose landing gear strut

SUPPORT EQUIPMENT: Jacks
Tire inflation equipment

ACCESS: None

REMOVAL:
1. Jack strut
2. Deflate tire
3. Remove safety screw
4. Remove axle nut
5. Remove wheel and bearings

INSTALLATION:
1. Reverse of removal
2. Inflate wheel

FUNCTIONAL CHECK: Spin check

TEST EQUIPMENT: None

CLOSE UP: None

ANALYST'S OPINION: Good installation. Simple to perform. The bearings stay in the wheel and are maintained in the tire shop. This reduces the effort at the airplane.

WORK UNIT CODE 13412 ITEM NLG WHEEL/TIRE ASSEMBLY AIRCRAFT F-8

LOCATION: NLG shock strut axle beam.

SUPPORT EQUIPMENT: Fuselage jack
Nitrogen servicing bottle

ACCESS: No access required

REMOVAL:
1. Jack nose of aircraft
2. Deflate tire.
3. Remove screw securing axle nut and remove axle nut.
4. Remove axle from left side
5. Remove wheel and tire from axle beam.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Rotate tire and check bearing for freeness.

TEST EQUIPMENT: Air gauge

CLOSE UP: None

ANALYST'S OPINION: Wheel bearings stay with wheel assembly and are processed to the shop for repair. Spacer stays with axle and is presumed to be left with aircraft. The spacer used prevents overtorqueing wheel bearing when axle and wheel are installed. Wheel design is simple and straightforward and is simple to remove.

WORK UNIT CODE 13521 ITEM NLG WHEEL & TIRE AIRCRAFT F-14

LOCATION: Lower End of Nose Landing Gear Strut

SUPPORT EQUIPMENT: Jack
Special wheel nut tool
Tire inflation equipment

ACCESS: None required

REMOVAL: 1. Jack nose wheel
2. Remove cotter pin and wheel nut
3. Remove wheel

INSTALLATION: 1. Reverse of removal
2. Inflate tire to proper pressure

FUNCTIONAL CHECK: None

TEST EQUIPMENT: None

CLOSE UP: None

ANALYST'S OPINION: The false axle simplifies wheel and tire removal. No bearing maintenance required at the airplane. A special tool required to remove the wheel nut is undesirable. Other than this, the installation is quite good.

WORK UNIT CODE 13521 ITEM Nose Undercarriage Wheel & Tire AIRCRAFT AV-8

LOCATION: Nose Fuselage, Bottom Centerline

SUPPORT EQUIPMENT: 2 Jacks (special nose gear frame or forward jacking trestle with tall jacks)
Nitrogen Cart

ACCESS: None

REMOVAL:
1. Jack strut
2. Deflate tire
3. Remove retainer plate, each side (1 bolt each)
4. Unscrew wheel bolts, each side
5. Remove wheel and false axle

INSTALLATION:
1. Reverse (split nut on L/H side)
2. Inflate tire

FUNCTIONAL CHECK: Spin wheel

TEST EQUIPMENT: None

CLOSE UP: None

ANALYST'S OPINION: Very simple. Axle and bearings go to tire shop with wheel. Special jacking equipment is required because of the tandem gear arrangements. This is inconvenient and the massive equipment presents a handling and storage problem.

SYSTEM: 13 Landing Gear

NOMENCLATURE: MLG Wheel Brake Assembly

MUC: A-4: 13716 A-6: 13611 A-7: 13511 F-4: 13440

F-8: 13511 F-14: 13811 AV-8: 13716

GENERAL OBSERVATIONS. All aircraft require wheel removal prior to brake removal. Otherwise, access is excellent. The working space available tends to be constrained on low wing airplanes. Disc brakes present a problem in achieving and maintaining disc alignment during installation.

DESIRABLE FEATURES: 1. One aircraft (A-4) has provision to check brake action and bleed brakes without external hydraulic power. Manual brake action is adequate for this purpose. 2. Interchangeable (left and right) brake assemblies are very desirable and several airplanes are so equipped. 3. The F-14 brake is remarkably simple to remove requiring removal of a pin rather than the bolts usually required. 4. The F-4 has a special tool available to assist in disc alignment.

UNDESIRABLE FEATURES: 1. Aircraft with full power brake systems require external hydraulic power to operate brakes for check. This increases time span required for replacement and increases size of crew. 2. Dual and multiple disc brakes presents a problem of support and alignment of discs as noted for wheel replacement. In this case, locking brakes to hold discs as suggested for wheel removal will not suffice as a remedy. 3. Installations that require shuttle valve

SYSTEM: 13 Landing Gear

NOMENCLATURE: MLG Wheel Brake Assembly

UNDESIRABLE FEATURES: (Cont.)

removal from brake assembly run risk of bending hydraulic line to shuttle valve. 4. The F-4 shimming requirement is an undesirable task. 5. The sealant on the F-4 brake increases difficulty of removal and installation.

ADDITIONAL REMARKS: 1. Self bleeding brake systems (i.e. the ability to eliminate air during first engine run after brake system maintenance without taking additional maintenance steps) would reduce task time and improve availability. 2. Interchangeability of left and right items grows increasingly important as a Logistics requirement. 3. Brake assembly definition should include all items attached to brake (i.e. valves, cylinders, etc.) so O-level removal requires only line disconnect. 4. Lines attaching to brake assembly should be flexible or routed to prevent damage or "brute force" positioning during brake installation.

Brake disc alignment should be maintained in some manner to simplify re-installation of wheel. Special fixture such as used with the F-4 may be required but it is more desirable to have this feature built in as part of the brake.

Clearances should not be so critical that shimming is required during installation. Also, if an extra water seal is required, it should be a replaceable gasket or O-ring rather than an elastomer seal. Breaking an elastomer seal, subsequent surface cleaning, and forming a new seal is time consuming. If an elastomer is the only

SYSTEM: 13 Landing Gear

NOMENCLATURE: MLG Wheel Brake Assembly

ADDITIONAL REMARKS: (Cont.)

recourse, one surface should be coated with a release agent to reduce repair effort.

WORK UNIT CODE 13716 ITEM MLG Brake Assy AIRCRAFT A-4M

LOCATION: Inboard Side of MLG Wheel

SUPPORT EQUIPMENT: Aircraft Jack

ACCESS: Requires removal of wheel and tire assembly

REMOVAL:

1. Jack Landing Gear Strut
2. Disconnect Hydraulic Line
3. Remove 8 Bolts
4. Remove Brake Cylinder and Discs

INSTALLATION:

1. Re-install in reverse order of removal
2. Service and bleed brakes

FUNCTIONAL CHECK: Check for brake application

TEST EQUIPMENT: None Required

CLOSE UP: Replace wheel and the tire assembly.

ANALYST'S OPINION: Good system. Power assisted brake system allows bleeding and check to be done without external power application. Low wing degrades work space

WORK UNIT CODE: 13611 ITEM: Wheel Brake Assembly AIRCRAFT: A-6

LOCATION: MLG Schock Strut

SUPPORT EQUIPMENT: Jack to support strut.
Tools to remove tire and wheel assembly.
External hydraulic power

ACCESS: Remove wheel and tire

REMOVAL:
1. Jack Strut
2. Remove safety wire and bolt securing shuttle valve.
3. Remove 12 mounting bolts and remove brake assembly.

INSTALLATION:
1. Torque 12 bolts securing brake assembly to strut to specified value.
2. Align brake discs.
3. Bleed brakes.

FUNCTIONAL CHECK: Connect external hydraulic power to aircraft.
Functional check brakes with normal hydraulic power, auxiliary hydraulic power, and emergency hydraulic power.

TEST EQUIPMENT: External Hydraulic Power

CLOSE UP: Replace wheel and tire assembly.

ANALYST'S OPINION: Alignment of brake discs during wheel installation adds maintenance effort. A method of locking the brake discs in align is needed. Twelve mounting bolts is considered excessive. Altogether, this installation is rated as fair.

WORK UNIT CODE 13511 ITEM MLG Brake Assy AIRCRAFT A-7E

LOCATION: Inboard of Wheel and Tire Assy

SUPPORT EQUIPMENT: Jack, External Hydraulic Power

ACCESS: Requires Wheel and Tire Removal
(see Analyst's Opinion)

REMOVAL:

1. Jack Landing Gear Strut
2. Disconnect Brake Shuttle Valve (1 Bolt) Discard 2 seals
3. Remove Anti-Skid Bracket (2 Bolts)
4. Remove Brake Retaining Bolt
5. Slide Brake Off Axle

INSTALLATION:

1. Reverse of removal
2. Install 2 new seals with shuttle valve
3. Check brake clearance before installing wheel
4. Bleed brakes

FUNCTIONAL CHECK: Check brake application

TEST EQUIPMENT: Hydraulic test stand

CLOSE UP: Replace wheel and tire assembly.

ANALYST'S OPINION: Shuttle valve requires 2 new seals or leak may occur. External hydraulic power required for bleeding and brake check. Lines to shuttle valve can be bent during brake installation. Disc alignment required during wheel installation adds difficulty. An easy method of obtaining and holding alignment would be desirable.

NOTE: It was not determined what disposition is made of inner wheel bearing during brake change. Special tool is required to remove it. An arrangement to keep both bearings with the wheel is better than having one stay with the brake.

WORK UNIT CODE 13440 ITEM Brake Assembly AIRCRAFT F-4

LOCATION: Bottom of main landing gear strut

SUPPORT EQUIPMENT: Jacks
Brake rotor alignment tool
Hydraulic power

ACCESS: Remove wheel and tire

REMOVAL:
1. Disconnect emergency air and normal hydraulic lines
2. Remove 2 brake retainer nuts and washers
3. Break "gunk" seal and remove brake

INSTALLATION:
1. Reverse of removal
2. Seal axle with MIL-S-8802
3. Install wheel
4. Shim retaining bolts as required to obtain proper clearance
5. Bleed brake system

FUNCTIONAL CHECK: Brake check

TEST EQUIPMENT: Hydraulic power

CLOSE UP: Install wheel and tire.

ANALYST'S OPINION: A fairly normal installation except for the elastomer seal. This can be a pesky thing to release, requires careful removal to ensure adherence of the new seal, and has a long curing time. NARF personnel indicated MIL-S-8802 was used for this seal. High brake temperatures will effect the efficiency of this compound. The rotor alignment tool helps immensely. Clearances should not be so tight as to require critical shimming.

WORK UNIT CODE 13511 ITEM BRAKE ASSEMBLY AIRCRAFT F-8

LOCATION: MLG Tension Strut

SUPPORT EQUIPMENT: Torque wrench (inch lb) Allen type wrench adapted to socket drive
Hydraulic test stand
Tension strut jack

ACCESS: None

REMOVAL:
1. Remove wheel and tire assembly
2. Loosen shuttle valve from brake assembly (valve can be left in place)
3. Cut lockwire and remove five internal wrenching bolts (allen type) securing brake assembly to strut.
4. Remove brake assembly.

INSTALLATION:
1. Reverse of removal
2. Bleed brakes

FUNCTIONAL CHECK: Perform functional check of brake system.

TEST EQUIPMENT: None

CLOSE UP: None

ANALYST'S OPINION: Some risk is involved in bending the line to the shuttle valve when installing a new brake assembly. Shuttle valve might be removed with the brake assembly or be a part of the brake assembly design to minimize this possibility. The two discs are not supported as mentioned when removing a wheel and tire assembly. The same recommendation concerning not having to support and align brake discs with the wheel assembly are again being suggested. Brake assembly has a wear indicator that shows brake pad wear. When this indicator is flush brake assemblies have to be changed. Brake assy replacement in lieu of brake pad replacement is reasonable and would not require having to spend time working on replacing individual brake pads. Brake assemblies are interchangeable (right for left and left for right) and is a very desirable feature.

WORK UNIT CODE 13811 ITEM BRAKE ASSEMBLY AIRCRAFT E-14

LOCATION: End of LG Strut

SUPPORT EQUIPMENT: Jack

ACCESS: Remove wheel and tire assembly

REMOVAL:
1. Jack Strut
2. Disconnect 2 hydraulic lines
3. Pull ball lock pin in bottom lug
4. Remove brake

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Brake check

TEST EQUIPMENT: External hydraulic power

CLOSE UP: Install wheel and tire assembly

ANALYST'S OPINION: Remarkably simple task. Installation of a brake assembly was observed and no difficulty of any kind was experienced. This is a good installation.

WORK UNIT CODE 13716 ITEM Wheel Brake Assembly AIRCRAFT AV-8

LOCATION: Main Landing Gear Strut

SUPPORT EQUIPMENT: Jack
Hydraulic Power

ACCESS: Remove wheel and tire

REMOVAL:
1. Jack strut.
2. Remove anti-skid sensor (RH brake)(3 Allen head screws)
3. Disconnect banjo fitting
4. Remove 1 nut
5. Remove brake (tap with mallet)

INSTALLATION:
1. Reverse of removal
2. Adjust anti-skid sensor
3. New banjo seals required
4. Bleed brakes

FUNCTIONAL CHECK: Operate

TEST EQUIPMENT: Hydraulic Power

CLOSE UP: Install wheel and tire.

ANALYST'S OPINION: Wheel difficult to install because the disc alignment and master spline orientation is disturbed. Other than that, the removal is simple.

SYSTEM: 13 Landing Gear

NOMENCLATURE: Main Landing Gear Shock Strut

MUC: A-4: 13121 A-6: 13111 A-7: 13121 F-4: 13211

F-8: 13121 F-14: 13111 AV-8: 13111

GENERAL OBSERVATIONS: Low wing aircraft present head space problems when working on an item this heavy. Component weight is a factor in all airplanes. Tripod style gear allows design that reduces component weight and avoids the requirement for wheel and tire removal.

DESIRABLE FEATURES: 1. The tripod type MLG structure of the A-7 and F-8 avoid wheel and tire removal to change strut. 2. Access to all struts is good. 3. Handling equipment is available to accommodate the weight of the strut on the A-4 and A-6. 4. The F-14 is distinguished by exceptionally clear wheel wells. 5. Several struts used the same clamping arrangement discussed in the nose gear summary. This greatly simplifies build-up of a new strut. 6. A tandem arrangement such as the AV-8 reduces the number of main gear struts to be maintained and requires less fuselage space for retraction.

UNDESIRABLE FEATURES: 1. Low wing aircraft with struts mounted in the wing present the greatest burden with poor working space and wheel well closures fastened to the struts. 2. Except for tripod gears, wheel and tire removal is required. 3. The A-7/F-8 require trunnion removal for installation on the new strut. 4. The A-4 requires partial retraction for removal. In some cases, routing of lines and harnesses

SYSTEM: 13 Landing Gear

NOMENCLATURE: Main Landing Gear Shock Strut

UNDESIRABLE FEATURES: (cont.)

interferes with access to attach bolts. 5. The A-4 and F-4 require partial retraction and manual manipulation during removal. 6. The F-14 swivel interferes with trunnion pin removal and must be removed completely.

ADDITIONAL REMARKS: 1. Component build-up at the airplane should be avoided. 2. When the landing gear consists of more than one member, the axle should be attached to the member that is not involved in shock absorption. In this way, wheel and tire removal can be avoided during strut change and component weight is reduced. 3. Routing of lines and harnesses should avoid covering attach points. 4. Whenever possible, wheel well closures should be insensitive to strut position when retracted. This allows replacement of struts without the tedious job of rigging doors. 5. Handling equipment is necessary for heavier struts. 6. A requirement for partial retraction causes disturbance of the hydraulic system and adds a bleeding/servicing requirement that should not be required. 7. Lack of drag link on the AV-8 strut was reported by NARF technicians to substantially weaken all landing gear struts (not just the main) when operating in normal high speed landing modes.

WORK UNIT CODE 12121 ITEM MLG Shock Strut AIRCRAFT A-4

LOCATION: Below Center Wing Section

SUPPORT EQUIPMENT: Aircraft Jacks. Transfer Dolly, External Hydraulic Power, Nitrogen Servicing Equipment

ACCESS:

REMOVAL:
1. Jack aircraft
2. Relieve pressure in strut
3. Remove wheel and tire assy
4. Disconnect 1 Hydraulic Line, 1 Electric Harness, and 2 Clamps
5. Disconnect Door Actuator and Remove Door (2 hinge pins)
6. Remove outboard fairing (six screws), rear fairing (8 screws)
7. Remove nut at top of strut.
8. Attach hydraulic pressure to actuator and partially retract strut
9. Remove strut

INSTALLATION:
1. Reverse of removal
2. Rig fairings
3. Bleed hydraulic system
4. Rig spoiler switch

FUNCTIONAL CHECK: Drop check MLG

TEST EQUIPMENT: External hydraulic and electrical power.

CLOSE UP: None.

ANALYST'S OPINION: Requirement to partially retract strut to remove is not desirable. Fairings attached to strut require extra build-up during remove/install task. The low wing with the strut attached to the wing results in an awkward croucning work position. The single strut landing gear also requires additional effort to remove wheel, harnesses and hydraulic lines.

WORK UNIT CODE 33113 ITEM MLG Shock Strut AIRCRAFT A-6

LOCATION: Mid Fuselage Section Attached to Wing Structure.

SUPPORT EQUIPMENT: Wing jacks.
Special holding fixture to support large strut during removal. (Support for strut is also transportation dolly)

TOOLS: None

REMOVAL:
1. Jack aircraft.
2. Remove wheel and tire and brake assembly.
3. Depressurize strut.
4. Remove snubber from upper end of scissors.
5. Remove two bolts and disconnect drag brace.
6. Disconnect electrical wiring from strut.
7. Disconnect hydraulic lines at hydraulic swivel between strut attach points.
8. Remove swivel.
9. Support strut with holding fixture and remove strut attach hardware from inboard and outboard attach point by removing cotter key, nut and special bolt.
10. Remove strut from aircraft with supportand transportation dolly.

(See continuation sheet)

FUNCTIONAL CHECK: Connect external hydraulic power by disconnecting hoses from engine quick-disconnects and connecting to test stand. Perform landing gear retract check and landing gear drop check.

UNIT EQUIPMENT: External hydraulic and electrical power.

CLOSE UP: None required.

ANALYST'S OPINION: MLG shock strut is large and heavy requiring special holding and transportation dolly. A hydraulic swivel assembly is located between attach points which has to be physically removed before shock strut attach hardware can be removed. A link attached to the strut between wing attach lug and which has one end grounded to wing structure was also a corrosion prone area. Performing operational check requires opening engine accesses so that engine quick-disconnect hoses can be connected to the test stand. Separate service quick-disconnects would have improved the maintenance characteristics of this installation as well as other installations requiring hydraulic power.

CONTINUATION SHEET:

WORK UNIT CODE 13111 ITEM MLG Shock Strut AIRCRAFT A-6

INSTALLATION:
1. Reservice strut with hydraulic oil and nitrogen.
2. Service hydraulic system, if required.
3. Lub pivot points.

WORK UNIT CODE 13121 ITEM MLG Shock Strut AIRCRAFT A-7

LOCATION: Lower fuselage

SUPPORT EQUIPMENT: Wing Jacks (2)
Axle Jack & Adapter
Hydraulic Cart
Nitrogen Servicing Cart

ACCESS: Release MLG Doors & Stow out of way

REMOVAL:
1. Jack aircraft.
2. Bleed pressure
3. Support tension strut
4. Remove upper and lower attach bolts (2)
5. Remove shock strut
6. Remove trunnion sleeves from bulkhead fitting
7. Separate trunnion from shock strut (2 screws, 2 pins, 2 retainers)

INSTALLATION:
1. Reverse of removal
2. Service strut

FUNCTIONAL CHECK: Landing Gear Drop Check

TEST EQUIPMENT: Hydraulic Test Stand
External Electrical Power
Jacks

CLOSE UP: Reconnect MLG Doors

ANALYST'S OPINION: Does not require removal of wheel and tire, these components are not installed on the shock strut. Separate trunnion requires extra build-up at O-level. Should be shop build-up item.

WORK UNIT CODE 13211 ITEM MLG Shock Strut AIRCRAFT F-4

LOCATION: Lower Wing C/S (folds inboard)

SUPPORT EQUIPMENT: Jacks
Sling or jack to handle strut
Hydraulic and electrical power
Nitrogen servicing equipment

ACCESS: Plate, top of wing (18 screws, 6 with nuts)

REMOVAL:

1. Jack aircraft.
2. Remove wheel and brake.
3. Remove strut door (four bolts - keep track of shims and mark eccentric position) slide door down track and off.
4. Deflate lower and upper chambers
5. Remove upper chamber manifold (1 fluid passage bolt)
6. Remove swivels and lines (1 U-bolt, 3 clamps, 2 B nuts, 1 switch - record shim position on switch)
7. Disconnect shrink link (2 bolts)
8. Connect hydraulic test stand to drag brace/actuator (remove 2 lines), retract 25°, and support strut
9. Disconnect outer door link (1 bolt)
10. Remove aft drag link nut (2 fluid lines remov[illegible] for access)
11. Remove drag brace/actuator nut
12. Attach sling
13. Remove aft drag link bolt

(See continuation sheet)

FUNCTIONAL CHECK: Drop check
Brake check

TEST EQUIPMENT: Hydraulic and Electrical Power

CLOSE UP: Re-install plate

ANALYST'S OPINION: This is a poor installation. Removal tasks are both complicated and difficult to perform. The strut is heavy and must be manipulated excessively during removal. Partial retraction to gain access requires disturbing the actuator hydraulic system which then adds a bleeding requirement. The strut must be moved about to get the aft trunnion (drag link) disconnected. Many shims must be accounted for and returned to the correct places in the correct quantity. If the new strut differs dimensionally, reshimming is required.

CONTINUATION SHEET:

WORK UNIT CODE 13211 ITEM MLG Shock Strut AIRCRAFT F-4

REMOVAL: (Continued)

14. Remove lower drag link pin lock and pin.
15. Extend gear to vertical manually.
16. Remove aft drag link (also is aft trunnion).
17. Move strut aft to disengage forward trunnion.
18. Remove strut.

INSTALLATION:

1. Reverse of removal, minding shims and eccentrics.
2. Rig.
3. Bleed.
4. Reservice.

[illegible] 13121 [illegible] MIG Shock Strut AIRCRAFT F-8

LOCATION: Mid Fuselage section

SUPPORT EQUIPMENT: Wing Jacks
Dry Nitrogen
Hydraulic Servicing Stand
Air Gauge

ACCESS: No access required

REMOVAL:
1. Jack airplane
2. Depressurize strut
3. Remove hardware securing lower end of strut to tension strut
4. Remove lower attach pin
5. Remove cotter key, large nut, and bolt securing trunnion to bulkhead fitting.
6. Support strut and remove from aircraft

INSTALLATION:
1. Reverse of removal
2. Reservice strut

FUNCTIONAL TESTS: Landing Gear Drop Check

SUPPORT EQUIPMENT: Hydraulic Test Stand
External Electrical Power

SET UP: None

ANALYST'S OPINION: Removing upper bolt from trunnion area is obstructed by several hydraulic lines that are in line with the bolt removal path requiring that these lines be removed to facilitate strut removal. Lines should have been routed such that removing hydraulic lines is not a part of the shock strut removal procedures. A support dolly would be beneficial in supporting weight of strut during removal procedures.

WORK UNIT CODE 13111 ITEM MLG SHOCK STRUT AIRCRAFT F-14

LOCATION: Left Hand and Right Hand Sponson

SUPPORT EQUIPMENT: Removal dolly
Hydraulic and electrical power
Aircraft Jacks

ACCESS: Remove aft landing gear fairing door (3 hinge bolts & 1 actuator bolt)

REMOVAL:
1. Jack Aircraft
2. Remove wheel & brake
3. Bleed strut
4. Remove fwd drag brace (1 bolt)
5. Install removal dolly
6. Disconnect electrical plug
7. Disconnect actuator (1 bolt)
8. Disconnect 10 lines at swivel
9. Remove swivel (1 screw imbd, 1 nut locked with screw)
10. Remove outboard trunnion pin
11. Remove locking bolt thru inboard trunnion
12. Remove locking bolt thru nut
13. Remove inboard trunnion
14. Remove strut

INSTALLATION: 1.Reverse of removal.2.Rig strut and doors as required.

FUNCTIONAL CHECK: Drop check

TEST EQUIPMENT: External hydraulic and electrical power.

CLOSE UP: Install fairing door and rig.

ANALYST'S OPINION: A fairly good installation considering size and weight of the strut. The swivel arrangement is complex and it would be preferable if the swivel could be retained on the strut or the airplane. This would reduce the hydraulic disconnects to 5 rather than 10 and eliminate the extra effort to remove the swivel from fairly cramped quarters. The wheel well is exeptionally free of clutter except for hydraulic lines. Very few non-related components are installed in the wells to inhibit access to landing gear parts. This is the best looking main wheel well in the fighter fleet. A number of lines and harnesses must be transferred by clamping to large clamps which allow removal of all items as a unit, retaining routing and position until re-installed.

WORK UNIT CODE 13111 ITEM MLG Undercarriage Leg Assy AIRCRAFT AV-8

LOCATION: Mid Fuselage, Bottom Centerline

SUPPORT EQUIPMENT: Jacks
Jacking cradle
Hydraulic power
Electrical Power

ACCESS: 2 Plates (23 screws ea.)

REMOVAL:

1. Jack aircraft
2. Remove wheel and brakes
3. Disconnect forward door (1 bolt in ea of 2 links)
4. Disconnect manual hand operated strut (1 bolt)
5. Disconnect 3 harnesses (3 cannon plug) (approx 3 clamps - varies)
6. Disconnect recuperator air line (B-nut)
7. Disconnect actuator (1 bolt)
8. Remove brake line (long bolt through top of LH fulcrum, B-nut on bottom)
9. Remove phenolic clamp above LH end of trunnion
10. Disconnect brake line to trunnion, remove fitting (slips out)
11. Remove pin in RH trunnion
12. Remove pintle pins
13. Remove strut
14. Remove uplock roller
15. Deservice strut

(See continuation sheet)

FUNCTIONAL CHECK: Drop check
Brake check

TEST EQUIPMENT: Hydraulic and Electrical Power

CLOSE UP: Install Plates

ANALYST'S OPINION: Manual door operation to close doors during ground operation and before VTO. Gear will open them on retraction. Manual latch allows opening for maintenance. Electrical leads are very long and exposed to damage during strut removal. The uplock roller is not part of the strut and must be removed for installation on the new strut. Room is at a premium while removing this strut but overall it is a good installation.

CONTINUATION SHEET:

WORK UNIT CODE 13111 ITEM MLG Undercarriage Leg Assy AIRCRAFT AV-8

REMOVAL: (Continued)

INSTALLATION:
1. Bleed brakes
2. Rig
3. Service strut

SYSTEM: 13 Landing Gear

NOMENCLATURE: Nose Landing Gear Shock Strut

MUC: A-4: 13221 A-6: 13211 A-7: 13151 F-4: 13313

F-8: 13221 F-14: 13311 AV-8: 13216

GENERAL OBSERVATIONS: This component is relatively heavy and presents problems in handling during installation. Nose wheel wells are cramped for space in all airplanes except the F-14 and tend to be installation areas for components not related to landing gear function.

DESIRABLE FEATURES: 1. Outside access to trunnion pins as in the A-6, A-7 and F-14 are very desirable features when limited space in the nose wheel well is considered. 2. Handling equipment such as provided for the A-7 and F-8 assists in positioning strut for installation. 3. The A-6 nose launch system does not require removal of launch bar during strut replacement. 4. Several of the struts use large clamps to support harness and tubing clamps down the strut. This allows the cluster of tubes and wires to be removed as a single assembly for build-up on a new strut. 5. The V/STOL operation of the AV-8 eliminates need for catapult provisions. 6. The F-14 nose wheel well is exceptionally clear of clutter.

UNDESIRABLE FEATURES: 1. Close quarters make removal of trunnion pin(s) a tedious, difficult job if outside access is not provided. The F-8 requires special tools to remove pin. 2. Some struts have complex linkages or extra equipment installed which require special build-up at flight line. 3. Aircraft (such as A-7) with nose gear launch require removal of launch bar which requires special tools. 4. Special

SYSTEM: 13 Landing Gear

NOMENCLATURE: Nose Landing Gear Shock Strut

UNDESIRABLE FEATURES: (Cont.)

test equipment to checkout systems attached to strut (A-4 steering for example) adds complexity to task. The A-6 strut is inverted (See photos) and the gland nut forms a reservoir for water and dirt. The A-6 shimmy damper spring also appears to be susceptible to contamination. The AV-8 landing gear trunnions are in a very crowded area and hydraulic fittings have to be moved for access.

ADDITIONAL REMARKS: 1. Close working space can be helped by reducing equipment installed in nose wheel well and providing outside access to items such as trunnion pins. 2. Attachment of non-related items (such as lights, etc.) to strut should be minimized. Design of nose gear launch systems should provide for shop build-up of strut/launch bar to reduce aircraft downtime now invested in "curbside" build-up. 3. Linkages to strut should either accompany strut to shop or have single point attachment (preferably with quick disconnect pin) to disconnect linkage. 4. Design of strut installation should prevent disturbing critical circuits that require bleeding, rigging, or special test equipment to ensure proper function after installation. 5. Strut design should avoid natural cavities for water and items such as exposed torsional springs should be protected from contamination build-up. The A-6 nose strut appears both complicated and heavy. According to personnel associated with the airplane, it presents no special malfunction problems and is easily removed.

WORK UNIT CODE 13221 ITEM NLG Shock Strut AIRCRAFT A-4

LOCATION: Nose Wheel Well, Underside of Nose Fuselage

SUPPORT EQUIPMENT: 3 Aircraft Jacks
Strut Servicing Equipment

ACCESS: No access required.

REMOVAL:
1. Jack airplane
2. Relieve pressure in strut
3. Remove wheel and tire assembly
4. Disconnect and remove nose wheel steering (4 bolts, 2 hydraulic lines, 1 wiring harness)
5. Disconnect actuating cylinder (1 bolt)
6. Disconnect shrink link (1 bolt)
7. Remove trunnion bolt
8. Remove strut

INSTALLATION:
1. Reverse of removal
2. Service strut

FUNCTIONAL CHECK: Retraction check of landing gear
Nose wheel steering checkout

TEST EQUIPMENT: Hydraulic test stand
Nose wheel steering electrical tester
External electrical power

CLOSE UP: None required.

ANALYST'S OPINION: The nose wheel well is very cramped and access to trunnion bolt is difficult. Removal and installation is a tedious job. Test set required to checkout steering. For these reasons, the installation is considered to be poor. No strut handling equipment was available, according to the NARF technicians. Although this is a comparatively light strut, it is still too heavy to handle easily.

WORK UNIT CODE: 13211 ITEM: NLG Shock Strut AIRCRAFT: A-6

LOCATION: Nose of aircraft

SUPPORT EQUIPMENT: Fuselage jack
Installation and transportation dolly
External hydraulic and electrical power

ACCESS: Two access panels to trunnion pins (25 screws each)

REMOVAL:
1. Jack airplane
2. Remove both wheel and tire assemblies
3. Bleed air of hydraulic system reservoir
4. Remove nose gear steering actuator/shimmy damper
5. Disconnect electrical switch to nose wheel centering switch by removing switch assembly.
6. Disconnect hydraulic swivel at lower drag brace
7. Disconnect nose gear shrink linkage
8. Remove lower drag brace pin
9. Disconnect landing gear retract cylinder
10. Disconnect bolt at first scissors linkage in NG steering linkage
11. Disconnect both flipper door links from strut
12. Disconnect hydraulic flex line at top of strut
13. Remove clamp securing wiring to strut
14. Remove access to trunnion pins by removing 25 screws on each side

(See continuation sheet)

FUNCTIONAL CHECK: Perform drop check
Perform nose gear steering check and check for hydraulic leaks

TEST EQUIPMENT: Hydraulic Test Stand
External Electric Power

CLOSE UP: Replace access panels

ANALYST'S OPINION: Other than its large physical size, this shock strut was removable with apparently very few problems. There were a few observations made which should be reevaluated for future designs. The oleo part of the strut is inverted compared to the normal way of positioning an oleo strut. As a result, the tendency of the gland nut to retain water seems very favorable and would appear to be a natural condition for corrosion. The steering linkage for this strut is also unusual because of using several "scissors type" linkages from the wheel well down to linkage input to steering actuator. This linkage system would appear to be prone to damage from aircraft handling, etc. The shimmy damper function was also unusual

(see continuation sheet)

CONTINUATION SHEET:

WORK UNIT CODE 13211 ITEM NLG Shock Strut AIRCRAFT A-6

REMOVAL: (Continued)

15. Remove bolt and nut securing trunnion pins, and remove strut with installation and transportation dolly.

INSTALLATION: 1. Adjust trunnion for proper clearance
2. Service hydraulic system reservoir with nitrogen

ANALYST'S OPINION: (Continued)

in that a heavy coil spring is wrapped around the periphery of the steering actuator engaging spring stops at either end. The spring has a square cross section and has to be sturdy to provide the damper function. It seems that normal contaminants working in between adjacent spring coils could cause sluggish operation of the damper function. NARF NORVA did not indicate if this were a problem area. Inclosing the spring to exclude contaminants would seem beneficial if moisture/salt could also be excluded.

WORK UNIT CODE 13151 ITEM NLG Shock Strut AIRCRAFT A-7

LOCATION: Nose Wheel Well, Beneath Fuselage Nose Section

SUPPORT EQUIPMENT: Nose Jack
Multi-purpose Dolly & Adapter
Launch Bar Spring Release Tool
Hydraulic Test Stand

ACCESSIBILITY: 2 Access Panels (21 screws, 17 SPF)
Disconnect and Stow Nose Gear Doors

REMOVAL:

1. Jack airplane
2. Depressurize Strut
3. Remove Nose Wheels (2)
4. Remove Launch Bar (Note: Special tool required to release spring tension, 3 bolts - 2 pins)
5. Disconnect Lower Drag Link (loosen launch bar centering assy, remove 1 bolt)
6. Disconnect Steering Harness (1 connector) and remove bracket (2 bolts)
7. Remove NLG Steering Actuator (See data sheet for WUC 13612)
8. Disconnect Hydraulic Extension Units (2)
9. Install NLG Adapter and Multi-Purpose Dolly
10. Support Strut
11. Remove Trunnion Pins (2 bolts, 2 pins)
12. Remove Strut
13. Remove Attached Items from Strut (bellcranks, links, etc.)

(See continuation sheet)

FUNCTIONAL CHECK: Retraction Check
Steering Check

TEST EQUIPMENT: Hydraulic Test Stand
External Electrical Power

CLOSE UP: Close Access Panels
Reconnect NLG Doors

ANALYST'S OPINION: Many items attached to strut require removal for build-up of new strut. External access to trunnion pins is excellent. Nose wheel launch system requires additional special tools. Handling equipment is good assist in maneuvering and positioning heavy strut.

CONTINUATION SHEET:

WORK UNIT CODE 13151 ITEM NLG Shock Strut AIRCRAFT A-7

INSTALLATION: (Cont.)

1. Build-up strut with items removed from old strut
2. Install in reverse of removal
3. Bleed steering
4. Service strut

WORK UNIT CODE 13313 ITEM NLG Pneudraulic Strut AIRCRAFT F-4

LOCATION: Nose fuselage, bottom centerline

SUPPORT EQUIPMENT: Jacks
Nose gear strut jack
Nitrogen servicing equipment

ACCESS: None

REMOVAL:
1. Jack airplane
2. Deflate strut
3. Remove tires and wheels
4. Disconnect catapult extension pneumatic line - remove swivel
5. Disconnect NLG steering hydraulic line at right trunnion attach bolt
6. Disconnect NLG steer compensating line (remove swivel, 2 B nuts, 1 jam nut)
7. Remove 4 hydraulic lines from strut (6 clamps), compensator, filter
8. Remove steering elect harness (2 connectors)
9. Disconnect forward door (2 bolts)
10. Remove steering sector gear cover (6 bolts)
11. Remove nose steering unit (4 bolts)
12. Disconnect actuator down and up lines and connect hydraulic power
13. Retract strut 20° (gain access to trunnion retain bolt, nuts) and support strut
14. Remove 2 retaining bolts
15. Remove dragbrace attach bolt (See continuation sheet)

FUNCTIONAL CHECK: Drop check, check steering, catapult extension function

TEST EQUIPMENT: Hydraulic and electrical power

CLOSE UP: None

ANALYST'S OPINION: This installation is too complex and difficult. Partial strut retraction is undesirable because of the disturbance of the hydraulic system. Removal of the steering actuator should be accomplished in the shop rather than at the airplane (and probably is in some units). The strut jack is a help in handling the weight of the strut. A notable item is the practice of clamping lines and harnesses to large axial screw type clamps which allows removal of all lines and harnesses as an assembly. Routing is preserved and re-installation is easier, clamp fit and paint condition under the clamp must be watched to avoid a corrosion problem.

CONTINUATION SHEET:

WORK UNIT CODE 13313 ITEM NLG Pneudraulic Strut AIRCRAFT F-4

REMOVAL: (Continued)

16. Remove dragbrace from strut attachment
17. Install strut jack on piston , remove support
18. Remove trunnion pins (2)
19. Remove strut, compress piston for shipping.

INSTALLATION:
1. Reverse of removal
2. Reservice
3. Rig
4. Bleed hydraulics

WORK UNIT CODE 13221 ITEM NLG SHOCK STRUT AIRCRAFT F-8

LOCATION: Nose wheel well

SUPPORT EQUIPMENT: Special wrenches to remove trunnion pins.
Normal hand tools.
Transportation dolly to move and position strut. (See continuation sheet)

ACCESS: Access to trunnion pins and hydraulic fittings is restricted because of being high in the wheel well.

REMOVAL:
1. Jack airplane
2. Deflate strut
3. Remove wheel and tire
4. Attach special jack to strut
5. Remove hydraulic lines
6. Disconnect actuating cylinder
7. Disconnect nose gear steering wiring
8. Disconnect and lower "A" frame
9. Remove bolts securing trunnion pin
10. Retract trunnions using special wrenches
11. Lower strut with jack and mount strut on transporation dolly

INSTALLATION:
1. Reverse of removal
2. Lubricate grease fittings
3. Service strut

FUNCTIONAL CHECK: Retract and extend landing gear and check for proper clearances between landing gear doors and shock strut.

TEST EQUIPMENT: External Hydraulic Power
External electric power

CLOSE UP: None

ANALYST'S OPINION: The NLG shock strut installation is hard to work on because of the relatively small area in which to work in when disconnecting hydraulic lines, actuator, and electrical connections. Trunnion pin removal is unique but requires special wrenches to retract trunnion pins. Installation of trunnion pins requires using special wrenches to extend trunnion pins until holes in trunnion pins align with holes in shock strut trunnion supports. Performing this is difficult because of one man having to extend pin until trunnion pin security bolt can be installed through shock strut trunnion and pin. The installation, although functional, is difficult to work on from a maintainability consideration. These observations should be taken into consideration on new designs and avoided, if possible. The areas of concern are access to the trunnion pins as well as positioning and locking of the trunnion pins, access to hydraulic fittings and electrical connectors.

CONTINUATION SHEET:

WORK UNIT CODE 13221 ITEM NLG Shock Strut AIRCRAFT F-8

SUPPORT EQUIPMENT: (Cont.)

Modified auto jack for removal and installation of shock strut
Aircraft jacks
Hydraulic test stand
Hydraulic servicing stand

WORK UNIT CODE 13311 ITEM NLG SHOCK STRUT AIRCRAFT F-14

LOCATION: Nose Wheel Well

SUPPORT EQUIPMENT: Removal dolly
Transportation dolly
Jacks
Trunnion pin puller
Hydraulic and electrical power

ACCESS: L.H. access (2 latches)-- Rounds counter must be removed
R.H. access (36 screws) -- Canopy bellcrank must be repositioned

REMOVAL:
1. Jack aircraft
2. Remove wheel and tire assemblies (2)
3. Remove bolt in drag link
4. Disconnect launch bar tension springs
5. Remove 3 hydraulic connections
6. Remove 2 electrical connectors
7. Disconnect actuator (1 bolt)
8. Remove 2 trunnion bolsts
9. Disconnect aft door rods (2 bolts each)
10. Support strut on removal dolly
11. Pull trunnion pins
12. Remove strut and place on transport dolly

INSTALLATION:
1. Reverse of removal.
2. Rig strut and doors as required.

FUNCTIONAL CHECK: Drop check

TEST EQUIPMENT: Hydraulic and electrical power.

CLOSE UP: Re-install rounds counter and canopy bellcrank
Close 2 access panels.

ANALYST'S OPINION: The first impression by the observer is the extrememly uncluttered appearance of the nosewheel well. Access is very good to everything in the well. A number of items are fastened to the strut which would require removal and installation on a new strut if the old one is not to be re-installed. Clamping arrangements allow these items to almost be removed as a single assembly which simplifies re-installation Trunnion pin removal is easily accomplished thru outside access openings. The hydrauli swivel is mounted on the strut allowing disconnect of only the lines extending to the airframe. The swivel can subsequently be removed with the hydraulic lines intact for buildup on a new strut.

WORK UNIT CODE 13216 ITEM Nose Undercarriage Leg Assy AIRCRAFT AV-8

LOCATION: Nose Fuselage, Bottom Centerline

SUPPORT EQUIPMENT: Jacks (special jacking trestle) Transport pin
Hydraulic power
Removal dolly
Strut lock

ACCESS: 1 Plate (7 screws)
1 Block and 2 connectors must be disconnected to relocate in-the-way hydraulic lines

REMOVAL:
1. Jack aircraft
2. Depressurize steering accumulator
3. Disconnect aft door (2 bolts), prop door out of way
4. Unlock gear hydraulically (valve in main gear well)
5. Disconnect steering input arm (2 bolts)
6. Remove steering pushrod (1 bolt)
7. Disconnect electrical harness (2 cannon plugs, 4 clamps)
8. Disconnect nose steering sequence valve
9. Disconnect swivels, each side (1 cotter pin)
10. Disconnect hydraulic lines to airframe (1 block)
11. Disconnect actuator (1 pin)
12. Retract strut manually to 45° and remove link to liquid spring
13. Remove cotter pins through trunnion retaining pins

(See continuation sheet)

FUNCTIONAL CHECK: Drop check
Nose steering check

TEST EQUIPMENT: Hydraulic and Electrical Power

CLOSE UP: Reinstall plate and hydraulic lines

ANALYST'S OPINION: This is only a fair installation, although it is rather complex. Access is very cramped because of the small wheel well. Hydraulic lines have to be moved to gain access to fittings. A micro switch on the aft side of the strut is vulnerable to damage if aft door is not propped out of the way. Landing lights are removed after the strut is removed. Nose gear steering is integral with the strut.

CONTINUATION SHEET:

WORK UNIT CODE 13216 ITEM Nose Undercarriage Leg Assy AIRCRAFT AV-8

REMOVAL: (Continued)

14. Install removal dolly
15. Remove insert from pintle pins, each side
16. Push pins outboard slightly to release downlock mechanism

INSTALLATION:
1. Reverse of removal
2. Bleed hydraulics
3. Rig

SYSTEM: 13 LANDING GEAR

NOMENCLATURE: Nose Wheel Steering Unit

MUC: A-4: _____ A-6: 13724 A-7: 13612 F-4: 13342

F-8: 13311 F-14: 13921 AV-8: _____

GENERAL OBSERVATIONS: Generally, all airplanes except the F-8 have simple installations. Access is good and tasks are not complex.

DESIRABLE FEATURES: 1. The A-6 installation includes a simple rigging procedure which is accomplished during installation. All airplanes demonstrated good maintainability features (except for the F-8 installation). 2. The F-14 and F-4 installations were excellent geared units that had no complex linkages. 3. Rigging pin or indexing provisions to allow proper adjustment during installation is a most desirable feature on the A-6, F-4 and F-14 systems.

UNDESIRABLE FEATURES: The F-8 installation is mounted on top of the NLG shock strut and requires strut removal to replace.

ADDITIONAL REMARKS: No comment is deemed necessary concerning removal of a strut to replace the steering actuator. Later designs have indicated progress beyond that. Simplified indexing and rigging such as the A-6 system permits should be included. The AV-8 steering is integral with the strut and is not included as a review item.

WORK UNIT CODE 13724 ITEM Nose Wheel Steering Assembly AIRCRAFT A-6

LOCATION: On NLG Shock Strut

SUPPORT EQUIPMENT: External Hydraulic Power
External Electrical Power
Nose Fuselage Jack

ACCESS: None

REMOVAL:
1. Deservice hydraulic system reservoir
2. Disconnect 2 hydraulic lines
3. Remove bolt that connects input linkage to actuator
4. Remove hardware securing steering input bellcrank
5. Remove 4 bolts securing actuator to strut and remove actuator

INSTALLATION:
1. Reverse of removal with check of linkage position with rigging pin. Rigging pin inserted in actuator input bellcrank.
2. Reservice hydraulic system reservoir.

FUNCTIONAL CHECK: Perform nose gear steering check and check nose gear steering centering function.

TEST EQUIPMENT: External hydraulic and electrical power required to perform check.

CLOSE UP: None

ANALYST'S OPINION: Component is reported to leak frequently and data plate is not visible when unit is installed. The installation is otherwise very good. The rigging pin simplifies installation and ensures minimum problems with the checkout. Access is excellent and in spite of the fairly complex linkage, removal tasks are quite simple.

WORK UNIT CODE 13612 ITEM NLG Steering Cyl AIRCRAFT A-7

LOCATION: Rt Hand Nose Wheel Well

SUPPORT EQUIPMENT: External Hydraulic and Electrical Power

ACCESS: Open Access

REMOVAL:
1. Disconnect wiring harness and 2 Hyd Lines
2. Remove top attach bolt (1)
3. Remove lower attach bolt (1)
4. Remove lower pin
5. Remove cylinder

INSTALLATION:
1. Reverse of removal
2. Rigging Required

FUNCTIONAL CHECK: Check of steering operation

TEST EQUIPMENT: Aircraft Jack
Hydraulic & Electrical Power

CLOSE UP: Close access

ANALYST'S OPINION: The cylinder is easily reached from the nose wheel well. Access to fittings and attachments is good. Each cylinder requires rigging after installation to ensure proper nose gear positioning. It would be preferable to provide a indexing device to ensure nose wheel and cylinder are installed in an indexed position to eliminate rigging.

WORK UNIT CODE 13342 ITEM Steering Power Unit AIRCRAFT F-4

LOCATION: On nose landing gear strut

SUPPORT EQUIPMENT: Hydraulic and electrical power

ACCESS: None

REMOVAL:
1. Disconnect hydraulic lines
2. Disconnect 2 electrical connectors
3. Remove steering sector gear cover (6 bolts)
4. Remove steering actuator (4 bolts)

INSTALLATION: Reverse of removal (index gears during installation) bleed system.

FUNCTIONAL CHECK: Steering check

TEST EQUIPMENT: Hydraulic and electrical power

CLOSE UP: None

ANALYST'S OPINION: This is a good installation. Access is reasonably good and the task is simple. No linkages or complex hookups are required. Proper indexing of gears eliminates rigging.

WORK UNIT CODE 13311 ITEM NLG STEERING CYLINDER AIRCRAFT F-8

LOCATION: NLG shock strut

SUPPORT EQUIPMENT: Aircraft Jacks

ACCESS: Remove NLG Shock Strut (see Data Sheet for WUC 13221)

REMOVAL:

1. Disconnect 5 lines from actuator.
2. Remove two security bolts and remove pins from mount.
3. Remove nut from steering actuator rod end.
4. Remove steering actuator

INSTALLATION:

1. Reverse of removal
2. Bleed actuator and hydraulic system

FUNCTIONAL CHECK: Perform nose wheel steering functional check.

TEST EQUIPMENT:

External Hydraulic & Electrical Power

CLOSE UP: Reinstall NLG Shock Strut

ANALYST'S OPINION: Removing entire strut to only change the steering actuator results in spending a great deal of time which could have been avoided if steering actuator could be removed without removing the entire shock strut. This condition should be avoided on new designs.

WORK UNIT CODE 13921 ITEM NOSE WHEEL STEERING DAMPER AIRCRAFT F-14

LOCATION: Nose Landing Gear Strut

SUPPORT EQUIPMENT: None

ACCESS: Disconnect left hand aft door (1 bolt)

REMOVAL:
1. Disconnect 3 hydraulic and 2 electrical lines
2. Remove 2 clamps (axial screw)
3. Remove upper bolt
4. Remove 2 lower bolts
5. Remove 4 blots in collar and remove collar
6. Remove unit

INSTALLATION: Reverse of removal. (Gears in damper unit must be indexed to the gear i strut.)

FUNCTIONAL CHECK: Operate steering

TEST EQUIPMENT: Hydraulic and electrical power

CLOSE UP: Reconnect door

ANALYST'S OPINION: A good installation. It is simple to remove and install and if properly indexed, requires no rigging or adjustment.

SYSTEM: 13 Landing Gear

NOMENCLATURE: Arresting Hook Assembly

MUC: A-4: 1382J A-6: 13811 A-7: 13810 F-4: 13520

F-8: 13811 F-14: 13A15 AV-8: _____

GENERAL OBSERVATIONS: What would appear to be a readily accessible component actually varies considerably in ease of access. Engineering solutions to the hook functional problems also provide varying degrees of complexity. The AV-8 is optimized by V/STOL landing - no hook required.

DESIRABLE FEATURES: The A-4 installation requires no panel removal. Except for the F-8 installation, reasonably easy access is available in all airplanes. The A-6 installation is outstanding in its capability of having each component of the arrestment system removable without disturbing other components. The F-4 hook is complete with all dampers and snubbers part of the hook. Removal is simple once access is gained (see below).

UNDESIRABLE FEATURES: Extremely low belly profiles of some of the airplanes create access and work space problems that require jacking of aircraft. The F-8 also has 3 access panels secured with 60 screws. Even after jacking and removing the panel, the job is still complex and difficult to accomplish. Both the F-4 and F-14 have very difficult access with many fasteners involved. The F-14 requires a special tool to release the centering spring.

SYSTEM: 13 Landing Gear

NOMENCLATURE: Arresting Hook Assembly

ADDITIONAL REMARKS: Difficulty of access must be considered in the design of this item. Reduced task complexity is essential for small or low slung aircraft. A tail hook design should allow removal by merely disconnecting at the actuator and airframe. Most of the airplanes approach this. When low profiles degrade access and working convenience, additional side access should be considered to eliminate jacking. Systems that have integral pressure sources (such as the A-7/F-4/F-8 accumulator) should be carefully considered to ensure that functional improvement is worth the additional task time to exhaust their pressure before removal and the additional hazards associated with working around a pressurized and cocked system. The A-6 provides an example of an all around good system installation. The F-14 uses a mechanical spring for hook centering and provides a potential hazard if error is made in use of the unloading tool.

WORK UNIT CODE: 1382J ITEM: Hook Assembly AIRCRAFT: A-4

LOCATION: Under Aft Fuselage

SUPPORT EQUIPMENT: Hydraulic Test Stand
Aircraft Jacks

ACCESS: No access required

REMOVAL:
1. Jack aircraft
2. Lower hook
3. Disconnect from actuator (1 bolt)
4. Remove 2 catapult attach bolts
5. Remove hook attach bolt
6. Remove hook

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Operational check by cycling hook

TEST EQUIPMENT: External Hydraulic Power

CLOSE UP: None required

ANALYST'S OPINION: Very simple, direct installation. Easy access reduces the task effort. Jacking aircraft is not desirable, but is necessary due to low fuselage lines. This installation would be excellent if pressure could be removed from the actuator and then disconnect made without raising the airplane. If a small access panel was required it would be worth it to eliminate jacking.

WORK UNIT CODE 13811 ITEM ARRESTING HOOK ASSEMBLY AIRCRAFT A-6

LOCATION: Aft Fuselage section

SUPPORT EQUIPMENT: External Hydraulic Power
External Electrical Power

ACCESS: One Access Panel (18 screws)

REMOVAL:
1. Lower hook.
2. Remove cotter key from nut securing arresting gear frame attach bolts.
3. Remove bolt and nut securing dashpot to arresting gear frame.
4. Drive attach bolt pins outboard and remove frame.

INSTALLATION: Reverse of removal.

FUNCTIONAL CHECK: Perform operational check.

TEST EQUIPMENT: External Electric Power
Hydraulic Test Stand

CLOSE UP: Replace removed panel

ANALYST'S OPINION: This installation except for its large size is desirable from a maintainability consideration in that the individual components, AG actuator, AG dashpot, and the AG "A" frame and hook, are all separate such that each major component can be removed without disturbing the other component. The hook shaft has a rubber bumper assembly which is a part of the hook shank to "A" frame assembly. This bumber provides shank centering and absorbs the shock from side loads tending to deflect shank off center. This arrangement is simple and apparently effective. The rubber would arpear to deteriorate because of frequent deflections. If the item is t

(See continuation sheet)

CONTINUATION SHEET:

WORK UNIT CODE 13811 ITEM Arresting Hook Assembly AIRCRAFT A-6

ANALYST'S OPINION: (Continued)

changed, rubber deterioration would not be a problem. The damper and retract actuator are located in the fuselage, but can be reached by opening an extendable equipment platform. The damper is serviced from inside of the fuselage with equipment platform open. External servicing capability would eliminate having to open equipment access.

WORK UNIT CODE 13810 ITEM Arrest Gear Assy AIRCRAFT A-7

LOCATION: Below Aft Fuselage

SUPPORT EQUIPMENT: External Hydraulic Pressure
Nitrogen Servicing
Aircraft Jacks

ACCESS. Remove Lower Access Panel (30 CPF)

REMOVAL:
1. Jack Airplane
2. Lower Tail Hook Assy
3. Bleed Accumulator Pressure (Rt Wheel Well)
4. Remove Pin Retainer Bolts (2)
5. Remove Nut from Actuator Rod End
6. Remove Retainer Pins (2) & Rotate Hook to Remove Actuator Bolt
7. Remove Hook Assy

INSTALLATION:
1. Reverse of Removal
2. Service Accumulator

FUNCTIONAL CHECK: Perform Operational Check

TEST EQUIPMENT: External Hydraulic Pressure
External Electrical Power

CLOSE UP: Replace Access.

ANALYST'S OPINION: Extra steps are required to bleed and service accumulator. Proximity of access panel to deck makes opening of 30 fasteners rather tedious. Quick release fasteners help this problem. Jacking of aircraft needed to allow hook to move far enough for attach points to clear structure. It would be preferable to orient attach points so they can be reached with the aircraft on its wheels. Additional access may be required.

WORK UNIT CODE 13520 ITEM Hook Assembly AIRCRAFT F-4

LOCATION: Aft Section

SUPPORT EQUIPMENT: Use aero stand to support hook
Hydraulic and electric power
Nitrogen servicing equipment

ACCESS: 2 fairing panels (60 screws each)
2 wedge panels - (2 bolts, 3 DZUS, 1 screw ea)
2 engine access - (1 coax, 11 DZUS ea)

REMOVAL:
1. Lower hook
2. Bleed air from snubber (2 DZUS, schrader valve)
3. Disconnect forward fairing door (unscrew clevis, 2 places)
4. Support hook and remove actuator attach bolt
5. Remove trunnion, pin, spring, mooring ring
6. Remove hook

INSTALLATION:
1. Reverse of removal
2. Rig fairing door
3. Service snubber

FUNCTIONAL CHECK: Operate hook

TEST EQUIPMENT: Hydraulic and electrical power

CLOSE UP: Re-install panels

ANALYST'S OPINION: Except for access, this is a good installation. Removal is simple and items such as the horizontal dampers are part of the removable assembly. Access requires removing too many fasteners and the wedge panels actually have three different kinds of fasteners securing them. The bolts securing the forward fairing door cannot be removed because of interference of surrounding structure. This requires disassembly of the two clevises resulting in a complete rigging each time. The hook assembly is heavy and should have some type of handling equipment. While explaining the task, the NARF technician conjectured on the feasibility of using the nose gear strut jack for this purpose.

WORK UNIT CODE 13811 ITEM ARRESTING GEAR ASSEMBLY AIRCRAFT F-8

LOCATION: Tail hook well

SUPPORT EQUIPMENT: Aircraft Jacks. Hydraulic servicing stand.
Hydraulic test stand.
Nitrogen servicing bottle.

ACCESS Poor because of low silhouette of airplane.
3 Access Panels (60 screws)

REMOVAL:
1. Remove forward access plate to tail hook assembly. Approximately 60 fasteners have to be removed to remove assembly. Fasteners are MS 24694-S50
2. Bleed nitrogen service off accumulator.
3. Disconnect liquid shock cylinder.
4. Disconnect tail hook actuating cylinder.
5. Remove side bolt access plates.
6. Remove "A" frame nuts and drive bolts outward.
7. Remove forward nuts and remove entire assembly.

INSTALLATION:
1. Reverse of removal.
2. Check clearance of installation and rig.
3. Reservice accumulator.

FUNCTIONAL CHECK: Perform normal operational check.
Perform emergency operational check.

TEST EQUIPMENT:
Hydraulic Test Stand
External Electrical Power

CLOSE UP: Replace access panels.

ANALYST'S OPINION: Access provisions, quantity of fasteners used with the access panels, and the low silhouette are the most serious objections to this installation. When the work area is this close to the deck, access provisions should be simplified. As it is, removing 60 screws to gain access is a substantial burden. Tasks are also relatively difficult.

WORK UNIT CODE 13A15 ITEM ARRESTING GEAR HOOK SHANK AIRCRAFT F-14

LOCATION: Under Aft Section, on Centerline

SUPPORT EQUIPMENT: Centering Spring Compressor
Nitrogen Servicing Cart

ACCESS: 1 Fairing (52 SPF and 4 screws)
1 Door in right hand sponson (2 latches)

REMOVAL:
1. Bleed air (right hand sponson).
2. Drop hook.
3. Remove one bolt locking vertical pin assembly to dashpot.
4. Remove bolt holding link assy.
5. Remove bolt securing cap on horizontal pin assembly; remove cap and horizontal pin.
6. Remove arresting hook assembly, trunnion assembly, and vertical pin from aircraft.
7. Install spring compressor & remove bolt thru vertical pin.
8. Loosen spring compressor shaft, remove trunnion.
9. Remove shock spring.
10. Remove uplock assy (4 nuts and bolts).
11. Remove bumper (4 bolts).

INSTALLATION: Reverse of removal, service and rig.

FUNCTIONAL CHECK: Operation of hook

TEST EQUIPMENT: Electrical and hydraulic power.

CLOSE UP: Install fairing and access door

ANALYST'S OPINION: The removal tasks are complex and do not follow an approach that would seem logical by inspection. The loaded centering spring is concealed in the hook shank and appropriate warning was not found on the shank. An attempt to remove or make subsequent trunnion disassembly could result in injury if the proper special tool is not used. Too many fasteners are involved in removing the fairing. Two shorter fairings would be better.

SYSTEM: 13 Landing Gear

NOMENCLATURE: Brake Control Valve

MUC: A-4: _____ A-6: _____ A-7: 1352A F-4: 13411

F-8: _____ F-14: 13821 AV-8: 13726

GENERAL OBSERVATIONS: The data sort resulted in an "apples and oranges" comparison with brake pedal valves, an anti-skid control box, and an anti-skid electronic control being included. The results were quite interesting with some fine features revealed. These are enumerated below and on the component data sheets.

DESIRABLE FEATURES: 1. The AV-8 does not have differential braking because of its tandem gear. The brake "pedal" valve can be located in a much more accessible location than the traditional deep in the cockpit, forward of the rudder pedal position. 2. The anti-skid control box in the F-14 is located in an uncluttered wheel well and is readily removed. A self test function tests the box, the sensors and the valve.

UNDESIRABLE FEATURES: 1. The A-7 anti-skid valve is located in the wheel well but in a rather congested area. It is rather small and has six hydraulic lines connected to it. Brazed hydraulic tubing leading to the valve makes disconnect and valve removal difficult. 2. The F-4 is a fairly standard brake pedal valve installation. It is very difficult to reach and work must be done in both the cockpit and nose wheel well. Once the nut is installed on the nearly inaccessible attach bolt, a cotter pin must be installed.

SYSTEM: 13 Landing Gear

NOMENCLATURE: Brake Control Valve

ADDITIONAL REMARKS: The key here is space. Each component is fairly simple. Peculiarities of function often place them in inaccessible locations. The A-7 anti-skid valve is an example of a need for constraint when brazed or cryogenic hydraulic fittings are used. The lines can no longer be loosened at both ends to provide flexibility. Care must be taken to avoid "box nailing" the component in place.

WORK UNIT CODE 1352A ITEM ANTISKID CONTROL VALVE AIRCRAFT A-7

LOCATION: RH Wheel Well

SUPPORT EQUIPMENT: None.

ACCESS: None.

REMOVAL:
1. Dump emergency accumulators.
2. Remove electrical connector from valve.
3. Backoff one brazed fitting jamnut on forward face of valve.
4. Loosen jamnut at opposite end of brazed tube assembly addressed in step 3 above.
5. Remove brazed fitting bushing from valve.
6. Loosen and disconnect B-nut from elbow connected to other port on forward face of valve.
7. Loosen and disconnect line B-nut from lower inboard fitting on aft face of valve.
8. Loosen and disconnect B - nut at opposite end of line addressed in Step 7 and disconnect line from tee fitting.
9. Loosen B - nut on line connected to lower outboard fitting on aft face of valve. Loosen B - nut at opposite end of line if line B - nut can't be disengaged from valve. (See continuation sheet)

FUNCTIONAL CHECK: Verify proper operation of antiskid system.

TEST EQUIPMENT: External electrical and hydraulic power; Antiskid test set transducer adapter; Jack to lift MLG wheel; Multimeter; Antiskid test set

CLOSE UP: None

ANALYST'S OPINION: The installation is readily accessible because of its location in the open. Although the valve is in the open, it is cluttered by the 6 tube assemblies attached to the ports on the valve body. Excepting the time spent disconnecting and removing tube assemblies, actual valve removal is as simple as removing 4 bolts. The small size of valve and the selective disconnection of the tube assemblies complicates the removal task. Possibly a different aircraft tube configuration might have helped in facilitating the removal tasks. The existing valve, if located in a less cramped working area, would also have made removing the valve easier.

CONTINUATION SHEET:

WORK UNIT CODE 1352A ITEM ANTISKID CONTROL VALVE AIRCRAFT A-7

REMOVAL: (Continued)

10. Loosen jamnut on brazed line assembly connected to upper outboard fitting on aft side of valve.
11. Loosen 2 B-nuts at opposite end of brazed line assembly.
12. Remove clamp securing brazed tube assembly and remove tubing assembly.
13. Loosen jamnut on brazed tube assembly connected to upper inboard fitting on aft face of valve.
14. If required, remove tube clamp or loosen B-nut at opposite end of tube assembly. Remove fitting from valve.
15. Remove 4 bolts securing valve to aircraft structure.

INSTALLATION:

1. Reverse of removal procedures
2. Aircraft hydraulic system has to be satisfactorily bled before functional check can be accomplished.

WORK UNIT CODE 13411 ITEM Brake Control Valve AIRCRAFT F-4

LOCATION: Nose wheel well, 2 valves forward of NLG trunnion

SUPPORT EQUIPMENT: Hydraulic power
Nitrogen servicing equipment

ACCESS: Remove seat

REMOVAL:
1. Bleed accumulator (shrader valve in nose well)
2. Disconnect 3 hydraulic lines
3. Disconnect lower attach point (1 bolt)
4. Disconnect rudder cont rod (1 bolt)
5. Remove cover in cockpit floor (4 screws)
6. Remove cylinder upper attach bolt (cotter pin)

INSTALLATION:
1. Reverse of removal.
2. Bleed.
3. Reservice.

FUNCTIONAL CHECK: Brake check

TEST EQUIPMENT: Hydraulic and electrical power

CLOSE UP: Install seat

ANALYST'S OPINION: These valves are hard to work on in most airplanes. This installation requires work in both the nosewheel well and the cockpit. A very agile person might reach the upper attach points without removing the seat, but the extra effort is worth it. Access to the upper attachment is bad and the mechanic is in an almost inverted position to accomplish it. As the NARF technician put it, "You're upside down working in an area that's out of sight and out of reach - now, try to find the cotter pin hole."

WORK UNIT CODE 13821 ITEM POWER BRAKE CONTROL MODULE AIRCRAFT F-14

LOCATION: Nose Wheel Well

SUPPORT EQUIPMENT: None

ACCESS: None

REMOVAL: 1. Disconnect 1 electrical plug
2. Remove 4 screws
3. Remove module

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Self test

TEST EQUIPMENT: Electrical power

CLOSE UP: None

ANALYST'S OPINION: Very good installation. Access is excellent and removal is easy. Self test adequately and quickly checks out the installation. The test initiation and readout is accomplished at the module which is an advantage when compared to a centralized self test system with the function performed remotely from the system being tested.

WORK UNIT CODE 33726 ITEM Wheel Brake Control Valve AIRCRAFT AV-8

LOCATION: Nose Wheel Well, Forward, Left Side

SUPPORT EQUIPMENT: None

ACCESS: Very tight - No panels
Lines routed around valve

REMOVAL:
1. Disconnect control cable in cockpit
2. Remove pin in control linkage, retract and disconnect cable (1 pin)
3. Disconnect 3 hydraulic lines
4. Disconnect 3 bolts and remove valve

INSTALLATION:
1. Reverse of removal
2. Rig cable
3. Bleed

FUNCTIONAL CHECK: Brake check

TEST EQUIPMENT: Hydraulic power

CLOSE UP: None

ANALYST'S OPINION: In spite of the very tight quarters, this is probably the best brake control valve installation in any fighter airplane. The tandem landing gear arrangement dispenses with differential braking, so there is no need to tuck this up behind the rudder pedals. Access is much better but still snug.

SYSTEM: 13 Landing Gear

NOMENCLATURE: Emergency Air Bottle/Accumulator

WUC: A-4: _____ A-6: 13451 A-7: 13311 F-4: 13153

F-8: _____ F-14: 13712 AV-8: 13415

GENERAL OBSERVATIONS: The A-7 component is a hydraulic accumulator as opposed to a pneumatic reservoir. It has a higher maintenance requirement than the others because of its greater complexity. This is compensated for in its easier access. The bottles in the other aircraft apparently depend on their simplicity and reliability to justify more inaccessible installation.

DESIRABLE FEATURES: 1. The A-7 accumulator is very accessible and fairly easy to remove. 2. The F-14 bottle is also quite accessible in the uncluttered nose wheel well. Tasks are very simple and there is adequate space.

UNDESIRABLE FEATURES: 1. Generally, the air bottles except the F-14 are encumbered with poor access. The F-4 requires sliding the radar out to reach the bottle. The A-6 bottle is mounted high in a crowded nose wheel well with a curtain and the nose gear actuator in the way. The AV-8 has two bottles in the main gear well. The forward bottle is fairly easy to remove. The rear bottle is almost totally obscured in the corner with several items in the way. 2. The A-7 accumulator requires build-up with items removed from the old bottles.

SYSTEM: 13 Landing Gear

NOMENCLATURE: Emergency Air Bottle/Accumulator

ADDITIONAL REMARKS: Perhaps reliability is a justification for not providing adequate access. If, however, it is merely a matter of design expediency, then it must be realized that someone will eventually have to change it.

WORK UNIT CODE 13451 ITEM LDG GR Emer Control Air Bottle AIRCRAFT A-6

LOCATION: Nose Wheel Well

SUPPORT EQUIPMENT: Nitrogen servicing bottle
Airplane jacks

ACCESS: No access required but item is difficult to reach. Canvas curtain must be opened and nose gear actuator disconnected.
Engine access must be opened to connect the hydraulic test stand.

REMOVAL:
1. Bleed off air charge
2. Disconnect nose landing gear actuator from strut
3. Disconnect cable linkage and pneumatic lines
4. Remove bottle from aircraft by loosening clamps.

INSTALLATION:
1. Reverse removal steps
2. Service pneumatic bottle.

FUNCTIONAL CHECK: Connect external hydraulic power and retract landing gear.
Perform emergency landing gear drop check.
Reset bottle and dump valves.
Cycle gear 10 times to remove air from hydraulic system.
Disconnect hydraulic test stand from quick-disconnects to engine.

TEST EQUIPMENT: Hydraulic Test Stand
Aircraft Jacks

CLOSE UP:
Install canvas curtain.

ANALYST'S OPINION: Air bottle is inconveniently located and is miserable to work on because of not being able to get to it. A better location would have improved the remove and replace capability of this component.

WORK UNIT CODE 13311 ITEM Emergency LG Accumulator AIRCRAFT A-7

LOCATION: Left Forward Fuselage Equipment Bay

SUPPORT EQUIPMENT: External Electric Power
Nitrogen Servicing Equipment
Hydraulic Test Stand

ACCESS: Remove Access Panel (16 fasteners)

REMOVAL:
1. Connect External Electrical Power
2. Relieve Hydraulic Pressure (SW in RT Wheel Well)
3. Relieve Nitrogen Pressure (Right Wheel Well)
4. Remove Blanket (Unlace)
5. Disconnect Electrical Harness (?)
6. Disconnect 1 Nitrogen Line, 3 Hydraulic Lines
7. Release Retainer Bands
8. Remove Accumulator (Several fittings removed for build-up of new item)

INSTALLATION:
1. Install in Reverse of Removal
2. Service Accumulator
3. Bleed Hydraulics

FUNCTIONAL CHECK: Perform Emergency Drop Check
Cycle Gear to Remove Air From System

TEST EQUIPMENT: Hydraulic Test Stand
External Electrical Power
Aircraft Jacks

CLOSE UP: Close Access Panel

ANALYST'S OPINION: Access is excellent. Heater Blanket and several fittings have to be transferred to new component. O-level tasks could be expedited by definition of a built-up item (LRU) which could be delivered from the shop with these items installed.

WORK UNIT CODE 13153 ITEM Air Bottle AIRCRAFT F-4

LOCATION: In radar compartment, top, R/H side

SUPPORT EQUIPMENT: Radome jury strut
Radome hinge clamp

ACCESS: Open Radome
Radar unit must be repositioned to reach bottle

REMOVAL:
1. Slide Radar unit Forward (4 nuts, 7 cannon plugs, 1 cooling air line quick disconnect, 2 cooling liquid lines quick disconnects, 1 connecto: block (elect)).
2. Bleed bottle
3. Disconnect 2 pneumatic lines
4. Release 2 clamps and remove bottle

INSTALLATION:
1. Reverse of removal
2. Service

FUNCTIONAL CHECK: Leak check

Radar check
APN 154 check

TEST EQUIPMENT: Hydraulic and electric power

CLOSE UP: Close radome

ANALYST'S OPINION: A simple job made complex by bad access.

WORK UNIT CODE 13712 ITEM EMERG AIR ACCUMULATOR AIRCRAFT F-14

LOCATION: Nose Wheel Well, Right Side

SUPPORT EQUIPMENT: Nitrogen servicing equipment

ACCESS: None

REMOVAL:
1. Bleed bottle (Schrader valve)
2. Disconnect 2 lines
3. Disconnect 2 clamps
4. Remove bottle

INSTALLATION:
1. Reverse of removal.
2. Reservice bottle.

FUNCTIONAL CHECK: Leak check

TEST EQUIPMENT: None

CLOSE UP: None

ANALYST'S OPINION: Access is good in the nose wheel well. The tasks are simple.

WORK UNIT CODE 13415 ITEM Undercarriage Emergency Nitrogen Bottle AIRCRAFT AV-8

LOCATION: Main Wheel Well. Aft, Left Side

SUPPORT EQUIPMENT: Nitrogen Service Equipment

ACCESS: Aft Bottle: 1 Panel (20 screws), ASA-83, 1 Panel (14 screws)
Forward Bottle: None

REMOVAL:
1. Deflate bottle
2. Remove nitrogen lines (4 connectors)
3. Remove thumbscrew, open clamp
4. Remove bottle

INSTALLATION:
1. Reverse of removal
2. Service bottles

FUNCTIONAL CHECK: Leak check

TEST EQUIPMENT: None

CLOSE UP: Aft Bottle: Re-Install removed panels and components
Forward Bottle: None

ANALYST'S OPINION: Two bottles in this system. The forward bottle installation is excellent. The aft bottle is nearly inaccessible. Mounting is simple.

FLIGHT CONTROL SYSTEMS

ELEVATOR/UHT ACTUATOR

AILERON ACTUATOR

AILERON TRIM ACTUATOR

SPOILER ACTUATOR

RUDDER ACTUATOR

TE FLAP ACTUATOR

HORIZONTAL STABILIZER/
ELEVATOR

LE FLAP ASSEMBLY

TE FLAP ASSEMBLY

AILERON

RUDDER

SPOILER ASSEMBLY

PILOT'S STICK GRIP

FLIGHT CONTROL SYSTEMS

CONTENTS

COMPONENT	A-4	A-6	A-7	F-4	F-8	F-14	AV-8
Elevator/UHT Actuator	14421	14521	14531	14326	1442D	14431	14331
Aileron Actuator	14221	14321	14233	14222	14231	N/A	14131
Aileron Trim Actuator	1421L	N/A	14241	14261	N/A	14234	14142
Spoiler Actuator	14A22	N/A	1423B	14252	14232	14232	N/A
Rudder Actuator	14721	14421	14431	14423	N/A	14342	N/A
TE Flap Actuator	N/A	N/A	14757	14555	N/A	1462Q	14532
Horizontal Stabilizer/ Elevator	14611 14311	14131	14511	14310	1441G	14411	14310
LE Flap Assembly	N/A	14814	14710 14720	14510	14611 14612	14611 14612	N/A
TE Flap Assembly	14511	N/A	14730	14540	1471A	14614	14510
Aileron	14211 14212	N/A	14220	14210	14211 14212	N/A	14110
Rudder	14711	N/A	14410	14410	14312	14311	14210
Spoiler Assembly	14A11	N/A	14311	14240	N/A	14211	N/A
Pilot's Stick Grip	N/A	14211	14111	14111	14111	5771A	14411

SYSTEM: 14 Flight Controls

NOMENCLATURE: Elevator/UHT Actuating Cylinder

WUC: A-4: 14321 A-6: 14521 A-7: 14531 F-4: 14326

F-8: 14420 F-14: 14431 AV-8: 14331

GENERAL OBSERVATIONS: 1. The elevator/UHT actuating cylinders are hidden behind well fastened accesses. They are heavy and generally difficult to extricate from the aircraft. 2. The location of about half the elevator/UHT actuators can be worked on without a work stand.

DESIRABLE FEATURES: 1. Once access is complete, the ability to easily work on the component in place enhances the A-7 and AV-8 installations. 2. Deck level accessibility is a strong asset exhibited by the AV-8, A-7, F-8 and A-4 installations.

UNDESIRABLE FEATURES: 1. The excessive number of fasteners to gain access to the cylinder is considered a drawback. 2. Obscuring attachment bolts by harnesses, linkages, lines and poor positioning unnecessarily increases the overall removal effort. The F-14, F-8, F-4 and A-4 are typical. 3. Heaviness and poor positioning combine to make removal very difficult (A-4, A-6). Design of the component should avoid excessive weight and high, buried installations. 4. Linkage disconnection prior to removal, as in the A-7, should be avoided as it adds to the complexity of removal and may result in loss/damage to linkage components.

ADDITIONAL REMARKS: 1. Components should be as light as possible with no clutter in front of or at the ends of the installation. 2. Efforts should

SYSTEM: 14 Flight Controls

NOMENCLATURE: Elevator/UHT Actuating Cylinder

ADDITIONAL REMARKS: (Cont.)

be made to disturb as little as possible of the other flight control components plus reducing the extent of rigging required. The AV-8 design and installation is an excellent example of what can be done with this bulky actuator. 3. Where possible, deck level installation of the actuator is the preferred approach.

WORK UNIT CODE 14321 ITEM Elevator Actuating Cylinder AIRCRAFT A-4M

LOCATION: Below horizontal stabilizer

SUPPORT EQUIPMENT: External electric power. Torque wrench.
External hydraulic power.
Hydraulic servicing equipment.

ACCESS: 2 access panels (28 screws)
Access fair. Space fairly cramped under stabilizer.

REMOVAL:
1. Remove starboard and port panels.
2. Raise horizontal stabilizer.
3. Disconnect four (4) hydraulic lines, 2 screws, 2 bolts.
4. Disconnect bungee (1 bolt), input rod (1 bolt).
5. Disconnect cable retaining pin, 1 cable disconnect.
6. Disconnect elevator actuating rod.
7. Remove actuator cylinder assembly.

INSTALLATION:
1. Reverse removal order.
2. Bleed and service hydraulic system.

FUNCTIONAL CHECK: Check elevator travel.

TEST EQUIPMENT: External electric power.
External hydraulic power.
Protractor.

CLOSE UP: Install access panels

ANALYST'S OPINION: Access to this cylinder is only fair. As much paneling is removed as is feasible but the remaining work space between the stabilizer and fuselage structure is very restricted. Removal tasks have been kept simple but wrench access is difficult on some of the fittings. Rigging and functional check are performed concurrently.

WORK UNIT CODE 14521 ITEM STABILIZER ACTUATOR AIRCRAFT A-6

LOCATION: Vertical fin

SUPPORT EQUIPMENT: Surface protractor
External hydraulic and electrical power.

ACCESS: Remove 4 access panels (total of 198 screws)

REMOVAL:
1. Disconnect electrical connector for auto pilot from actuator.
2. Depressurize hydraulic system reservoir.
3. Remove pressure and return lines (hoses) of flight control system hydraulic system from actuator, and remove pressure and return hoses of combined system hydraulic system from actuator.
4. Disconnect input bungee by trimming to neutral.
5. Disconnect cotter key, nut, and bolt and disconnect actuator from "A" frame.
6. Support stabilizer actuator and remove lug end hardware and attach pin.
7. Remove actuator through vertical stabilizer access.

INSTALLATION:
1. Reverse of removal.
2. Surface throws have to be checked and adjusted if required.
3. Adjustment accomplished by adjusting actuator rod end with final adjustment made by adjusting input bungee.

FUNCTIONAL CHECK: Connect external hydraulic and electrical power, and verify surface throws and adjust as required.

TEST EQUIPMENT: None

CLOSE UP: Close removed accesses.

ANALYST'S OPINION: The most serious objection to this installation is its overall access. Actuator is difficult to get to because of having to work in confines of aft end of fuselage plus working through the vertical stabilizer access. Hoses as well as rod end are difficult to get to. Lug end pivot pin is hard to get out because of corrosion requiring that pin be forcefully driven out sometimes resulting in damaged pins. Actuator weights more than 75 lbs. and has to be supported with ropes, etc., to support weight while pin in removed. Not doing this could result in injury to maintenance personnel. Stabilizer surface has to be supported or blocked during stabilizer actuator removal.

WORK UNIT CODE 14531 ITEM UHT ACTUATING CYLINDER AIRCRAFT A-7

LOCATION: Aft Section

SUPPORT EQUIPMENT: External Hydraulic Power
External Electric Power
Protractor

ACCESS: 1 Panel 90 Screws
1 Panel 38 Screws

REMOVAL:
1. Remove four (4) taper pins, three (3) bolts.
2. Disconnect springs (2).
3. Remove bolt from forward end of transducer.
4. Remove Support.
5. Remove nuts and bolts from bellcrank.
6. Remove bolt at horn - Let UHT trailing edge down till clear of fork.
7. Disconnect four (4) hydraulic lines.
8. Remove actuator with forward bellcranks attached.
9. Remove bolt thru forward end of actuator.
10. Remove bolt between bellcranks.
11. Remove bolt from link to pilot valve.
12. Remove bellcrank assembly from actuator.

INSTALLATION: 1. Reverse of removal.
2. Bleed and service hydraulic system.
3. Rig UHT System.

FUNCTIONAL CHECK: Perform operational check of UHT system.

TEST EQUIPMENT: External hydraulic power
External Electric Power

CLOSE UP: Install two panels

ANALYST'S OPINION: Except for the large number of screws, this is a good installation. Perhaps the screws are justified because of location and space, but 128 of them are a definite burden. Normally, work will be done with the UHT in place and access is very good from the working position. Linkage disconnect is rather complex and some parts have to be removed subsequent to cylinder removal from the airplane. This is not desirable because of the inconvenience of performing such work beside the airplane and the problem of stowing the loose parts until the new actuator arrives. Considering the space available, though, this is preferrable to attempting to remove the actuator without the linkage.

WORK UNIT CODE 14326 ITEM Stabilator Power Control Cylinder AIRCRAFT F-4

LOCATION: Aft Section

SUPPORT EQUIPMENT: Protractor
Work stand
Hydraulic and electrical power

ACCESS: 3 doors (1 - 82 screws ea, 2 - 62 screws ea)
Remove electrical cable that are in the way (auto pilot)
(3 clamps, 1 cannon plug)

REMOVAL:
1. Remove 4 hydraulic swivels (1 thru bolt ea)
2. Disconnect upper attach point (1 bolt)
3. Manipulate control valve to retract piston
4. Move stabilator to gain access to lower attach point and remove bolt
5. Guide cylinder through structure in fwd direction to remove from airframe

INSTALLATION:
1. Reverse of removal
2. Bleed
3. Rig

FUNCTIONAL CHECK: Position check
Auto pilot check

TEST EQUIPMENT: Hydraulic and electrical power
Protractor

CLOSE UP: Reinstall electrical cable
Reinstall accesses

ANALYST'S OPINION: This is a poor installation. It is high off the ground and access is bad. A total of 206 screws to remove is nearly overwhelming. There is a harness in the way that requires disturbance of the autopilot to remove. Finally, the actuator is heavy and has to be worked forward and out through the structure. A fairly difficult job.

WORK UNIT CODE 1442D ITEM UHT CONTROL PACKAGE AIRCRAFT F-8

LOCATION: Aft fuselage section

SUPPORT EQUIPMENT: Hydraulic test stand.
Special tool for removing taper pins.
UHT protractors

ACCESS: Obstructed somewhat by UHT surface.
2 Access panels (135 screws total)

REMOVAL:
1. Disconnect hydraulic lines.
2. Disconnect electrical connections.
3. Disconnect UHT actuator rod end from UHT horn.
4. Disconnect UHT actuator input rod.
5. Disconnect feedback rod.
6. Remove UHT potentiometer from package and leave with aircraft.
7. Disconnect pneumatic lines to UHT surface locking actuator.
8. Remove hydraulic lines to aft half of actuator.
9. Disconnect lines to forward half of actuator.
10. Remove bolts and pins securing forward and aft end of package to structur
11. Selectively position UHT surface to facilitate removing package.

INSTALLATION:
1. Reverse of removal
2. Bleed and rig

FUNCTIONAL CHECK: Check that UHT surface throws are within limits.

TEST EQUIPMENT: External hydraulic power
External electric power
Protractor

CLOSE UP: Replace access panels.

ANALYST'S OPINION: Removal of UHT package is involved because of the large quantity of fasteners to remove to gain access in addition to removing pneumatic and hydraulic lines. Package removal requires removing special taper pins and bolts, plus jockeying UHT surface to remove package. Installation is awkward to work on, but no specific recommendations are being offered other than to suggest that designers avoid this type of design, or study way in which to simplify it in some fashion so that removal and replacement capability will be improved.

WORK UNIT CODE 14431 ITEM HORIZ. STABILIZER SERVO CYLINDER AIRCRAFT F-14

LOCATION: Upper Aft Sponson, both sides

SUPPORT EQUIPMENT: Sling
Hoist

ACCESS: 1 panel (75 stress panel fasteners)
1 panel (38 stress panel fasteners)

REMOVAL:
1. Attach sling
2. Disconnect 4 extension units
3. Remove follow-up rod (2 bolts)
4. Remove bolt at stabilizer horn
5. Remove bolt, 2 big washers, attachment pin
6. Remove cylinder

INSTALLATION:
1. Reverse of removal
2. Rig stabilator

FUNCTIONAL CHECK: Motion check

TEST EQUIPMENT: Protractor
Hydraulic and electric power

CLOSE UP: Install 2 panels

ANALYST'S OPINION: Good access but large size of the cylinder requires large panels with many fasteners. The location outboard of the fin and about midway of the stabilizer chord is a little inconvenient to reach. Some of the fittings are hard to get on with tools and access to the forward attach bolt is obscured by linkages and lines. This is disappointing when the size of the access opening is considered.

WORK UNIT CODE 14331 ITEM Tail Plane Tandem Jack AIRCRAFT AV-8

LOCATION: Aft Section, Below Tail Plane

SUPPORT EQUIPMENT: Hydraulic Power
Protractor (Not special for aircraft

ACCESS: 2 Panels (22 screws each)

REMOVAL:
1. Disconnect 4 hydraulic lines
2. Disconnect cannon plug
3. Disconnect input rod (1 bolt)
4. Disconnect drain line (1 string)
5. Remove top and bottom mount bolts
6. Collapse cylinder and remove

INSTALLATION:
1. Reverse of Removal
2. Bleed
3. Rig

FUNCTIONAL CHECK: Check motion

TEST EQUIPMENT: Hydraulic Power
Electrical Power
Protractor

CLOSE UP: Close Panels

ANALYST'S OPINION: First impression by the observer is that the access is much to small to remove the item. It is soon learned, however, that component design and installation have been coordinated with the access size and location so that all removal tasks are easily accomplished through the small holes. This is an outstanding installation. The string tied, plastic drain line seem a little unsophisticated but quite effective.

SYSTEM: 14 Flight Controls

NOMENCLATURE: Aileron Actuator

WUC: A-4: 14221 A-6: 14321 A-7: 14233 F-4: 14222

F-8: 14231 F-14: _____ AV-8: 14131

GENERAL OBSERVATIONS: Cramped aileron actuator accesses were prevalent. Accordingly, problems with attach bolts and hose disconnects were the primary removal problems. The high wing aircraft required work stands and, in all cases, the work spaces were awkward. The F-14 does not utilize an aileron actuator.

DESIRABLE FEATURES: The large access of the F-4 and A-4 gives a good opening for removal of the actuator after it has been completely disconnected.

UNDESIRABLE FEATURES: 1. All the actuator rigging is done in place by adjusting the actuator, except the AV-8. The AV-8 adjustment is in the push-rod, a possible "Murphy". Accidental adjustment of the actuator, which is pre-adjusted in the shop, causes structural damage. 2. All the aircraft suffered from congested accesses and/or poor panel placement. This increased task complexity by obstructing bolts, hose connections and bungee adjustment. 3. The required removal or disconnection of a bellcrank is a feature deemed undesirable from the extra work and rigging involved. This occurred in the AV-8 and F-4 installations. 4. The F-8 required extra equipment to pressurize the cylinder. Pneumatic pressurization should not be necessary in this type of application if the aileron actuation system is properly designed.

SYSTEM: 14 Flight Controls

NOMENCLATURE: Aileron Actuator

ADDITIONAL REMARKS: 1. Crowded accesses provide little solace to the maintenance man trying to replace the aileron actuator. Design of this area should avoid crowding the attachment points and easily allow common hand tool access to hose connections. Where this is not possible, additional access from the other surface of the wing should be provided. 2. The requirement to run the engine up in the F-8 to functionally check the actuator is unacceptable. This bad feature has been circumvented in newer aircraft through the use of external hydraulic disconnects.

WORK UNIT CODE 14221 ITEM AILERON POWER MECHANISM AIRCRAFT A-4

LOCATION: Wing, Center Section, Front Spar

SUPPORT EQUIPMENT:
External Hydraulic Power
External Electrical Power
Hydraulic Servicing Equipment

ACCESS: One Panel (19 DZUS)
Compartment very congested

REMOVAL:
1. Open access.
2. Disconnect one Idler Arm (1 bolt), Aileron Actuating Rod (1 bolt).
3. Disconnect two control cables (1 bolt).
4. Disconnect the disconnect cable (1 bolt).
5. Disconnect Trim Arm.
6. Disconnect Bungee (1 bolt).
7. Disconnect 4 hydraulic lines.
8. Remove four (4) bolts.
9. Remove power mechanism from aircraft.

INSTALLATION:
1. Reverse removal order.
2. Bleed and service hydraulic system.

FUNCTIONAL CHECK:
Check aileron deflection.
Functionally check trim system.
Check stick orientation.
Check aileron disconnect.

TEST EQUIPMENT:
External electric power
External hydraulic power
Protractor

CLOSE UP: Install Panel

ANALYST'S OPINION: This compartment is very congested. The access panel gives a good opening into the compartment, but view and wrench access is difficult. The tasks are fairly complex. Location of the compartment forces a bad working position (kneeling, reaching overhead) in poor light.

WORK UNIT CODE 14321 ITEM FLAPERON ACTUATOR AIRCRAFT A-6

LOCATION: TE of wing center section.

SUPPORT EQUIPMENT: Work stand
External hydraulic and electrical power
Surface protractors.

ACCESS: Several access panels (151 screws, total)

REMOVAL:
1. Disconnect input rod and feedback rod.
2. Disconnect 4 hoses from actuator by working through round access.
3. Hydraulic system has to be depressurized before disconnecting hoses.

INSTALLATION:
1. Reverse of removal
2. Bleed and rig

FUNCTIONAL CHECK: Perform operational check and check surface throws.
Check adtuator for leaks.
If surface throws are incorrect, adjustment accomplished by adjusting input bungee link.

TEST EQUIPMENT: None

CLOSE UP: Close accesses opened.

ANALYST'S OPINION: Access to actuator is cramped and removal of actuator is difficult because of this. Actuator hose access is small restricting easy wrenching of the hose fittings. Removal is achieved by disconnecting related hardware and by removing actuator from beneath the wing. Access would have been further improved if additional access from the top of the wing were possible, if structurally feasible. Adjustment of the input bungee is difficult because of being relatively deep in compartment plus being cluttered by adjacent hardware.

WORK UNIT CODE 14233 ITEM AILERON ACTUATOR AIRCRAFT A-7

LOCATION: Wing, Trailing Edge

SUPPORT EQUIPMENT: Workstand
External Hydraulic Power
Protractor

ACCESS: 1 Panel (52 screws)

REMOVAL:
1. Disconnect four (4) extension units from actuator (safetied).
2. Remove bolt at end of cylinder, drive out bushing.
3. Break safety and remove clevis on piston end by turning piston (count turns).
4. Remove bolt from inboard end of input rod.
5. Twist and remove actuator.
6. Remove input rod.

INSTALLATION:
1. Reinstall in reverse order of removal.
2. Bleed and service hydraulic system.
3. Rig Ailerons.

FUNCTIONAL CHECK: Check Ailerons for proper operation.

TEST EQUIPMENT: External Hydraulic Power.

CLOSE UP: 1 Panel

ANALYST'S OPINION: Falls short of a good installation because of the shape of the access. Excellent access is available to everything except the bolt connecting the piston to the linkage. The mechanic will generally remove the clevis from the piston by turning the piston with a wrench rather than removing bellcrank and linkage for disassembly outside the airplane. A slight change to access shape would allow direct access to the clevis bolt. The high wing design places this area overhead and a small workstand is handy. If wings are folded, a tall workstand can be used.

WORK UNIT CODE 14222 ITEM Aileron Power Actuator AIRCRAFT F-4

LOCATION: Trailing edge, center wing section

SUPPORT EQUIPMENT: Spoiler lock
Contour board
Hydraulic and electrical power

ACCESS: Lift spoiler manually
1 stress panel (140 screws)
1 panel (6 screws)

REMOVAL:
1. Disconnect viscous damper (1 bolt)
2. Disconnect 4 screws (12 point wrench) from hinge block
3. Disconnect control rod (1 bolt) to valve
4. Disconnect 3 lines, remove 1 swivel
5. Disconnect 1 control rod to bellcrank (allows access to bolt)
6. Remove 1 forward attach bolt
7. Remove actuator

INSTALLATION:
1. Reverse of removal
2. Bleed
3. Rig

FUNCTIONAL CHECK: Motion check

TEST EQUIPMENT: Hydraulic and electrical power
Control board

CLOSE UP: Reinstall panels

ANALYST'S OPINION: A fairly good installation after access is gained. The access panel is large enough to give access to a number of items in the wing but is to large for anyone of them. A larger quantity of smaller panels would be preferable, allowing access to each component without involving 140 screws. An extra step is required to disconnect a bellcrank to allow motion providing access to a bolt. This is not desirable when the disconnect is not otherwise required for removal.

WORK UNIT CODE: 14231 ITEM AILERON PC PACKAGE AIRCRAFT F-8J

LOCATION: Center wing section

SUPPORT EQUIPMENT: Work stand.
Nitrogen servicing bottle.
Aileron surface protractor.
External Hydraulic Power.
Hydraulic servicing stand.

ACCESS: Compartment is a "tight" installation, and access to hydraulic lines has to be accomplished by going through the spoiler door.

Remove 1 access panel

REMOVAL:
1. Depressurize hydraulic system reservoir.
2. Disconnect hydraulic lines by gaining access through spoiler door.
3. Disconnect input link.
4. Disconnect "Funk Spring" from both attach points.
5. Disconnect both actuator ends from attach points.
6. Lift up on aileron surface to properly position actuator cylinder and remove actuator.

INSTALLATION:

1. Reverse of removal procedures.
2. Final adjustment of aileron surface to rigged position is accomplished by adjusting rod end.
3. Service reservoir with nitrogen.

FUNCTIONAL CHECK: Run engine and check surface throws with protractor
actuator for leaks.
Actuator for leaks.

TEST EQUIPMENT: Equipment required for engine run

Protractor

CLOSE UP: Close and secure access panel with removed screws.

ANALYST'S OPINION: More work space in actuator compartment would be beneficial in making it easier to remove hardware and actuator. The aileron actuators are of the dual tandem type requiring two PC system operation. Connecting external power to some F-8 aircraft requires disconnecting pump hose disconnect from pump to connect external hydraulic power. An external power quick-disconnect fitting is desirable and is fairly commonplace on today's aircraft. This concept still seems valid and should be incorporated on new designs so that running the engine will not be required to assure that system worked on is still operational.

WORK UNIT CODE 14131 ITEM Aileron Power Control Unit AIRCRAFT AV-8[redacted]

LOCATION: Top of Wing

SUPPORT EQUIPMENT:
Ruler or Protractor to rig
Hydraulic Power
Electrical Power (must have electrical power with mule)
Work Stand

ACCESS:
1 Panel (40 screws)
1 Panel, Aileron Leading Edge (14 screws)
1 Fwd Brace (5 bolts)

REMOVAL:
1. Disconnect cannon plug
2. Disconnect the input rod (1 bolt)
3. Disconnect 4 hydraulic lines
4. Disconnect 1 drain line (1 string)
5. Disconnect actuator rod at aileron (1 bolt)
6. Remove nut from stud retaining bellcrank axle pin
7. Remove retaining clip (1 nut)
8. Remove forward actuator bolt
9. Remove actuator, aft bellcrank and actuator rod
10. Remove bellcrank and actuator rod

INSTALLATION:
1. Reverse of removal
2. Bleed and rig

FUNCTIONAL CHECK: Motion check

TEST EQUIPMENT: Hydraulic and Electrical Power

CLOSE UP:
Install brace
Close access panels

ANALYST'S OPINION: This installation is characterised by very bad access to the actuator bolts and the potential of causing structural damage through maintenance error. The aft bellcrank must be removed with the actuator because access to that bolt is not possible in the airplane. The actuator is rigged dimensionally in the shop and rigging in the aircraft is accomplished at the aileron pushrod. Adjustment of the actuator, which is a more normal rigging procedure, will result in structural damage to the wing. The negative dihedral of the wing makes it a very unstable work platform.

SYSTEM: 14 Flight Controls

NOMENCLATURE: Aileron Trim Actuator

WUC: A-4: 1421L A-6: _____ A-7: 14241 F-4: 14261

F-8: _____ F-14: 14234 AV-8: 14142

GENERAL OBSERVATIONS: Accessibility to this component was either very good or extremely poor. Work space on the A-4, A-7, and F-4 was limited due to physical location of the component. The A-6 and F-8 installations were not investigated.

DESIRABLE FEATURES: 1. The use of electro-mechanical actuators provides a simplier, faster, cleaner, and easier removal than a hydraulic actuator (F-14). Fewer bolts, connections and less bulk were characteristics of the electro-mechanical actuators. 2. The appropriate use of anchor nuts facilitated installation in several instances especially the F-14 component.

UNDESIRABLE FEATURES: 1. Depaneling, in general, involved too many fasteners. This needlessly increases accessibility time and promotes possible additional panel repair time. Effort should be taken to avoid the use of two different fasteners on the same panel as in the F-4. 2. The removal of unrelated components to gain access is undesirable. Particularly poor is the A-7 which is very difficult to reach and requires an engine run after replacement because a bleed air line must be displaced. The F-4 is compromised by the need to remove the LAU-7A.

SYSTEM: 14 Flight Controls

NOMENCLATURE: Aileron Trim Actuator

ADDITIONAL REMARKS: Most installations were located in congested compartments. When this is combined with the requirement to remove other installations, maintainability is compromised. Proper coordination during design can alleviate this situation.

WORK UNIT CODE 1421L ITEM Aileron Trim Actuator AIRCRAFT A-4M

LOCATION: Wing, center section, front spar, outboard of aileron power mechanism

SUPPORT EQUIPMENT: None required

ACCESS: Good, one panel (19 DZUS)

REMOVAL:
1. Disconnect bungee arm (1 bolt).
2. Remove drum (1 nut).
3. Disconnect three (3) electrical lines.
4. Remove attach bolts (4).
5. Remove actuator.

INSTALLATION: Re-install in reverse order.

FUNCTIONAL CHECK: Check actuator travel.

TEST EQUIPMENT: External electric power.
Protractor.

CLOSE UP: Install panel

ANALYST'S OPINION: Access is quite good although the compartment is rather congested. Access through bottom requires work to be done in crouched or kneeling position with effort applied overhead. This is fatiguing to the mechanic. Tasks have been kept simple. Light tends to be bad in the compartment requiring additional light source.

WORK UNIT CODE 14241 ITEM Aileron Roll Trim Actuator AIRCRAFT A-7

LOCATION: Wing, Aft, Top Fuselage (Dorsal area)

SUPPORT EQUIPMENT: External electric power
Rigging pins

ACCESS: RH Dorsal Panel (56 screws)
3 Hinged Panels (28 SPF)

REMOVAL:
1. Gain access (on A-7C/E loosen bleed air lines)
2. Disconnect spring from actuator
3. Disconnect electrical plug
4. Disconnect aileron control rod (O/B end) and position bellcrank for access to bolt.
5. Remove bolt at each end
6. Remove actuator

INSTALLATION:
1. Re-Install in reverse order of removal
2. Rig roll trim actuator (rigged to neutral in NARF shop)

FUNCTIONAL CHECK: Perform operational check of aileron roll trim system

TEST EQUIPMENT: External electric power

CLOSE UP: On A-7C/E perform engine turn-up to check bleed air ducts for leaks
Right hand dorsal panel
3 Hinge panels

ANALYST'S OPINION: Access is very bad. Many lines routed between unit and access opening. It may be necessary to remove insulation from rain removal bleed line and loosen clamp to get arm in far enough to reach actuator. Once arms and tools in place to work on unit, it is very difficult to see.

WORK UNIT CODE 14261 ITEM Lateral Feel Trim Rotory Actuator AIRCRAFT F-4

LOCATION: Fuselage keel between engines

SUPPORT EQUIPMENT: Hydraulic and electrical power
Contour board

ACCESS: Remove LAU 7 launcher
Engine access (16 DZUS, 6 screws) left side
Right engine aux air door (actuated door)
Cover plate (10 fasteners)

REMOVAL:
1. Remove left and right aileron trim cables (1 nut each)
2. Remove 4 screws mounting trim motor
3. Disconnect plug
4. Remove actuator

INSTALLATION:
1. Reverse or removal.
2. Rig trim function.

FUNCTIONAL CHECK: Motion check

TEST EQUIPMENT: Hydraulic and electrical power
Contour board

CLOSE UP: Reinstall accesses
Reinstall LAU-7

ANALYST'S OPINION: This item was reviewed on an airplane with the engines removed. With engines installed the difficulty will increase tremendously. There is very little space to work. Tasks have been kept simple. The access has been improved over the years and is as good as it can get considering the location of the component. Use of two types of fasteners in one access panel is undesirable.

WORK UNIT CODE 14234 ITEM Lateral Series Input Servo Actuator AIRCRAFT F-14

LOCATION: Top of Fuselage on Centerline, Aft

SUPPORT EQUIPMENT: Protractor

ACCESS: 1 Access (36 stress panel fasteners)

REMOVAL:
1. Disconnect 2 electrical plugs
2. Remove, bolt through bellcrank and control rod
3. Disconnect 4 hydraulic lines
4. Remove 4 bolts and actuator (anchor nuts)

INSTALLATION:
1. Reverse of removal
2. Rig and adjust as necessary

FUNCTIONAL CHECK: Check trim action and surface motion

TEST EQUIPMENT: Protractors
Hydraulic and Electrical Power

CLOSE UP: Close access

ANALYST'S OPINION: This particular unit is mounted on a bracket close to the top of the access and is fairly easy to reach. The lower mounting bolts are blind access but sufficient room is available and anchor nuts are used. So this one is considered snug but tolerable. On the other hand, a nearly identical unit is mounted on the opposite side of the compartment and fairly deep. Several components are in the way and the lower bolts are almost totally inaccessible. Incredibly, nuts are used on these bolts rather than nut plates. Technicians complained rather loudly about this one.

WORK UNIT CODE 14142 ITEM Aileron Trim Actuator AIRCRAFT AV-8

LOCATION: Right Hand Bottom of Nose Section

SUPPORT EQUIPMENT: Electrical and Hydraulic Power

ACCESS: 2 Panels (16 screws ea)

REMOVAL:
1. Remove retaining plate, forward end (nut)
2. Remove 2 bolts (1 forward, 1 aft)
3. Remove tie wraps and cannon plug
4. Remove actuator

INSTALLATION:
1. Reverse of removal
2. Rig

FUNCTIONAL CHECK: Aileron position check
Indication check

TEST EQUIPMENT: Hydraulic and Electrical Power

CLOSE UP: Re-Install panels

ANALYST'S OPINION: Except for the 32 screws involved in access, this is a good installation. Removal tasks are simple and access is good.

SYSTEM: 14 Flight Controls

NOMENCLATURE: Spoiler Actuator

WUC: A-4: 14A22 A-6: _____ A-7: 1423B F-4: 14252

F-8: 14232 F-14: 14232 AV-8: _____

GENERAL OBSERVATIONS: 1. Spoiler actuator installations tend to be either good or extremely poor. 2. Work area was mostly confined to sitting or kneeling on the upper wing surface or utilizing a work stand. The A-6 and AV-8 do not have spoilers.

DESIRABLE FEATURES: 1. Accessibility without removing any panels is a highlight of a good A-7 installation.

UNDESIRABLE FEATURES: 1. Removal of associated components to gain access to the actuator, e.g. the F-14 torque tube, is undesirable. Component placement should consider availability of access during the design stages. 2. The overwhelming number of fasteners required to be removed on the F-4 is due to access panels which are too large for the area and equipment involved. Design of appropriately sized panels will correspondingly reduce fasteners. 3. Internal actuator locking components are necessary, however, they fault themselves from a maintainability stand point when they require external hydraulic power to be unlocked.

ADDITIONAL REMARKS: Cramped quarters was a serious problem on the F-8 where two actuators are located in the same access area. One F-14 hydraulic fitting was difficult to work on but not unsurmountable. The outstanding A-7 installation can become challenging if the aircraft is spotted at the edge of a windy carrier deck.

WORK UNIT CODE 14A22 ITEM SPOILER ACTUATING CYLINDER AIRCRAFT A-4M

LOCATION: Wing, Aft, Inboard, Lower Side

SUPPORT EQUIPMENT: External hydraulic power
Hydraulic Servicing Equipment

ACCESS: Good, 1 fairing (8 screws), 2 accesses (20 screws)

REMOVAL:

1. Remove upper control bolt (1).
2. Disconnect two (2) hydraulic lines.
3. Remove three (3) bolts.
4. Remove Retainer Plate.
5. Remove Actuating Cylinder.

INSTALLATION:
1. Reverse removal order
2. Bleed and service hydraulic system

FUNCTIONAL CHECK: Check Spoiler Actuation

TEST EQUIPMENT: External Hydraulic Power

CLOSE UP: Reinstall 1 Fairing and 2 Access Panels

ANALYST'S OPINION: Except for the use of screws in the fairing and panels, the installation is good. Screws are undesirable because they are time consuming to operate, require keeping track of a large number of loose items (in this case, 48 screws), and often freeze in the threads. Under certain circumstances, removing the panels can be more frustrating than removing the actuator. Working overhead is uncomfortable but is mainly accommodated by the easy removal.

WORK UNIT CODE 1423B ITEM Spoiler/Deflector Cylinder AIRCRAFT A-7

LOCATION: Wing, Upper, Trailing Edge

SUPPORT EQUIPMENT: External Hydraulic Power
Protractor - Spoiler and Aileron

ACCESS: Open Spoiler

REMOVAL:
1. Disconnect four (4) extension units
2. Disconnect input rod (1 bolt) and spring
3. Disconnect inboard bolt and bushing
4. Disconnect outboard bolt from crank
5. Remove actuator

INSTALLATION:
1. Reverse removal process
2. Bleed and service hydraulic power
3. Rig spoiler/deflector

FUNCTIONAL CHECK: Check spoiler/deflector for proper operation

TEST EQUIPMENT: External hydraulic power

CLOSE UP: Close spoiler

ANALYST'S OPINION: Good installation. Access is readily available without opening any panel fasteners. Tasks are simple and straight forward. Work can be done while sitting or kneeling on top of wing. Proximity to the trailing edge could make this a little sporty if the airplane is spotted at the deck edge.

WORK UNIT CODE 14252 ITEM Spoiler Power Cylinder AIRCRAFT F-4

LOCATION: Upper side, wing center section
2 cylinders

SUPPORT EQUIPMENT: Hydraulic and electrical power
Contour board

ACCESS: Inboard cylinder: 1 panel (140 screws)
Outboard cylinder: 1 panel (226 screws)

REMOVAL:
1. Raise spoiler manually
2. Disconnect actuator from spoiler (1 bolt)
3. Disconnect 4 hydraulic lines
4. Disconnect forward attach point (1 bolt)
5. Collapse cylinder and remove

INSTALLATION:
1. Reverse of removal
2. Rig
3. Bleed

FUNCTIONAL CHECK: Motion check

TEST EQUIPMENT: Hydraulic and electrical power

CLOSE UP: Reinstall access panels

ANALYST'S OPINION: The spoiler is operated by two cylinders. Removal tasks are the same except for access. Removal is good with reasonable tool access to all fittin and attach points. Entirely too many screws are involved in gaining access. The panels are too big for the job being performed.

WORK UNIT CODE 14232 ITEM SPOILER ACT CYL AIRCRAFT F-8

LOCATION: Wing Center Section

SUPPORT EQUIPMENT: Work stand to gain access to spoiler from the top of the wing.
Hydraulic test stand.

ACCESS: Compartment access is good, but spoiler actuator is somewhat hidden by linkages and bellcranks of spoiler mechanism.
1 aileron access (42 stress panel fasteners)

REMOVAL:
1. Depressurize reservoir
2. Disconnect funk strut from aileron PC lug.
3. Raise spoiler door and hold in open position.
4. Disconnect spoiler links from PC cylinder bellcranks.
5. Disconnect cylinder rod end from bellcrank.
6. Disconnect cylinder lug end from bellcrank.
7. Disconnect slider valve from idler.
8. Disconnect two hoses from cylinder.
9. Remove lug from cylinder.
10. Work actuator out of wing access.
11. Remove cylinder lug end trunnion from cylinder.

INSTALLATION:
1. Reverse of removal
2. Bleed and rig

FUNCTIONAL CHECK: Check surface throws.
(Spoiler door closed position is adjusted by adjusting the actuator rod end until the proper door closed position is reached. Final adjustment is done by adjusting spoiler up and down limit stops.)

TEST EQUIPMENT: External Hydraulic Power

CLOSE UP: Close aileron package access.

ANALYST'S OPINION: The spoiler actuator installation and associated linkages are tightly packaged thereby inhibiting the remove and replace procedures. The mechanism required to operate the spoiler surface is relatively complex. The maintainability characteristics would have been improved by not having two different actuators in the same access compartment.

WORK UNIT CODE 14232 ITEM Mid Wing Spoiler Actuator AIRCRAFT F-14

LOCATION: Top Wing Panel Under Spoiler

SUPPORT EQUIPMENT: Hydraulic Power
Electrical Power
Work Stand

ACCESS: Open Spoiler
Remove flap torque tube

REMOVAL:
1. Disconnect spoiler rod at bellcrank (outboard)
2. Retract cylinder
3. Disconnect cylinder from bellcrank
4. Disconnect electrical connector
5. Disconnect 2 hydraulic lines
6. Disconnect spoiler rod (inboard)
7. Remove 4 bolts
8. Remove actuator

INSTALLATION:
1. Reverse of removal
2. Rig and bleed

FUNCTIONAL CHECK: Operate Spoiler

TEST EQUIPMENT: Hydraulic and Electrical Power

CLOSE UP: Re-Install flap torque tube
Close spoilers

ANALYST'S OPINION: This installation is only fair. Removal of the flap torque tube for access is undesirable. Hydraulic power is required to open spoiler because of internal locks. The forward hydraulic fitting is positioned so it is very difficult to reach. This causes problems mainly during installation and imposes danger of cross threading or improper torque with resulting leakage.

SYSTEM: 14 Flight Controls

NOMENCLATURE: Rudder Actuator

WUC: A-4: 14721 A-6: 14421 A-7: 14431 F-4: 14423

F-8: _____ F-14: 14342 AV-8: _____

GENERAL OBSERVATIONS: 1. Component location requires use of a work stand in all instances. 2. Common to the rudder actuator installations is the excessive use of panel fasteners.

DESIRABLE FEATURES: 1. Innovative use of rubber "donuts" in the A-4 hold hydraulic tubing in place when the panel is closed, thus eliminating clamps which would have to be removed during actuator replacement. 2. Interchangeability of actuators is a positive feature on the F-14. However, because of right hand access on both vertical stabilizers (instead of inboard access) removal and replacement of the right hand actuator is compounded by the difficulty of placing a work stand near the work area.

UNDESIRABLE FEATURES: 1. De-paneling is time consuming for all installations but the F-14 because of the relatively large quantity of screws to be removed and stored. The A-7 de-paneling is further degraded by the use of 2 different size fasteners on the same panel, a situation that should be avoided. Accesses on the F-14 have few fasteners, a plus; however, the accesses are inadequate for the size of the actuator to be removed. 2. Better positioning during design with regard to structure would have eliminated problems disconnecting or removing bolts, fittings and hoses in the A-6, A-7 and F-14.

SYSTEM: 14 Flight Controls

NOMENCLATURE: Rudder Actuator

ADDITIONAL REMARKS: 1. Considering the reaching type of motion required to remove the actuator panel fasteners, a reduction in the number of panel fasteners or changing the fasteners to a quicker, easier to remove type is justified. 2. Actuator location should be such that the actuator can easily be reached by standing on the aircraft or by using a work stand. Work stand usage should also be considered in placement/design of adjacent flight control surfaces.

WORK UNIT CODE 14721 ITEM POWER RUDDER MECHANISM AIRCRAFT A-4

LOCATION: Midway, Vertical Fin

SUPPORT EQUIPMENT: External Electric Power
External Hydraulic Power
Workstand

ACCESS: One (1) Access Panel (41 Screws)

REMOVAL:
1. Disconnect Rudder Actuator Arm (1 Bolt).
2. Disconnect Wire Harness, Four (4) Hydraulic Lines, Input Actuating Arm (1 bolt).
3. Remove four (4) Attach Bolts.
4. Remove Mechanism.

INSTALLATION:
1. Reverse Removal Order.
2. Bleed and service Hydraulic System.

FUNCTIONAL CHECK: Check surface deflection.
Perform nose wheel steering function check.
Perform AFCS directional control test.

TEST EQUIPMENT: External Hydraulic Power
External Electric Power
Electric Circuit Tester
Protractor

CLOSE UP: Install one panel

ANALYST'S OPINION: This is a fairly standard rudder actuator installation. Access is good, generally. One hydraulic fitting is difficult to reach because of substructure that's in the way. The design accommodated this by using a 90° swivel fitting but the B-nut is still poorly located. Probably this fitting is not disconnected until the actuator is disconnected and partially removed from the compartment. The flexible hose has a large "S" turn in it which should make this possible. Caution is required to ensure proper routing on installation or hose chafing will

(See continuation sheet)

CONTINUATION SHEET:

WORK UNIT CODE 14721 ITEM POWER RUDDER MECHANISM AIRCRAFT A-4

ANALYST'S OPINION: (Continued)

result. A notable feature is the use of rubber "donuts" on the other 3 flexible hoses to hold them in position between the frame and the access panel. This is a very simple solution to maintaining routing in a difficult area and is superior to clamps which would require removal. Care is required in positioning the "donuts" or all is for naught.

WORK UNIT CODE 14h21 ITEM Rudder Actuating Cylinder AIRCRAFT A-6

LOCATION: Fuselage Aft Section

SUPPORT EQUIPMENT: Surface protractors
Step ladder or work stand
External hydraulic and electrical power

ACCESS:
Tail cone is very narrow in this area
2 Panels (18 screws each)

REMOVAL:
1. Deflect rudder surface to right to gain access to rod end attach hardware.
2. Disconnect actuator rod end from rudder bellcrank by removing bolt washer nut and pin. Pin is retained by bolt and nut, and functions to carry actuating loads.
3. Remove 4 hoses from actuator, and remove hoses from actuator.
4. Remove cable from actuator.
5. Disconnect input rod to actuator.
6. Disconnect grounded end of actuator by removing bolt, nut, washer, and pin.

INSTALLATION:
1. Reverse of removal.
2. Actuator is pre-adjusted to length and probably does not need adjustment.
3. If additional adjustment is required, adjustment done at input pungee.

FUNCTIONAL CHECK: Perform functional check to verify surface throws.

TEST EQUIPMENT: External hydraulic and electrical power
Protractor

CLOSE UP: Replace removed accesses.

ANALYST'S OPINION: Aircraft aft section tail cone narrows down substantially in cross sectional area making it hard to remove input linkage and grounded actuator lug end. Actuator rod end is fairly easy to get to because of being located between fuselage aft section and rudder surface. NARF NORVA has also indicated that lug end and rod end attach pins are hard to remove after having being installed for extended periods of time. If binding occurs, removal is difficult because of not being able to get a good "shot" at pins to drive them out.

WORK UNIT CODE 14431 ITEM RUDDER ACTUATOR AIRCRAFT A-7

LOCATION: Vertical Stabilizer

SUPPORT EQUIPMENT: Work stand capable of reaching rudder and stabilizer

ACCESS: Remove 60 screws from RH rudder actuator access
Remove 58 screws from LH rudder actuator access
(Both access panels use two different size of hardware)

	One Size	Different Size
RH	58	2
LH	56	2

REMOVAL:
1. Remove 5 bolts and nuts securing false beam
2. Remove remaining bolt and nut from false beam attaching bonding jumper from rudder to structure and remove false beam.
3. Remove cotter key, nut, and bolt securing feedback rod to actuator rod end.
4. Tape loose end of feedback rod to LE of rudder surface.
5. Loosen and remove 4 B-nut fittings on actuator and cap & plug open fittings
6. Remove cotter key, nut, washer and bolt securing rod end of actuator.
7. Remove cotter key, nut, washer and bolt securing lug end of actuator.
8. Carefully remove actuator from aircraft.

INSTALLATION:
1. Reverse of removal
2. Hydraulic system has to be bled prior to performing functional check.

FUNCTIONAL CHECK: Verify proper operation of rudder system and check for proper rudder deflection.

TEST EQUIPMENT: External hydraulic & electrical power
Rudder surface protractor

CLOSE UP: Re-install accesses.

ANALYST'S OPINION: Access from both sides of stabilizer provides a great deal of freedom as far as access is concerned. A greater stand off distance of the hydraulic tube assemblies from the actuator would also have permitted easier removal of the actuator without the risk of damaging the tube assemblies. Overall installation was considered acceptable.

WORK UNIT CODE 14423 ITEM Rudder Power Cylinder AIRCRAFT F-4

LOCATION: Aft section, left hand side beneath fin

SUPPORT EQUIPMENT: Workstand
Hydraulic and electrical power

ACCESS: 3 panels (53 screws total)

REMOVAL:
1. Disconnect 1 cannon plug and 2 wire clamps
2. Disconnect 2 hydraulic lines
3. Disconnect attach points (forward and aft - 1 bolt each)
4. Remove actuator

INSTALLATION:
1. Reverse of removal
2. Rig
3. Bleed

FUNCTIONAL CHECK: Position check

TEST EQUIPMENT: Hydraulic and electrical power

CLOSE UP: Reinstall panels

ANALYST'S OPINION: Access is quite good to this item and tasks are fairly simple. Fifty-three screws are still too many for access. Obtaining a good space to stand while working is difficult. The stabilizer has a pronounced negative dehedral which precludes standing on it and is located so it interfers with a workstand. The NARF uses a platform that attaches to the stabilizer root and provides a stable, level work surface.

WORK UNIT CODE 14342 ITEM Rudder Authority Control Actuator AIRCRAFT F-14

LOCATION: Bottom of each vertical stabilizer, access on right hand side of both stabilizers

SUPPORT EQUIPMENT: Hydraulic and Electrical Power
Work Stand (right hand actuator)
Protractor

ACCESS: Fairing (15 screws)
Movable Fairing (2 bolts)

REMOVAL:
1. Remove 1 bolt and pin to rudder
2. Remove 4 hyd lines
3. Remove bolt in control rod
4. Remove bolt and pin attaching actuator to airframe
5. Work actuator out of access hole

INSTALLATION:
1. Reverse of removal
2. Bleed and rig

FUNCTIONAL CHECK: Motion check

TEST EQUIPMENT: Protractor
Hydraulic and Electrical Power

CLOSE UP: Reinstall fairings

ANALYST'S OPINION: This is a poor installation. Access is far from adequate. Although left right interchangeability of the stabilizer is achieved, the right hand only access places the work area for the right actuator outboard of the surface. This offers only a narrow portion of the fuselage and the horizontal stabilizer as airframe work areas which also inhibit positioning a work stand for convenience. Positioning of hydraulic fittings on the actuator makes connections difficult and there is a great "Murphy" potential. The lines can easily be hooked up wrong. The access opening is much too small and the airframe attach point is completely obscured. Proper installation is very difficult as is inspection of the area. This is hardly acceptable for a primary flight control installation.

SYSTEM: 14 Flight Controls

NOMENCLATURE: Trailing Edge Flap Actuator

WUC: A-4: _____ A-6: _____ A-7: 14757 F-4: 14555

F-8: _____ F-14: 14620 AV-8: 14532

GENERAL OBSERVATIONS: Excepting the F-4, access was generally good; however, the workspace tended to be slightly cramped. The A-4, A-6 and F-8 trailing edge actuators were not investigated.

DESIRABLE FEATURES: Use of a single actuator and torque tube to operate the flap, as in the AV-8 and F-14, reduces overall maintenance time and complexity. Inherently, fewer components and a central location allow a large, accessible work space, minimum panel removals and a convenient work area. The AV-8 uses a single actuator for both left and right wings while the F-14 has a single actuator unit driving both leading and trailing edge flaps in both wings.

UNDESIRABLE FEATURES: 1. The F-4 design presented a potential of flap mechanism damage if the flap is not supported during actuator removal. This requires extra effort or GSE to prevent the flap from reaching its normal free hanging position. Mechanisms and linkages should tolerate normal overtravel during maintenance without damage or should be capable of being quickly disconnected. 2. The use of two different fasteners on one panel should be avoided. The combination use of allen screws and quick release fasteners marred an otherwise good AV-8 installation. 3. Because of the proximity to the wing edge and the restricted space

SYSTEM: 14 Flight Controls

NOMENCLATURE: Trailing Edge Flap Actuator

UNDESIRABLE FEATURES: (Cont.)

in the wing, access to cotter keys, safety wire, attachments, and hydraulic fittings were slightly hampered.

ADDITIONAL REMARKS: The F-14 actuator discussed is a mechanical device mounted in the wing which is driven by a centrally located drive motor. The AV-8 centrally located actuator drives the flap directly with a torque tube. Either installation is a significant improvement over several hydraulic actuators mounted in the narrow wing.

WORK UNIT CODE 14757 ITEM TRAILING EDGE FLAP ACTUATOR (INBOARD) AIRCRAFT A-7

LOCATION: Aft inboard underside of wing, forward of TE flap surface.

SUPPORT EQUIPMENT: Work Stand

ACCESS: Remove 45 screws attaching actuator access panel
Lower flaps to gain access to small panel attached to TE of wing through which actuator piston rod passes. (Hydraulic power required to extend flaps) (See continuation sheet)

REMOVAL:
1. Loosen and disconnect B-nuts from both ends of tube assembly connected to extend port of actuator.
2. Same as above for retract tube assembly.
3. Remove cotter key, nut, washer, and bolt securing rod end to flap attach fitting.
4. Remove cotter key, nut, washer, and bolt securing actuator lug end to wing attach fitting.
5. Remove actuator from wing cavity.

INSTALLATION:
1. Reverse of removal
2. Hydraulic system has to be bled before functional can be made.
3. Rigging of flap actuator also has to be checked and adjusted, if required.

FUNCTIONAL CHECK: Verify proper operation of flap system

TEST EQUIPMENT: Flap protractor
External electrical & hydraulic power

CLOSE UP: Re-install accesses.

ANALYST'S OPINION: The overall installation allows removing actuator without a great deal of difficulty. Access to the cotter keys, especially the rod end, was cramped slightly making cotter key removal somewhat tedious. The work space was not, however, considered unsatisfactory.

CONTINUATION SHEET:

WORK UNIT CODE 14757 ITEM TRAILING EDGE FLAP ACTUATOR (INBOARD) AIRCRAFT A-7

ACCESS: (Continued)

Remove 5 countersunk phillips head screws and 2 oval phillips head screws securing access through which piston rod passes. Panel is removed so actuator can be removed.
Remove inboard access on LE of TE flap. (Access has 8 countersunk screws and is removed to gain access to rod end attach hardware.)

WORK UNIT CODE 14555 ITEM TE Flap Power Cylinder AIRCRAFT F-4

LOCATION: Inboard on wing center section trailing edge

SUPPORT EQUIPMENT: Hydraulic and electrical power
Contour board
Stand to support disconnected flap

ACCESS: Lower speed brake and disconnect actuator
Remove hinge fairing (4 screws)
Remove stress panel, bottom of wing (88 screws)
(Flaps are presumed to be down)

REMOVAL:
1. Support flap and remove aft attachment nut
2. Manually raise flap to position actuator attachment point for access to bolt
3. Remove bolt and support flap
4. Disconnect 4 hydraulic swivels, and 2 cannon plugs
5. Remove forward attach bolt
6. Remove actuator

INSTALLATION:
1. Reverse of removal.
2. Bleed and rig.

FUNCTIONAL CHECK: Flap motion check
Speed brake operation

TEST EQUIPMENT: Hydraulic and electrical power

CLOSE UP: Reinstall panel and fairing
Connect speed brake actuator

ANALYST'S OPINION: Access to fittings is not good even after all panels, etc. are out of the way. The electrical plugs are difficult to reach. A short socket with hinge handle or an offset box wrench is required to hold the bolt head on the forward attach point. The flap must not be allowed to fully lower while disconnecting the actuator or damage to the boundary layer control rod and malfunction switch will occur. Many screws in the access.

WORK UNIT CODE: 1462Q ITEM: Flap Actuator Assembly No. 4 AIRCRAFT: F-14

LOCATION: Under Spoiler on Wing Trailing Edge

SUPPORT EQUIPMENT: Hydraulic and Electrical Power
Protractor

ACCESS: Open lower outboard slot door (2 screws, 2 hinge pins, 1 bolt)
Open upper slot door (2 bolts in linkage)
Open spoiler
Small panel (4 screws and 1 bolt)

REMOVAL:
1. Disconnect torque shaft (1 bolt, splined shaft)
2. Disconnect inner slot door (1 bolt)
3. Remove 2 attach bolts
4. Disconnect electric connector
5. Remove actuator

INSTALLATION:
1. Reverse of removal
2. Rig flap

FUNCTIONAL CHECK: Flap motion

TEST EQUIPMENT: Protractor
Hydraulic and Electrical Power

CLOSE UP: Re-Install Accesses

ANALYST'S OPINION: This is one of several actuators that operate the flap. Except for rather cramped quarters, it is a fairly good installation. These actuators are fairly simple mechanical cranks driven by a torque tube. The torque tube receives its power from a fuselage mounted wing slat/flap drive motor which also powers wing leading edge flaps (slats) through a sequencer/gearbox. This actuator arrangement is excellent because it requires only relatively small units in the narrow wing spaces. The variable geometry wing makes the shafting arrangement somewhat complex but overall the arrangement is an improvement over many individual actuators deployed down the wing.

WORK UNIT CODE 14532 ITEM Wing Flap Operating Jack AIRCRAFT AV-8

LOCATION: Overwing Fairing (one actuator for both flaps which drives torque tube)

SUPPORT EQUIPMENT: Hydraulic and Electrical Power
Protractor or Ruler

ACCESS: 2 Panels (16 SPF each & 7 Allen screws). Left hand panel has anti-collisio light on it.
1 Panel (30 fasteners)

REMOVAL:
1. Disconnect 2 hydraulic lines
2. Remove bolt through bellcrank
3. Remove 2 mount bolts
4. Remove seal (6 bolts)
5. Remove actuator

INSTALLATION:
1. Reverse of removal.
2. Bleed and rig.

FUNCTIONAL CHECK: Position check

TEST EQUIPMENT: Hydraulic and Electrical Power
Protractor or Ruler

CLOSE UP: Re-Install Panels

ANALYST'S OPINION: This is a good installation. Utilizing one actuator to operate both left and right flaps. Quick release fasteners speed access. Removal tasks are simple. The negative slope of the wings make them poor work platforms.

Comment was made by NARF technicians concerning the bronze flap torque tube bearings. These are split bearing, the halves of which are not interchangeable, and are retained by rivets. No seals are provided and the specimens shown had heavily clogged grease grooves & substantial scoring from foreign matter. Several showed wear severe enough to cause the rivets to contact the shaft.

SYSTEM: 14 Flight Controls

NOMENCLATURE: Horizontal Stabilizer/Elevator

MUC: A-4: 14311 14611 A-6: 14131 A-7: 14511 F-4: 14310

F-8: 1441G F-14: 14411 AV-8: 14310

GENERAL OBSERVATIONS: Only the A-4 uses a split stabilizer and elevator. Except for the A-4 elevator, the removal tasks are relatively hard in all aircraft. All of the later designs show attempts by design to improve replacement capability but size, weight, and location conspire to make these attempts only partially successful.

DESIRABLE FEATURES: 1. The A-6 installation is simplest to remove because the surface bolts to the stabilizer shaft. Acce is easy and removal tasks involve only the physical connection to the movable shaft. 2. The A-7, F-8 and F-14 are mounted low enough to permit most removal tasks to be performed from deck level. 3. The A-7 and F-14 removal is similar to the A-6 except that the actuator connections must be removed. Actual physical removal is relatively simple.

UNDESIRABLE FEATURES: 1. In most cases, except the A-6, access panel removal is extensive to reach necessary working areas. Worst case is the AV-8 which requires vertical fin removal. 2. The F-14 stabilizer requires careful manipulation and careful observance of close structural clearances to avoid damage during removal. All surfaces are heavy and require joist and sling.

SYSTEM: 14 Flight Controls

NOMENCLATURE: Horizontal Stabilizer/Elevator

ADDITIONAL REMARKS: The "plug-in" surfaces with simple removal tasks should continue to be exploited. The stabilizer is subject to damage from personnel walking on them, items ejected from tires during ground rolls, flight deck crunches, etc.

WORK UNIT CODE 14311 ITEM Elevator Assembly AIRCRAFT A-4M

LOCATION: Horizontal stabilizer, trailing edge

SUPPORT EQUIPMENT: Sling
Hoist
Workstand

ACCESS Remove gap seal (4 screws, 7 dzus)

REMOVAL:
1. Disconnect actuating arm (1 bolt).
2. Disconnect pivot attachment (1 bolt).
3. Remove gap seal.
4. Disconnect hinge fittings (3).
5. Remove elevator.

INSTALLATION: 1. Reverse removal procedure.

FUNCTIONAL CHECK: Check elevator for proper operation.

TEST EQUIPMENT: External hydraulic power.

CLOSE UP: Replace gap seal.

ANALYST'S OPINION: Good installation. Access is good to all attach points. Tasks are simple.

WORK UNIT CODE 14611 ITEM HORIZONTAL STABILIZER AIRCRAFT A-4

LOCATION: Aft Fuselage

SUPPORT EQUIPMENT:

Sling	Workstand (B-4)
Hoist	External Hydraulic Power
Transport Dolly	Hydraulic Servicing Equipment

ACCESS: 2 Fairings (28 screws) below stabilizer
2 access panels (32 screws) below stabilizer
Fairing above stabilizer

REMOVAL:
1. Remove Elevator
2. Remove Elevator power pack
3. Disconnect surface position indicator (1 bolt), actuator (1 bolt), AFCS position indicator arm
4. Remove two (2) forward attach bolts
5. Remove horizontal stabilizer

INSTALLATION:
1. Reverse removal order.
2. Bleed and service hydraulic system.

FUNCTIONAL CHECK: Check elevator for proper travel
Perform AFCS position indicating check

TEST EQUIPMENT: External hydraulic power
External electric power
Protractor

CLOSE UP: Replace access panels

ANALYST'S OPINION: Access to perform replacement is good although the height above the deck requires workstands. The presence of the elevator provides an additional item to remove during the stabilizer removal. The actuator is actually attached to the lower stabilizer surface and also must be removed. This situation is normal for a split surface design. The one piece stabilizer is heavy enough to require hoist capability to handle it during maintenance. The hinge points (forward mounts) are below the stabilizer which facilitates installation. The actual

(See continuation sheet)

CONTINUATION SHEET:

WORK UNIT CODE 14611 ITEM HORIZONTAL STABILIZER AIRCRAFT A-4

ANALYST'S OPINION: (Continued)

positioning and securing of the stabliizer appears to be easily accomplished. Rigging could be a problem since there are several points (elevator actuator, trim actuator, position indicator attach points) that may be affected by tolerances on a ne.. -urface. Rigging can be accomplished during functional checkout.

WORK UNIT CODE 14131 ITEM Horizontal Stabilizer AIRCRAFT A-6

LOCATION: Tail Section of Aircraft

SUPPORT EQUIPMENT: Support sling for surface.
Overhead hoist.
Torque wrench.

ACCESS: 1 Panel (18 screws)

REMOVAL: 1. Remove 4 large bolts per side.
2. Support surface with sling and slide surface off shaft.

INSTALLATION: 1. Reverse of removal.
2. Torque bolts to specified value.

FUNCTIONAL CHECK: None

SPECIAL EQUIPMENT: None

CLOSE UP: Close access opened.

ANALYST'S OPINION: Stabilizer has a non-metallic material fastened to the butt end of the surface. Material acts as a seal between moving surface and fuselage. As stabilizer moves, material rubs against fuselage surface causing eventual abrasion of the fuselage skin. The moving seal has a tendency to hold and retain contaminants thus aggravating the fuselage skin abrasion condition. The end results are that the fuselage skin is more likely to corrode because of the rubbing of the seal against the fuselage skin. This is one area that should be investigated to develop a seal that would not abrade the faying fuselage skin.

WORK UNIT CODE 14511 ITEM UHT ASSY AIRCRAFT A-7

LOCATION: Aft Fuselage

SUPPORT EQUIPMENT: External Hydraulic Power
Sling
Hoist
Protractor (for rigging)

ACCESS: 1 Panel (94 screws)
1 Panel (38 screws)
Tail Cone (4 latches & connectors)
1 Panel (11 screws)

REMOVAL:
1. Disconnect actuator/followup rods from bellcrank (3 bolts).
2. Pull stick back to disengage rods from bellcrank.
3. Remove eleven (11) screws from panel beneath UHT.
4. Install sling.
5. Remove eight (8) large bolts and two (2) allenhead bolts from casting.
6. Remove UHT to side.

INSTALLATION:
1. Reverse removal procedures.
2. Rig UHT if new unit installed to ensure symmetry.

FUNCTIONAL CHECK: Perform operational check of UHT.

TEST EQUIPMENT: External Hydraulic Power

CLOSE UP: Re-install 3 panels and tailcone. Purge AIQ-126 Waveguide
Perform operational check of AIQ-126 Antenna System

ANALYST'S OPINION: This installation has some very good features. Although a sling and hoist is called out, the height and weight of the surface allows removal by hand (with several persons to lift). All work can be accomplished while standing on the deck. Removal of half the surface at a time reduces the space required around the airplane. Access is excellent although it involves many, many screws. The involvement of the waveguide in tailcone removal is unfortunate and will occasionally result in degraded AIQ-126 function. Two piece UHT requires symmetry check as an additional rigging task.

WORK UNIT CODE 14310 ITEM Stabilator Assy AIRCRAFT F-4

LOCATION: Aft Section

SUPPORT EQUIPMENT: Aero stand to support tailcone during removal
Sling and hoist
Protractor Workstand

ACCESS: Remove jet blast fairing (38 screws)
Release drag chute cable clevis
Release 1 wiggins connector (fuel vent)
Unclamp aft fuselage cooling duct connection (See continuation sheet)

REMOVAL:
1. Install sling (8 bolts)
2. Remove actuator lower attach bolt
3. Remove 2 bonding wires (1 bolt ea)
4. Remove 2 attach bolts
5. Remove stabilator

INSTALLATION: 1. Reverse of removal.
2. Rig and shim.

FUNCTIONAL CHECK: Movement check
Drag chute release check
Leak check, opened duct connections
Antenna check

TEST EQUIPMENT: Hydraulic and electrical power
Engine run equipment

CLOSE UP: Reinstall removed panels and fairings
Remake all connections

ANALYST'S OPINION: Most of this effort is invested in gaining access. Once the access panels have been removed and the disconnections made, the removal of the stabilator is very simple. Access must be considered bad and several systems not involved in the maintenance task are disturbed creating extra functional check requirements and increasing maintenance risk.

CONTINUATION SHEET:

WORK UNIT CODE 14310 ITEM Stabilator Assy AIRCRAFT F-4

ACCESS: (Continued)

Disconnect 2 coax cables.
Disconnect 1 fuel vent discharge wiggins fitting.
Remove stabilator fairing (30 screws, 2 hinge pins, each side).
Remove tail cone (36 screws, 24 bolts).

WORK UNIT CODE 1441G ITEM Unit Horizontal Tail AIRCRAFT F-8

LOCATION: Removable Tail Section

SUPPORT EQUIPMENT: Hoist or engine installation dolly with F-8 tail cradle.
Hydraulic test stand.
External electrical power.

ACCESS: Not readily accessible.
2 Panels (16 screws)
2 Panels (34 screws)
2 Panels (3 screws)
1 Panel (59 fasteners, 8 screws)
2 Panels (14 fasteners)
1 Panel (28 screws)
1 Panel (15 fasteners)
2 Panels (16 screws)
1 Panel (20 screws)
1 Panel (18 fasteners)

REMOVAL:
1. Jack aircraft
2. Depressurize hydraulic system
3. Disconnect control rods, cables, hydraulic lines, electrical connections, and fuel vent lines
4. Support tail section with sling and hoist
5. Remove 4 large bolts securing tail section, and separate tail section from mid section by hoisting tail section and placing it in F-8 tail cradle.
6. Remove 37 rivets securing heat shield located on inside of tail section. (NOTE: Shield covers UHT bearing housing, and one is located on each side)
7. Disconnect UHT rod and feed back rods from UHT horn.
8. Support UHT surface.
9. Remove 8 bolts securing each UHT support housing, including shims

(See continuation sheet)

FUNCTIONAL CHECK: Operational check of UHT
Operational check of Rudder
Perform arresting gear check
Check fuel vent mast

TEST EQUIPMENT: Gauges to check vent mast.
External electrical power.
External hydraulic power.

CLOSE UP: Close access panels removed or opened.

ANALYST'S OPINION: This installation is very poor. Fifteen access panels with 194 screws and 120 fasteners is entirely too many. Also, to include removal of the aft section requires additional space and support equipment. Finally, to require drilling out rivets in order to remove the heat shield will result in progressively larger holes as each removal is accomplished. The UHT is too vulnerable to damage from runway debris, hangar/flight deck crunches, and ordnance products to consider this installation acceptable.

CONTINUATION SHEET:

WORK UNIT CODE 1441G ITEM Unit Horizontal Tail AIRCRAFT F-8

REMOVAL: (Cont.)

10. Remove UHT surface with sling.

INSTALLATION: 1. Reverse of removal
2. Rig surface

WORK UNIT CODE 14411 ITEM Horizontal Stabilizer AIRCRAFT F-14

LOCATION: AFT Fuselage

SUPPORT EQUIPMENT: Sling and transport dolly
Removal tool
Protractor

ACCESS: Plugs in hoist point
Accesses top and bottom of skin (2 screws each)
Access to actuator bolt (38 SPF)
Access to hinge link (40 screws)
Stringer between accesses (2 bolts)

REMOVAL:
1. Disconnect actuator (1 bolt)
2. Disconnect bracket and follow-up rod (3 bolts)
3. Attach hoist
4. Disconnect 2 bondwires (4 screws, 4 center keys)
5. Install removal tool
6. Remove nut
7. Position leading edge down till clear of airframe structure
8. Carefully remove stabilizer

INSTALLATION:
1. Reverse of removal.
2. Rig stabilizer.

FUNCTIONAL CHECK: Motion check
Rig check

TEST EQUIPMENT: Protractor
Hydraulic and Electrical Power

CLOSE UP: Close accesses
Install stringer

ANALYST'S OPINION: Good access has been provided to attach hardware. The removable stringer is a necessity. Too many fasteners are involved in gaining access. Clearances with fuselage are very close and great care is required during removal and installation of the surface to prevent damage. Because of size and weight of the surface, this requires coordinated effort of several people.

WORK UNIT CODE 14310 ITEM Tail Plane Assembly AIRCRAFT AV-8

LOCATION: Aft Section

SUPPORT EQUIPMENT: Sling and Hoist
Hydraulic and Electrical Power
Protractor or Scale

ACCESS: Remove fin
2 Fairings (10 hex head, 1 screw each) (bottom)
2 Fairings (11 screws each) (top)
2 Fairings (20 screws each) fuselage top

REMOVAL:
1. Disconnect pitch control rod at front end (1 bolt)
2. Disconnect actuator (1 bolt)
3. Disconnect position transmitter rod (1 bolt)
4. Remove 2 hinge bolts
5. Remove UHT.

INSTALLATION:
1. Reverse of removal.
2. Rig.

FUNCTIONAL CHECK: Motion check

TEST EQUIPMENT: Hydraulic and Electrical Power
Protractor or Scale

CLOSE UP: Re-Install fairings and fin

ANALYST'S OPINION: Simple tasks with very hard access. The fin locks the tailplane in place and must be removed first. This results in an installation that is rated as poor.

SYSTEM: 14 Flight Controls

NOMENCLATURE: Leading Edge Flap Assembly

WUC: Inboard A-4: _____ A-6: 14814 A-7: 14710 F-4: 14510

F-8: 14611 F-14: 14611 AV-8: _____

Outboard A-7: 14720 F-8: 14612 F-14: 14612

GENERAL OBSERVATIONS: Leading Edge flaps generally suffer from lack of space forward of the wing structural box. This is solved in various ways resulting in various degrees of complexity. Some actuators are installed in the flap, others are reduced in size and increased in quantity and others are driven by torque tube arrangements. Aerodynamic sealing adds additional complication.

DESIRABLE FEATURES: 1. The piano hinge arrangement in the F-4 serves as both a hinge and an aerodynamic seal. This reduces problems with maintaining a good seal. 2. Installation of actuators in the flaps permits better access to the actuators although the flaps tend to be heavier. 3. Mounting of small actuators behind the flaps is mechanically the simplest but access to actuators is inhibited.

UNDESIRABLE FEATURES: 1. Torque tube installations tend to be mechanically complex. 2. The flap track installations on the A-6 and F-14 require flap build-up and are further complicated by non-interchangeability of hardware. 3. Cutting and splicing of wires as in the F-4 installation is not acceptable. 4. Double droops as used in the F-8 actually double flap removal effort. This type of arrangement should be avoided if there is another aerodynamically feasible approach. 5. Both inboard and outboard flaps on the F-14 come off as a unit and must be separated afterwards.

SYSTEM: 14 Flight Controls

NOMENCLATURE: Leading Edge Flap Assembly

ADDITIONAL REMARKS: Leading edge flaps will present a problem as long as they are an aerodynamic necessity. A really clever way to overcome the shortage of space for actuators is not apparent at this time.

WORK UNIT CODE 14814 ITEM Slat Assembly AIRCRAFT A-6

LOCATION: LE of Wing

SUPPORT EQUIPMENT: Work stand
External hydraulic or electrical power

ACCESS: Connect external electrical or hydraulic power and extend LE slats. (Note: Slats can be extended electrically or hydraulically, and wings can be spread or folded when performing tasks.)

REMOVAL:
1. Disconnect screwjack(s) from surface. (One for inboard slat and two for outboard slat).
2. With screwjack disconnected, slat rolls forward and off of wing.

INSTALLATION:
1. Reverse of removal.
2. Slat adjustment, if required, is accomplished by adjusting jackscrew rod end connected to slat surface fitting. This is accomplished by disconnecting screwjack and by turning rod and relative to screw.

FUNCTIONAL CHECK: Extend slats to check surface for proper throws. (Check can be done with electrical power).

TEST EQUIPMENT: Surface throwboards
External electrical or hydraulic power

CLOSE UP: Retract slat assembly

ANALYST'S OPINION: The slot surface itself is fairly easy to remove once the jackscrew drives are disconnected. The jackscrews are driven by gearboxes which are connected by drive shafts which are routed back to a central or main gear box drive. The central or main gear box is hydraulically or electrically driven. This arrangement, by necessity, is mechanically complicated because of all the drive shafts and gearboxes. Maintenance to remove and replace the gear box drives will require synchronizing all the drives after maintenance is completed. No recommendations are obvious that would simplify actuation of this system using gearboxes and jackscrews.

RK UNIT CODE 14710 ITEM Inboard Leading Edge Flap Assembly AIRCRAFT A-7

LOCATION: Wing, Leading Edge

SUPPORT EQUIPMENT:
- Work stand
- Flap seal checking fixture
- External hydraulic power
- Flap contour board
- External electric power

ACCESS:
- 2 Panels (45 screws each) bottom of wing
- 1 Panel (18 screws) top
- 9 Panels (2 screws each) bottom

REMOVAL:
1. Cut safety wire, remove bolt in outboard actuator
2. Cut safety wire, remove bolt in inboard actuator
3. Disconnect bond, strap
4. Disconnect flap indicator linkage (LH flap only).
5. Remove nine (9) hinge pins
6. Remove flap

INSTALLATION:
(Flap seal check required before flap is installed. Care is required during positioning of flap for installation to prevent damage to seal.)

1. Check flap seal for condition
2. Re-Install flap assembly in reverse order of removal
3. Rig flaps

FUNCTIONAL CHECK: Check leading edge fairing clearance and flaps for proper operation

TEST EQUIPMENT:
- External hydraulic power
- External electrical power

CLOSE UP:
- 2 Panels bottom of wing
- 1 Panel top
- 9 Panels bottom

ANALYST'S OPINION: This installation is rated as fair. Access is good but consists of many panels held on by screws. Removal is fairly normal but there are several critical clearances that must be maintained. The flap seal requires a special tool applied to the flap and the wing leading edge to ensure proper contours. Care must be taken during flap installation to prevent distortion of the seal halves by dumping them. Once installed the clearance between the trailing edge and the flap fairing is critical. Both of these checks require special techniques and are time consuming. The trailing edge/fairing problem could be overcome by a slightly increased overlap to prevent cutting the fairing if the clearance is lost through damage or excessive airload. This would also reduce the criticality of the clearance during installation.

WORK UNIT CODE 14720 ITEM Outboard Leading Edge Flap Assembly AIRCRAFT A-7

LOCATION: Wing, Outer Panel, Leading Edge

SUPPORT EQUIPMENT: Work stand
Flap seal checking fixture
External hydraulic power
Contour board
External electrical power

ACCESS: 2 Access Panels (24 and 18 screws) top of wing
6 Access Panels (2 screws each) bottom

REMOVAL:

1. Extend wing.
2. Disconnect actuators (nut, bolt, washer, cotter pin).
3. Disconnect strap and bond (inboard access)
4. Remove hinge pins
5. Remove flap

INSTALLATION: (Flap seal check required with flap removed. Care required during installation to prevent damage to seals).

1. Check flap seals for condition.
2. Re-Install flap assembly in reverse order or removal
3. Rig flaps

FUNCTIONAL CHECK: Check leading edge fairing clearance and flaps for proper operation.

TEST EQUIPMENT: External hydraulic power
External electric power

CLOSE UP: 2 Access Panels top of wing
6 Access Panels bottom

ANALYST'S OPINION: This installation is rated as fair. Good access but many panels and screws. It shares the critical clearance problems noted in the inboard section (WUC 14710). Adjusting these clearances require special techniques and is time consuming. Otherwise, the component removal is of normal complexity.

WORK UNIT CODE 14510 ITEM Inboard LE Flap Assy AIRCRAFT F-4

LOCATION: Wing Leading Edge

SUPPORT EQUIPMENT: Hydraulic and electrical power
Protractor
Special stress plate

ACCESS: Actuator link cover (18 screws, 4 bolts) including bellcrank
Actuator access panel (62 screws)
Fulcrum bearing
Pin lock cover (7 screws)

REMOVAL:
1. Lower flap
2. Disconnect boundary layer control valve spring (1 bolt)
3. Disconnect power cylinder hose
4. Remove actuator attach bolt
5. Force flap full down (disengages lower funcrum)
6. Cut wire bundle at inboard end of actuator access
7. Remove 5 clamps and feed cut wires thru hole in flap
8. Disconnect and remove 2 swivels
9. Remove 2 bond wires (1 screw each)
10. Remove outboard hinge pin
11. Remove inboard hinge lock and remove pin

INSTALLATION:
1. Reverse of removal
2. Splice cut wires
3. Trim flap to fit
4. Rig flap
5. Bleed hydraulic system

FUNCTIONAL CHECK: Exterior lights (spliced wires)
Motion check

TEST EQUIPMENT: Hydraulic and electrical power
Protractor

CLOSE UP: Re-install accesses

ANALYST'S OPINION: The actuator is mounted in the flap itself and is an interesting package. If a new flap is to be installed the actuator must be removed. Many screws are involved in access. Having to cut and splice wires to replace the flap is unacceptable. The job is relatively easy otherwise.

WORK UNIT CODE 14611 ITEM Center Section Droop AIRCRAFT F-8J

LOCATION: Wing Center Section

SUPPORT EQUIPMENT: Crane and support sling to lift droop surface from wing center section.
Contour Boards.

ACCESS: Fairly good.
1 Panel (39 screws)
1 Panel (48 screws)
1 Panel (31 screws)

REMOVAL:
1. Depressurize utility system reservoir.
2. Disconnect 4 hydraulic hoses from each actuator (two per each droop).
3. Disconnect droop links from wing center section and lower droop surface.
4. Attach special sling to droop surface and support weight of droop with crane.
5. Remove hinge pins and separate droop surface from center wing section.

INSTALLATION:
1. Reverse of removal.
2. Contour boards have to be used to check droop position of surface.
3. Rigging pin is also required to check clean condition position of droop surface.
4. Service reservoir with oil and nitrogen.

FUNCTIONAL CHECK: Perform operational check of droop system.

TEST EQUIPMENT: External hydraulic power.

CLOSE UP: Close accesses that were opened.

ANALYST'S OPINION: The double droop surface with two integral actuators is a very heavy assembly that cannot be removed without the use of a special sling and hoist. This results in increasing the manhours to accomplish a complete removal and installation. The check to verify contour position of the droop surface is extremely difficult to achieve because of surface warpage and is reported to be rarely done to factory specifications. The droop surface provides a necessary aerodynamic function that is achieved with a relatively complex mechanism. This type of mechanism is cumbersome to work on and should be mechanically simplified, if possible.

WORK UNIT CODE 14612 ITEM Outer Panel Droop AIRCRAFT F-8J

LOCATION: LE Outer Wing Panel

SUPPORT EQUIPMENT: Crane and support sling to lift droop surface from wing center section.
Contour Boards.

ACCESS: Access panels (78 screws).

REMOVAL:
1. Spread wings.
2. Remove 6 bolts from linkage system.
3. Disconnect actuator rod end from one end of actuator.
4. Disconnect 3 bonding wires.
5. Remove 16 screws and bolts from hinge keepers.
6. Remove 26 screws securing forward edge of curtain to LE droop.
7. Disconnect electrical connector.
8. Install special sling and support weight of droop with crane.
9. Remove hinge pins.
10. Remove droop surface with sling and crane.

INSTALLATION:
1. Reverse removal procedure.
2. Cruise condition end of actuator is pre-set when overhauled.
3. The droop or landing condition has to be checked with contour

(See continuation sheet)

FUNCTIONAL CHECK:
Connect external hydraulic power and check droops for proper throws.

TEST EQUIPMENT: None

CLOSE UP: Close accesses that were opened.

ANALYST'S OPINION: The double droop sufrace with two integral actuators is a very heavy assembly that cannot be removed without the use of a special sling and hoist. This results in increasing the manhours to accomplish a complete removal and installation. The check to verify contour position of the droop surface is extremely difficult to achieve because of surface warpage and is reported to be rarely done to factory specifications. The droop surface provides a necessary aerodynamic function that is achieved with a relatively complex mechanism. This type of mechanism is cumbersome to work on and should be mechanically simplified, if possible.

CONTINUATION SHEET:

WORK UNIT CODE 14612 ITEM Outer Panel Droop AIRCRAFT F-8J

INSTALLATION: (Continued)

boards and adjusted, if required. Cruise condition contour is also checked with contour board (usually 1 instead of 3 because of droop warpage).

WORK UNIT CODE 14611 ITEM Inboard Slat Assembly AIRCRAFT F-14

LOCATION: Leading Edge of Wings

SUPPORT EQUIPMENT: Jork Stand
Hydraulic and Electrical Power

ACCESS: Lower Flap
Remove 14 access panels

REMOVAL:
1. Remove 2 bond wires (1 screw each)
2. Remove bolts through shaft couplers and disconnect shaft 4 places
3. Remove 4 structural stops (5 nuts)
4. Pull slats forward and disengage tracks
5. Remove 7 track and interface hardware (hardware not interchangeable between tracks) (seven nuts, spacers, pins)
6. Remove 7 links (7 nuts) remove tracks
7. Remove spanwise interface pin and separate flaps

INSTALLATION:
1. Reverse of removal.
2. Rig

FUNCTIONAL CHECK: Operational check of flap motion

TEST EQUIPMENT: Hydraulic and Electrical Power

CLOSE UP: Reinstall Access Panels

ANALYST'S OPINION: The inboard and outboard slats are removed as a unit and separated afterwards. Tracks must be removed after slat removal. Interface hardware is not interchangeable between tracks which requires a method of segregating and accounting for parts. Lots of little panels, hardware, and pieces to take care of. Removal is too complicated to call this a good installation.

WORK UNIT CODE 14612 ITEM Outboard Slat Assembly AIRCRAFT F-14

LOCATION: Leading Edge of Wings

SUPPORT EQUIPMENT: Work Stand
Hydraulic and Electrical Power

ACCESS: Lower Flap
Remove 14 Access Panels

REMOVAL:
1. Remove 2 bond wires (1 screw each)
2. Remove bolts through shaft couplers and disconnect shaft 4 places
3. Remove 4 structural stops (5 nuts)
4. Pull slats forward and disengage tracks
5. Remove 7 track and interface hardware (hardware not interchangeable between tracks) (seven nuts, spacers, pins)
6. Remove 7 links (7 nuts) remove tracks
7. Remove spanwise interface pin and separate flaps

INSTALLATION:
1. Reverse of removal.
2. Rig

FUNCTIONAL CHECK: Operational check of flap motion

TEST EQUIPMENT: Hydraulic and Electrical Power

CLOSE UP: Reinstall access panels

ANALYST'S OPINION: The inboard and outboard slats are removed as a unit and separated afterwards. Tracks must be removed after slat removal. Interface hardware is not interchangeable between tracks which requires a method of segregating and accounting for parts. Lots of little panels, hardware, and pieces to take care of. Removal is too complicated to call this a good installation.

SYSTEM: 14 Flight Controls

NOMENCLATURE: Trailing Edge Flap Assembly

FUC: A-4: 14511 A-6: _____ A-7: 14730 F-4: 14540

F-8: 1471A F-14: 14614 AV-8: 14510

GENERAL OBSERVATIONS: The flap installations are generally good. Aircraft with boundary layer control (BLC) show some difficulty in the removal tasks. Low wing airplanes present better working conditions.

DESIRABLE FEATURES: 1. The multiple section flap, like the F-14, reduces weight of each flap section. 2. The A-4 flap is ideally located for removal while standing on the deck and is light enough for manual handling. 3. Low quantities of small access panels on all the airplanes except the F-4 reduce access time. Generally, they are all of adequate size for the job. 4. Use of piano hinges, with their inherent difficulties, reduce the requirement for gap seals.

UNDESIRABLE FEATURES: 1. Boundary layer control adds a great deal of complexity to those flaps so equipped. 2. The F-4 requires an excessive amount of effort to obtain access (nearly 150 fasteners). Even then, good access is not gained and the flap must be manipulated hydraulically to position attachment points. 3. The F-14 uses a large bulb seal between the inboard and outboard flaps which resists positioning the flap during installation.

SYSTEM: 14 Flight Controls

NOMENCLATURE: Trailing Edge Flap Assembly

ADDITIONAL REMARKS: 1. A characteristic of variable geometry wings is that flaps cannot be lowered in the swept position. Flap design should allow removal without lowering flaps even if additional access provisions are required. 2. Flap design other than variable geometry wings should allow complete disconnect with the flap down. Manipulation for access should not be required.

WORK UNIT CODE 14511 ITEM Trailing Edge Flap Assembly AIRCRAFT A-4

LOCATION: Trailing Edge of Wing

SUPPORT EQUIPMENT: External hydraulic power

ACCESS: None required

REMOVAL:
1. Lower flap..
2. Raise spoiler.
3. Disconnect actuating arm (1 bolt).
4. Remove hinge pins (2).
5. Remove flaps.

INSTALLATION: 1. Reverse order of removal.

FUNCTIONAL CHECK: Check flaps for proper operation.

TEST EQUIPMENT: External hydraulic power.

CLOSE UP: None required.

ANALYST'S OPINION: Excellent installation. Flap at optimum working height to remove by hand. Access is good. Piano hinges provide a good hinge method with two exceptions: (1) the pin can corrode in the hinge halves which makes it difficult to remove and (2) installation can be tedious if hinge halves do not line up exactly.

WORK UNIT CODE: 14730 ITEM: Trailing Edge Flap Assembly AIRCRAFT: A-7

LOCATION: Wing, Trailing Edge

SUPPORT EQUIPMENT:
External electric power
External hydraulic power
Protractor
Work stand

ACCESS:
Remove two (2) plates (3 screws each)
Remove two (2) brackets (2 bolts)
Open Panel (10 fasteners)

REMOVAL:
1. Disconnect two (2) bonds
2. Disconnect seven (7) flap gap door links
3. Disconnect flap indicator arm
4. Disconnect 6° cable at turnbuckle
5. Disconnect cable from flap (1 pin)
6. Remove two (2) doors (4 screws each)
7. Remove bolts from flap actuator (2 bolts)
8. Remove hinge bolts (2)
9. Remove flap

INSTALLATION:
1. Re-Install flap in reverse order of removal
2. Rig flaps as required
3. Adjust flap gap door preload

FUNCTIONAL CHECK: Perform operational check

TEST EQUIPMENT:
External electric power
External hydraulic power

CLOSE UP:
Two (2) plates
Two (2) brackets
One (1) panel

ANALYST'S OPINION: This is a fairly good installation. The high wing requires work stands. Access is good with stress panel fasteners used in the largest panel. The flap gap door rigging is time consuming and requires a careful adherence to the procedures.

WORK UNIT CODE 14540 ITEM TE Flap AIRCRAFT F-4

LOCATION: Trailing edge, center wing section, inboard

SUPPORT EQUIPMENT: Hydraulic and electrical power
Protractor

ACCESS: Lower speed brake
1 stress panel (88 screws)
1 hinge fairing (4 screws)
1 panel (38 screws)
Remove LAU-7A launcher
Open eng bay door (16 DZUS, 6 screws)

REMOVAL:
1. Manipulate flap to remove BLC link from flap (1 bolt) (bolt, cotterpin hard to reach)
2. Manipulate flap to remove actuator bolt
3. Remove 2 bond wires (1 bolt ea)
4. Remove hinge pin lock plate (3 bolts)
5. Remove hinge pin and flap

INSTALLATION:
1. Reverse of removal.
2. Bleed actuator.
3. Rig.

FUNCTIONAL CHECK: Motion check
BLC function check

TEST EQUIPMENT: Hydraulic and electrical power
Engine run equipment
Protractor

CLOSE UP: Re-install panels, doors, LAU-7 and raise speed brake.

ANALYST'S OPINION: This is an awkward installation. Access involves too many panels and fasteners for the job at hand. Large panels are removed to get at a single bolt. Access must be gained to the actuator to hook up hydraulics to allow manipulation of the flap to get at attachments. Piano hinges are difficult to lubricate properly in use and often present removal and installation problems.

WORK UNIT CODE 1471A ITEM FLAP AIRCRAFT F-8J

LOCATION: Inboard edge of wing center section trailing edge adjacent fuselage.

SUPPORT EQUIPMENT: Work stand.
Hydraulic test set.

ACCESS: None.

REMOVAL:
1. Position flap to landing condition position.
2. Remove 12 screws securing aerodynamic seal.
3. Disconnect BLC ducts. (F-8J only)
4. Disconnect turnbuckle from flap surface.
5. Remove 2 small pins and 1 large one.
6. Remove flap surface.

INSTALLATION:
1. Reverse removal procedure.
2. Rig.

FUNCTIONAL CHECK: Perform functional check by checking surface throws.

TEST EQUIPMENT: External hydraulic power.

CLOSE UP: None

ANALYST'S OPINION: The F-8J has boundary layer control which adds complication to the flap surface and increases task difficulty. NARF personnel reported that it sometimes takes as much as 3 hours to remove this flap. Without boundary layer control, the flap installation is a good one.

WORK UNIT CODE 14614 Inboard ITEM Inboard Flap Assembly AIRCRAFT F-14

LOCATION: Trailing Edge of Wing

SUPPORT EQUIPMENT:
- Work stand
- Spoiler locks
- Hydraulic power
- Electrical power
- Protractor

ACCESS:
- Spread wings
- Extend flaps
- Raise spoiler
- Open cove doors (5 bolts)
- 2 Panels (16 screws each)

REMOVAL:
1. Remove gasket (IB/OB flap joint) (4 screws)
2. Remove 2 bond straps
3. Remove hinge fairing (4 screws, 1 pin)
4. Disconnect 2 actuators (1 bolt each)
5. Remove 2 hinge pins
6. Remove flap

INSTALLATION:
1. Reverse of removal.
2. Rig flap.

FUNCTIONAL CHECK: Operational check

TEST EQUIPMENT:
- Hydraulic and electrical power
- Protractor

CLOSE UP: Install panels

ANALYST'S OPINION: The flap has three sections: auxilliary, inboard, and outboard. The inboard flap is used as a typical flap installation for this analysis. Overall, flap removal is easy after access is gained. The wings must be spread which dictates spotting the airplane with sufficient clear space. Hydraulic power is required for access to spread wings, lower flaps, and raise spoilers. A large bulb seal between the inboard and outboard flap resists positioning the flap during installation.

WORK UNIT CODE 14510 ITEM Wing Flap Assembly AIRCRAFT AV-8

LOCATION: TE Wing

SUPPORT EQUIPMENT: Work Stand
Protractor or Scale
Hydraulic and Electrical Power

ACCESS: 2 Plates (10 screws each)
4 Plates (4 screws each)

REMOVAL:
1. Remove brace 4 screws
2. Remove 3 bolts, torque tube attach
3. Remove 2 hinge bolts

INSTALLATION:
1. Reverse of removal.
2. Rig up stops.

FUNCTIONAL CHECK: Position check

TEST EQUIPMENT: Hydraulic and Electrical Power
Protractor or Scale

CLOSE UP: Install access panels

ANALYST'S OPINION: Good installation. Easy to reach with good access. Very simple task.
(Note relating to all flight control surfaces: NARF technicians indicated that all control surface movement dimensions are given in both angular and linear terms so either a protractor or scale can be used for rigging.)

SYSTEM: 14 Flight Controls

NOMENCLATURE: Aileron

WUC: A-4: 14211 14212 A-6: _____ A-7: 14220 F-4: 14210

F-8: 14211 14212 F-14: _____ AV-8: 14110

GENERAL OBSERVATIONS: The F-14 does not have ailerons. Most aircraft use individual hinges. Only the F-4 uses a piano style hinge. High wing airplanes require work stands while low wing airplanes provide deck level work capability. In general, aileron removal tasks are simple.

DESIRABLE FEATURES: 1. Most airplanes provide simple access to necessary attachments. 2. The AV-8 aileron is quite small and easily handled. 3. Including the hinge bearing in the aileron half of the hinge allows bearing maintenance to be performed in the shop. When a surface is installed, this assures that the bearing has maximum life available. 4. The piano hinge style attachment of the actuator to the F-4 aileron is very strong and permits removal with a minimum of access.

UNDESIRABLE FEATURES: 1. An excessive number of fasteners are involved in removal of ailerons from the A-7 (52 fasteners) and the F-8 (200 screws and 60 fasteners). 2. High wing aircraft required work stands which could be avoided on low wing airplanes. 3. The piano hinge used in the F-4 is simple and includes no bearings but requires a tool for installation and removal and presents lubrication problems.

SYSTEM: 14 Flight Controls

NOMENCLATURE: Aileron

ADDITIONAL REMARKS: Aileron removal should require only a minimum of small accesses over attach points. A comparison of piano hinge and standard hinges shows each has virtues. This analyst prefers the latter because piano hinges become increasingly hard to manipulate as the airframe becomes older.

WORK UNIT CODE 14211/14212 (RH / LH) ITEM Aileron AIRCRAFT A-4

LOCATION: Wing, Trailing Edge

SUPPORT EQUIPMENT: None

ACCESS: 2 gap seals (14 screws)

REMOVAL:
1. Remove gap seal.
2. (LH only) disconnect trim actuator arm (1 bolt).
3. Disconnect aileron actuator arm (1 bolt).
4. Disconnect hinges (3 bolts).
5. Slide aileron aft to remove.

INSTALLATION: Reverse removal order.

FUNCTIONAL CHECK: Check ailerons for proper operation.

TEST EQUIPMENT: External hydraulic power.

CLOSE UP: Install gap seals

ANALYST'S OPINION: A good installation. Aileron hinging is good and relatively accessible. It was noted that the hinge bearings are part of the aileron side of the hinge and will be sent to the shop with the aileron. Presuming the shop practices allow appropriate maintenance of the bearing, this insures maximum bearing life after installation of a new aileron. Working height is excellent for manually handling the aileron.

WORK UNIT CODE 14220 ITEM Aileron Assembly AIRCRAFT A-7

LOCATION: Wing, Trailing Edge

SUPPORT EQUIPMENT: Work stand
External hydraulic power
External electric power
Protractor

ACCESS: 1 Panel (52 screws)

REMOVAL:
1. Gain access
2. Remove bolt from aileron push/pull rods (2)
3. Disconnect three (3) bond wires
4. Remove hinge bolts (3 ea)
5. Lower aileron

INSTALLATION:
1. Re-Install aileron assembly in reverse order of removal
2. Rig aileron assembly

FUNCTIONAL CHECK: Perform operational test of ailerons

TEST EQUIPMENT: External hydraulic power

CLOSE UP: 1 Panel

ANALYST'S OPINION: A very good installation except for the large number of screws in the access panel and the high wing. Tasks are very simple and fairly typical of other aileron installations.

WORK UNIT CODE 14210 ITEM Aileron Assy AIRCRAFT F-4

LOCATION: Trailing edge, center wing section, outboard

SUPPORT EQUIPMENT: Slide hammer for hingepin
Contour board

ACCESS: 1 panel: 6 screws (damper attach fairing)
1 panel: 6 screws and hinge (inner LE fairing)
Open spoilers.
Hinge lock access (6 screws)

REMOVAL:
1. Remove hinge pin lock pin (cotter pin) at the actuator attachment
2. Remove 2 bond wires (1 bolt each)
3. Remove damper attach bolt
4. Remove actuator hinge pin
5. Remove hinge lock access
6. Install slide hammer
7. Support aileron and remove hinge pin
8. Temporarily close inner LE fairing

INSTALLATION: Reverse of removal and rig

FUNCTIONAL CHECK: Motion check

TEST EQUIPMENT: Hydraulic and electrical power

CLOSE UP: Reinstall panels

ANALYST'S OPINION: A fairly good installation. A minimum of small access panels must be removed. Normal piano hinge problems can be expected but removal appears to be easy.

WORK UNIT CODE: 14211 & 14212 ITEM: LH and RH Aileron AIRCRAFT: F-8

LOCATION: TE of Wing Center Section.

SUPPORT EQUIPMENT: Crane and sling to hold aileron.
Hydraulic test stand.

ACCESS: Access Panels (200 screws and 60 fasteners)

REMOVAL:
1. Disconnect swivel actuating arm from aileron surface (two per aileron)
2. Rotate aileron down.
3. Remove springs and chains from BLC doors. (F-8J only)
4. Support aileron weight with sling and crane.
5. Remove three aileron hinge bolts and remove aileron with crane.

INSTALLATION:
1. Reverse of removal.
2. Rig.

FUNCTIONAL CHECK: Cycle flaps and check for proper clearances.

TEST EQUIPMENT: External hydraulic power.

CLOSE UP: Install removed accesses.

ANALYST'S OPINION: Partially disassembling lower wing to gain access to the hinge pins is not considered a desirable maintainability characteristic. Locating the hinge line so that the aileron hinge pins would not have been in line with the wing lower surface skin would have eliminated removing the wing lower surface accesses. Only the F-8J series of aircraft incorporate the BLC system requiring that the springs and chains be removed to facilitate the aileron tasks.

WORK UNIT CODE 14110 ITEM Aileron Assembly AIRCRAFT AV-8

LOCATION: Trailing Edge of Wing

SUPPORT EQUIPMENT: Work Stand
Hydraulic and Electrical Power
Protractor or Scale

ACCESS: 2 Plates (12 screws total)

REMOVAL:
1. Disconnect actuator rod (1 bolt)
2. Disconnect reactor nozzle rod (1 bolt)
3. Disconnect 2 bond wires (1 screw each)
4. Remove 2 hinge bolts
5. Remove aileron

INSTALLATION:
1. Reverse of removal.
2. Rig.

FUNCTIONAL CHECK: Position check

TEST EQUIPMENT: Hydraulic and Electrical Power
Protractor or Scale

CLOSE UP: Install Plates

ANALYST'S OPINION: A simple job which can be done mainly while standing on the deck. It is notable that the aileron is very small and easily handled. A good installation achieved by keeping the design simple.

SYSTEM: 14 Flight Controls

NOMENCLATURE: Rudder

WUC: A-4: 14711 A-6: _____ A-7: 14410 F-4: 14410

F-8: 14312 F-14: 14311 AV-8: 14210

GENERAL OBSERVATIONS: Rudders are necessarily mounted high on the airplane and provide handling problems proportional to their size. Most aircraft except the F-4 and F-8 have simple, straightforward removal tasks.

DESIRABLE FEATURES: 1. The AV-8 rudder is not powered and checkout can be accomplished without hydraulic power. 2. For the most part, rudder removal is a simple "nut and bolt" job and requires no special skills or techniques.

UNDESIRABLE FEATURES: 1. The F-8 required excessive access (116 screws in one panel) and had a zipped-in aerodynamic seal that required partial rudder removal to open. 2. The F-4 removal is complicated and requires excessive access. Several parts have to be removed from the old rudder for assembly on the new rudder. 3. NARF personnel commented on difficulties removing the A-7 middle hinge pin if it is slightly corroded. The access is not sufficient to drive the pin out when it is not sliding freely enough to pull from the head.

ADDITIONAL REMARKS: The AV-8 has provision to make either angular or linear measurement of rudder motion. This has some virtue particularly for an airplane operating from forward bases with limited support. Control surface designs should allow disconnect of all items while the surface is still supported by the hinges.

WORK UNIT CODE 14711 ITEM Rudder AIRCRAFT A-4

LOCATION: Vertical Stabilizer, Trailing Edge

SUPPORT EQUIPMENT: Workstand

ACCESS: 1 gap seal (7 DZUS)

REMOVAL:

1. Disconnect actuating arm (1 bolt).
2. Disconnect three (3) hinge fittings (4 bolts).
3. Remove rudder.

INSTALLATION: Reverse removal order.

FUNCTIONAL CHECK: Check rudder for proper operation.

TEST EQUIPMENT: External hydraulic power.

CLOSE UP: Re-Install gap seal.

ANALYST'S OPINION: Good installation. Access is excellent and removal tasks are simple. Normal height of a rudder requires workstand, but this is inherent in this component on any airplane.

WORK UNIT CODE 14410 ITEM RUDDER ASSEMBLY AIRCRAFT A-7

LOCATION: Vertical Tail

SUPPORT EQUIPMENT: Workstand

ACCESS: 2 Small Doors (4 screws)
1 Access Panel (7 screws)

REMOVAL:

1. Disconnect Pushrod (1 bolt).
2. Disconnect Bond at each Hinge (3).
3. Remove attach bolts (3).
4. Remove Rudder.

INSTALLATION: Reverse removal order.

FUNCTIONAL CHECK: Operation Check
Check neutral - rerig if needed

TEST EQUIPMENT: External Hydraulic Power

CLOSE UP: 2 Small Doors
1 Access Panel

ANALYST'S OPINION: A good installation. Access is adequate with few screws required. Stress panel fasteners would be better. Technicians cite problems with the middle hinge pin corroding and freezing in the stator half of the hinge. There is no way to drive the pin out and removal is a tedious job. Access gap below hinge would help. The rudder shares the height and location problems inherent to vertical surface installations.

WORK UNIT CODE 14410 ITEM Rudder Assy AIRCRAFT F-4

LOCATION: Trailing edge of vertical fin

SUPPORT EQUIPMENT: Workstand
Plates

ACCESS: 2 plate (15 screws each)
1 hinge fairing (4 screws) mid
1 hinge fairing (2 screws) upper
1 plate (31 screws)

REMOVAL:
1. Remove small fairing below rudder (no fasteners - same screws as held accessed)
2. Remove rudder damper attach bolt
3. Remove rudder actuator attach bolt
4. Remove 6 bolts holding rudder horn to weight and bearing assy
5. Remove 4 screws securing center hinge and flutter damper
6. Remove 4 screws securing bottom hinge
7. Remove 2 screws securing upper hinge
8. Move rudder aft and remove bond wire (1 screw)
9. Remove rudder
10. Remove rudder transmitter (1 bolt)
11. Remove 4 bolts holding weight assembly, remove weight assy.
12. Reassemble weight asembly on new rudder.

INSTALLATION:
1. Reverse of removal.
2. Install weight assembly prior to installation.
3. Rig rudder.

FUNCTIONAL CHECK: Motion check

TEST EQUIPMENT: Electrical and hydraulic power

CLOSE UP: Reinstall panels and fairings

ANALYST'S OPINION: Removal is complicated and access to attach fittings is marginal. The weight assembly should be part of the rudder to preclude subsequent removal. A simple item like the bond wire should not require partial removal of the rudder to disconnect. Many are apt to be broken off.

WORK UNIT CODE 14312 ITEM Rudder Surface AIRCRAFT F-8

LOCATION: On Vertical Fin

SUPPORT EQUIPMENT: High work stand to gain access to rudder assembly.
Battens

ACCESS: Rudder surface itself is in the open, but several access panels have to be removed to facilitate removal.
3 hinge access doors (12 screws total)
2 rudder PC access panels (53 fasteners for one, 63 fasteners for other)

REMOVAL:
1. Install Batten
2. Remove actuator arm sleeve retaining bolt on RH side and remove sleeve.
3. Open aerodynamic seal between rudder and vertical fin.
4. Remove batten.
5. Position rudder as far left as possible without damaging skin and linkage.
6. Open three hinge point access doors (center door has screws on LH and RH side).
7. Remove upper and lower hinge bolts and disconnect bonding jumper.
8. Support weight of rudder and remove middle hinge bolt and bonding jumper. (Surface has to be supported to prevent damage to attached seals at upper end of rudder).
9. Move rudder slightly aft to gain access to zipper and open zipper at upper end of rudder between rudder vertical fin with extra long nose pliers. (See continuation sheet).

FUNCTIONAL CHECK: Perform operational check for proper surface deflection and operation.

TEST EQUIPMENT: External hydraulic power.
Rudder position protractor.

CLOSE UP: Re-install accesses.

ANALYST'S OPINION: Excessive time is spent in gaining access to the PC package to facilitate removing the rudder surface. The overall task time could have been reduced by not having to remove additional access panels which are not really related to the actual removal of the rudder. If surface to structure sealing is a requirement for supersonic operation, the design of the surface and structure should be such that a zipper and fabric seal not be used. The reason here is that with this installation, the surface has to be supported away from its attach point while the aerodynamic seal zipper is opened and disengaged. The chances to incur damages to the seal during removal and installation seem very likely. Also, having to disturb the rudder neutral indicating

(See continuation sheet)

CONTINUATION SHEET:

WORK UNIT CODE 14312 ITEM Rudder Surface AIRCRAFT F-8

REMOVAL: (Continued)

10. Remove rudder surface.

INSTALLATION: 1. Reverse of removal (rudder neutral switch actuator has to be removed to prevent damage to the neutral switch.)
2. Rig rudder neutral switch.

ANALYST'S OPINION: (Continued)

system to facilitate work on the rudder surface also seems like it could have been avoided, thereby reducing the total time to complete all maintenance on the rudder surface.

WORK UNIT CODE 14311 ITEM Rudder AIRCRAFT F-14

LOCATION: Trailing edge of each vertical stabilizer

SUPPORT EQUIPMENT: Work stand
Hoist and sling
Hydraulic & electrical power
Protractor

ACCESS: 7 accesses (each rudder)

REMOVAL:
1. Disconnect bungee (fairing to rudder) (1 bolt)
2. Disconnect actuator from horn (1 bolt)
3. Disconnect rudder position transducer link (1 bolt)
4. Manually move rudder to gain access and remove 3 jumpers (3 screws)
5. Remove lower hinge pin (1 bolt, pin)
6. Remove upper hinge pin (1 bolt, pin)
7. Remove mid hinge pin (1 bolt, pin)
8. Remove rudder

INSTALLATION: 1. Reverse of removal.
2. Rig.

FUNCTIONAL CHECK: Operate and check motion

TEST EQUIPMENT: Hydraulic and electrical power
Protractor

CLOSE UP: Close accesses

ANALYST'S OPINION: A good installation. The flat "beaver tail" section of the fuselage makes a good work platform. A tall workstand is needed to reach upper hinges and help handle the rudder. This is inherent in most any rudder installation. The rudders are interchangeable which is a good feature.

WORK UNIT CODE 14210 ITEM Rudder Assembly AIRCRAFT AV-8

LOCATION: Aft Edge of Fin

SUPPORT EQUIPMENT: Work Stand
Protractor or Ruler

ACCESS: 1 Plate (13 screws)

REMOVAL:
1. Pull cannon plug
2. Disconnect control rod (1 bolt)
3. Remove 2 nuts (top hinge)
4. Remove 4 nuts (bottom hinge)
5. Remove rudder and hinge assy
6. Remove hinges

INSTALLATION:
1. Reverse of removal.
2. Rig.

FUNCTIONAL CHECK: Motion check

TEST EQUIPMENT: Protractor or Scale

CLOSE UP: Reinstall plate

ANALYST'S OPINION: The rudder is driven by the nozzle control linkage. No hydraulic power is required for checkout according to NARF technicians. A good, simple installation.

SYSTEM: 14 Flight Controls

NOMENCLATURE: Spoiler Assembly

WUC: A-4: 14A11 A-6: _____ A-7: 14311 F-4: 14240

F-8: _____ F-14: 14211 AV-8: _____

GENERAL OBSERVATIONS: The AV-8 and A-6 are not equipped with spoilers. The spoilers observed are all reasonably easy to work on. Most spoilers are locked down and hydraulic pressure is required to open them for maintenance.

DESIRABLE FEATURES: 1. Access to connections is relatively easy on all spoilers. They provide their own access door. 2. The F-14 spoiler is reported to require no rigging.

UNDESIRABLE FEATURES: 1. The A-7 has a linkage arrangement that must be transferred to the new spoiler. The inboard and outboard links are not interchangeable. 2. The F-14 requires partial spreading of the wings to open and work on the spoilers. This requires spotting the airplane with enough room on each side to accomplish this spread. 3. Except for the A-7 and F-14, additional access is required to remove the spoiler. One of the accesses in the A-4, however, allows disconnection of the actuator so the spoilers may be opened without hydraulic pressure. This particular access is desirable.

ADDITIONAL REMARKS: 1. Since hydraulic pressure is required only to unlatch the actuators, it would be worthwhile to ensure this could be done with a manual pressure source such as a hand pump. 2. The spoiler provides ample access. Hinges and actuators should be made to disconnect without removing additional panels.

WORK UNIT CODE 14A11 ITEM Spoiler Assembly AIRCRAFT A-4M

LOCATION: Wing, trailing edge, top

SUPPORT EQUIPMENT: External hydraulic power.

ACCESS: 3 accesses (26 screws)

REMOVAL:
1. Lower flap.
2. Open two (2) lower and one (1) upper access panels.
3. Disconnect spoiler actuator (1 bolt).
4. Raise spoiler manually.
5. Remove three (3) hinge pins.
6. Lift off spoiler.

INSTALLATION:
1. Reverse removal order.
2. Rigging required during installation.

FUNCTIONAL CHECK: Check for proper operation of spoiler.

TEST EQUIPMENT: External electric power.
External hydraulic power.

CLOSE UP: Install access panels

ANALYST'S OPINION: Except for the use of screws in the access panels, access is ver good. Fasteners for panels are a trade-off item during design and the use of screws is often justified. Qualitatively, they are less than desirable because they represent 26 loose items that must be kept track of and have failure modes which inhibit flow of maintenance.

WORK UNIT CODE 14311 ITEM Spoiler Assembly AIRCRAFT A-7

LOCATION: Wing center section TE, between wingfold and fuselage.

SUPPORT EQUIPMENT: External hydraulic power.
Wood block to hold spoiler door open.

ACCESS: Open access to spoiler stops for rigging

REMOVAL:
1. Apply External hydraulic power and open desired spoiler.
2. Hold stock pressure and shut down hydraulic power.
3. Hold spoiler assembly open with suitable wood blocks.
4. Disconnect both deflector links from spoiler surface attach fittings.
5. Disconnect both spoiler door linkages from both powered bellcranks. (Accomplished by removing cotter key, nut, washer, and bolt).
6. With spoiler open, remove cotter key, nut,washer, and both pivot bolts.
7. Remove spoiler surface.
8. Disconnect both spoiler linkages from door torque tube bearing unit, and transfer linke to new spoiler surface.

INSTALLATION:
1. Reverse of removal
2. Trim replacement door to fit
3. Rig spoiler and deflector surfaces

FUNCTIONAL CHECK: Verify proper throws of spoiler surface.

TEST EQUIPMENT: Spoiler protractor
External hydraulic power

CLOSE UP: Replace access to spoiler stops.

ANALYST'S OPINION: Care has to be exercised in transferring spoiler door linkages to a new door because of the possibility of mixing the inboard and outboard linkages. Designing these links to be the same would minimize mixing or attempts to mix these links. The use of one actuator simplifies system because deflector is slaved to the spoiler surface and is rigged in conjuntion with the spoiler.

WORK UNIT CODE 14240 ITEM Spoiler Assembly AIRCRAFT F-4

LOCATION: Upper Surface Center Wing

SUPPORT EQUIPMENT: External hydraulic and electric power
Protractor [illegible]ds

ACCESS: Hinge Pin Access (19 screws)
Open Spoiler

REMOVAL: 1. Remove actuator attach bolt
2. Remove 2 bonding wires (1 bolt ea)
3. Remove hinge pin

INSTALLATION: 1. Reverse of removal
2. Rig

FUNCTIONAL CHECK: Motion check

TEST EQUIPMENT: Hydraulic and Electrical Power

CLOSE UP: Re-Install access

ANALYST'S OPINION: The spoilers consist of two surfaces on each wing hinged on a single hinge pin. Each surface is driven by its own actuator. The procedure observed is the same for either surface. This is a good installation with two minor deficiencies: 1. 19 screws are too many just to gain access to the end of the hinge pin, and 2. The single hinge pin has to be pulled from both surfaces if only the one next to the access is to be removed. Otherwise, the tasks are simple and direct.

WORK UNIT CODE 14211 ITEM Inboard Spoiler AIRCRAFT F-14

LOCATION: Top, wing trailing edge

SUPPORT EQUIPMENT: Work stand
Hydraulic and electrical power

ACCESS: Spread wings to 20'
Open spoilers

REMOVAL:
1. Disconnect 2 bellcrank linkages (1 bolt each)
2. Remove 2 bond wires (1 bolt each)
3. Remove 1 wire clamp
4. Remove 2 hinge pins (1 bolt each)
5. Remove spoiler

INSTALLATION: Reverse of removal
(no rigging required)

FUNCTIONAL CHECK: Operational check

TEST EQUIPMENT: Hydraulic and electrical power

CLOSE UP: Close spoilers
Close wings

ANALYST'S OPINION: There are 4 spoilers on each wing. The inboard spoiler is used as a typical installation. Except for spreading the wings, the spoiler removal is easy with no requirement for access other than opening the spoilers.

SYSTEM: 14 Flight Controls

NOMENCLATURE: Pilot's Stick Grip

MUC: A-4: _____ A-6: 14211 A-7: 14111 F-4: 14111

F-8: 14111 F-14: 5771A AV-8: 14411

GENERAL OBSERVATIONS: The stick grips in all airplanes are easily removed and convenient to work on. Either a cannon plug type connection or a simple bolt-on connection with separate electrical plug is used. The A-6 is the most complex yet is acceptable.

DESIRABLE FEATURES: The cannon plug style connector which accomplishes both physical and electrical connection to the control stick column reduces the job to its simplest form.

UNDESIRABLE FEATURES: The harnesses associated with the bolt-on type stick grips are vulnerable to handling damage and add steps of disconnect and unclamping to the removal task.

ADDITIONAL REMARKS: Positive locking features in the plug-in grips would eliminate the locking screws and provide an automatic locking action which would prevent inadvertent omission of the locking screws. A good visual indication of an unlatched lock would be needed.

WORK UNIT CODE 14211 ITEM CONTROL STICK AIRCRAFT A-6

LOCATION: Cockpit

SUPPORT EQUIPMENT: External hydraulic and electrical power

ACCESS: None

REMOVAL:
1. Disconnect two plugs and remove clamp securing electrical cable assembly.
2. Remove nut and bolt connecting flaperon input rod to control stick assembly.
3. Remove one pivot bolt for stick and remove stick assembly.
4. Canvas boot has to be opened to gain access to clamp mentioned above in

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Because electrical connectors are disconnected, 7 separate systems checks have to be made to assure that all systems are operable.

TEST EQUIPMENT: Hydraulic and electric power

CLOSE UP: None

ANALYST'S OPINION: Control stick is easily removed because quantity of fasteners used to secure stick assembly to column is held to a minimum. There are only two electrical connectors to disconnect. When they are disconnected, however, extensive system checking is required on several systems. Recommend some kind of "BITE" check be developed to minimize the extent to which systems checking has to be done.

WORK UNIT CODE 14111 ITEM Stick Grip AIRCRAFT A-7

LOCATION: Cockpit

SUPPORT EQUIPMENT: None

ACCESS: None

REMOVAL:
1. Loosen three (3) set screws - (Allen).
2. Turn ring nut clockwise.
3. Lift off.

INSTALLATION: Reverse removal procedure.

FUNCTIONAL CHECK: Functionally check the following:
a. AFCS
b. Trim
c. Weapons release
d. Gun fire
e. Nose gear steering

TEST EQUIPMENT: External electric power

CLOSE UP: None required

ANALYST'S OPINION: Excellent installation. Extremely easy to remove and replace. Use of what is essentially a cannon plug to both make the numerous electrical connections and physically secure the stick grip to the control column is good design for simplicity. It is virtually "Murphy" proof.

WORK UNIT CODE 14111 ITEM Stick Grip AIRCRAFT F-4

LOCATION: Cockpit

SUPPORT EQUIPMENT: None

ACCESS: None

REMOVAL: 1. Loosen three (3) set screws - (Allen)
2. Turn ring unit clockwise
3. Lift off

INSTALLATION: Reverse removal procedure

FUNCTIONAL CHECK: Functionally check the following:
a. AFCS
b. Trim
c. Weapons Release
d. Gunfire
e. Nose gear steering

TEST EQUIPMENT: External electrical power

CLOSE UP: None required

ANALYST'S OPINION: Excellent installation. Extremely easy to remove and replace. Use of what is essentially a cannon plug to both make the numerous electrical connections and physically secure the stick grip to the control column is good design for simplicity. It is virtually "Murphy" proof.

WORK UNIT CODE 14111 ITEM Pilot Control Stick AIRCRAFT F-8

LOCATION: Cockpit

SUPPORT EQUIPMENT: None

ACCESS None

REMOVAL:
1. Remove two bolts on bottom of unit and lift stick grip off.
2. Disconnect two connectors and remove unit.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Check aircraft controls for proper response, if not aligned, trim pots need to be adjusted.

TEST EQUIPMENT:
Protractor
Hydraulic Power
Electrical Power

CLOSE UP: None

ANALYST'S OPINION: This is a good installation. Like all modern stick grips, it has numerous control switches incoroporated in it. The harnesses are subject to handling damage.

WORK UNIT CODE 5771A ITEM Aircraft Control Stick AIRCRAFT F-14

LOCATION: Cockpit

SUPPORT EQUIPMENT: None

ACCESS: None

REMOVAL: 1. Loosen three (3) set screws - (Allen)
2. Turn ring nut clockwise
3. Lift off

INSTALLATION: Reverse removal procedure

FUNCTIONAL CHECK: Functionally check the following:
a. AFCS
b. Trim
c. Weapons Release
d. Gunfire
e. Nose gear steering

TEST EQUIPMENT: External electric power

CLOSE UP: None required

ANALYST'S OPINION: Excellent installation. Extremely easy to remove and replace. Use of what is essentially a cannon plug to both make the numerous electrical connections and physically secure the stick grip to the control column is good design for simplicity. It is virtually "Murphy" proof.

WORK UNIT CODE 14411 ITEM Control Column Handle AIRCRAFT AV-8

LOCATION: Cockpit

SUPPORT EQUIPMENT: None

ACCESS: None

REMOVAL:
1. Remove 2 bolts at base of stick grip
2. Remove 1 clamp
3. Disconnect cannon plug
4. Remove grip and harness

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK:
Trim check
Armament check
Nose steering check

TEST EQUIPMENT: Electrical Power

CLOSE UP: None

ANALYST'S OPINION: Easy job. This would be a good installation except for the long electrical harness. It is subject to handling damage.

POWER PLANT INSTALLATION

APPROACH POWER COMPUTER [redacted]

THROTTLE QUADRANT [redacted]

POWER PLANT INSTALLATION

CONTENTS

COMPONENT	A-4	A-6	A-7	F-4	F-8	F-14	AV-8
Approach Power Computer	N/A	N/A	29C26	29C1N	29C73	29C31	N/A
Throttle Quadrant	29315	29313	29311	29313	29310	29322	29117

SYSTEM: 29 Power Plant Installation

NOMENCLATURE: Approach Power Compensator/Computer

WUC: A-4: _____ A-6: _____ A-7: 29C26 F-4: 29C1N

F-5: 29C73 F-14: 29C31 AV-8: _____

GENERAL OBSERVATIONS: The AV-8 does not have an approach power compensator. The computer is fairly small and easily removed. Access is good except for the requirement to remove the F-4 seat.

DESIRABLE FEATURES: All installations are simple and easily removed. No significant differences exist except in access. Location of the computer in a wheel well of the F-8 provides outstanding access to this component but adds to the congestion in the wheel well.

UNDESIRABLE FEATURES: 1. Removal of the seat to gain access to the computer in the F-4 is not acceptable. 2. The F-14 installation is almost good except for a transformer rectifier that blocks access to two mounting screws and an access panel that is too big with too many fasteners for the job. This panel has 49 panel fasteners and 4 latches. What is gained with the 4 latches?

ADDITIONAL REMARKS: 1. Avoidance of seat removal is a necessary design requirement in all cockpit items. Seat removal involves too many people and too much time. Its criticality to pilot safety demands that it be disturbed as little as possible. 2. The subject of scaling and access to the job is recurrent throughout this survey. Many individual installations are marred by oversize doors with many fasteners. A single large, non-structural door that exposes several components

SYSTEM: 29 Power Plant Installation

NOMENCLATURE: Approach Power Compensator/Computer

ADDITIONAL REMARKS: (Cont.)

is acceptable, even desirable if it is secured with a few latches (such as the A-7 avionics bay door). When normally spaced quick release fasteners, such as DZUS or Camlocks, are used, access problems increase tremendously. If the access is a stress panel held with screws, any oversize for the job becomes a significant detriment. Any access has to be evaluated from the stand point of the component being removed.

WORK UNIT CODE 29C26 ITEM APC Computer AIRCRAFT A-7

LOCATION: Left Hand Cheek Bay

SUPPORT EQUIPMENT: None

ACCESS: 1 panel (23 SPF)

REMOVAL:
1. Disconnect electrical plug
2. Cut safety wire and remove one (1) bolt
3. Slide computer off shelf

INSTALLATION: Reverse removal procedure

FUNCTIONAL CHECK:
Perform computer test
Perform rotary actuator test
Perform accelerometer test
Perform system operational test

TEST EQUIPMENT:
External electric power
Equipment required for engine operation

CLOSE UP: One Panel

ANALYST'S OPINION: This is a good installation. Access is easy and reachable by a man standing on the deck. Single bolt installation reduces task time. It could be carried one step further by using a fastener with the same head style as the access panel thereby reducing tool requirement to one screwdriver.

WORK UNIT CODE 29C1N ITEM Approach Power Compensator AIRCRAFT F-4 F-4B

LOCATION: On floor below & behind number 2 circuit breaker panel, right hand console, aft cockpit

SUPPORT EQUIPMENT: None

ACCESS: Remove seat

REMOVAL:
1. Remove 3 hex screws
2. Disconnect 1 cannon plug
3. Remove unit

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: APC checkout: Engine run - Balance RPM against angle of attack vane position. (Adjust at engine).

TEST EQUIPMENT: Engine run equipment.

CLOSE UP: Install seat

ANALYST'S OPINION: A fairly good installation except for the requirement to remove the seat. Tasks are simple. It would appear that checkout would take considerably more time than replacement. This would be a good candidate for BITE.

WORK UNIT CODE 29C73 ITEM A.P.C. Computer AIRCRAFT F-8

LOCATION: Left Wheel Well

SUPPORT EQUIPMENT: None

ACCESS: None

REMOVAL: Disconnect two cables and remove four bolts.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Unit is functionally checked by positioning the servo actuator and the angle-of-attack vane and checking for proper response. Voltages are checked at the test connector with a meter.

TEST EQUIPMENT: Multimeter

External electric power

CLOSE UP: None

ANALYST'S OPINION: Good installation. Access is very easy and tasks are simple. Checkout is simple and does not require engine run.

WORK UNIT CODE 29C31 ITEM Approach Power Compensator CP1040( )/ASN105( ) Throt Cont Cmptr AIRCRAFT F-14

LOCATION: Fuselage, Aft of Cockpit, Right Hand Side

SUPPORT EQUIPMENT: None

ACCESS: 1 Panel (49 fasteners, 4 latches)

REMOVAL:
1. Disconnect 1 electrical connector.
2. Remove 4 screws. (2 screws Blind, Transformer/Rectifier in way of Rt/Rear Screw)
3. Remove unit.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Self test

TEST EQUIPMENT: Electrical power

CLOSE UP: Install panel

ANALYST'S OPINION: Access is too big for the job to be done. It is questioned why the four latches when 49 fasteners are also used in the panel? This is an expense and a weight that does not accomplish much in reducing access time. The unit is mounted in the compartment so that the transformer/rectifier inhibits access to 2 of the mounting screws. They must be removed and installed blind. The result is an installation that looks good but is not.

SYSTEM: 29 Power Plant Installation

NOMENCLATURE: Throttle Quadrant

MUC: A-4: 29315 A-6: 29313 A-7: 29311 F-4: 29313

F-8: 29310 F-14: 29322 AV-8: 29117

GENERAL OBSERVATIONS: The key question with this component is whether or not it can be removed with the seat installed. Most of the airplanes achieved this but in either case, the job is intricate and time consuming.

DESIRABLE FEATURES: 1. All aircraft except the A-6 and F-14 permit removal with the seat installed. 2. Some versions of the F-4 quadrant have replaced the original 12 terminals with two connectors. This is a significant improvement.

UNDESIRABLE FEATURES: 1. Access is generally bad involving removal of access panels as well as console mounted control panels. Once open, limited tool space is involved and various linkages must be manipulated in order to reach the attachments. The areas below the console are high density areas that inhibit work and make a dropped fastener a serious problem. 2. The AV-8 manual is not adequate to guide a mechanic easily through the task. 3. The large number of systems operated through the controls on the quadrant as well as involved in the displaced console panels created a substantial checkout effort.

ADDITIONAL REMARKS: As more and more functions are added to the throttle quadrant, design attention should be concentrated on the maintainability aspects

SYSTEM: 29 Power Plant Installation

NOMENCLATURE: Throttle Quadrant

ADDITIONAL REMARKS: (Cont.)

of it. As pilot workload increases, more items are included in the "fingertip" control provided by the quadrant. Frequency of maintenance goes up, and the quadrant becomes harder to remove.

WORK UNIT COD 29315 ITEM Throttle Quadrant Assembly AIRCRAFT A-4M

LOCATION: Cockpit, Left Console

SUPPORT EQUIPMENT: External electric power

ACCESS: Internal from cockpit, two (2) console panels must be removed to gain access (10 camlocks)

REMOVAL:
1. Remove two (2) panels.
2. Disconnect two (2) linkages (2 bolts).
3. Raise flap handle.
4. Disconnect flap linkage (1 bolt) and cannon plug.
5. Disconnect seven (7) camlocks.
6. Disconnect one (1) link (1 bolt).
7. Remove throttle quadrant from aircraft.

INSTALLATION:
1. Re-install in reverse order from removal.
2. Rig throttle quadrant assembly.

FUNCTIONAL CHECK: Check out the following electrical circuits:
a. Rain repellant
b. JATO Ignition
c. Trim
d. Spoilers
e. APC (See Continuation Sheet)

TEST EQUIPMENT:

External electric power
External hydraulic power

CLOSE UP: Re-install control panels and functional check affected systems.

ANALYST'S OPINION: As with all units requiring work below the console panel, access is not desirable. The throttle quadrant is neatly designed to allow access thru minimum space to all attach points. Inclusion of controls and switches for non-related systems as part of the throttle quadrant requires additional effort in checking out the installation. The problems noted in this installation do not result from poor quadrant design; but, rather, from a very cramped cockpit.

CONTINUATION SHEET:

WORK UNIT CODE 29315 ITEM Throttle Quadrant Assembly AIRCRAFT A-4M

FUNCTIONAL CHECK: (Continued)

f. Jettison
g. Check throttle operation
h. Check flap operation

WORK UNIT CODE: 29313 ITEM: THROTTLE QUADRANT AIRCRAFT: A-6

LOCATION: Cockpit

SUPPORT EQUIPMENT:
Canopy sling
Pilot seat sling
Overhead crane
External hydraulic power

ACCESS: Remove canopy and seat, if needed. (NARF NORVA indicates that mechanics proficiency determines if seat has to be removed.)

REMOVAL:
1. Remove 8 screws from panel below quadrant
2. Disconnect input rods from bellcrank.
3. Remove electrical plug.
4. Remove screws , 3 front, 3 aft, and 3 on side.
5. Lift up quadrant with rods attached and remove from airplane.

INSTALLATION:
1. Transfer control rods from old quadrant to new quandrant.
2. Reverse of removal procedures.

FUNCTIONAL CHECK: The following systems have to be checked when replacing a quadrant assembly:
a. Flaps (normal and emergency)
b. Slats (normal and emergency)
c. Spin recovery check
d. Speed brake functional check
e. Start engine

(See continuation sheet)

TEST EQUIPMENT: External electrical and hydraulic power
Equipment required for engine run.

CLOSE UP: Replace canopy and seat, if applicable.

ANALYST'S OPINION: Assembly is prone to electrical failure. Unit or assembly should be more reliable, or should be located so that disassembly of aircraft is not required to remove quadrant. Removing canopy is reasonable on this airplane, but removing seat should be avoided, if possible.

CONTINUATION SHEET:

WORK UNIT CODE 29313 ITEM Throttle Quadrant AIRCRAFT A-6

FUNCTIONAL CHECK: (Continued)

f. With engine running check following:
   1. Chaff dispense check
   2. Microphone
   3. ICS switch
   4. Hard strut check

WORK UNIT CODE 29311 ITEM Throttle Quadrant AIRCRAFT A-7

LOCATION: LH Cockpit Console

SUPPORT EQUIPMENT: None

ACCESS: Remove radar control panel
Remove fuel management panel
Remove generator control panel
Remove 9 screws from access panel to quadrant control linkage, remove panel.

REMOVAL:
1. Remove cotter key, nut, and washers securing fuel shutoff controlex to quadrant. (Quadrant lever may have to be selectively positioned to permit removing hardware)
2. Remove cotter key, nut, spacer, and bolt securing throttle controlex to quadrant.
3. Disconnect emergency brake cable from quadrant mounted lever.
4. Remove electrical connector from quadrant.
5. Remove two flush (countersunk) screws from radar control cavity securing aft end of quadrant.
6. Remove two botton head screws from generator control cavity securing forward end of quadrant.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Functional check will have to be made of all the functions of the following control panels:
a. Generator control panel
b. Throttle control quadrant
c. Radar control panel
d. Fuel management panel

TEST EQUIPMENT: External electrical & hydraulic power

CLOSE UP: Replace panels

ANALYST'S OPINION: Task time is long because of having to disturb adjacent systems merely to gain access to control quadrant. Area of installation is densely packaged such that access to the quadrant has been sacrificed. Total maintenance time is lengthened because of having to check those systems disturbed to gain access. High density packaging is being paid for by having to check other systems.

WORK UNIT CODE 29313 ITEM THROTTLE CONTROL BOX AIRCRAFT F-4

LOCATION: Left Hand Console, Front Cockpit

SUPPORT EQUIPMENT: Work Stand

ACCESS: 1 Panel (console access) 79 screws
Engine Control Panel (in console)
Console side panel 7 Dzus

REMOVAL:
1. Remove throttle handle seal (4 QR panel fasteners)
2. Disconnect 2 plugs under quadrant*
3. Release 2 telescopic control rods - cotter pin
4. Disconnect 4 legs (2 bolts & shims ea).
5. Wiggle it out - may have to unclamp nearby wire bundles to get space.

INSTALLATION:
1. Reverse
2. Rig Throttles

* some throttles have terminal strip - about 12 terminals

FUNCTIONAL CHECK: Check: Speed Brake
Microphone
Chaff dispenser/flare function
ignition, both engines
throttle function
run engine

TEST EQUIPMENT: Equipment for engine run.

CLOSE UP: 1 Panel
Engine Control Panel
Console Side Panel (7 DZUS)

ANALYST'S OPINION: Like all throttle quadrants, this item was not installed with much thought of easy removal. Working space is very close and there are many items to disconnect. Eliminating the 12 terminals by use of 2 plugs was an excellent improvement. Once disconnected, the quadrant has to be wiggled and turned to get it out of the panel.

WORK UNIT CODE 29310 ITEM THROTTLE/POWER LEVER AIRCRAFT F-8

LOCATION: Cockpit, on left hand console.

SUPPORT EQUIPMENT: Work stand.
Throttle rigging tools.
Cable tensiometer

ACCESS:

1 Exterior Panel (50 screws)
1 Interior Panel (17 screws)
Adjacent control boxes

REMOVAL:

1. Disconnect special throttle rod.
2. Disconnect electrical plug.
3. Disconnect 4 pneumatic lines.
4. Remove stab panel.
5. Remove console boxes.
6. Remove 6 bolts and 3 screws and remove throttle quadrant.

INSTALLATION:
1. Reverse of removal
2. Rig throttle controls.

FUNCTIONAL CHECK: Run engine and perform stab check.

TEST EQUIPMENT: Equipment for engine run

CLOSE UP: Replace removed accesses.

ANALYST'S OPINION: Removing a cockpit console mounted control is usually not easy depending on what type of control it is, especially if the control operates or is connected to a linkage system. Disconnecting additional functions such as the pneumatic lines in order to permit throttle assembly removal should be kept to a minimum, if possible, in order to reduce the quantity of systems to be functionally checked after maintenance if performed.

WORK UNIT CODE 29322 ITEM Throttle Quadrant AIRCRAFT F-14

LOCATION: Left hand console, front cockpit only

SUPPORT EQUIPMENT: None

ACCESS: Remove seat/canopy
Remove console control panels
Remove console side panel

REMOVAL:
1. Disconnect wing sweep cable (1 bolt)
2. Disconnect flap cable (1 bolt)
3. Disconnect throttle cables (2 bolts)
4. Disconnect electrical connector
5. Release 6 screws and remove quadrant

INSTALLATION:
1. Reverse of removal.
2. Rig throttle auto, boost, and manual modes; wing sweep; and flaps

FUNCTIONAL CHECK: Operate flaps, wing sweep, and engine

TEST EQUIPMENT: Engine run equipment

CLOSE UP: Re-install console side panel, control panels, seat, and canopy

ANALYST'S OPINION: This is not a good installation. Access is bad even after seat and panels are removed. The quadrant controls must be moved during removal to provide limited access to cable connector bolts. The system is sensitive to this motion and manual tasks must be followed very closely to prevent damage to the engine throttles.

WORK UNIT CODE 29117 ITEM Combined Throttle/Nozzle Control Box AIRCRAFT AV-8

LOCATION: LH Console

SUPPORT EQUIPMENT: None

ACCESS: Remove port aft console panel, and support it out of the way.

REMOVAL:
1. Disconnect throttle cable 1 pin.
2. Disconnect 2 harnesses.
3. Disconnect control rod from nozzle lever 1 bolt.
4. Remove bolts attaching quadrant, lift quadrant.
5. Disconnect parking brake lock cable.
6. Remove quadrant.

INSTALLATION:
1. Reverse removal procedure.
2. Rig.

FUNCTIONAL CHECK: Perform functional check of:
a. throttle/nozzle control box
b. parking brake

TEST EQUIPMENT: Equipment for engine run

CLOSE UP: Replace the console panel

ANALYST'S OPINION: This component is little different from other throttle quadrants in difficulty of removal. The nozzle position lever is an added function.

NOTE: A throttle installation was not available for observation at NARF so the manual was used to determine the task. The manual was difficult to use because it assumed an expertise in the system that the observer did not possess and was poorly illustrated.

UTILITY SYSTEMS

CABIN TEMPERATURE CONTROL [redacted]

GENERATOR CONTROL/
SUPERVISORY PANELS [redacted]

INTERNAL LIGHT CONTROL PANEL [redacted]

EXTERIOR LIGHTS [redacted]

RESERVOIR (PC OR FLIGHT CONTROL) [redacted]

LIQUID OXYGEN CONVERTER [redacted]

M61A1 GUN/AMMO DRUM [redacted]

UTILITY SYSTEMS

CONTENTS

COMPONENT	A-4	A-6	A-7	F-4	F-8	F-14	AV-8
Cabin Temp Control	41126	N/A	41134	4111J	N/A	41152	41126
Generator Control/ Supervisory Panels	N/A	42121	42216	42127 4212A	4222C	42152 42124	N/A
Internal Light Control Pnl	44231	44222	44231	44112 44121	N/A	44X11	44121
Exterior Lights	44111 44113 44115	44115	44115	44232 44223 44224	N/A	44113 44111 44140	44211 44212
Reservoir (PC or Flt. Control)	N/A	N/A	45213	4512A	45112	45112	45112
Liquid Oxygen Converter	47111	47111	47111	47111	47115	47111	47111
M61A1 Gun/Ammo Drum	N/A	N/A	75510 75531	N/A	N/A	75611 75631	N/A

SYSTEM: 41 Air Conditioning and Pressurization

NOMENCLATURE: Cabin Temperature Control

WUC: A-4: 41126 A-6: _____ A-7: 41134 F-4: 4111J

F-8: _____ F-14: 41152 AV-8: 41126

GENERAL OBSERVATIONS: Generally, this installation was very good. It is traditionally mounted in the right console. The most common removal method is to lift the panel free of the console and disconnect the connectors. The A-4 and AV-8 depart from this and the installation is substantially degraded.

DESIRABLE FEATURES: 1. Providing sufficient cabling beneath the panel to lift it clear of the console is a big assist in removal tasks. By this method, the removal is reduced to the simplest element. 2. Should maintenance of other systems alter routing in the console, alternate outside access is available in the A-7 airplanes. This allows removing connectors without removing the seat or disturbing unassociated systems control boxes. Alternate access in several airplanes is available by removing adjacent control boxes. This is adequate but less desirable.

UNDESIRABLE FEATURES: 1. Hard wiring of the control box into the airplane, such as in the AV-8 is to be avoided. Cutting and splicing, unpotting and unsoldering, or repair of the box in the airplane are all undesirable options. 2. The A-4 installation is very difficult to remove because of poor access to mounting hardware. The control panel is not modular and the temperature switch uses nuts and bolts, head downward, in an extremely congested area for mounting. 3. The A-7 installation in-

SYSTEM: 41 Air Conditioning and Pressurization

NOMENCLATURE: Cabin Temperature Control

UNDESIRABLE FEATURES: (Cont.)

cludes five identical hoses which present a significant potential for incorrect hookup.

ADDITIONAL REMARKS: Electric control systems are preferable from a maintenance stand point because of the greater simplicity of installation. Control panels that include the basic temperature control electronics are replaced with significant frequency. A comprehensive built-in-test would ease troubleshooting and reduce occurrence of replacement.

WORK UNIT CODE 41126 ITEM Cabin Temperature Switch AIRCRAFT A-4

LOCATION: Cockpit, Right Console

SUPPORT EQUIPMENT: None

ACCESS. Remove TACAN and IFF panels.

REMOVAL:

1. Remove knob (1 set screw).
2. Remove terminal strip (2 screws).
3. Remove two (2) mounting screws (screw driver from below, wrench above).
4. Open mounting strap.
5. Disconnect connector (safetied).
6. Assembly must be moved downward approximately two (2) inches to clear shaft.

INSTALLATION: Reverse removal order.

FUNCTIONAL CHECK: Perform operational check of temperature control.
Check TACAN for operation.
Check IFF for operation.

TEST EQUIPMENT: Equipment required for engine operation.

CLOSE UP: Re-install console panels

ANALYST'S OPINION: Anchor nuts on mounting screws would improve this installation tremendously. Access is very tight. Screws can be dropped into console cavity and be exceedingly hard to find. Mounting strap difficult to reconnect. Safetying of plug has to be done by mirror. This has to be considered a bad installation. Too much blind work is required, space is very limited, large bundles of wires inhibit access and component motion, and great potential damage and console FOD exists.

WORK UNIT CODE 41134 ITEM Environmental Control Panel AIRCRAFT A-7

LOCATION: Cockpit, Right Hand Console

SUPPORT EQUIPMENT: None

ACCESS: Open Canopy
(Outside access is also available (39 screws) if routing beneath console does not allow lifting control panel sufficiently to accomplish disconnects)

REMOVAL:
1. Loosen 4 captive screws and lift panel from console
2. Disconnect electrical connector
3. Disconnect one large hose
4. Disconnect and mark five small hoses
5. Remove panel

INSTALLATION: Re-Install in opposite order of removal
Caution is required to connect proper hoses to proper fittings

FUNCTIONAL CHECK: Operational check of electrical and air circuits
(can be done during engine run)

TEST EQUIPMENT: External electrical power
Source of low pressure air or nitrogen or equipment for engine run

CLOSE UP: Close canopy

ANALYST'S OPINION: This installation is easy to remove/install if the five small lines are adequately marked during removal. A high possibility of making a wrong connection exists with the five closely located identical fittings. This is compounded by the fact that, during normal installation, the mechanic cannot see the bottom of the panel from the point of view depicted in illustrations. Because of this, some mechanics prefer to use the optional access through the side of the aircraft to disconnect/connect the lines. Task effort is increased but there is less risk of mistake. There is adequate length on all lines and the harness to lift the panel sufficiently to make the disconnects above the console. If proper routing has been lost in the console, the optional access through the side allows disconnect below the console and the lines can be rerouted before installation.

WORK UNIT CODE 4111J ITEM AIR COND CONT PNL AIRCRAFT F-4

LOCATION: RH Console

SUPPORT EQUIPMENT: None

ACCESS: None

REMOVAL:
1. Remove 4 mount screws
2. Lift box, remove 2 cannon plugs
3. Remove box

INSTALLATION: Reverse removal procedure.

FUNCTIONAL CHECK: Air Conditioner for proper temp control

TEST EQUIPMENT: Equipment for Engine Run

CLOSE UP: None

ANALYST'S OPINION: A good installation with simple tasks. Depends on proper routing below panel to allow enough slack to clear panel with plugs.

WORK UNIT CODE 41152 ITEM Cooling Effect Controller (ECS Control Panel) AIRCRAFT F-14

LOCATION: Right hand inboard console

SUPPORT EQUIPMENT: None

ACCESS: None required

REMOVAL:
1. Release four panel screws
2. Lift panel clear of console
3. Disconnect 2 electrical plugs

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Operate air conditioning

TEST EQUIPMENT: Engine run equipment

CLOSE UP: None

ANALYST'S OPINION: This is a good installation as long as routing under the console permits lifting the control box. Misrouting would require removing an adjacent panel to gain access to the plugs. This unit has the same difficulty experienced universally in air conditioning systems of requiring an engine run to check out proper function.

WORK UNIT CODE 41126 ITEM TEMPERATURE CONTROLLER AIRCRAFT AV-8

LOCATION: RH Console

SUPPORT EQUIPMENT: Pilot's Ladder

ACCESS: Position ladder
Open cockpit

REMOVAL:
1. Remove 3 high torque screws securing controller to console.
2. Remove 2 bolts on outboard side of controller.
3. Lift controller up and to the side.
4. Disconnect 1 electrical connector.

Note: This unit cannot be removed from aircraft; most wires are hard wired, potted to switches, etc. Repair would be in place.

FUNCTIONAL CHECK: Functional test circuit of component replaced - check continuity, etc.

TEST EQUIPMENT: Multimeter

CLOSE UP: Close cockpit
Remove ladder

ANALYST'S OPINION: Hard wiring of instruments and controls is apparently a weight saving feature that can, perhaps, be excused on the AV-8. From a maintenance standpoint, it is not acceptable. Repairing the controller in place is undesirable. Cutting and splicing of wires to allow shop repair is equally undesirable.

SYSTEM: 42 Electrical Systems

NOMENCLATURE: Generator Control/Supervisory Panels

WUC: A-4: _____ A-6: 42121 A-7: 42216 F-4: 42127 4212A

F-8: 4222C F-14: 42152 42124 AV-8: _____

GENERAL OBSERVATIONS: This summary includes the several devices used to control generator function. The electrical power supply control systems vary considerably in complexity, particularly when two or more generators are supplying power simultaneously. This results in designers having a broad selection of components to use. Removal tasks are not impacted excessively by these selections because the individual components within the spectrum are all relatively small and simple in hookup. Location in the airplane and access seem to be the driving factor and for the most part this was done quite well in most of the airplanes. The data screening called out WUC 4211A for the A-4 aircraft. This is simply a switch and was eliminated from the survey because it is not a comparable item.

DESIRABLE FEATURES: 1. Modularization of regulator devices, such as the F-14 installation, places the interfacing components together which simplifies troubleshooting. 2. Simplified mounting methods (one bolt in the A-7) speeds the removal task and is an accepted practice for avionics devices. 3. The A-7, and F-4 installations can be reached from deck level. The F-14 master generator panel can be reached from the top surface of the intake which can be boarded by the crew ladder.

SYSTEM: 42 Electrical Systems

NOMENCLATURE: Generator Control/Supervisory Panels

UNDESIRABLE FEATURES: 1. This component has too much maintenance activity to allow poor access such as that in the F-4 aircraft. Ordnance items and other in-the-way components must be removed and work-space is very limited. The F-14 ground power monitor is easier to expose but is mounted nearly out of reach. 2. Maintenance stands are required on about half of the aircraft. 3. In some cases, access panels were far too big for the job to be performed and access within the compartment was still inhibited.

ADDITIONAL REMARKS: Work stands and access are major inhibitions to a fairly simple task. Ideally, reaching the component should not take longer than the removal task itself. Large panels are acceptable if fastening devices are sufficiently few and quickly opened.

WORK UNIT CODE 42121 ITEM Voltage Regulator Supervisory Panel Left Side AIRCRAFT A-6

LOCATION: Forward Left Hand Fillet Area

SUPPORT EQUIPMENT: Maintenance stand

ACCESS: Remove 15 panel fasteners and remove aircraft panel

REMOVAL:
1. Disconnect cables
2. Remove four bolts
3. Remove unit

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Functional check electrical system

TEST EQUIPMENT: Aircraft power

CLOSE UP: Replace panel

ANALYST'S OPINION: Removal/replacement of the unit is acceptable. Access to the unit could be improved by providing quick release panel fasteners and a hinged door. This would eliminate handling of the access panel.

WORK UNIT CODE 42121 ITEM Voltage Regulator Supervisory Panel Right Side AIRCRAFT A-6

LOCATION: Right Turtle Back Area

SUPPORT EQUIPMENT: Maintenance stand

ACCESS: Aircraft panel is removed by removing 28 panel fasteners and eight phillip head screws.

REMOVAL:
1. Disconnect connector
2. Remove four bolts

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System functional test

TEST EQUIPMENT: Aircraft power

CLOSE UP: Replace aircraft panel

ANALYST'S OPINION: Removal/replacement of this unit is acceptable however considering the high removal rate, this unit should be located in a more accessible location. Access can be improved by using quick release panel fasteners and hinged door. This would eliminate handling of the access panel.

WORK UNIT CODE 42216 ITEM Gen Cont Panel AIRCRAFT A-7

LOCATION: Left Hand Cheek Bay

SUPPORT EQUIPMENT: None required

ACCESS: 1 Door (23 SPF)

REMOVAL:
1. Disconnect plug
2. Cut safety wire, remove one (1) bolt
3. Slide unit out of shelf

INSTALLATION: Reverse removal procedure

FUNCTIONAL CHECK: Check generator operation in cockpit

TEST EQUIPMENT: Engine run equipment

CLOSE UP: 1 Door

ANALYST'S OPINION: Good installation. Easy replacement. Access is good and the use of one bolt to secure the item is an effort saving factor. Work can be done from deck level without any special tools.

WORK UNIT CODE 42127 ITEM GEN CONT PNL AIRCRAFT F-4

LOCATION: LH and RH Fuselage Chine R/T NLG Well

SUPPORT EQUIPMENT: None

ACCESS: Remove LAU-7
1 Panel (5 Screws)

LH Only: Remove miscellaneous relay panel

REMOVAL:

Left Hand Component:

1. Remove Cannon Plug
2. Remove 2 Screws & 2 Bolts
3. Remove 2 Screws from Mount
4. Slide out and work around till free

Right Hand Component:

1. Remove cannon plug
2. Remove 4 end screws & 2 aft screws
3. Remove frame & all

INSTALLATION: Reverse removal procedure

FUNCTIONAL CHECK: Generator Operation

TEST EQUIPMENT: Engine Run Equipment

CLOSE UP: 1 Panel
Replace LAU-7

ANALYST'S OPINION: These are bad installations with the left one worse than the right. Direct access to the mounting screws is not possible. Work is from below the component and the component is mounted on top of structure. Screw heads are on top requiring the mechanic to reach above the rack then work downwards. The left hand unit requires prior removal of a relay panel and must be unmounted from the frame in the airplane. Intricate maneuvering is required to work the unit out of the hole.

WORK UNIT CODE 4212A ITEM GENERATOR REGULATOR AND SUPERVISORY PANEL AIRCRAFT F-4

LOCATION: Above LAU-7 in forward fuselage

SUPPORT EQUIPMENT: None

ACCESS: Remove LAU-7

REMOVAL: 1. Disconnect 1 Cannon Plug
2. Remove 4 Screws

INSTALLATION: Reverse removal procedure.

FUNCTIONAL CHECK: Generator Operation

TEST EQUIPMENT: Equipment for Engine Run

CLOSE UP: Replace LAU-7

ANALYST'S OPINION: Not considered a good installation because of the requirement to remove the LAU-7 (and potentially a need to download a missile). Working access is fairly good and the unit comes out quite easily.

Note: This item is not installed in the F-4J

WORK UNIT CODE 4222C ITEM Supervisory Panel AIRCRAFT F-8

LOCATION: Electrical Equipment Compartment (Right Side)

SUPPORT EQUIPMENT: Maintenance Stand

ACCESS: 1 Access (20 panel fasteners), install door brace.

REMOVAL: Remove electrical connections (terminal type) and four bolts. Unit is removed very easy.

INSTALLATION: Reverse of removal.

FUNCTIONAL CHECK: Perform operational test.

TEST EQUIPMENT: Multimeter
Equipment for engine run.

CLOSE UP: Close aircraft panel

ANALYST'S OPINION: Installation is considered good except for requirement for maintenance stand. Terminal connections would be improved by use of a connector but actually are not bad because they are accessible.

WORK UNIT CODE 42152 ITEM Ground Power Monitor AIRCRAFT F-14

LOCATION: LH side of forward fuselage

SUPPORT EQUIPMENT: Work stand

ACCESS: 1 panel (29 fasteners)

REMOVAL:
1. Disconnect 1 electrical connector.
2. Remove 4 screws (screw heads down, 2 are blind)

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: External power application

TEST EQUIPMENT: Engine run equipment

CLOSE UP: Install panel

ANALYST'S OPINION: This is a very simple installation that looks a great deal better than it is. The item is mounted very deep in the compartment, almost out of reach. Other items mounted outboard interfer with using both arms to work in the area; yet, the component is mounted below the shelf requiring that it be supported while the screws are inserted - definitely a two man job. The screws are installed head down and a dropped screw can be difficult to find in the maze of wires below. Finally the two inboard screws must be worked blind at extreme reach and very close to the far wall of the compartment.

WORK UNIT CODE 42124 ITEM Master Generator Panel AIRCRAFT F-14

LOCATION: Fuselage, aft of cockpit, right hand side

SUPPORT EQUIPMENT: None

ACCESS: 1 panel (49 fasteners, 4 latches)

REMOVAL:
1. Disconnect 4 thumb screws
2. Disconnect 3 electrical connectors
3. Remove component

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Electrical system check

TEST EQUIPMENT: Engine run equipment

CLOSE UP: Install panel

ANALYST'S OPINION: This unit consists of the emergency, AC, and DC regulators mounted on a single rack. It is easy to reach while standing on the intake and well located in the compartment. The access panel is too big for the job which would be alright if it were a latched, quick opening panel. The 49 fasteners, however, cannot be construed as making it a quick opening panel and too much effort is invested in gaining access. Once open, the installation is good.

SYSTEM: 44 Lighting System

NOMENCLATURE: Internal Light Control Panel

WUC: A-4: 44231 A-6: 44222 A-7: 44231 F-4: 44112 44121

F-8: _____ F-14: 44X11 AV-8: 44121

GENERAL OBSERVATIONS: The screening data called out the light control electronics component in the F-14 and the pilot's light control panel was called out on the others. The latter panel is discussed in this summary but the F-14 box is included in the data sheets for information purposes. Overall, the pilot's control panels exhibit the same simplicity as other console panels.

DESIRABLE FEATURES: 1. Simple mounting and easy connections are used on all but the AV-8. Because of limited access, the A-7 makes excellent use of captive fasteners to improve removal.

UNDESIRABLE FEATURES: 1. The AV-8 panel is hard wired in leaving the mechanic with a choice of cutting and splicing or repairing the control in place. This is not acceptable even with the weight constraints inherent in the VTOL design.

ADDITIONAL REMARKS: A great deal of comment is not necessary. For the most part, standard cockpit installation methods are used and could be improved only by use of plug-in control boxes or rack and panel mounting. For items this simple, it is doubtful that this is justified. Hard wiring is definitely to be avoided.

WORK UNIT CODE 44231 ITEM Internal Lighting Cockpit Panel AIRCRAFT A-4

LOCATION: Right Console

SUPPORT EQUIPMENT: Aircraft Ladder

ACCESS: None

REMOVAL:
1. Loosen four (4) Dzus fasteners
2. Remove panel from console
3. Disconnect cables

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Check operation of panel

TEST EQUIPMENT: External Electric Power

CLOSE UP: None

ANALYST'S OPINION: The location and installation of the panel makes the removal/replacement an easy task.

WORK UNIT CODE 44222 ITEM Cockpit Interior Light Panel AIRCRAFT A-6

LOCATION: Cockpit Right Hand Console

SUPPORT EQUIPMENT: None

ACCESS: None

REMOVAL:
1. Loosen four Dzus fasteners
2. Lift light panel from console
3. Disconnect cable

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Functional check both dimmer light controls, one for console area and one for instrument panel.

TEST EQUIPMENT: Aircraft power

CLOSE UP: None

ANALYST'S OPINION: Installation of the unit with four Dzus fasteners and good connectors simplifies removal/replacement of the panel.

WORK UNIT CODE 44231 ITEM Interior Lights Control Panel AIRCRAFT A-7

LOCATION: Right Hand console

SUPPORT EQUIPMENT: Work stand to remove access panel on right hand side of aircraft

ACCESS: Remove RH access panel by removing 40 screws. (Access allows removing quick disconnect electrical connector to light control panel)

REMOVAL:
1. Loosen 3 inboard DZUS fasteners on panel.
2. Loosen and disengage 5 captive fasteners
3. Disconnect electrical connector from light control panel.
4. Lift panel from console.

INSTALLATION:
1. Lower panel into console cavity.
2. Tighten 5 outboard captive panel fasteners.
3. Tighten 3 DZUS fasteners on inboard edge of panel.
4. Install quick-disconnect electrical connector to panel.

FUNCTIONAL CHECK: Verify operation of lighting functions.

TEST EQUIPMENT: External electrical test stand

CLOSE UP: Replace RH fuselage access panel

ANALYST'S OPINION: The 5 captive fasteners facilitate removing the "hard to get to" outboard panel fasteners. Overall removal capability is fairly easy even though panel is in a high density area.

WORK UNIT CODE 44112 (Fwd) 44121 (Aft) ITEM PANEL LIGHTING CONTROL AIRCRAFT F-4

LOCATION: LH Side above console aft (44121)
RH console Fwd (44112)

SUPPORT EQUIPMENT: None

ACCESS: None (Lift out Fwd Panel for access to plug)

REMOVAL: Remove 6 screws & disconnect 1 cannon plug.

INSTALLATION: Reverse removal.

FUNCTIONAL CHECK: Check lights.

TEST EQUIPMENT: External electrical power

CLOSE UP: None

ANALYST'S OPINION: A good installation. Quickly removed. No access problems.

WORK UNIT CODE 44X11 ITEM C91281A Multichannel Lighting Control AIRCRAFT F-14

LOCATION: Aft of Radome Bulkhead

SUPPORT EQUIPMENT: Jury Strut

ACCESS: Open Radome
Open 1 panel (16 screws, 1 hose clamp) in Radome Bulkhead

REMOVAL:
1. Disconnect 2 electrical plugs
2. Unscrew 2 thumbscrews
3. Remove control

INSTALLATION:
Reverse of Removal

FUNCTIONAL CHECK: Visual check of lites

TEST EQUIPMENT: Electrical power

CLOSE UP: Close access
Close radome

ANALYST'S OPINION: A good installation. Access is from ground level or a small workstand. Tasks are simple. Access panel is sized to the job. Minor improvement to access could be made by using quick release fasteners and/or providing outside access to avoid extra step of opening the radome. It is not immediately obvious why the additional access in the bulkhead is necessary.

WORK UNIT CODE 44121 ITEM CABIN LIGHTING DIMMING SWITCH AIRCRAFT AV-8

LOCATION: Lower center Instrument Panel

SUPPORT EQUIPMENT: Pilot's Ladder

ACCESS: Position ladder
Open canopy

REMOVAL:
1. Remove 2 bolts securing panel on front side of panel.
2. Loosen 2 high torque screws on side of panel.
3. Pull panel forward and lift up.
4. Lay panel off to side and repair in place - hardwired.

INSTALLATION: Reverse removal procedure

FUNCTIONAL CHECK: Perform operational check of dimming function

TEST EQUIPMENT: External Electrical Power

CLOSE UP: Close Canopy
Remove Pilot's Ladder

ANALYST'S OPINION: Work on this item is very inconvenient. It is hard wired in requiring either that it be repaired in place or the wires cut for removal. Not only is the cockpit too cramped to allow comfortable working conditions, the airplane is down during the whole repair. Cutting and splicing of wires eventually shortens the aircraft wiring to the point of requiring replacement.

SYSTEM: 44 Lighting System

NOMENCLATURE: Exterior Lights

MUC:	A-4:	44111 44113 44115	A-6:	44115 44113 44111	A-7:	44115 44211	F-4:	44232 44223 44224
	F-8:	____	F-14:	44140	AV-8:	44212		

GENERAL OBSERVATIONS: Position and anti-collision lights are combined under this heading because of similarity among the aircraft. Light assemblies are simple from the mechanic's standpoint and provide problems mainly in the locations required for them to perform their function. Generally, the installations are good and light assembly removal is only slightly more effort than changing a bulb.

DESIRABLE FEATURES: 1. Position lights were fairly simple to replace. Most aircraft except A-4 and F-4 had connectors or terminals for electrical wiring. 2. Tail lights mounted on the fuselage of the AV-8 and F-14 were easily reached. 3. Anti-collision lights are modular and illumination and rotating functions are replaced together. Bulbs can be changed separately but not as easily as position light bulbs.

UNDESIRABLE FEATURES: 1. The A-4 position lights were hard wired into the circuit and required cutting and splicing. After several replacements, the working slack becomes very short. 2. Very few installations considered the effect of wing folding on wingtip light access. It would be good if the light could be removed while working from one side of the surface. 3. The A-6 speed brakes inhibit access to the wingtip light and have to be actuated open for light replacement. Removal of this light requires a special technique and damage observed indicates this technique is not universally understood. The F-4 has a long elec-

SYSTEM: 44 Lighting System

NOMENCLATURE Exterior Lights

UNDESIRABLE FEATUPES: (Cont.)

trical lead which is threaded through structure to reach a terminal block in a nearby access. Terminals on the light would eliminate the extra access effort and the bother of using a tracer string.

4. The retainer ring in the A-7 lens is difficult to remove.

ADDITIONAL REMARKS: Strobe flashers are smaller lighter units than the rotating beacons and their continued use should be encouraged. Not a great deal can be done about location of lights because their marking function fairly well dictates it. If a light does not have to be high, however, it should not be mounted high. Rapid bulb replacement is important.

WORK UNIT CODE 44111 ITEM Wing Tip Light AIRCRAFT A-4

LOCATION: Outer Wing Tip

SUPPORT EQUIPMENT: Aircraft power

ACCESS: Remove clamp/bracket
Slide lens assembly forward and remove

REMOVAL: Remove bulb.

INSTALLATION: Replace bulb.

FUNCTIONAL CHECK: Operate light

TEST EQUIPMENT: Aircraft power.

CLOSE UP: Replace lens and bracket on assembly

ANALYST'S OPINION: When the assembly is replaced, the cables must be spliced. This splicing should be eliminated by using a terminal block for the leads.

WORK UNIT CODE 44113 ITEM Tail Light AIRCRAFT A-4

LOCATION: Lower Tail Section

SUPPORT EQUIPMENT: Maintenance stand
Aircraft power

ACCESS: Remove lens cover

REMOVAL: 1. Remove three (3) bolts securing lens assembly
2. Remove two (2) bolts from right side of tail to remove assembly
3. Replace faulty bulb

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Check light

TEST EQUIPMENT: Aircraft power.

CLOSE UP: Replace lens cover

ANALYST'S OPINION: Removal/replacement is simple, however, if and when the light assembly is replaced the leads for the light must be spliced to the acft cables. This installation could be improved by having a terminal block for the power leads rather than splicing the wires.

WORK UNIT CODE 44115 ITEM Lower Anti-Collision Light AIRCRAFT A-4

LOCATION: Aft of Left Gear

SUPPORT EQUIPMENT: Aircraft Power

ACCESS: Remove bolt securing the lens
Move lens forward to remove

REMOVAL: Remove faulty bulb.

INSTALLATION: Replace bulb.

FUNCTIONAL CHECK: Check light

TEST EQUIPMENT: Aircraft power.

CLOSE UP: Replace lens cover and secure

ANALYST'S OPINION: The use of this type light simplified the replacement of bad bulbs.

WORK UNIT CODE: 44115 ITEM: Position Lights AIRCRAFT: A-6

LOCATION: Wing Tip

SUPPORT EQUIPMENT: Maintenance stand

ACCESS: Open speed brake (operate system)

REMOVAL:
1. Remove 11 screws on the outside securing the shield and one screw on the back of the shield (accessible through the speed brake area)
2. Remove light assembly.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Check light

TEST EQUIPMENT: Aircraft Power

CLOSE UP: Close speed brake by operating system

ANALYST'S OPINION: Speed brake must be operated before light assembly shield can be removed. Inspection of a number of light assemblies indicate the screw in the back of the assembly is not always installed or is stripped. Evaluation of a wing assembly removal indicates the removal/installation should be modified and/or technical publication be provided to insure proper removal and installation.

WORK UNIT CODE 44115 ITEM Tail Light AIRCRAFT A-7

LOCATION: Vertical stabilizer above rudder and below stabilizer fiberglass fairing.

SUPPORT EQUIPMENT: High work stand which will permit climbing to the top of the aft end of vertical stabilizer.

ACCESS: Remove 6 flat head screws securing lens retainer.
(Note: there is a tail light on each side of the vertical stabilizer)

REMOVAL:
1. Pry retainer ring from recess.
2. Remove lens.
3. Remove and replace bulb.

INSTALLATION:
1. Position lens in recess.
2. Install retainer ring by seeing that notch in lens matches notch in retainer ring.

FUNCTIONAL CHECK: Verify position light operates and flashes as required.

TEST EQUIPMENT: External electrical power test stand

CLOSE UP: Install 6 screws retaining white lens and retainer ring.

ANALYST'S OPINION: No provisions seem apparent for removing retainer without damaging either or both retainer ring and lens. Ring looks as if it has to be pryed out so that lens can be removed to change bulb. It would have been desirable to provide a better means by which to remove the retainer ring. It also appears that even with the screws out that removal of the ring could be difficult requiring removing access panels forward of tne light assembly to facilitate prying the lens and retainer ring from these accesses. This method could also result in breaking the lens while prying from the adjacent access cavity.

WORK UNIT CODE 44232 ITEM WING TIP LIGHT AIRCRAFT F-4

LOCATION: Wing Tip - One each on Leading and Trailing Edge

SUPPORT EQUIPMENT: Work Stand

ACCESS: Extend Wings or use Work Stand

REMOVAL: 1. Remove 8 screws - front, 6 screws - rear.
2. Disconnect wires from terminal.

INSTALLATION: Reverse of removal procedures

FUNCTIONAL CHECK: Visual check of lights

TEST EQUIPMENT: External electrical power

CLOSE UP: None

ANALYST'S OPINION: A fairly standard installation. It is easily removed although a workstand is required. It is possible to accomplish this task with the wings folded if a tall workstand is available. With wings spread, it can be accomplished while standing on the deck and wing surface without the use of a workstand.

WORK UNIT CODE 44223 ITEM TAIL LIGHT AIRCRAFT F-4

LOCATION: Top of Tail

SUPPORT EQUIPMENT: Tall Stand

ACCESS: 1 Panel - 40 screws

REMOVAL:
1. Remove 6 screws
2. Disconnect from Terminal Strip
3. Pull wires thru structure (tracer string required) and remove light.

INSTALLATION: Reverse removal procedure.
(Use tracer string to pull wires thru structure)

FUNCTIONAL CHECK: Check bulb for illumination.

TEST EQUIPMENT: External electrical Power

CLOSE UP: 1 Panel

ANALYST'S OPINION: This is not a good installation. The terminal strip is a foot or more from the light. A tracer string must be attached to the wires during removal so the new wires can be pulled into place. The tail light need not be mounted this high on the airplane. Since it shines only to the side and rear, it could be mounted on the aft point of the fuselage.

WORK UNIT CODE 44224 ITEM ANTI-COLLISION LIGHTS AIRCRAFT F-4

LOCATION: Upper Leading Edge of Fin

SUPPORT EQUIPMENT: Work Stand

ACCESS: None

REMOVAL: 1. Remove 14 screws and remove assy
2. Disconnect 2 wires from terminals

INSTALLATION: Reverse removal procedures

FUNCTIONAL CHECK: Check lights for illumination

TEST EQUIPMENT: External electrical Power

CLOSE UP: None

ANALYST'S OPINION: Except for the height, this is a good installation. The assembly comes off intact.

WORK UNIT CODE 44113 ITEM Wing Position Light AIRCRAFT F-14

LOCATION: Each wing tip

SUPPORT EQUIPMENT: Work stand

ACCESS: Lens fairing (10 screws) and lens

REMOVAL:
1. Remove 4 screws
2. Remove 2 wires (held with nuts to terminals)

INSTALLATION: Reverse of removal.

FUNCTIONAL CHECK: Visual light check

TEST EQUIPMENT: Electrical power

CLOSE UP: Install lens fairing and lens

ANALYST'S OPINION: This is a fairly standard installation. The bulb can be changed by removing the lens fairing and lens. High wing and big airplane require a workstand. An adventurous soul could change the assembly while lying on the wing. It can be changed with the wing swept.

WORK UNIT CODE 44111 ITEM Tail Light AIRCRAFT F-14

LOCATION: Aft End of Fuselage

SUPPORT EQUIPMENT: None

ACCESS: None

REMOVAL: 1. Remove 12 screws
2. Remove 2 wires (nuts)
3. Remove assembly

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Visual check of lights

TEST EQUIPMENT: Electrical Power

CLOSE UP: None

ANALYST'S OPINION: A good installation except for the 12 screws that hold item to the airplane. Access is from deck level and tasks are simple.

WORK UNIT CODE 44140 ITEM Anticollision Lights AIRCRAFT F-14

LOCATION: Forward Tip L/H Fin.
Aft Tip R/H fin
Nose fairing

SUPPORT EQUIPMENT: Very tall stand

ACCESS: Lens fairing (12 screws LH, 14 screws RH and nose)

REMOVAL:
1. Remove fairing
2. Remove 4 screws
3. Disconnect plug

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Visual check of lights

TEST EQUIPMENT: Electrical Power

CLOSE UP: Install lens fairing

ANALYST'S OPINION: The object of anti-collision lights is to be seen from all angles. This objective is accomplished very well in this installation but to the detriment of maintenance. The fin mounted lights are very high off the deck making them difficult to work on. Considering the shadow area of the fins in reference to any other location makes it obvious that this is the best possible. Otherwise this is a good installation.

WORK UNIT CODE 44211 ITEM Tail Light AIRCRAFT AV-8

LOCATION: End of Fuselage

SUPPORT EQUIPMENT: None

ACCESS: None

REMOVAL:
1. Remove 2 camlocks.
2. Remove cover.
3. Remove 3 screws.
4. Disconnect 2 wires.
5. Remove assy.

INSTALLATION:

Reverse removal procedure.

FUNCTIONAL CHECK: Visual check of lights.

TEST EQUIPMENT: External electric power.

CLOSE UP: None

ANALYST'S OPINION: A remarkably good installation. Access is quicker than most lights and removal is quite simple. It is easily reached from the deck.

WORK UNIT CODE 44212 ITEM Anti Collision Lights AIRCRAFT AV-8

LOCATION: Over · 'g fairing

SUPPORT EQUIPMENT: Workstand

ACCESS: 1 Access panel (16 SPF, 7 allen screws).

REMOVAL:

1. Disconnect cannon plug.
2. Remove glass 1 screw.
3. Remove light assy 2 screw.

INSTALLATION: Reverse removal procedure.

FUNCTIONAL CHECK: Visual check of lights.

TEST EQUIPMENT: External electric power.

CLOSE UP: Install access panel.

ANALYST'S OPINION: A good installation. Access is good and tasks are simple. Looking at items mounted within the compartment that is covered by the panel to which the light is mounted, this arrangement degrades access. It adds weight and bulk to the panel and requires care in handling that creates problems in working on those other systems.

SYSTEM: 45 Hydraulic Systems

NOMENCLATURE: Reservoir (PC or Flight Control)

MUC: A-4: _____ A-6: _____ A-7: 45213 F-4: 4512A

F-8: 45112 F-14: 45112 AV-8: 45112

GENERAL OBSERVATIONS: Replacement is generally difficult in most airplanes. The A-7 PC-1 and PC-2 reservoirs are the most accessible with the reservoirs mounted in the wheel well. Because of the function of the reservoir, servicing and bleeding are critical parts of the procedure.

DESIRABLE FEATURES: 1. The access to the F-4 and A-7 reservoirs is excellent. 2. The ability of the quantity indicators in the A-7 to show air inclusion and good access make frequent inspection for air feasible. 3. In all cases, once access is gained, removal tasks are quite simple.

UNDESIRABLE FEATURES: 1. Access is of considerable concern in most installations. The AV-8 requires wing removal. This appears to be exhorbitant no matter how easily the wing is removed. The F-8 requires engine removal. The F-14 involves large access panels and complete removal of in-the-way hydraulic lines. Except to the A-7 and F-4, not enough attention was given to the removal problem. In the F-14 this is disappointing because, not only is it the newest design, the access looks so good to the casual observer.

SYSTEM: 45 Hydraulic Systems

NOMENCLATURE: Reservoir (PC or Flight Control)

ADDITIONAL REMARKS: Component design has not kept up with such features as cryogenic or brazed hydraulic line fittings. Lines using this type of fitting are inflexible and cannot be loosened by backing off the next connector down the line. When lines enter a component from both sides, a whole cluster of lines must be removed to release the component. Brazed or cryogenic fittings are excellent for eliminating leaks at fittings but component design must evolve to one sided hookup to facilitate removal.

WORK UNIT CODE 45213 ITEM PC-2 Hydraulic Reservoir AIRCRAFT A-7

LOCATION: Aft End of RH Wheel Well

SUPPORT EQUIPMENT: External Hydraulic Power

ACCESS: None

REMOVAL:
1. Connect external hydraulic power to ground test quick-disconnects, and bleed reservoir until indicator shows empty.
2. Disconnect high pressure line connected to high pressure port on reservoir.
3. Disconnect return system tube assemblies connected to reservoir return fitting.
4. Remove aft inboard upper attach bolt, two outboard aft attach bolt, and loosen forward T-bolt assembly.
5. Disengage T-bolt and remove reservoir from wheel well.

INSTALLATION:
1. Reverse of removal
2. Prior to functional check, reservoir has to be filled and aircraft hydraulic system has to be completely bled.

FUNCTIONAL CHECK: Pressurize system to verify leaks
Perform hydraulic system air check

TEST EQUIPMENT: Hydraulic system fill stand
External hydraulic and electrical power

CLOSE UP: None

ANALYST'S OPINION: Reservoir is a boot-strap type of reservoir, which by design will pressurize the aircraft return lines. System fluid flow doesn't pass through the reservoir, but merely supplies flow during high system demands. Because of this factor, bleeding the reservoir and aircraft hydraulic system are relatively complex requiring that aircraft and reservoir be bled with minimum pressure on return side of system. This feature requires specific airplane bleeding procedures as well as special considerations concerning the external hydraulic power test stands. Stand has to have the capability of operating in either "open" or "closed" system modes. Also, when bleeding the PC-2

(See continuation sheet)

CONTINUATION SHEET:

WORK UNIT CODE 45213 ITEM PC-2 Hydraulic Reservoir AIRCRAFT A-7

ANALYST'S OPINION: (Continued)

system, the other intact system(s) (PC-1 and PC-3) have to be pressurized so that air is not induced into these systems. Airplane and AGE requirements are important considerations that influence the time necessary to accomplish servicing and bleeding.

Reservoir attach hardware is fairly easy to get at except the inboard aft upper bolt attaching reservoir to the structure. The wheel well is fairly densely packaged, and is a factor in hindering attach hardware removal. Reservoir draining is not a difficult task because requirement can be quickly accomplished by operating test stand in and open loop configuration. Because reservoir is practically the lowest point in the system, the potential for excessive fluid drainage during removal can occur which will have to be completely taken care of during the bleeding operation. The non-pressurized side of the reservoir piston is vented to the well through a breather type device mounted on the reservoir housing cover and indicator assembly. Over an extended period of time, the vented side of the reservoir ingests wheel well and atmospheric contaminants which are deposited on the inside of the reservoir housing bore. Reservoir piston movement in the housing will result in contaminants being imbeded into the piston seal as piston moves to wipe contaminants from the bore. The net result is that reservoir leakage will eventually occur because of worn seals. A different venting arrangement, or at least venting to a cleaner area could potentially improve piston seal life and reduce the intervals between removals.

WORK UNIT CODE 4512A ITEM PC2 SYS RESERVOIR AIRCRAFT F-4

LOCATION: Bottom of Wing Forward of Wheel Well

SUPPORT EQUIPMENT: Hydraulic and Electrical Power

ACCESS: 1 Panel (12 DZUS)

REMOVAL:
1. Depressurize
2. Disconnect system
3. Remove 4 mounting screws
4. Lower reservoir

INSTALLATION:
1. Reverse removal procedure
2. Service reservoir
3. Bleed reservoir

FUNCTIONAL CHECK: Leak check

TEST EQUIPMENT: External hydraulic power
External electric power

CLOSE UP: 1 Panel

ANALYST'S OPINION: This item is conveniently located behind a quickly opened access panel. Tasks are simple and easily performed. This is a good installation.

WORK UNIT CODE 45112 ITEM PC Reservoir AIRCRAFT F-8

LOCATION: Aft of Fuselage Mid Section

SUPPORT EQUIPMENT: Hydraulic test stand
Nitrogen servicing stand

ACCESS: 1 Panel (19 fasteners)
Remove aft section and engine

REMOVAL:
1. Loosen 19 camlock to wing pivot area hinged access plate.
2. Remove several items and remove 1 bolt securing forward end of reservoir.
3. Remove engine and tail section.
4. Remove hydraulic and air lines.
5. Loosen clamp bolts and open clamp.
6. Remove reservoir.

INSTALLATION:
1. Reverse of removal.
2. Service reservoir.

FUNCTIONAL CHECK: Perform engine run to check system and check for leaks.

TEST EQUIPMENT: Equipment required for engine run.

CLOSE UP: Replace removed access panel.
Re-install aft section and engine.

ANALYST'S OPINION: Reservoir is not easy to remove and replace because of having to remove tail section and engine, and is a very poor maintainability feature. If a leak occurs during the functional check after maintenance, the engine and tail section will have to be removed to correct problem.

WORK UNIT CODE 45112 ITEM Flt Sys Hydr Reservoir AIRCRAFT F-14

LOCATION: Right hand sponson

SUPPORT EQUIPMENT: Workstand
Hydraulic Power

ACCESS: 1 panel (approximately 125 fasteners)
1 plate (11 screws)
1 plate (40 fasteners)

REMOVAL: 1. Disconnect 7 hydraulic lines
2. Remove cluster of lines (3 nuts, 3 clamps)
3. Remove 2 support clamps
4. Remove reservoir

INSTALLATION: 1. Reverse of removal.
2. Service.
3. Bleed.

FUNCTIONAL CHECK: Leak check

TEST EQUIPMENT: Hydraulic Power

CLOSE UP: Install 3 panels

ANALYST'S OPINION: This could have been a very acceptable installation had it not been for exhorbitantly large access requirement. One very large panel must be removed only to find that the component extends beyond the opening and two other panels must come off. The large cluster of hydraulic tubes routed below the reservoir prevent removing the component from the mounts unless they are first removed. Actually, orientation of the fittings is such that most of that cluster would have to be removed in order to get the lines to release the reservoir.

WORK UNIT CODE 45112 ITEM Hyd Reservoir AIRCRAFT AV-8

LOCATION: Mid Fuselage, Below Wing

SUPPORT EQUIPMENT:

Hydraulic power	Wing sling	Wing stand
Jacking cradle, fore and aft	Hoist	
4 jacks	Workstand	

ACCESS: Remove wing

REMOVAL:
1. Remove 4 hydraulic lines
2. Remove 2 forward bolts
3. Remove 1 large b-nut aft
4. Remove reservoir

INSTALLATION:
1. Reverse removal procedure.
2. Bleed and service reservoir.

FUNCTIONAL CHECK: Leak check.
Checkout systems in wing.

TEST EQUIPMENT: External hydraulic power
External electrical power

CLOSE UP: Replace wing

ANALYST'S OPINION: One additional access panel would have made this an acceptable installation. To remove the wing for this simple job is totally unacceptable. Weight saving has been carried too far in this case. Once the wing is gone, the job is quite easy.

SYSTEM: 47 Oxygen System

NOMENCLATURE: Liquid Oxygen (LOX) Converter

WUC: A-4: 47111 A-6: _____ A-7: 47111 F-4: 47111

F-8: 47115 F-14: 47111 AV-8: 47111

GENERAL OBSERVATIONS: The LOX converter is a standardized, GFE item and, except for location, is identical in all aircraft except the F-8. The other installations reflect the replacement for replenishment aspect and are easily reached. The F-8 is serviced in the airplane and accordingly is more difficult to remove.

DESIRABLE FEATURES: Generally all are accessible and easily removed.

UNDESIRABLE FEATURES: 1. The F-8 is not designed for rapid replacement as is required today. 2. Access through the main wheel well of the AV-8 is less convenient than the other aircraft.

ADDITIONAL REMARKS: Except as noted, the installations must all be considered good. The CFE LOX package is well done.

WORK UNIT CODE 47111 ITEM LOX Converter AIRCRAFT A-4

LOCATION: Aft Aircraft Compartment

SUPPORT EQUIPMENT: None

ACCESS: Open two latches and lower door

REMOVAL:
1. Remove two quick disconnect
2. Loosen two thumb screw tie downs
3. Remove LOX converter

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: None

TEST EQUIPMENT: None

CLOSE UP: Close access panel

ANALYST'S OPINION: Location and installation is very good. The LOX converter can be removed/replaced at ground without special tools. Access to the converter is excellent.

WORK UNIT CODE: 47111 ITEM LOX Converter AIRCRAFT A-6

LOCATION: Aft Fuselage

SUPPORT EQUIPMENT: None

ACCESS: Open Access Panel

REMOVAL:
1. Remove 2 quick disconnects
2. Remove one tie down bolt
3. Remove LOX Converter

INSTALLATION: Reverse of removal.

FUNCTIONAL CHECK: None

TEST EQUIPMENT: None

CLOSE UP: Close panel

ANALYST'S OPINION: Good access and good installation.

WORK UNIT CODE 47111 ITEM LOX Converter AIRCRAFT A-7

LOCATION: Lower Left Hand Side of Forward Fuselage

SUPPORT EQUIPMENT: None

ACCESS: Hinged Panel (4 latches)

REMOVAL:
1. Remove 2 quick disconnects
2. Loosen 2 thumbscrew tie down
3. Remove converter

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: None

TEST EQUIPMENT: None

CLOSE UP: Close access

ANALYST'S OPINION: Very good access. The door is hinged at the bottom and stayed at just below horizontal with a cable. There is a natural tendency to lean on this door while installing the bottle and it also makes a good table on which to set tools, components, etc. Door stay failures result. It would be preferable to strengthen the door and stay rather than to try to limit its utility as a platform.

WORK UNIT CODE 47111 ITEM LOX CONVERTER AIRCRAFT F-4

LOCATION: Aft of Nose Wheel

SUPPORT EQUIPMENT: None

ACCESS: 1 Panel (17 DZUS & Hinge)

REMOVAL:
1. Remove two quick disconnects.
2. Loosen two thumb screw tie downs.
3. Remove LOX Converter

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: None

TEST EQUIPMENT: None

CLOSE UP: 1 Panel

ANALYST'S OPINION: A standard installation. It is not as convenient as most because of the 17 fasteners. These are quick release type; and, while not as desirable as latches, are acceptable.

WORK UNIT CODE 47115 ITEM LOX Converter AIRCRAFT F-8

LOCATION: Right side of the canopy deck area.

SUPPORT EQUIPMENT: None

ACCESS: Removal of the unit requires removing the canopy.

REMOVAL: Normal servicing of the LOX converter does not require removing the unit. Service port is located on the right side (ground level) of the aircraft. Should the LOX converter require removal, the canopy must be removed, the oxygen system must be depleted, various lines must be disconnected and the four bolts must be removed.

FUNCTIONAL CHECK. Unit is checked using ground service cart to determine proper operation and/or fix leaks.

TEST EQUIPMENT: LOX Cart

CLOSE UP: If LOX converter is removed the canopy must be replaced.

ANALYST'S OPINION: Very poor installation. Current Navy directives require LOX converter be removed and replaced as a service action.

WORK UNIT CODE 47111 ITEM LOX Converter AIRCRAFT F-14

LOCATION: Low, right hand side of nose

SUPPORT EQUIPMENT: None

ACCESS: 1 panel (4 latches)

REMOVAL:
1. Remove 2 quick disconnects
2. Loosen 2 thumbscrew tiedowns
3. Remove LOX converter

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: None

TEST EQUIPMENT: None

CLOSE UP: Close access

ANALYST'S OPINION: Good access, good installation.

WORK UNIT CODE 47111 ITEM Container Package (LOX) AIRCRAFT AV-8

LOCATION: Aft of MLG Well

SUPPORT EQUIPMENT: None

ACCESS: Through MLG Well
1 Panel (hinged, 2 screws)

REMOVAL:
1. Remove two quick disconnects.
2. Loosen two thumb screw tie downs.
3. Remove LOX converter.

INSTALLATION: Reverse removal procedure.

FUNCTIONAL CHECK: None

TEST EQUIPMENT: None

CLOSE UP: Replace panel.

ANALYST'S OPINION: A clever way to utilize the tailcone area. Access thru the wheel well is cramped and handling a full bottle in this area might be a problem. The bottle is the same GFE component used in other aircraft and differs only in location.

SYSTEM: 75 Weapons Delivery

NOMENCLATURE: M61A1 Gun/Ammo Drum

WUC: Gun: A-7: 75510 F-14: 75611

Drum: A-7: 75531 F-14: 75631

GENERAL OBSERVATIONS: The A-7 and F-14 are the only aircraft currently equipped with the M61A1 gun. For this reason, the gun (a GFE item) and the drum are considered together. The gun system is quite complex and requires accurate interface timing.

DESIRABLE FEATURES: 1. The guns are attached with quick release pins and do not require boresighting after replacement. 2. The F-14 has removable frames over the gun barrels which allow removal of the gun without removing the barrels. Barrel removal with the gun installed is also simplified. 3. The low mounted drum in the F-14 allows removal with a dolly rather than hoist. 4. The F-14 blast port need not be removed during gun removal.

UNDESIRABLE FEATURES: 1. Critical timing, particularly at the drum entrance unit interface, complicates removal and installation of the drum. 2. The A-7 gun access is complicated and time consuming. Gun gas shrouds are especially difficult. After access is gained, the gun cannot be removed with the barrels attached. 3. The A-7 blast port and gas seal require close tolerance adjustment. The blast port must be removed during gun or barrels removal.

SYSTEM: 75 Weapons Delivery

NOMENCLATURE: M61A1 Gun/Ammo Drum

ADDITIONAL REMARKS: Although the F-14 has several advantages, the installation is still cramped, specially around the ammunition chute runs and their interfaces with the end units. The chutes and conveyor are critical parts of this system. Future designs should stress improved hookup and timing on all the interfaces.

WORK UNIT CODE 75510 ITEM Automatic Gun Installation AIRCRAFT A-7

LOCATION: Left Hand Nose Section

SUPPORT EQUIPMENT:
- Multi-purpose dolly and adapter
- Transfer unit timing lock pin
- Transfer unit support

ACCESS:
- 1 Panel 31 screws
- 1 Panel 18 screws
- 1 Panel 17 SPF
- 1 Panel 48 SPF
- 1 Panel 23 SPF
- 1 Panel 17 screws
- Gas shroud (4 zippers, 10 snaps)

REMOVAL:
1. Disconnect gun firing connector
2. Disconnect clearing solenoid connector
3. Time gun and disconnect transfer unit (2 quick release pins), support transfer unit
4. Disconnect gun drive assembly (quick disconnect)
5. Remove muzzle clamp, mid-barrel clamp and barrels
6. Position multi-purpose dolly and connect to housing
7. Support gun, disconnect aft mount (1 quick release pin)
8. Remove forward mount quick release pins (2)
9. Lower gun

INSTALLATION: (Timing between gun and transfer unit is critical on installation)

Re-Install in reverse order of removal

FUNCTIONAL CHECK:
- Rotate gun by hand
- Check electrical circuits

TEST EQUIPMENT:
- Hand crank
- External electric power

CLOSE UP:
- Re-install gas shroud
- Re-install 6 panels

ANALYST'S OPINION: Aircraft structure requires removal of gun barrels to remove gun. Barrel removal accounts for ½ to 2/3 of task time. Gas shroud inhibits any access to gun housing and is tedious to open and close.

Gun can be removed with transfer unit installed if mounting pins are distorted by hard gun jam.

The quick release pins in the gun mount are excellent. Boresighting is <u>not</u> required for a gun replacement.

WORK UNIT CODE 75611 ITEM M61A1 Automatic Gun AIRCRAFT F-14

LOCATION: Left hand side of nose

SUPPORT EQUIPMENT: Hoist (Aero 67 on Aero 21 skid)

ACCESS: 1 panel (25 fasteners)
1 panel (30 fasteners, purge door ball lock pin)
1 removable frame (2 ball lock pins)

REMOVAL:
1. Remove ground strap
2. Disconnect firing lead (1 plug)
3. Disconnect clearing sector solenoid (1 plug)
4. Disconnect gun drive quick disconnect
5. Swing aft mount inboard (1 ball lock pin)
6. Remove transfer loader (2 ball lock pins)
7. Support weight on bomb hoist
8. Remove 2 forward mount ball lock pins
9. Slide gun out and aft

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Crank gun system manually

TEST EQUIPMENT: Hand crank

CLOSE UP: Install panel

ANALYST'S OPINION: Very good access. Reasonably few fasteners are involved. The removable frame allows gun to be removed without prior barrel removal. There is no need to remove the blastport. The gun is fairly high in the air but easily reached from the deck.

WORK UNIT CODE 75531 ITEM Drum Assembly AIRCRAFT A-7

LOCATION: Top, Fuselage Forward Section

SUPPORT EQUIPMENT: Sling, drum hoist, transporter
Handcrank

ACCESS: 1 Panel 20 SPF
1 Panel 30 SPF
1 Panel 46 SPF

REMOVAL:

1. Time drum, remove return and feed chutes from end units
2. Break conveyor at end units (1 screw each place)
3. Disconnect drum drive (1 bolt)
4. Disconnect LR switch on exit unit (1 connector)
5. Remove four (4) mounting bolts
6. Install sling
7. Hoist drum from compartment
8. Lower to transporter
9. Remove bypass chute

INSTALLATION: Reverse removal operations

FUNCTIONAL CHECK: Handcrank operation to ensure proper hook-up and no binding
Check conveyor tension

TEST EQUIPMENT: Handcrank

CLOSE UP: Re-install 3 panels.

ANALYST'S OPINION: Conveyor connections are difficult to accomplish, particularly at entrance unit end. All conveyor elements must be engaged in chute trackways or damage to unit will result. Some organizations remove entrance and exit units to replace drum. Entrance unit has critical timing which requires better view access than is available in airplane. Severe damage to gun system can occur if improperly installed. Follow-on designs by GE have eliminated the critical timing problem.

WORK UNIT CODE 75631 ITEM Drum Unit Assembly AIRCRAFT F-14

LOCATION: Lower left side of fuselage, just below duct.

SUPPORT EQUIPMENT: Removal dolly

ACCESS: 1 panel (14 fasteners) (overlaps next panel)
1 panel (24 fasteners) (overlapped by first panel)
1 panel (24 fasteners, 1 screw, 6 bolts)

REMOVAL:
1. Time system
2. Disconnect exit unit (2 screws, 2 nuts on studs, 1 plug)
3. Disconnect entrance unit (2 screws, 2 nuts on stubs, 1 purge hose)
4. Disconnect drive unit (1 quick disconnect)
5. Support drum and remove upper bolt
6. Rotate drum outboard and remove 2 lower bolts
7. Remove drum

INSTALLATION: Reverse of removal (Note: Timing of the entrance unit is critical and complex).

FUNCTIONAL CHECK: Crank system manually
Check conveyor tension

TEST EQUIPMENT: Hand crank

CLOSE UP: Reinstall 3 panels

ANALYST'S OPINION: This installation is convenient and access involves a reasonable number of fasteners for this big a component. It is quite difficult to get a tool on the screws and nuts securing the entrance and exit units because of the drum shape and the chutes. Work can be accomplished from deck level. The observer is concerned with the critical timing of the entrance unit to the drum during installation. Not all of the possible timing positions of the entrance unit can be used. If the system is not timed to the proper position during drum removal, serious difficulties will be encountered in achieving that position prior to installation. Mistiming of either the exit or entrance unit will result in a severe system jam.

SECTION II
AVIONICS SYSTEMS

QUALITATIVE MAINTENANCE EXPERIENCE HANDBOOK

SECTION II, AVIONICS SYSTEMS

CONTENTS

INSTRUMENT SYSTEMS

AIRCRAFT FLIGHT INSTRUMENTS [redacted]

INSTRUMENT SYSTEMS

CONTENTS

COMPONENT	A-4	A-6	A-7	F-4	F-8	F-14	AV-8
Aircraft Flight Instruments	51214	51412	5111F	51423	51541	51371	51221
	51215	51413	51118	51441	51442	51341	51313
	51415	51711	5111A	51844	51131	51521	51312
	51116	51111	51153	51113	51133	51131	51112
	51117	51118	51152	51111		51111	51116

SYSTEM: 51 Instruments

NOMENCLATURE: Aircraft Flight Instruments

		51214		51412		5111F		51423
		51215		51413		51118		51441
		51415		51711		5111A		51844
		51116		51111		51153		51113
WUC:	A-4:	51117	A-6:	51118	A-7:	51152	F-4:	51111
		51541		51371		51221		
		51442		51341		51313		
		51131		51521		51312		
	F-8:	51133		51131		51112		
			F-14:	51111	AV-8:	51116		

GENERAL OBSERVATIONS: This summary incorporates comments for the five cockpit instruments studied: EGT Indicator, Fuel Flow Indicator, Fuel Quantity Indicator, Airspeed Mach Indicator and Counter Drum Altimeter. All the instruments are panel or console mounted and by necessity required canopy opening and the required GSE, if any, for the mechanic to climb into the cockpit. In general, the installations were straight-forward and tasks were simple.

DESIRABLE FEATURES: 1. The F-14 installations utilize an aircraft installed master instrument test check instrument (BIT) to check out replaced indicators. This very worthwhile feature provides a fast, accurate, simple check of the instrument, in most cases, without additional test sets. The engine run required by other aircraft for the EGT and fuel flow indicators is eliminated by this internal test set. 2. The use of a rack and panel installation in the A-7 airspeed mach indicator is outstanding for its ease of removal and installation. This installation eliminates the awkward handling of pneumatic hose/line connections common to airspeed/altimeter indicators.

UNDESIRABLE FEATURES: 1. Requirements to perform an engine run to operationally checkout an instrument is undesirable. The cost of designing a test set to check out the instrument or designing a

SYSTEM: 51 Instruments

NOMENCLATURE: Aircraft Flight Instruments

UNDESIRABLE FEATURES: (Cont.)

system which requires no check is well invested capital compared to the manhour and fuel expense of turning an engine each time the EGT or fuel flow indicator is replaced 2. The necessity to remove adjacent panels or controls to gain access for removal is very poor on an instrument panel. Instruments should be able to be removed without disturbing any other components. 3. Many of the installations do not provide enough slack in wiring harnesses or pneumatic hose assemblies to allow easy removal once several connector repairs have been made. Lack of slack necessitates removal of adjacent instruments in order to remove connectors. The F-14 counter drum altimeter installation, an exception, has been designed with sufficient slack to make several repairs. 4. Where face plates are involved, the plates should be an integral portion of the indicator and not require prior removal as in the A-6 EGT and fuel flow indicators.

ADDITIONAL REMARKS: Indicator installations should make optimum use of rack and panel connectors, quick release connectors and provide suffcient repair slack in harness/hoses to avoid removal of other components. Inclusion of built-in-test devices should be emphasized as a valuable maintenance tool.

A common problem involving engine instruments is worthy of comment. In many cases, an instrument such as TOT or Exhaust Gas Temperature Gage can be installed and the instrument adequately checked by DIT or other simple test. Criticality of the engine instruments, however, dictates that the system be checked to ensure system function. This currently requires engine run and use of the appropriate engine test equipment. The philosophy of requiring a system check in addition to component check is not arguable. Common sense and caution both confirm this is the time to do it. What is needed is a reasonably simple method to substitute test equipment for the engine run. Spotting and preparing an aircraft for engine run is extremely time consuming, particularly on a carrier. Future aircraft

SYSTEM: 51 Instruments

NOMENCLATURE: Aircraft Flight Instruments

ADDITIONAL REMARKS: (Cont.)

and engine designs should consider inclusion of the capability to test critical instrument systems by use of test equipment or BIT.

WORK UNIT CODE 51214 ITEM EXHAUST GAS TEMP. INDICATOR AIRCRAFT A-4

LOCATION: Cockpit Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Loosen screw on clamp securing indicator
2. Slide indicator out of panel
3. Remove electrical connector

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Indicator checked at engine run-up

TEST EQUIPMENT: Engine Run Up/Checkout Equipment

CLOSE UP: Close canopy

ANALYST'S OPINION: The removal/replacement of the indicator is a very simple task. The major concern is the requirement for an engine run-up to functionally check the indicator. Although this is common with other aircraft, a major improvement can be made by designing a test set for this check and/or the indicators should be calibrated in the maintenance shop to make them interchangeable with each aircraft.

WORK UNIT CODE 51412 ITEM EGT INDICATOR AIRCRAFT A-6

LOCATION: Cockpit Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Remove four screws to remove indicator face plate.
2. Remove four screws securing indicator
3. Remove indicator from instrument panel.
4. Disconnect electrical cable.

INSTALLATION: Reverse of removal.

FUNCTIONAL CHECK: Indicator checked at engine run-up.

TEST EQUIPMENT: Engine Run Up/Checkout Equipment

CLOSE UP: Close canopy

ANALYST'S OPINION: The removal/replacement procedure can be improved by making the indicator face plate a part of the indicator. Some procedure should be developed to delete the requirement for an engine run-up to functionally test the indicator. The capability should exist to calibrate these indicators in the maintenance shop so as to make them interchangeable with each aircraft. The development of a universal tester is more than justified when the engine run-up, fuel, additional maintanance support needed in relocating the aircraft, additional manpower and the manhours expended in completing the functional test is considered.

WORK UNIT CODE: 5111F ITEM: TURBINE OUTLET TEMPERATURE INDICATOR AIRCRAFT: A-7

LOCATION: Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open Canopy

REMOVAL:
1. Remove 1 screw securing indicator to panel.
2. Slide indicator out from panel until sufficient access space to connection is available.
3. Disconnect electrical connector.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform a functional check to ensure fail flag does not appear and that instrument indicates ambient temperature.

Perform operational check during engine run-up.

TEST EQUIPMENT: Engine Run Equipment
Engine Limiter Test Set

CLOSE UP: Close canopy

ANALYST'S OPINION: The removal/replacement of the indicator is good. The functional check of the indicator is accomplished by verifying that the indicator does operate. System checkout requires engine run-up.

WORK UNIT CODE 51423 ITEM EGT INDICATOR AIRCRAFT F-4

LOCATION: Cockpit Instrument Panel (front cockpit)

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Loosen screw on clamp securing indicator to panel.
2. Slide indicator from panel
3. Disconnect electrical connector
4. Remove indicator

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Check indicator to ensure fail flag does not appear and instrument indicates ambient temperature. Operational check is accomplished during engine run-up.

TEST EQUIPMENT: Engine Run-up and checkout equipment.

CLOSE UP: Close canopy

ANALYST'S OPINION: The removal/replacement of the indicator is an easy task. However, the functional test of the unit requires an engine run-up. This requirement for an engine run-up also exists in other aircraft and is considered a major area where improvements can be made. The installation/removal could be improved by using a quick disconnect type connector rather than a screw-on.

WORK UNIT CODE 51541 ITEM EXHAUST GAS TEMP. INDICATOR AIRCRAFT F-8

LOCATION: Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Remove four screws
2. Remove indicator from panel
3. Disconnect electrical cable.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System checked during engine run-up

TEST EQUIPMENT: Engine Run-up and checkout equipment

CLOSE UP: Close canopy

ANALYST'S OPINION: The installation/removal of the indicator is simple and easily performed. Major improvements can be made by providing an indicator that is interchangeable with all aircraft and one that does not need an engine run-up to functionally check the indicator.

WORK UNIT CODE 51371 ITEM EGT INDICATOR AIRCRAFT F-14

LOCATION: L. H. Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open Canopy

REMOVAL:
1. Remove 4 screws securing EGT Indicator to instrument panel.
2. Slide indicator from panel.
3. Disconnect 2 electrical connectors.

INSTALLATION: Reverse of removal.

FUNCTIONAL CHECK: On board Master Test Check (BIT), instrument function.

System function checked on engine run-up.

TEST EQUIPMENT: Electrical power for BIT check

Engine run-up and checkout equipment

CLOSE UP: Close canopy

ANALYST'S OPINION: Removal is possible without removing adjacent instruments. The Master Test feature is excellent and saves considerable time. An engine run-up is required after replacing the EGT Indicator in the F-14 only to verify the total system is functioning.

WORK UNIT CODE 51221 ITEM **Jet Pipe Temperature Indicator** AIRCRAFT AV-8

LOCATION: Cockpit Instrument Panel

SUPPORT EQUIPMENT: Pilot's ladder

ACCESS: Open canopy

REMOVAL:
1. Loosen one screw securing indicator in the panel
2. Slide indicator out of panel
3. Disconnect electrical connector

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Indicator operations checked during engine run-up.

TEST EQUIPMENT: Engine run-up and checkout equipment
Exhaust gas thermometer (6C/966)

CLOSE UP: Close canopy

ANALYST'S OPINION: The removal/replacement of the indicator is a simple task The requirement for an engine run-up to perform a functional test of the indicator is also similiar to other aircraft and a problem that should be corrected. The indicator should be made interchangeable without the requirement for an engine run-up.

WORK UNIT CODE 51215 ITEM FUEL FLOW INDICATOR AIRCRAFT A-4

LOCATION: Cockpit Instrument Panel

SUPPORT EQUIPMENT: Cockpit ladder

ACCESS: Open canopy

REMOVAL:
1. Loosen screw on clamp securing indicator
2. Slide indicator out from panel
3. Disconnect electrical connector

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Indicator is checked during engine run-up.

TEST EQUIPMENT: Portable synchro test set
Engine run equipment

CLOSE UP: Close canopy
Remove ladder

ANALYST'S OPINION: The use of a bracket type installation simplifies the removal/installation of the indicator. This type installation also reduces the problem of stripped nut plates. The functional test require engine run.

WORK UNIT CODE 51413 ITEM FUEL FLOW INDICATOR AIRCRAFT A-6

LOCATION: Cockpit Instrument Panel

SUPPORT EQUIPMENT:

None

ACCESS: Open canopy

REMOVAL:

1. Remove four screws to remove face plate
2. Remove four screws securing indicator
3. Remove indicator from instrument panel
4. Disconnect cable

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System check by applying power to electrically check indicator (off flag). Operation of system is checked during engine run-up.

TEST EQUIPMENT: Electrical power

Engine run equipment

CLOSE UP: Close canopy

ANALYST'S OPINION: Unit should be redesigned to eliminate the indicator face plate. This would simplify maintenance and improve the installation of the indicator. Ground support equipment should be developed which will provide a more acceptable test of the indicator after replacement rather than verifying its operation during an engine run-up.

WORK UNIT CODE 51118 ITEM FUEL FLOW INDICATOR AIRCRAFT A-7

LOCATION: Cockpit Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Remove screw securing indicator to panel
2. Slide indicator out of the panel
3. Disconnect electrical connector

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Indicator is checked during engine run-up

TEST EQUIPMENT: Engine run equipment

CLOSE UP: Close canopy

ANALYST'S OPINION: Removal/replacement of the indicator is an easy task. The functional test, which requires engine run, should be changed to eliminate engine run-up.

WORK UNIT CODE 51441 ITEM FUEL FLOW INDICATOR (2 each) AIRCRAFT F-4

LOCATION: Forward Cockpit Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open Canopy

REMOVAL:
1. Loosen screw on clamp securing indicator
2. Slide indicator out of panel
3. Disconnect electrical connector

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Indicator is checked during engine run-up

TEST EQUIPMENT: Engine run-up equipment

CLOSE UP: Close canopy

ANALYST'S OPINION: The use of a bracket type installation simplifies the removal/installation of the indicator. A procedure should be developed to eliminate engine run-up as a means of functionally checking the indicator.

WORK UNIT CODE 51341 ITEM FUEL FLOW INDICATOR AIRCRAFT F-14

LOCATION: L. H. Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Lower aircraft boarding ladder.

Open canopy.

REMOVAL:
1. Remove 4 screws securing fuel flow indicator to instrument panel
2. Slide indicator from panel
3. Disconnect electrical connector.

INSTALLATION: Reverse of removal.

FUNCTIONAL CHECK: On board Master Test check (BIT), instrument function.

System test during engine operation.

TEST EQUIPMENT: Electrical power for BIT.

Engine run-up equipment.

CLOSE UP: Close canopy

ANALYST'S OPINION: Removal is possible without removing adjacent instruments. This instrument provides readings for fuel flow for both engines. The Master Test (BIT) feature is an excellent maintenance aid and saves time. The time to accomplish the Master Test, instrument function, is less than 1 minute. System functional test still requires engine run.

WORK UNIT CODE 51313 ITEM FUEL FLOW RATE INDICATOR AIRCRAFT AV-8

LOCATION: Cockpit Instrument Panel (R. H.)

SUPPORT EQUIPMENT: Aircraft ladder

ACCESS: Open cockpit
Remove navigational display computer (NDC) panel (two screws, unit is not disconnected)

REMOVAL:
1. Remove two screws securing indicator to panel
2. Cut tie wraps securing wire bundle
3. Disconnect electrical connector
4. Slide indicator out of panel

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Indicator is checked during engine run-up

TEST EQUIPMENT: None

CLOSE UP: Replace NDC panel
Close canopy
Remove ladder

ANALYST'S OPINION: The removal of the navigational display computer complicates a rather simple task. Improper handling of the computer panel during removal/replacement can cause damage to the panel and induce malfunctions in the system. This can cause extended maintenance trouble shooting time on a system considered in an up status. Repeated removal can also cause damage or shorting conditions in the cable. The removal/installation is further complicated by the length of cable that must be untied and removed with the indicator. Modifications can be made to improve the installation/removal by providing a connector on the indicator and including the wire harness, now part of the indicator, as part of the aircraft harness.

WORK UNIT CODE 51415 ITEM FUEL QUANTITY INDICATOR AIRCRAFT A-4

LOCATION: Cockpit Instrument Panel (Lower Right)

SUPPORT EQUIPMENT: Cockpit ladder

ACCESS: Open canopy
Remove the handle to the tail hook actuator

REMOVAL:
1. Loosen screw on clamp holding indicator
2. Slide indicator from clamp
3. Disconnect electrical connector

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Indicator is checked using test equipment

TEST EQUIPMENT: TF-20 and aircraft power

CLOSE UP: Replace tail hook actuator handle and close canopy

ANALYST'S OPINION: Access to the indicator could be improved by modifying the tail hook actuator handle. The actual removal/replacement of the indicator from the panel is an easy task. Consideration should be given to modifying the actuator handle.

WORK UNIT CODE 51711 ITEM FUEL QUANTITY INDICATOR AIRCRAFT A-6

LOCATION: Cockpit Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS:

Open canopy

REMOVAL:
1. Remove four screws
2. Remove indicator from instrument panel
3. Disconnect cable

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System check using test equipment.

TEST EQUIPMENT: TF-20 and aircraft power

CLOSE UP: Close canopy

ANALYST'S OPINION: The installation of the indicator is considered normal to other aircraft. There are cases when the caution panel must be removed in order to remove the connector on the indicator. Removal of the caution panel is normally required after the connector/cable to the indicator is repaired. The length of the cable for the indicator should be increased to accomodate a few repair actions.

WORK UNIT CODE 5111A ITEM FUEL QUANTITY INDICATOR AIRCRAFT A-7

LOCATION: Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Remove three (3) screws securing indicator to panel.
2. Remove protective cover by releasing two (2) quick release latches
3. Reach under instrument panel and disconnect one (1) electrical connector.
4. Slide fuel quantity indicator out of instrument panel

INSTALLATION: Reverse removal procedure.

FUNCTIONAL CHECK: Perform self test.
Perform functional test of fuel quantity indicating system.

TEST EQUIPMENT: TF-20 Fuel Quantity Tester
External electric power

CLOSE UP: Close canopy

ANALYST'S OPINION: The installation and location of the indicator is considered good. Removal/replacement action of the indicator is a relatively easy task to perform. Locating the indicator in the lower part of the instrument panel provides easy access to the electrical connection. This may generate a problem since the connector is somewhat blindmated to the indicator.

WORK UNIT CODE 51844 ITEM FUEL QUANTITY INDICATOR AIRCRAFT F-4J

LOCATION: Cockpit Instrument Panel (R. H.)

SUPPORT EQUIPMENT: None

ACCESS: Open Canopy

REMOVAL:
1. Loosen one screw on clamp
2. Slide instrument from panel
3. Disconnect electrical connector
4. Remove indicator

INSTALLATION: Reverse of removal.
NOTE: Indicator must be adjusted (balanced) with the system before it is secured in the panel.

FUNCTIONAL CHECK: Accomplish a system functional test of the indicator with test equipment and adjust indicator to the system.

TEST EQUIPMENT: MD-1-fuel quantity tester and aircraft power

CLOSE UP: Close canopy

ANALYST'S OPINION: The requirement to make adjustments on the indicator at replacement is considered a bad feature.

WORK UNIT CODE 51442 ITEM FUEL QUANTITY IND. AIRCRAFT F-8

LOCATION: Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Remove four screws securing indicator
2. Slide unit out of the panel
3. Remove electrical connector

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System checked using test set

TEST EQUIPMENT: MD-1 for indicator
MD-2A capacity system test
Electrical Power

CLOSE UP: Close canopy

ANALYST'S OPINION: The removal/replacement of the indicator is a simple task. Frequent repair of the connector may require removal of the adjacent indicator for access to the connector because of loss of slack in the harness.

WORK UNIT CODE: 51521 ITEM: FUEL QTY. INDICATOR AIRCRAFT: F-14

LOCATION: R. H. Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Remove 4 screws securing fuel qty. indicator to instrument panel.
2. Slide indicator from panel.
3. Disconnect 1 electrical connector.

INSTALLATION: Reverse of removal.

FUNCTIONAL CHECK: On board Master Test check (BIT), instrument function.

TEST EQUIPMENT: Electrical power

CLOSE UP: Close canopy

ANALYST'S OPINION: Removal is accomplished without disturbing adjacent instruments in the panel. Incorporating a BIT function which performs a functional test of the indicator is an excellent feature. This feature allows testing of total fuel and individual tank fuel quantity indications.

WORK UNIT CODE 51312 ITEM FUEL POUND REMAINING INDICATOR AIRCRAFT AV-8

LOCATION: L.H. side of AFT Cockpit.

SUPPORT EQUIPMENT: Pilot's ladder

ACCESS:

Position ladder
Open cockpit

REMOVAL:

1. Remove 2 screws securing indicator to wall (bulkhead).
2. Cut tie wraps securing wire bundle.
3. Disconnect 1 electrical connector
4. Slide indicator upward and remove from aircraft

INSTALLATION: Reverse of removal.

FUNCTIONAL CHECK: Perform operational check with fuel flow system. Engine run required.

TEST EQUIPMENT: None

CLOSE UP:

Close canopy
Remove ladder

ANALYST'S OPINION: An AFC relocated this indicator from the instrument panel to the aft cockpit bulkhead. This relocation of the indicator has improved the access, and has made the removal/replacement a very simple task. The functional test of the indicator, which now requires an engine run, should be changed. Test equipment, available in the current inventory, such as the TF-20 or MD-1 should be evaluated for this application. This would simplify the functional test of the indicator and eliminate the need for an engine run.

WORK UNIT CODE 51116 ITEM AIRSPEED/MACH INDICATOR AIRCRAFT A-4

LOCATION: Cockpit Instrument Panel

SUPPORT EQUIPMENT: Cockpit ladder

ACCESS: Open canopy

REMOVAL:
1. Loosen screw on clamp holding indicator
2. Remove unit from panel
3. Disconnect hose connection

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform pressure leak check and functionally check system

TEST EQUIPMENT: TTU-205 and aircraft power

CLOSE UP: Close canopy

ANALYST'S OPINION: The installation of the unit is considered good. However, if the pneumatic hose is short, the adjacent component must be removed to gain access to the connector.

WORK UNIT CODE: 51111 ITEM: Mach CMD Airspeed Indicator AIRCRAFT: A-6

LOCATION: Cockpit Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

Remove glare shield (7 DZUS Fasteners)

REMOVAL:
1. Disconnect hose from indicator by reaching in behind instrument panel.
2. Disconnect electrical connector by reaching in behind instrument panel.
3. Remove four screws
4. Remove indicator

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System functionally checked using test set.

TEST EQUIPMENT: Air Data Tester, TS-1809/APM-123, and acft power

CLOSE UP: Replace glare shield.
Close canopy.

ANALYST'S OPINION: Removal of the glare shield to gain access to the indicator complicates removal of the unit. Access to the pneumatic connections on indicators is a basic problem in most all aircraft. Major improvements can be made in the installation/removal of these type indicators by designing pressure connections for these hose connections.

WORK UNIT CODE: 51153 ITEM: Mach Air Speed Indicator AIRCRAFT: A-7

LOCATION: Cockpit Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Remove four screws securing indicator to panel
2. Slide indicator from panel

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform pressure leak check and functional test of pitot and static system.

TEST EQUIPMENT: TTU-205
External Electrical Power

CLOSE UP: Close canopy

ANALYST'S OPINION: The installation of the indicator is excellent. Removal and replacement of the indicator is a very simple and straight forward task. The rack and panel installation eliminates the access problems associated with other aircraft installations. The use of rack and panel type installation should be standardized in all aircraft.

WORK UNIT CODE 51113 ITEM Air Speed/Mach Indicator AIRCRAFT F-4

LOCATION: Cockpit Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Remove four screws securing indicator to panel
2. Slide indicator from panel
3. Disconnect pneumatic lines (hoses)
4. Remove electrical connector
5. Remove indicator

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform pressure leak test and functionally check system.

TEST EQUIPMENT: AN/PSM-15

CLOSE UP: Close canopy

ANALYST'S OPINION: The present installation/removal procedures are good. Removal of adjacent components is required if the cables or pneumatic connections are too short.

WORK UNIT CODE 51131 ITEM AIRSPEED INDICATOR AIRCRAFT F-8

LOCATION: Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open Canopy.
Remove ADI.

REMOVAL:
1. Remove electrical connector
2. Remove pressure lines
3. Remove four screws securing indicator
4. Slide indicator out of panel

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Indicator is checked using test equipment.

TEST EQUIPMENT: TTU-205

CLOSE UP: Replace ADI and functional check systems.
Close Canopy

ANALYST'S OPINION: Access to the indicator is considered poor. The ADI must be removed to gain access to the connections on the indicator. Removal of the ADI only provides limited access to these connections and may cause improper installation. Because of the access problem, the removal/installation time for this task is considered high.

WORK UNIT CODE 51131 ITEM AIR SPEED INDICATOR AVU-24/A AIRCRAFT F-14

LOCATION: L.H. Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open Canopy

REMOVAL:
1. Remove 4 screws securing indicator to instrument panel.
2. Slide indicator from panel.
3. Disconnect 1 Electrical Connector
4. Disconnect 2 pneumatic line (static & Pitot) fittings

INSTALLATION: Reverse of removal.

FUNCTIONAL CHECK: Perform leak check and pitot & static systems functional test.

TEST EQUIPMENT: TTU-205
Electrical power

CLOSE UP: Close canopy

ANALYST'S OPINION: The present installation of the airspeed indicator is similar to most aircraft. Removal problems will be encountered when repair of the cable or pneumatic hoses are made. This will require removal of an adjacent component to gain access to the connections on the indicator.

WORK UNIT CODE 51112 ITEM AIR SPEED IND. AIRCRAFT AV-8

LOCATION: LH Instrument Panel

SUPPORT EQUIPMENT: Pilot's ladder

ACCESS: Position ladder
Open cockpit
Remove Weapons Control Panel

REMOVAL:
1. Remove 4 screws securing the indicator to the panel.
2. Remove 2 clamps securing pneumatic lines (pitot & static).
3. Push indicator inward and instrument will drop down.
4. Slide hoses off indicator.

INSTALLATION: Reverse of Removal

FUNCTIONAL CHECK: Perform leak test and pitot & static systems functional test

TEST EQUIPMENT: Leak Tester Model 175Y

CLOCK UP: Replace weapon control panel, close canopy and remove ladder.

ANALYST'S OPINION: The installation of the airspeed indicator is considered poor. Access to the indicator for removal/replacement requires the removal of the weapon control panel. This increases the possibility of inducing malfunctions in the weapons control panel (system). Installation of the indicator from the rear of the instrument panel is considered to be a poor design. Installations of the indicator from the front of the instrument panel would greatly improve the removal/installation procedure.

WORK UNIT CODE 51117 ITEM AAU 19/A COUNTER DRUM ALTIMETER AIRCRAFT A-4

LOCATION: Left side of instrument panel

SUPPORT EQUIPMENT: Cockpit ladder

ACCESS: Open canopy

REMOVAL:
1. Loosen screw on clamp securing indicator
2. Remove indicator from panel
3. Disconnect electrical connector
4. Disconnect pneumatic hose

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform leak check and functional test system using test equipment.

TEST EQUIPMENT: TTU-205
Acft Power

CLOSE UP: Close canopy

ANALYST'S OPINION: The installation of the unit is considered good. However, the same problems exists as in other aircraft, i.e., if the cable connection on the pneumatic line (hose) is short, then the adjacent component must be removed to gain access to the connections. Also, the use of a clamp to secure the unit is quick but may cause a problem if the clamp is stretched and won't securely retain the instrument.

WORK UNIT CODE 51118 ITEM COUNTER DRUM ALTIMETER AIRCRAFT A-6

LOCATION: Cockpit Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

Remove glare shield (7 DZUS Fasteners)

REMOVAL:
1. Disconnect hose connector.
2. Remove electrical connector.
3. Remove four screws.
4. Remove indicator.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System check using test equipment.

TEST EQUIPMENT: TS-1809/APM-123
Air Data Tester
Electrical Power

CLOSE UP: Replace glare shield

Close canopy

ANALYST'S OPINION: Removal of the glare shield to gain access to the instrument complicates removal of the unit. Access to the pneumatic connections of the indicator is a basic problem on most aircraft. Major improvements must be made in the installation/removal of panel mounted instruments that use hose (air or pressure) connections.

WORK UNIT CODE 51152 ITEM AAU 19/A COUNTER DRUM ALTIMETER AIRCRAFT A-7

LOCATION: Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

Remove ADI from instrument panel (four screws and one electrical connector).

REMOVAL:
1. Remove electrical connector
2. Remove pneumatic lines
3. Remove four screws securing indicator
4. Slide indicator out or panel

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform leak test and functional test of the Air Data Computer, the static & pitot pressure system and ADI.

TEST EQUIPMENT: TTU-205
Acft. Power

CLOSE UP: Replace ADI Indicator

Close canopy

ANALYST'S OPINION: Access to the instrument is considered poor. Removal of an adjacent instrument, for access, is a problem also associated with other aircraft installations. However, in this case, removal of the ADI provides only limited access to the connections on the altimeter and can cause damage to the connections or improper installation. Major improvements could be made on the installation/ removal of this indicator.

WORK UNIT CODE: 51111 ITEM: AAU-19A COUNTER DRUM ALTIMETER AIRCRAFT: F-4J

LOCATION: RH side of instrument panel (both cockpits)

SUPPORT EQUIPMENT: None

ACCESS: 1 Panel (18 screws) for checkout only
Open canopy

REMOVAL:
1. Remove four screws securing indicator
2. Slide indicator out of panel
3. Disconnect electrical connector
4. Remove static line from indicator

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform leak test of static system and system test of servoed altimeter.

TEST EQUIPMENT: TTU-205, VPT-30, Environment Simulator, TTU-229 Servo Altimeter Test Set, a Bleed Air Nitrogen Source, and Electrical Power.

CLOSE UP: Secure Access Panel
Close canopy

ANALYST'S OPINION: The removal/replacement of the indicator is a relatively simple task, however, a problem does exist as in other aircraft, ie, if the static line (hose) is too short, access to this connection is gained by removing an adjacent instrument. In this case, the radar indicator must be removed. Consequently, a radar system functional test must also be accomplished. The functional test of the indicator requires too much support equipment. In addition, access to the test fitting should be improved by using quick release fasteners instead of 18 screws.

WORK UNIT CODE 51133 ITEM COUNTER DRUM ALTIMETER AIRCRAFT F-8

LOCATION: Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy
Remove ADI

REMOVAL: 1. Disconnect pneumatic lines
2. Disconnect electrical connector
3. Remove 4 screws
4. Slide indicator from panel

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Indicator is checked using test equipment

TEST EQUIPMENT: TTU-205

CLOSE UP: Replace ADI and functionally check system.
Close canopy.

ANALYST'S OPINION: Access to the indicator is considered poor. Access to the connections on the indicator is gained by removal of the ADI. Removal of the ADI only provides limited access to the connections. Consequently, a simple task of removing an indicator becomes a rather tedious task which could cause additional system problems if not installed properly. Improvements in the removal/installation are required.

WORK UNIT CODE 51111 ITEM AAU19/A ALTIMETER AIRCRAFT F-14

LOCATION: LH Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS Lower aircraft boarding ladder
Open canopy

REMOVAL:
1. Remove 4 screws securing altimeter to instrument panel.
2. Slide altimeter from panel.
3. Disconnect 1 electrical connector.
4. Disconnect pneumatic line (static) fitting.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform leak test and functional check of static system.

TEST EQUIPMENT: TTU-205
Electrical Power

CLOSE UP: Close Canopy
Secure Boarding ladder

ANALYST'S OPINION: The removal/replacement of the indicator is good. The unit can be removed/replaced without removing an adjacent component. The installation on this aircraft is improved over other aircraft by simply increasing the length of the electrical cable and pneumatic line to allow the disconnection of lines after the unit is pulled from the instrument panel. This type installation should be standardized in all aircraft.

WORK UNIT CODE 51116 ITEM AAU 19/A COUNTER DRUM ALTIMETER AIRCRAFT AV-8

LOCATION: Instrument Panel (LH Side)

SUPPORT EQUIPMENT: Crew Ladder

ACCESS: Open Canopy
Remove Weapon Control Panel (2 screws)

REMOVAL:
1. Remove one clamp on pneumatic line.
2. Remove four screws on indicator.
3. Slide unit out of instrument panel.
4. Disconnect electrical connector.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform leak check and functional test of static system and functional test of the weapon system.

TEST EQUIPMENT: Leak Tester (Model 1754)
Electrical Power

CLOSE UP: Close Canopy.

ANALYST'S OPINION: Removal/installation of the indicator is considered poor. Access to the connections or the indicator is gained by removing an adjacent unit. This is the same problem identified on most other aircraft. Removal of adjacent components require a system functional test of the disturbed system which only increases ground operational time in that system and also permits malfunctions to be induced in a system not directly associated with the maintenance.

FLIGHT REFERENCE/AFCS SYSTEMS

FLIGHT INSTRUMENTS 

AIR DATA COMPUTER 

AUTOMATIC FLIGHT
DIRECTIONAL COMPUTERS 

FLIGHT REFERENCE/AFCS SYSTEMS

CONTENTS

COMPONENT	A-4	A-6	A-7	F-4	F-8	F-14	AV-8
Flight Instruments:	56861	51142	51141	56861	51191	56X1C	51151
	56X11	56882	51142	56865	51193	51X1D	51152
	56851		71X1R	56X14	51163	564F2	51113
			56X11	56X11			51614
				56X13			
Air Data Computer	56550	565A0	73A61	56454	N/A	56X18	56990
Automatic Flight	57514	N/A	57575	N/A	576C3	57711	57890
Directional Computers	57512		57577		576A4	57712	
			57576		576A5	57713	

SYSTEM: 56 Flight Reference System

NOMENCLATURE: Flight Instruments

MUC:	A-4:	56861 56X11 56851 51191	A-6:	51142 56882 56X1C	A-7:	51141 51142 71X1R 56X11	F-4:	56861 56865 56X14 56X11 56X13
	F-8:	51193 51163	F-14:	51X1D 564E2	AV-8:	51151, 51152, 51113, 51614		

GENERAL OBSERVATIONS: Angle of Attack transducers and indicators, compass transmitters, attitude indicators, and gyros are included in this general category. All installations are relatively simple with access usually good to indicators and generally tight for transmitters. Functional check of these items tends to be complex and time consuming unless a good built-in-test (BIT) is provided.

DESIRABLE FEATURES: 1. Instrument access is generally good with provisions for removal from the front side of the panel. The A-7 uses a rack and panel mount on the attitude direction indicator which simplifies removal/installation tasks. Other aircraft provide ample wire slack for disconnect. 2. The F-14 makes good use of BIT to simplify functional check tasks. The F-8 checkout of its attitude horizon indicator makes use of a simulator set to ease checkout problems. 3. Aircraft using probe style angle of attack transducers appear to have better installations than vane style. The probe is more easily installed in non-vulnerable locations because of its shape and operational concept. 4. Some aircraft such as the A-7, F-4, and AV-8 have managed to install compass transmitters in remote locations that are easily reached. The fuselage location of the AV-8 transmitter provides working space that is far superior to other aircraft surveyed.

SYSTEM: 56 Flight Reference System

NOMENCLATURE: Flight Instruments

UNDESIRABLE FEATURES: 1. While most instrument locations allow easy removal, the AV-8 attitude indicator requires removal of an adjacent control panel and the removal from the rear side of the instrument panel. This is tedious in a small cockpit such as in this airplane. The A-4 angle of attack indicator is easily removed after the landing gear handle is moved to the "UP" position. Although the A-4 landing gear appears tolerant of this, if appropriate precautions are taken, it still presents certain obvious hazards. 2. The effort to locate sufficiently remote real estate to mount the compass transmitter has resulted in its location high in the vertical fin of the A-4 and F-14. Usually (except the AV-8) the transmitter is difficult to remove because of cramped quarters and placing it this high makes it even more difficult. 3. Functional checks are generally complex and involved. This is particularly true of integrated systems such as the A-7. Extensive test equipment hookup is required. 4. Terminal strips used in some airplanes are more time consuming than connectors. Although the time difference involved is not very much, terminals also provide a hazard of dropped hardware. Recovering a nut that has come adrift in the vertical fin is significantly time consuming.

ADDITIONAL REMARKS: Functional check methods are a good field for improvement. Simplified test equipment or built-in-test will have more impact on effort in this system than will design improvements to the installation. Removal and installation in most cases is a minor part of the job due to attention previously given by design.

WORK UNIT CODE 56861 ITEM ANGLE OF ATTACK INDICATOR AIRCRAFT A-4

LOCATION: Cockpit Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy
Position the "Landing Gear Handle" in the "Up" position.

REMOVAL: 1. Remove four screws securing indicator in the panel.
2. Slide indicator out of panel.
3. Disconnect electrical connector.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Functional test is accomplished by moving the angle of attack probe and checking the indicator for proper display.

TEST EQUIPMENT: Aircraft external electrical power

CLOSE UP: Position landing gear handle in the "down" position.
Close Canopy.

ANALYST'S OPINION: The removal/replacement of the indicator is considered a simple task. However, the requirement to position the landing gear handle in the "up" position for access to the indicator is not considered a safe maintenance practice. Although this may be considered a safe procedure to follow, it is one that can be considered as a "Murphy" item. This maintenance procedure should be evaluated to insure adequate safeguards are provided and followed by technicians accomplishing the maintenance.

WORK UNIT CODE 51142 ITEM Angle of Attack Indicator AIRCRAFT A-6

LOCATION: Cockpit Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Loosen indicator clamp
2. Remove indicator from panel
3. Disconnect cable

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Rotate angle-of-attack vane and check indicator for proper operation

TEST EQUIPMENT: Aircraft external electrical power

CLOSE UP: Close canopy

ANALYST'S OPINION: The removal/replacement of the indicator is a relatively easy task. The functional check described by NARF Personnel is quite simple and requires no special test equipment. Although the test confirms proper installation of the component, a more strigent test of the system might occasionally

WORK UNIT CODE 51141 ITEM Angle of Attack Indicator AIRCRAFT A-7

LOCATION: Cockpit Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Remove one (1) screw to remove mask light
2. Remove two (2) screws securing indicator to panel
3. Slide indicator out from panel to provide sufficient access to electrical connector
4. Disconnect electrical connector and remove indicator

INSTALLATION: Reverse removal procedure

FUNCTIONAL CHECK: Perform system operational checkout and check alignment

TEST EQUIPMENT: Alignment set, AOA, 215-00112-27
External electric power

CLOSE UP: Close canopy

ANALYST'S OPINION: The installation/removal of the indicator is a simple task and similar to other aircraft. The functional test of the system is relatively simple. Majority of the time expended in performing the overall task is used in setting up the alignment on the aircraft. Overall system functional test can be improved by using a Probe type transducer rather than a Vane type.

WORK UNIT CODE 56861 ITEM Angle of Attack Indicator AIRCRAFT F-4B

LOCATION: Front Cockpit Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Remove three screws securing indicator to the panel
2. Slide indicator out of panel
3. Disconnect electrical connector
4. Remove indicator

INSTALLATION: Reverse of installation

FUNCTIONAL CHECK: System functional test is accomplished by checking the limits of the indicator and response to the movement of the angle of attack Probe.

TEST EQUIPMENT: Electrical Power

CLOSE UP: Close canopy

ANALYST'S OPINION: The access, installation and removal of the indicator is good. Functional test of the system is a rather simple task. This installation should be used on all aircraft and considered as a standard installation.

WORK UNIT CODE 51191 ITEM Angle of Attack Indicator AIRCRAFT F-8

LOCATION: Cockpit Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Remove four screws securing indicator to the panel
2. Remove indicator from panel
3. Disconnect electrical connector

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: The angle of attack indicator and transducer are checked as a system using test equipment

TEST EQUIPMENT: AOA Alignment Set

Electrical Power

CLOSE UP: Close canopy

ANALYST'S OPINION: The access, installation and removal of the indicator is good. The major portion of the time, used in accomplishing a functional test, is needed to set up the alignment set. This system functional test could be reduced if the vane type transducer is replaced by a Probe type.

WORK UNIT CODE 56X1C ITEM Angle of Attack Indicator ID-1777/A AIRCRAFT F-14

LOCATION: LH Side, Upper Instrument Panel (Air Combat Maneuver Panel)

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Remove 2 screws securing AOA Indicator to panel
2. Slide indicator from panel
3. Disconnect 1 electrical connector

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: On board Master Test Check (BIT), Instrument function

TEST EQUIPMENT: Electrical power

CLOSE UP: Close canopy

ANALYST'S OPINION: The AOA Indicator installation is similar to installations in other aircraft. Removal is possible without removing adjacent instruments. The use of the Master Test Check in accomplishing the functional test is an excellent feature and one that saves time and eliminates the need for test equipment that is used in checking other aircraft installations.

WORK UNIT CODE 51151 ITEM Angle of Attack Indicator AIRCRAFT AV-8

LOCATION: Upper LH Side of Instrument Panel

SUPPORT EQUIPMENT: Pilot's Ladder

ACCESS: Open canopy

REMOVAL:
1. Loosen 1 screw securing indicator to panel
2. Slide indicator from panel
3. Disconnect 1 electrical connector

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Move the air stream direction detector (AOA Probe) and observe if indicator readings follow movement. Check full travel readings of the indicator.

TEST EQUIPMENT: Electrical power

CLOSE UP: Close canopy
Remove ladder

ANALYST'S OPINION: The access, installation and removal of the indicator is good. Removal and installation of the unit is considered a simple task. The functional test of the indicator and the probe can be accomplished without the use of test equipment. The installation should be used on all aircraft.

WORK UNIT CODE 51142 ITEM Angle of Attack Transducer AIRCRAFT A-7

LOCATION: Left Cockpit Console Area Under Canopy Rail

SUPPORT EQUIPMENT: work stand
torque wrench

ACCESS: Open canopy

REMOVAL:
1. Remove 2 screws securing AOA vane or transducer
2. Remove vane
3. Remove clamp securing AOA transducer cable
4. Disconnect electrical connector
5. Cut safety wire and remove 7 bolts securing AOA transducer
6. Remove transducer and replace vane on transducer

INSTALLATION: Reverse removal procedures

FUNCTIONAL CHECK: Perform AOA transducer alignment and system operational checkout

TEST EQUIPMENT: AOA Alignment Set
APC Flight Line Test Set
External Electrical Power

CLOSE UP: Close canopy

ANALYST'S OPINION: The location of the AOA vane is undesirable because of the susceptibility to damage during normal aircraft maintenance or ground operations. However, this occasional damage could be prevented if the vane guard (provided as support equipment) is installed. The location of the transducer, under the canopy rail, does cause some difficulty in the removing and installation of the bolts (7) securing the transducer. The functional check of the system does take more time and support equipment compared to other aircraft. Also, the use of a Air Stream Direction Detector would simply be the removal/replacement action as well as the functional test.

WORK UNIT CODE 56865 ITEM A/A Transducer AIRCRAFT F-4B

LOCATION: Left Side Forward Fuselage Area

SUPPORT EQUIPMENT: Maintenance stand

ACCESS: Remove access panel by removing (18) screws

REMOVAL:
1. Remove six (6) screws securing transmitter to aircraft
2. Lift transmitter from aircraft
3. Reach through access panel and disconnect the electrical connector
4. Remove transmitter

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System functional test is accomplished by rotating the transmitter and checking the response of the indicator. The heater circuits are also checked during the functional test.

TEST EQUIPMENT: Aircraft electrical power

CLOSE UP: Close canopy

ANALYST'S OPINION: The removal and replacement of the transmitter is rather easy. The location of the probe does not expose it to any damage that may occur during aircraft maintenance. Functional test of the equipment is simple and does not require test equipment.

WORK UNIT CODE 51193 ITEM Angle of Attack Transducer AIRCRAFT F-8

LOCATION: Right Cockpit Console Area Under Canopy Rail

SUPPORT EQUIPMENT: Maintenance stand

ACCESS: Open canopy

REMOVAL:
1. Remove transducer vane
2. Remove 7 bolts securing transducer
3. Disconnect electrical connector
4. Remove transducer and replace vane on transducer

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Angle of attack transducer is checked with the indicator as a system

TEST EQUIPMENT: Angle of attack vane alignment set
Aircraft electrical power

CLOSE UP: Close canopy

ANALYST'S OPINION: The removal and replacement of the transducer requires the specialist to change his work area from outside the aircraft to the cockpit area. Although the removal/installation of the transducer is not difficult the specialist must be careful and not drop any of the bolts in the cockpit area. The functional test of the system requires two specialists to complete with most of the time expended on installing the alignment set. Use of a Air Stream Direction Detector would improve the overall maintenance task.

WORK UNIT CODE 56X1D ITEM Angle of Attack Transducer AIRCRAFT F-14

LOCATION: LH Forward Fuselage Compartment

SUPPORT EQUIPMENT: work stand

ACCESS Remove 8 bolts and remove panel over transducer
Loosen 29 Calfax fasteners and open access panel positioning holding bar

REMOVAL:
1. Disconnect electrical connector
2. Remove clamp securing cable
3. Remove four screws securing transducer to panel
4. Remove unit from aircraft

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform an on-board master test check (BIT) instrument function. Check function of indicator as you rotate transducer.

TEST EQUIPMENT: Electrical power

CLOSE UP: Replace access panel
Secure compartment panel

ANALYST'S OPINION: The functional test of the system is very good. The transducer does not require alignment after replacement and can be checked without peculiar ground support equipment. The loosening of 20 Colfax fasteners slightly impairs the access to the transducer.

WORK UNIT CODE 51152 ITEM Air Stream Direction Detector AIRCRAFT AV-8

LOCATION: R.H. Side forward cockpit

SUPPORT EQUIPMENT: Aircraft ladder

ACCESS: Open canopy
Remove 14 screws and remove aircraft panel

REMOVAL:
1. Disconnect electrical connector
2. Cut tie wraps
3. Remove four bolts securing detector to fuselage support bracket
4. Slide detector probe out of fuselage

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Move detector probe (rotate) and observe that the indicator follows probe movement. Check probe heater and freedom of movement of the probe.

TEST EQUIPMENT: Electrical Power

CLOSE UP: Replace panel, close canopy

ANALYST'S OPINION: Accessibility to the detector is considered marginal from a maintenance view point. The functional test, although a simple task, requires two men to accomplish. The overall functional test does not seem adequate to determine proper operation and accuracy of the system.

WORK UNIT CODE 56X11 ITEM ML-1 Compass Transmitter AIRCRAFT A-4M

LOCATION: Vertical Tail

SUPPORT EQUIPMENT: Work stand.

ACCESS: Remove 18 screws to remove panel.
Open canopy.

REMOVAL:
1. Disconnect six terminals from terminal strip.
2. Remove three screws.
3. Remove transmitter.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: The compass system is functionally checked then the system is calibrated in the Compass Rose.

TEST EQUIPMENT: Compass calibrator
Electrical power

CLOSE UP: Close canopy
Replace panel

ANALYST'S OPINION: The access to the transmitter is somewhat restricted. Removal and replacement is a one hand operation. Removal/replacement could be improved by using a connector instead of a terminal strip.

WORK UNIT CODE 56X11 ITEM ML-1 Compass Transmitter AIRCRAFT A-7

LOCATION: Right wing tip area

SUPPORT EQUIPMENT: None

ACCESS: Remove 12 screws and remove panel.

REMOVAL:
1. Remove two ground leads
2. Remove two clamps
3. Disconnect electrical connector
4. Remove three screws securing transmitter
5. Remove transmitter

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System must be calibrated on Compass Rose using test equipment.

TEST EQUIPMENT: MC-2 Compass Calibrator.
Electrical power.

CLOSE UP: Replace acft access panel

ANALYST'S OPINION: Caution must be exercised when the access panel is replaced. All screws must be replaced in the hole they are removed from or recalibration is required. This is undesirable because of the extra screw accounting procedures involved. Access is good.

WORK UNIT CODE 56X11 ITEM Remote Compass Transmitter AIRCRAFT F-4J

LOCATION: Bottom side of left wing

SUPPORT EQUIPMENT: Maintenance stand

ACCESS: Remove 36 non-magnetic high torque screws and remove access panel.

REMOVAL:
1. Remove ground strap
2. Remove clamp securing wiring harness
3. Disconnect electrical connector
4. Remove three allen head screws
5. Remove transmitter

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System is functionally checked and calibrated on a Compass Rose

TEST EQUIPMENT: Compass tester.
Electrical power.

CLOSE UP: Replace access panel

ANALYST'S OPINION: Access to the unit is restricted by the aircraft structure. Removal of the inside allen head screw is a one-hand operation and must be accomplished without visual reference.

WORK UNIT CODE 564E2 ITEM TRU 79 A/A Transmitter Induction AIRCRAFT F-14

LOCATION: Inboard side of L.H. vertical stabilizer.

SUPPORT EQUIPMENT: Maintenance stand

ACCESS: Remove 4 screws securing access panel.

REMOVAL:
1. Cut safety wire on electrical connector.
2. Disconnect 1 electrical connector.
3. Remove 3 screws securing transmitter.
4. Remove transmitter from aircraft.

INSTALLATION: Reverse of removal.

FUNCTIONAL CHECK: Perform operational check out & compass swing test

TEST EQUIPMENT: MC-2 Compass Tester

CLOSE UP: Replace panel

ANALYST'S OPINION: This installation is different in that it is installed in the Vertical Stabilizer rather than the wing tip location as in most aircraft. Location requires a high maintenance stand. The small number of screws in the access is noteworthy.

WORK UNIT CODE 51614 ITEM Flux Valve AIRCRAFT AV-8

LOCATION: Aft bottom tail section directly under IFF Antenna

SUPPORT EQUIPMENT: None

ACCESS: Remove sealant from screw heads and surface of panel.
Remove 12 screws on two access panels.

REMOVAL:
1. Remove two bolts on support plate.
2. Remove 1 screw on support plate.
3. Remove support plate from aircraft.
4. Remove 3 bolts securing transmitter.
5. Remove potting from 6 screws and remove screws securing wires to transmitter.
6. Remove transmitter from aircraft.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform compass swing & functional test

TEST EQUIPMENT: Electrical power. Compass test set.

CLOSE UP: Replace access panels

ANALYST'S OPINION: This location is very good, maintenance can be accomplished at ground level. Removal/replacement can be improved by using a connector rather than securing leads to a terminal strip. The potting on the terminal strip is not desirable. Sealant on the access panels could be eliminated by use of form-in-place gaskets. A drain hole would also help remove captured water (the aircraft viewed at NARF was missing the sealant and the area contained a substantial quantity of water).

WORK UNIT CODE 71X1R ITEM Attitude Direction Indicator AIRCRAFT A-7

LOCATION: Instrument panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Remove four (4) screws securing ADI to panel.
2. Slide ADI out of panel.

INSTALLATION: Reverse removal procedure

FUNCTIONAL CHECK: Perform an operational check of the heading mode system

TEST EQUIPMENT: External electric power
SM-639/ASM Test Set (Optional)

CLOSE UP: Close canopy

ANALYST'S OPINION: The accessibility to the ADI is ideal but the Heading Mode System operational checkout requires integration (input and outputs) to many systems and the check-out time is extensive.

WORK UNIT CODE 56X14 ITEM Attitude Directional Indicator AIRCRAFT F-4

LOCATION: Cockpit Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Remove 4 screws securing indicator to panel
2. Slide indicator from panel
3. Disconnect 2 electrical connectors
4. Remove indicator from cockpit

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform functional test of heading and attitude reference system.

TEST EQUIPMENT: Electrical power
Test set (type unknown)

CLOSE UP: Close canopy

ANALYST'S OPINION: Removal and replacement of the instrument is good. The functional testing of the system requires an operational test of the heading and attitude reference system which takes some time. Some methods should be developed to simply testing of the indicator.

WORK UNIT CODE 51163 ITEM Attitude Horz Ind AIRCRAFT F-8

LOCATION: Cockpit Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Remove four screws
2. Remove indicator from instrument panel
3. Disconnect electrical connector

INSTALLATION: Reverse of removal.

FUNCTIONAL CHECK: System checked by using simulator and verifying indicator response.

TEST EQUIPMENT: Simulator (nomenclature unknown).

CLOSE UP: Close canopy

ANALYST'S OPINION: Removal and replacement of the indicator is a easy task. Functional testing of the indicator, using the simulator, is accomplished in a short time. Overall maintenance task is considered good.

WORK UNIT CODE 51113 ITEM Artificial Horizon AIRCRAFT AV-8

LOCATION: Cockpit instrument panel

SUPPORT EQUIPMENT: Crew ladder

ACCESS: Open canopy
Remove Weapon Control Panel by removing two screws and lower panel.

REMOVAL:
1. Remove three screws securing indicator to panel.
2. Disconnect electrical connector.
3. Slide instrument from the rear side of the instrument panel and remove unit.

INSTALLATION: Reverse of removal.

FUNCTIONAL CHECK: Functional check is made by checking to see if the indicator will erect and that the "off" flag goes out of view.

TEST EQUIPMENT: Electrical power

CLOSE UP: Replace Weapon Control Panel.
Close canopy.

ANALYST'S OPINION: Access to the unit is marginal, the removal of the Weapon Control Panel degrades the overall task. Frequent removal of this panel may result in induced malfunctions or cause intermittent system problems. Removal of the indicator from the rear of the instrument panel is not considered a desirable procedure.

WORK UNIT CODE 56851 ITEM Pitch & Roll Gyro AIRCRAFT A-4M

LOCATION: Lower Aft Equipment Compartment

SUPPORT EQUIPMENT: None

ACCESS: Unlatch three quick release door fasteners and lower door
Remove cover of gyro box by removing ten bolts

REMOVAL: 1. Remove four bolts securing unit
2. Disconnect electrical connector

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Functional check is made by operating the unit.

TEST EQUIPMENT:
Aircraft electrical power

CLOSE UP: Replace cover on gyro
Close access panel

ANALYST'S OPINION: The access to the gyro could be improved by removing the cover from the gyro. The location of the equipment is good since all maintenance can be accomplished at ground level.

WORK UNIT CODE 56882 ITEM Pitch & Roll Gyro AIRCRAFT A-6

LOCATION: Aft Equipment Compartment

SUPPORT EQUIPMENT: None

ACCESS: Lower aft compartment door and enter aircraft.

REMOVAL: 1. Remove connectors
2. Loosen thumb screws securing unit
3. Remove component

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Specialist stated he rotates unit and checks indicator for response before he installs unit. He was not aware of any test equipment used to check system.

TEST EQUIPMENT: Electrical power
Test equipment unknown

CLOSE UP: Close compartment door

ANALYST'S OPINION: The location and accessibility of the unit is excellent. The functional test, as described by the specialist, is not adequate. A system simulator should be provided, or designed, for use in making a reliable functional test of the system.

WORK UNIT CODE 56X13 ITEM Roll & Pitch Gyro AIRCRAFT F-4B

LOCATION: Aft Cockpit Below Left Hand Console

SUPPORT EQUIPMENT: None

ACCESS: Open canopy
Loosen 14 fasteners and remove panel
Disconnect connectors in the AFCS, Nav. Computer Control and the Data Link Control

REMOVAL:
1. Remove two connectors
2. Remove three mounting bolts securing the unit
3. Slide gyro out of mounting

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System is checked by using a compass adapter compensator
Perform heading reference and attitude reference system check
Functionally check AFCS system
Check data link

TEST EQUIPMENT: PSM-18, Electrical Power, Hydraulic Supply needed for the Utility, PC-1 & PC-2 systems

CLOSE UP: Reconnect system connectors Close canopy
Replace panel

ANALYST'S OPINION: Access to the unit is too difficult and time consuming. The requirement to disconnect operational connectors for access is considered very poor. The functional check of the gyro system and those systems that were disconnected is very time consuming. Disconnecting systems that are not considered faulty only increases the possibility of inducing malfunctions and causing additional maintenance actions.

SYSTEM: 56 Flight Reference System

NOMENCLATURE: Air Data Computer

WUC: A-4: 56550 A-6: 565A0 A-7: 73A61 F-4: 56454

F-8: _____ F-14: 56X18 AV-8: 56990

GENERAL OBSERVATIONS: The A-7 and F-14 Built-in-Test (BIT) features prove the continuing desirability of this capability. Access varied from very good to very poor among the airplanes. Overall, component design allowed simple removal tasks.

DESIRABLE FEATURES: 1. The A-7 and F-14 provide BIT features that simplify functional test significantly. The F-14 is checked solely by BIT while the A-7 requires further check of the integration with other systems using the tactical computer operational test program and a test set. 2. The A-6, A-7, and AV-8 installations offer deck level access. The AV-8 access, however, is degraded by a removable panel held on with 24 fasteners.

UNDESIRABLE FEATURES: 1. Access appears as a problem in several airplanes. The location in the F-4 which requires removal of the seat and a radio R/T unit is not acceptable. The A-4 has too much congestion around the unit. The F-14 and AV-8 have numerous fasteners in the panel. 2. The A-6 probe is located on the vertical fin. Hooking up the pneumatic line from the test set could be a real adventure if the tail is extended over the deck edge. 3. The A-4 installation required bending of the pitot static lines to get the unit out.

SYSTEM: 56 Flight Reference System

NOMENCLATURE: Air Data Computer

ADDITIONAL REMARKS: Some ADC units, notably the A-4 unit, were mounted in a low area of the pitot system. This presents moisture problems and resulting additional maintenance.

WORK UNIT CODE: 56550 ITEM: Air Data Computer AIRCRAFT: A-4M

LOCATION: Left Side of Nose Wheel Well

SUPPORT EQUIPMENT: None

ACCESS: None

REMOVAL:
1. Remove electrical connectors and pitot, static lines
2. Remove four bolts securing unit to frame
3. Remove unit (removal of unit is difficult)

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System is checked using air data computer test set. Weapon System is checked for inputs from the air data computer.

TEST EQUIPMENT: TTU-205, CY-651/ASM-332A
Electrical power

CLOSE UP: None

ANALYST'S OPINION: Removal and installation of the two outside bolts securing the unit is very difficult. Once removed, the unit must be somewhat worked out of the area very slowly so as not to damage it. Removal/replacement is considered poor. Frequent removal of the unit also tends to damage the pitot and static lines, becuase they must be folded out of the way once disconnected. Unit should also be relocated in the aircraft. At present, it is at the lowest part of the pressure system which tends to damage the ADC because of water ingestion.

WORK UNIT CODE 565AO ITEM Air Data Computer AIRCRAFT A-6

LOCATION: Aft Equipment Compartment

SUPPORT EQUIPMENT: None

ACCESS: Lower aft compartment door (this provides a means to enter aircraft compartment).

REMOVAL:
1. Remove four connectors
2. Disconnect pitot/static lines
3. Remove unit

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Functional test using test equipment.

TEST EQUIPMENT: TS-1809/APM-123 Air Data Tester and aircraft power

CLOSE UP: Close compartment door

ANALYST'S OPINION: Location and installation of the unit in the aircraft is excellent. Design of the aircraft compartment provides a ground level access to a number of avionic components. The system functional test does pose a problem since the specialist must walk up the aircraft to install pneumatic line on probe located on the vertical tail.

WORK UNIT CODE 73A61 ITEM Air Data Computer AIRCRAFT A-7

LOCATION: Right Hand Avionics Bay

SUPPORT EQUIPMENT: None

ACCESS: Open avionic compartment door
(8 quick release fasteners)

REMOVAL:
1. Disconnect two (2) pressure lines. Cap lines.
2. Disconnect two (2) electrical plugs (safety wired).
3. Release one (1) quick release latch.
4. Remove air data computer.

INSTALLATION: Reverse removal operation

FUNCTIONAL CHECK: Perform self test of Air Data Computer
Check Tactical Computer utilizing OTP.
Perform a functional check of Air Data Computer.

TEST EQUIPMENT: TTU-205 Test Set
External Electric Power

CLOSE UP: Close access door (8 quick release fasteners)

ANALYST'S OPINION: Access to the ADC is excellent and the removal/replacement of the unit is a simple task accomplished at ground level. Self-test of the Air Data Computer checks only the unit. Other system checks are made to verify correct interface operation.

WORK UNIT CODE: 56454 ITEM Air Data Computer AIRCRAFT F-4J

LOCATION: Below LH Console Rear Cockpit

SUPPORT EQUIPMENT: Open canopy

ACCESS: Remove ejection seat
Remove radio R/T unit (loosen two bolts and slide unit out)

REMOVAL:
1. Loosen wing type fasteners securing ADC
2. Slide unit out from mount to position vacated by R/T unit. Slide ADC out of area and remove unit.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform functional check of Bell Mouth System, variable ram, AOA, pitot and static system, engine bleed air and leak check. Functional test is accomplished on associated systems.

TEST EQUIPMENT: AN/PSM-15

CLOSE UP: Replace radio R/T unit, replace ejection seat

ANALYST'S OPINION: Access to the ADC is considered poor. Unit should be located elsewhere on the aircraft to improve accessibility. Removal/replacement action of the ADC, on other aircraft, is generally an easy task. However, on this aircraft it is a major maintenance action requiring removal of the ejection seat. Location of the ADC leads one to believe it was an after-the-fact requirement.

WORK UNIT CODE: 56X18 ITEM: CP-1035/A AIR DATA COMPUTER (ADC) AIRCRAFT: F-14

LOCATION: RH side of mid fuselage area

SUPPORT EQUIPMENT: Work Stand

ACCESS: Loosen 41 Calfax fasteners securing panel.

REMOVAL:
1. Cut safety wire and loosen 2 hold down fasteners securing ADC.
2. Disconnect 3 electrical connectors.
3. Disconnect pitot & static line fittings.
4. Remove ADC from aircraft.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform ADC BIT check only

TEST EQUIPMENT: Aircraft Electrical power.

Note: The AE-42 CADC tester is used for an integrated system test but not on a R/R action.

CLOSE UP: Install panel.

ANALYST'S OPINION: The location, removal/replacement of the ADC is considered good. The removal of an access panel with forty-one (41) fasteners does consume too much time. The functional test, using BIT, is an asset to the maintenance task.

WORK UNIT CODE: 56990 ITEM: AIR DATA COMPUTER AIRCRAFT: AV-8

LOCATION: RH Avionics Bay, Bottom Equipment Shelf

SUPPORT EQUIPMENT: None

ACCESS: Remove 24 fasteners securing panel.
Remove panel from aircraft.
Open canopy.

REMOVAL:
1. Loosen clamp securing pitot & static lines and remove lines.
2. Cut safety wire on 2 retaining nuts.
3. Loosen retaining nuts securing unit.
4. Slide ADC from rack and panel mount and remove from aircraft.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform BIT check - this is a combined ADC and HUD check (5 minute check).
Perform AIM functional test.

TEST EQUIPMENT: Electrical Power
TTU-205
IFF Tester

CLOSE UP: Replace access panel
Close canopy

ANALYST'S OPINION: Removal/replacement of the ADC is a simple task. Access to the unit is degraded and could be improved by having quick release fasteners and a hinged panel rather than removing 24 fasteners and handling the aircraft panel.

SYSTEM: 57 Integrated Guidance and Flight Control

NOMENCLATURE: Automatic Flight Directional Computers

AUC:	A-4:	57514 57512 576C3 576A4	A-6:	57711 57712	A-7:	57575 57577 57576	F-4:
	F-8:	576A5	F-14:	57713	AV-8:	57890	

GENERAL OBSERVATIONS: Once access has been gained, all the installations were easy to remove. Functional checks required use of external hydraulic sources. In general, the computers were accessible from deck level. The A-6 and F-4 installations were not studied. AFCS yaw computers were observed only in the A-7, F-8 and AV-8 installations. Most of the AFCS computers for a given aircraft were located in the same compartment.

DESIRABLE FEATURES: 1. Installation of the AFCS computers on a single rack, using rack and panel connectors, is the strong point of the A-7 installation. The connectors alleviate unnecessary cable interference while the use of a single rack places all the computers in one area - a definite ease in troubleshooting. 2. The use of BIT in the F-14 and AV-8 reduces GSE requirements and facilitates the operational check. Utilization of BIT circuitry as a maintenance tool cannot be stressed too much as a time-saver.

UNDESIRABLE FEATURES: 1. The use of an excessive number of fasteners hampered access to the F-14, F-8 and AV-8 computers. Using quick release rather than stress panel fasteners and reducing the number of fasteners will reduce the difficulty of gaining access. 2. Using work stands, needed in the removal of the F-8 and AV-8 computers is a chore

SYSTEM: 57 Integrated Guidance and Flight Control

NOMENCLATURE: Automatic Flight Directional Computers

UNDESIRABLE FEATURES: (Cont.)

for those persons performing maintenance. The work stands are heavy, cumbersome and awkward to transport. Coordination during design of the component and the access should strive for the preferred deck-level installation. 3. Any adjustment after installation is undesirable. In the case of the A-7, four potentiometers need to be adjusted. To alleviate this problem, the design of the computers should be such that all adjustments, if any, are done in a shop environment.

ADDITIONAL REMARKS: Incorporation of built-in-test, rack and panel connectors and deck-level, single compartment location are features - when combined - that provide an optimum installation for this type of equipment.

WORK UNIT CODE: 57514 ITEM ROLL AMP COMPUTER AIRCRAFT A-4M

LOCATION: AFCS Compartment

SUPPORT EQUIPMENT: None

ACCESS: Open two quick release fasteners and lower panel.
Open canopy.

REMOVAL:
1. Remove safety wire
2. Disconnect electrical cable
3. Loosen two "spin-tights"
4. Remove unit from mount

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System run-up to determine proper response.

TEST EQUIPMENT: Hydraulic Power Source
Electrical external power

CLOSE UP: Close access panel
Close canopy

ANALYST'S OPINION: Access to the unit is excellent, removal/replacement can be accomplished at ground level. The use of a hydraulic stand is required to provide aircraft flight control responses.

WORK UNIT CODE 57512 ITEM PITCH AMP. COMPUTER AIRCRAFT A-4M

LOCATION: AFCS Compartment, Aft. Fuselage

SUPPORT EQUIPMENT: None

ACCESS: Open two quick diconnects, and lower access door

REMOVAL:
1. Remove connector
2. Remove safety wire on knurl knobs
3. Loosen two knurl knobs
4. Remove unit from mount

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System functional test is made using hydraulic stand to determine proper response.

TEST EQUIPMENT: Hydraulic source
Aircraft power

CLOSE UP: Close access panel, close canopy
Remove test stand

ANALYST'S OPINION: Access to the unit is excellent, removal/replacement can be accomplished at ground level.

WORK UNIT CODE 57575 ITEM PITCH AMP. COMPUTER AIRCRAFT A-7

LOCATION: Left Hand Avionic Bay

SUPPORT EQUIPMENT: None

ACCESS: Release eight (8) quick release door latches and lower door.

REMOVAL: 1. Remove safety wire
2. Release latch lock and remove computer from mount

INSTALLATION: Reverse of removal.

FUNCTIONAL CHECK: Perform self test on computer
Balance four potentiometers and functional test system

TEST EQUIPMENT: External hydraulic source
Electrical power
AN/ASM 245 or equivalent

CLOSE UP: Secure access panel,

ANALYST'S OPINION: The access to the pitch computer is excellent. The removal/replacment task is rather simple, and one that can be accomplished at ground level. The rack and panel installation of the computer into one common rack (pitch, roll and yaw) is considered ideal and reduces cable interface problems. The requirement to balance four potentiometers after installation degrades from the overall task.

WORK UNIT CODE 57577 ITEM YAW AMP COMPUTER AIRCRAFT A-7

LOCATION: Left Hand Avionic Compartment

SUPPORT EQUIPMENT:

None

ACCESS: Release 8 quick release latches and lower door

REMOVAL:
1. Remove safety wire on latch lock
2. Remove computer from mount

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform a self test on computer
Balance four potentiometers and perform a system functional test

TEST EQUIPMENT: External power
Hydraulic source
AN/ASM-245

CLOSE UP:

Close access panel

ANALYST'S OPINION: The access to the yaw computer is excellent. The removal/replacement task is easy and can be accomplished at ground level. The rack and panel installation of the computer is considered good, and it reduces cable interface problems. The requirement to adjust four potentiometers after installation degrades from the overall task.

WORK UNIT CODE: 57576 ITEM ROLL AMPLIFIER COMPUTER AIRCRAFT A-7

LOCATION: Left Hand Avionics Bay

SUPPORT EQUIPMENT: None

ACCESS: Release 8 quick release latches and lower avionics bay access panel.

REMOVAL:
1. Remove safety wire from latch handle lock (rack and panel installation).
2. Loosen two (2) hold down screws (captive).
3. Slide out amplifier.

INSTALLATION: Reverse removal procedure

FUNCTIONAL CHECK: Perform self test of roll amplifier computer. Balance four (4) potentiometers and perform functional test of roll amplifier computer.

TEST EQUIPMENT: External hydraulic power
External electric power
PAVM VM-2C2 (North Atlantic) and Breech Box AN/ASM-245

CLOSE UP: Close access door.

ANALYST'S OPINION: The accessibility to the roll amplifier is excellent. The task to remove and replace this unit is a simple task and one that is accomplished at ground level. The rack and panel installation of the unit in a mother-rack (these roll, pitch, & yaw computers are mounted in the same mount or rack) is considered an ideal installation and reduces cable interface problems.

WORK UNIT CODE 576C3/576A4/576A5 ITEM PITCH, ROLL, YAW AMPLIFIER AIRCRAFT F-8

LOCATION: Right side of aircraft aft of the cockpit.

SUPPORT EQUIPMENT: Work Stand is required.

ACCESS: Remove access panel by removing 24 panel fasteners

REMOVAL:
1. Remove angle bracket that secures the Roll and Yaw computer
2. Disconnect electrical connectors
3. Loosen thumb screws holding unit in
4. Remove computer from mount

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System is checked using AN/APM 102 tester.

TEST EQUIPMENT: Flight Control Test Set (AN/APM-102)
Hydraulic Power
Electrical Power

CLOSE UP: Replace panel

ANALYST'S OPINION: The flight control components are mounted in a mother rack housing each of the computers which simplifies removal/replacement and provides unobstructed access to the units. Functional testing of the system requires an external hydraulic source.

WORK UNIT CODE 57712 ITEM PITCH COMPUTER AIRCRAFT F-14

LOCATION: R.H. Mid Fuselage Bay

SUPPORT EQUIPMENT: None

ACCESS: Loosen 41 Calfax fasteners securing panel.

REMOVAL: 1. Cut safety wire and loosen 2 hold down fasteners securing pitch computer
2. Disconnect 3 electrical connectors
3. Remove computer from aircraft

INSTALLATION: Reverse of removal.

FUNCTIONAL CHECK: Perform BIT check of computer (activation switch is located on the computer) and perform a system functional test.

TEST EQUIPMENT: Electrical power unit
Hydraulic unit.

CLOSE UP: Replace aircraft panel and secure

ANALYST'S OPINION: Access to the computer is considered marginal due to the 41 fasteners that must be loosened. Access could be improved by using quick release latches and a swing/hinged aircraft panel. Functional check of system, using BIT, and a system integration test is common to all flight control computers in the F-14.

WORK UNIT CODE 57711 ITEM ROLL COMPUTER AIRCRAFT F-14

LOCATION: Left hand mid fuselage bay

SUPPORT EQUIPMENT: None

ACCESS: Loosen 41 Calfax fasteners and remove access panel.

REMOVAL:
1. Cut safety wire and loosen two hold down fasteners securing computer.
2. Disconnect electrical connector.
3. Remove computer from aircraft.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform BIT check of computer and a system functional test.

TEST EQUIPMENT: Hydraulic unit
Electrical power unit

CLOSE UP: Replace access panel and secure

ANALYST'S OPINION: Access to the computer is considered marginal due to the 41 fasteners that must be removed. This could be improved by using quick release fasteners and a swing down panel. The functicnal test of the unit is accomplished using "BIT."

WORK UNIT CODE: 57713 ITEM: Yaw Computer AIRCRAFT: F-14

LOCATION: RH Mid Fuselage Bay

SUPPORT EQUIPMENT: None

ACCESS: Loosen 41 Calfax fasteners securing panel.

REMOVAL:
1. Cut safety wire and loosen 2 hold down fasteners securing yaw computer.
2. Disconnect 3 electrical connectors.
3. Remove computer from aircraft.

INSTALLATION: Reverse of removal.

FUNCTIONAL CHECK: Perform BIT check of computer (activation switch is located on the computer) and perform a system functional test.

TEST EQUIPMENT: Electrical power unit.
Hydraulic unit.

CLOSE UP: Replace aircraft panel and secure.

ANALYST'S OPINION: Access to the computer is considered marginal due to the 41 fasteners that must be loosened. Access could be improved by using quick release latches and a swing/hinged aircraft panel. Functional check of system, using BIT, and a system integration test is common to all flight control computers in the F-14.

WORK UNIT CODE 57890 ITEM PITCH/ROLL COMPUTER AIRCRAFT AV-8

LOCATION: L.H. Avionic Bay, upper equipment rack

SUPPORT EQUIPMENT: None

ACCESS: Remove 24 fasteners securing access panel.

REMOVAL:
1. Cut safety wire
2. Disconnect 2 electrical connectors
3. Loosen captive screw securing computer
4. Remove computer from rack

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform "BIT" check of the Auto Stab System

TEST EQUIPMENT: Hydraulic Source
Aircraft Electrical Power

CLOSE UP: Replace access panel & secure

ANALYST'S OPINION: Access to the unit is somewhat hampered because of the requirement to remove 24 fasteners. Removal/replacement of the unit is easy. The "BIT" feature on the unit is a quick check of the unit.

COMMUNICATION SYSTEMS

UHF RADIO R/T SETS AND CONTROLS [redacted]

IFF RECEIVER/TRANSMITTER [redacted]

COMMUNICATIONS

CONTENTS

COMPONENT	A-4	A-6	A-7	F-4	F-8	F-14	AV-8
UHF Radio R/T Sets and Controls	6315Q 63155	63Y1Q	63Y28 6315Q	67X1F 67X1G	6315Q 6315U	6315Q	632MO
IFF Receiver/Transmitter	65341	N/A	65341	65321	65341 65Y1Y	65341	65341

SYSTEM: 63 UHF Communications System

NOMENCLATURE: UHF Radio R/T Sets and Controls

WUC: A-4: 6315Q 63155 A-6: 63Y1Q A-7: 6315Q 63Y28 F-4: 67X1F 67X1G

F-8: 6315Q 6315U F-14: 6315Q AV-8: 632M0

GENERAL OBSERVATIONS: Included in this summary are the UHF Radio Receiver/ Transmitter and the UHF Radio Control Box. Access to the console mounted radio control was uniform in its ease of removal. In general, the UHF radio R/T unit was easily removed, though, in most instances was poorly located. Some installations required PGSE to perform functional checks. All items required a checkout with the base radio station. The A-6 R/T unit and the F-14 and AV-8 radio controls were not investigated.

DESIRABLE FEATURES: 1. Access and removal of the control box was excellent employing several quick release fasteners and allowing sufficient wire slack to make disconnections. The A-7 R/T installation was alone in its convenient ground level access. Once access has been gained, all of the R/T units are easily removed. 2. The side by side cockpit seating of the A-6 and the center console location of the radio control enabled easy removal from either seat.

UNDESIRABLE FEATURES: 1. Location of the UHF radio R/T units was weakest point of their installations, excepting the A-7 and F-14. The F-4 unit requires ejection seat removal. The A-4 installation under the radome necessitates a work stand and cannot be worked on with the engine running. The F-8 R/T is poorly located on the air-

SYSTEM: 63 UHF Communications System

NOMENCLATURE: UHF Radio R/T Sets and Controls

UNDESIRABLE FEATURES: (Cont.)

craft spine, while the AV-8 cockpit installation requires the VHF/FM control be displaced. Considering that this component is a frequency removed component, placement is of paramount importance. 2. Resetting the channels of the UHF radio control adds time to the functional checks of the F-4 and F-8. Selection/design of the radio control should preclude this additional step.

ADDITIONAL REMARKS: Very little can be done to the design of the control boxes that will impart a significant improvement of the installation. However, much more consideration during design must be given to the placement of the frequency removed R/T unit. An installation which allows replacement with engines turning and preferably without need of a work stand is the desired approach. This enables maintenance personnel to avert a mission abort and is less hazardous for mechanics.

WORK UNIT CODE 63159 ITEM UHF Radio R/T AIRCRAFT A-4M

LOCATION: C.N.I. Rack

SUPPORT EQUIPMENT: Maintenance stand
$\frac{1}{2}$" speed wrench

ACCESS: Open nose compartment (using $\frac{1}{2}$" speed wrench the forward nose section is cranked open).

REMOVAL:
1. Remove safety wire
2. Remove connectors
3. Loosen thumb screws
4. Remove unit

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System is checked using base station

TEST EQUIPMENT: Electrical power.

CLOSE UP: Close nose compartment

ANALYST'S OPINION: The location of the radio R/T is not considered good. removal replacement can not be accomplished after engine start and would therefore require engine shut down for removal. This would cause a delay in take off or require a re-spot of the aircraft for removal of the unit. The frequent removal of the unit justifies that it be re-located on the aircraft.

WORK UNIT CODE 6315Q ITEM UHF RECEIVER TRANSMITTER AN/ARC 51(v) AIRCRAFT A-7

LOCATION: Right Hand Avionic Bay

SUPPORT EQUIPMENT: None

ACCESS: Release ten quick release fasteners and lower access door.

REMOVAL:
1. Remove three (3) connectors.
2. Remove safety wire.
3. Remove two hold down bolts.
4. Remove unit from mount.

INSTALLATION: Reverse removal procedure.

FUNCTIONAL CHECK: Perform power out check on 3-4 channels.
Check [illegible] pre-set channels.

TEST EQUIPMENT: External Electric power

CLOSE UP: Close avionic bay access door.

ANALYST'S OPINION: Access to the R/T unit is excellent. The radio unit can be replaced at ground level, without the use of special tools, and can be removed while the engine is running. This feature will allow removal/replacement of the unit prior to take off which will eliminate delays encountered in most aircraft installations.

WORK UNIT CODE 67X1F ITEM UHF RECR/TRANSMITTER AIRCRAFT F-4J

LOCATION: Aft Cockpit, Left Side Below Console

SUPPORT EQUIPMENT: None

ACCESS: Open canopy
Remove ejection seat

REMOVAL: 1. Remove safety wire
2. Loosen two hold down clamps
3. Remove bolt
4. Slide unit out of rack and remove

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform functional test using system test set, and an operational test using the base station.

TEST EQUIPMENT: ASM-23
Electrical power

CLOSE UP: Replace ejection seat
Close canopy

ANALYST'S OPINION: The location of the unit is considered poor. Access to the unit is gained only after the ejection seat is removed. Considering the frequent removal of the unit and the requirement of having to remove the ejection seat, this unit should be relocated in the aircraft. The present installation has generated the removal of the radio, what is considered a simple task in other aircraft, into a major maintenance action.

WORK UNIT CODE 6315Q ITEM UHF ARC/51 AIRCRAFT F-8

LOCATION: Unit is located in the CNI compartment behind the cockpit.

SUPPORT EQUIPMENT: Work stand.

ACCESS: Loosen 15 panel fasteners and remove two access panels

REMOVAL:
1. Remove two connectors.
2. Remove safety wire.
3. Remove two thumb screws.
4. Remove unit.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Functional check of all pre-set channels and the remote channel frequency indicator operation. ADF mode is also checked with base station.

TEST EQUIPMENT: Electrical power

CLOSE UP:
Secure panel.

ANALYST'S OPINION: The installation and location of the unit is poor. Specialist must walk on the wing of the aircraft to get to the location. He then must handle two access panels (pass them to a specialist on the ground) and then lift the unit up out of its mount. The handling/carrying of equipment over wing/aircraft surfaces increases the probability that the specialist could get hurt and/or damage could be caused to the airframe. The frequent removal of the unit warrants that it be relocated at a more accessible area on the aircraft.

WORK UNIT CODE 6315Q ITEM RT 743( )/ARC-51A Receiver Transmitter AIRCRAFT F-14

LOCATION: RH Forward Avionics Bay (Aft of Radar Compartment)

SUPPORT EQUIPMENT: Work Stand

ACCESS: Loosen 23 Calfax fasteners
Open access and position panel holding bar

REMOVAL:
1. Cut safety wire and loosen 2 wing nuts securing R/T unit
2. Disconnect 2 electrical connectors
3. Disconnect 1 RF connector
4. Remove R/T unit from aircraft

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform an operational test of UHF Radio Set

TEST EQUIPMENT: Electrical Power

CLOSE UP: Replace access panel

ANALYST'S OPINION: Access to the unit is degraded by the number and type of fasteners used on the aircraft panel. This could be improved by using quick release fasteners. The location of the unit is not considered favorable because of the need for a maintenance stand. The frequency of this task (removal rate of UHF radio) warrants it to be located on the aircraft to allow removal/replacement without the need for a maintenance stand.

WORK UNIT CODE 632MO ITEM UHF Radio Set AIRCRAFT AV-8

LOCATION: Cockpit Right Hand Console

SUPPORT EQUIPMENT: Pilot's Ladder

ACCESS: Open canopy
Loosen two dzus fasteners and remove side access panel
Loosen six dzus fasteners on VHF/FM set control and reposition

REMOVAL:
1. Loosen 8 dzus fasteners securing radio set to console
2. Lift radio set and disconnect the antenna connection and the electrical connection
3. Remove radio set from aircraft by tilting inboard and lifting out.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Reset preset channels
Perform operational check on the UHF and ADF system

TEST EQUIPMENT: Electrical Power

CLOSE UP: Replace VHF/FM radio set control
Replace access panel
Close canopy

ANALYST'S OPINION: The present method of installing the UHF Radio Set does not take full advantage of the console mounted features. The removal of an access panel, in the confines of the cockpit, and the requirement to remove or reposition adjacent components in order to remove the radio set is considered very undesirable. The removal/installation procedure should be evaluated and consideration be given to change the present installation.

WORK UNIT CODE 63155 ITEM UHF Radio Set Control AIRCRAFT A-4

LOCATION: Cockpit Right Console Area

SUPPORT EQUIPMENT: Cockpit Ladder

ACCESS: Open canopy

REMOVAL:
1. Remove eight dzus fasteners
2. Remove control box from console
3. Disconnect cables

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System is ground checked with base station

TEST EQUIPMENT: Electrical Power

CLOSE UP: Close canopy

ANALYST'S OPINION: Removal/replacement and access to the control box is considered a normal installation. The complete maintenance task is simple and can be accomplished without peculiar ground support equipment.

WORK UNIT CODE 63Y1Q ITEM UHF Radio Control AIRCRAFT A-6

LOCATION: Cockpit Center Console

SUPPORT EQUIPMENT: None

ACCESS: Open cockpit

REMOVAL:
1. Loosen four dzus fasteners
2. Lift control out of the console
3. Disconnect cable

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System is functional tested by contacting the base station.

TEST EQUIPMENT: Aircraft power

CLOSE UP: Close canopy

ANALYST'S OPINION: The location of the unit simplifies the removal/replacement of the control box. Unit can be removed from either side of the cockpit. Dual cockpit design allows maintenance to be scheduled concurrently with other actions.

WORK UNIT CODE 63Y28 ITEM Radio Set Control AIRCRAFT A-7

LOCATION: Cockpit Left Hand Console

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Remove four (4) quick release fasteners
2. Lift control from the console
3. Disconnect cables and remove unit.

INSTALLATION: Reverse removal procedure

FUNCTIONAL CHECK: System is ground checked with base station.

TEST EQUIPMENT: External Electric Power

CLOSE UP: Close canopy

ANALYST'S OPINION: Removal/replacement and access to the control box is considered a normal installation. The functional test of the system is easier than in other installations in that the pre-set channels (radio) are not set up in the radio control box. This feature simplifies the functional test of the control box.

WORK UNIT CODE 67X1G ITEM Radio Set Control AIRCRAFT F-4

LOCATION: Forward Cockpit (Right hand console)
Aft cockpit (Left hand console)

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Loosen eight fasteners
2. Lift control box from console
3. Remove two electrical connectors
4. Remove control box from the console

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Reset channel frequencies and functionally check system with ground station

TEST EQUIPMENT: Electrical Power

CLOSE UP: Close canopy

ANALYST'S OPINION: Removal/installation and access to the control box is considered a normal installation. The requirement to enter channel frequencies adds some time to the functional test.

WORK UNIT CODE: 6315U ITEM: UHF Control AIRCRAFT: F-8

LOCATION: Cockpit Right Console Area

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:

1. Remove eight fasteners
2. Lift control box from the console
3. Disconnect electrical connector
4. Remove control box from console

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Reset set channel frequencies and functionally check system with base station

TEST EQUIPMENT: Electrical Power

CLOSE UP: Close canopy

ANALYST'S OPINION: Removal/replacement and access to the control box is considered a normal installation. Functional test of the system is similar to other aircraft installations.

SYSTEM: 65 IFF Systems

NOMENCLATURE: IFF Receiver/Transmitter

NUC: A-4: 65341 A-6: _____ A-7: 65341 F-4: 65321

F-8: 65341 65Y1Y F-14: 65341 AV-8: 65341

GENERAL OBSERVATIONS: The IFF Receiver Transmitter and the F-8's IFF Encoding Computer are included in this summary. All components were easy to remove. Accessibility in some instances was inhibited by too many fasteners or location. All installations, except the AV-8, required operational tests utilizing a test set. The A-6 IFF R/T was not surveyed.

DESIRABLE FEATURES: 1. The AV-8 makes use of a BIT feature which greatly simplifies its operational test by eliminating test equipment. The incorporation of BIT where possible cannot be stressed too greatly as an excellent maintenance tool. 2. The convenient ground level work area of the A-7, F-4 and AV-8 installations facilitated their removal.

UNDESIRABLE FEATURES: 1. Access is a problem on both F-8 components. The IFF R/T unit is located on the forward spine of the aircraft. This entails clambering around on the wing with the removed unit-hazardous to personnel and potentially damaging to the component. The IFF Encoding Computer requires removal of non-associated equipment to gain access. This should be avoided as it requires unnecessary maintenance time and is possibly deterious to the disturbed system. 2. Too many fasteners on access panels in the F-14 and AV-8 and the nose installation in the A-4 degrade otherwise good installations. Changing location on the A-4 to a more accessible area would have eased removal.

SYSTEM: 65 IFF Systems

NOMENCLATURE: IFF Receiver/Transmitter

UNDESIRABLE FEATURES: (Cont.)

Likewise, fewer fasteners enhance an installations removal.

ADDITIONAL REMARKS: Little improvement can be made on the installation of the components. However, consideration of placement during design should/will help reduce maintenance times by improving access. Incorporation of BIT into avionics equipment is a "Godsend" in easing installation checkouts and in troubleshooting.

WORK UNIT CODE: 65341 ITEM IFF Receiver/Transmitter AIRCRAFT A-4

LOCATION: Nose CNI Compartment

SUPPORT EQUIPMENT: Maintenance stand

ACCESS: Open nose compartment (using $\frac{1}{2}$" speed wrench the forward nose section is cranked open).

REMOVAL:
1. Remove coaxial cable
2. Remove operational connector
3. Remove safety wire
4. Loosen two lock downs
5. Remove unit from mount

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System is functionally checked using test equipment

TEST EQUIPMENT: AN/APM-123(V)
External Electrical Power

CLOSE UP: Close nose section and secure

ANALYST'S OPINION: Removal/installation of the unit is considered common to other aircraft installations. The opening of the nose section, to gain access, and the requirement for a maintenance stand degrades the overall task.

WORK UNIT CODE 65341 ITEM IFF Receiver/Transmitter AIRCRAFT A-7

LOCATION: Right Hand Avionic Bay

SUPPORT EQUIPMENT: None

ACCESS: Open ten quick release fasteners and lower access door

REMOVAL:
1. Remove coaxial connector and operational connector
2. Remove 2 equipment hold down bolts
3. Slide unit out of mount

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System is functionally checked using test equipment.

TEST EQUIPMENT: AN/ASM-123(V)
External Electrical Power

CLOSE UP: Close and secure bay door

ANALYST'S OPINION: The location of the unit at ground level provides easy access to the unit for removal/replacement. The system functional check is common to other aircraft installations. Corrective maintenance is considered a simple task.

WORK UNIT CODE: 65321 ITEM: IFF Receiver/Transmitter AIRCRAFT: F-4

LOCATION: CNI Compartment

SUPPORT EQUIPMENT: None

ACCESS: Loosen six screws securing access panel and remove from aircraft.

REMOVAL:
1. Cut safety wire
2. Loosen wing bolt securing unit
3. Slide unit out of mount

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System is functionally checked using test equipment

TEST EQUIPMENT: AN/ASM-123(V)
Electrical Power

CLOSE UP: Replace access panel and secure

ANALYST'S OPINION: Removal/replacement of the unit is considered common to other aircraft installation. The access to this unit is considered good for the F-4 aircraft.

WORK UNIT CODE 65341 ITEM IFF Rec/Trans AIRCRAFT F-8

LOCATION: Located in the CNI Compartment Behind the Cockpit

SUPPORT EQUIPMENT: Maintenance stand

ACCESS: Loosen 15 fasteners and remove access panel

REMOVAL:
1. Remove one coaxial connector
2. Remove two bolts securing unit to mount
3. Lift unit out of mount

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System is checked using test equipment

TEST EQUIPMENT: AN/APM-123(V)
Electrical Power

CLOSE UP: Replace panel

ANALYST'S OPINION: The location and access to the unit is poor. Maintenance specialist must walk over the wing of the aircraft to the location, he must then handle two access panels and lift the unit from the mount. The handling/carrying of equipment over aircraft surfaces increases the probability of damage to the airframe. Functional test of the system is common to other aircraft installation.

WORK UNIT CODE 65341 ITEM RT-859( )/APX-72 IFF Receiver Transmitter AIRCRAFT F-14

LOCATION: LH Aft Avionics Bay

SUPPORT EQUIPMENT: Work stand

ACCESS: Loosen 30 Calfax fasteners securing panel
Remove access panel from aircraft

REMOVAL:
1. Loosen 2 screws securing electrical connector and disconnect electrical connector.
2. Disconnect 1 coax connector
3. Loosen 2 nut type hold down fasteners securing RT unit
4. Slide RT from rack and remove from aircraft

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform system functional test equipment

TEST EQUIPMENT: AN/ARM-378 and TTU-205
Electrical Power

CLOSE UP: Replace and secure the aircraft panel

ANALYST'S OPINION: The installation/removal/replacement of the unit is typical of most aircraft installation. The removal of 30 fasteners, handling of an aircraft panel and the requirement for a maintenance stand to accomplish the task complicates what is normally considered a simple maintenance task. Use of quick release fasteners and a hinged access panel would improve the maintenance task.

WORK UNIT CODE 65341 ITEM IFF Receiver/Transmitter AIRCRAFT AV-8

LOCATION: Left Hand Avionic Bay, Upper Equipment Rack

SUPPORT EQUIPMENT: None

ACCESS: Remove 22 fasteners securing aircraft panel
Remove access panel

REMOVAL:
1. Loosen two screws and remove connector
2. Remove coaxial connector
3. Cut safety wire and loosen two hold down bolts
4. Remove unit from mount

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform "BIT" test of system and accomplish AIMS interface test

TEST EQUIPMENT: Electrical Power

CLOSE UP: Replace access panel and secure

ANALYST'S OPINION: The installation, removal/replacement of the unit is typical to other aircraft installations. Access to the unit could be improved by using quick release fasteners and a hinged door.

WORK UNIT CODE 65Y1Y ITEM CPU-46/A(U) Computer AIRCRAFT F-8

LOCATION: Left Hand Utility Compartment

SUPPORT EQUIPMENT: None

ACCESS: 1 Panel (13 fasteners)
Remove analyzer (4 plugs, 5 bolts)

REMOVAL:
1. Remove two pressure lines
2. Remove three system connectors
3. Remove two knurl hold down fasteners to remove unit

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System check is accomplished using TTU-205 tester.
System check of analyzer unit.

TEST EQUIPMENT: TTU-205, analyzer test equipment unknown.

CLOSE UP: Replace analyzer and aircraft panel

ANALYST'S OPINION: The installation of the charger Blue equipment requires removal of a analyzer unit before the ADC can be removed. Installation and remova_ is not considered acceptable because of the removal requirement of another system WRA. However, the basic installation, removal/replacement of the unit was good prior to the addition of the charger Blue equipment.

NAVIGATION SYSTEMS

TACAN [redacted]

RADAR ALTIMETER [redacted]

DOPPLER RADAR [redacted]

NAVIGATION SYSTEMS

CONTENTS

COMPONENT	A-4	A-6	A-7	F-4	F-8	F-14	AV-8
TACAN	71X1L	N/A	71431	71X1L	71X1L	71X1L	71X1L
	71431						
	713C1			67170	71431	713C0	718Y1
Radar Altimeter	72361	72361	72361	72361	72241	722B1	722B1
	72362	72362	72362	72362	72242	722B5	722B2
	72364	72364	72364	72364			
Doppler Radar	72381	72381	73A31	N/A	N/A	N/A	N/A
	72382		73A32				
	72384		73A33				

SYSTEM: 71 Radio Navigation

NOMENCLATURE: Tacan

WUC:	A-4:	71X1L 71301	A-6:		A-7:	71431	F-4:	71X1L 67170
	F-8:	71X1L 71431	F-14:	71X1L 71360	AV-8:	71X1L 71871		

GENERAL OBSERVATIONS: The Tacan and BDHI are summarized together in this section. The BDHI is universally easy to work on and receives little comment. The Tacan is simple to replace and checkout. Access varies from fair to good.

DESIRABLE FEATURES: 1. The BDHI requires no test set making checkout quite simple. The Tacan unit requires a test set but checkout is relatively easy. 2. The F-14 and AV-8 incorporate built-in-test which is valuable in reducing Tacan checks to simplest actions.

UNDESIRABLE FEATURES: 1. Installations are generally good, but minor problems of access are encountered in some airplanes. Compartment height involves maintenance stands for the F-8, A-4 and F-14 aircraft. The AV-8, F-14, F-8, use several fasteners rather than the latches used in other aircraft for access panels. The fasteners are obviously less desirable.

ADDITIONAL REMARKS: Built-in-test is an item of significant value, especially in the case of avionics equipment which have benefitted to the maximum from simplification of replacement tasks. Functional test is now the most significant factor in the work effort.

WORK UNIT CODE: 71X1L ITEM: BDHI AIRCRAFT: A-4M

LOCATION: Cockpit Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Remove four bolts securing unit to panel
2. Slide indicator out of panel
3. Disconnect electrical connector
4. Remove unit

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: The heading portion of indicator is checked by rotating the compass deviation control. The Tacan and ADF portion is checked by operating each system.

TEST EQUIPMENT: Electrical Power

CLOSE UP: Close canopy

ANALYST'S OPINION: The access, removal/replacement of the indicator is considered good. Functional test of the unit can be accomplished without peculiar ground support equipment and is rather easy.

WORK UNIT CODE 71X1L ITEM BDHI AIRCRAFT F-4J

LOCATION: Cockpit Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Remove 2 screws securing lighting fixture and remove fixture
2. Remove 2 screws securing BDHI to panel
3. Slide BDHI from Instrument Panel
4. Disconnect 6 electrical connectors
5. Remove BDHI from aircraft

INSTALLATION: Reverse

FUNCTIONAL CHECK: Perform operational check of ADF, Tacan and Heading Systems

TEST EQUIPMENT: Electrical Power

CLOSE UP: Close canopy

ANALYST'S OPINION: The access, removal/replacement of the unit is considered good. Functional test is accomplished without peculiar ground support equipment as in other aircraft.

WORK UNIT CODE: 71X1L ITEM: Bearing, Distance & Heading Ind. AIRCRAFT F-8

LOCATION: Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Remove four screws securing indicator to the panel
2. Slide unit out of panel
3. Disconnect electrical connector
4. Remove unit from aircraft

INSTALLATION: Reverse of removal

FUNCTIONA CHECK: Heading portion is checked by rotating compass control and verifying indicator response. Remaining portion of indicator is checked using base station.

TEST EQUIPMENT: Electrical power.

CLOSE UP: Close canopy

ANALYST'S OPINION: The access, removal/replacement of the indicator is good. Functional test of unit is completed without the use of peculiar ground support equipment as in other aircraft.

WORK UNIT CODE: 71XLL ITEM: BDHI ID-663/U AIRCRAFT: F-14

LOCATION: RH Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Remove 4 screws securing indicator to instrument panel
2. Slide indicator from panel
3. Disconnect 1 electrical connector

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform operational checks of Tacan, ADF and Heading Systems

TEST EQUIPMENT: Electrical power.

CLOSE UP: Close canopy.

ANALYST'S OPINION: The installation and functional test of the BDHI is similar to installations in other aircraft.

WORK UNIT CODE: 71XLL ITEM BDHI ID-663 AIRCRAFT AV-8

LOCATION: Bottom Center of Cockpit Instrument Panel

SUPPORT EQUIPMENT: Ladder

ACCESS: Position ladder
Open canopy

REMOVAL:
1. Remove 4 screws securing indicator to panel
2. Reaching behind panel, disconnect 1 electrical connector
3. Slide indicator from panel and remove from aircraft

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform operational test of compass system, Tacan and VHFFM ADF

TEST EQUIPMENT: Electrical Power

CLOSE UP: Close canopy
Remove ladder

ANALYST'S OPINION: Access, removal/replacement of the instrument is considered good. Removal could be improved by extending the length of the cable harness. Functional test of the unit is accomplished without test equipment.

WORK UNIT CODE 71431 ITEM Tacan Recv/Trans AIRCRAFT A-4

LOCATION: CNI Compartment

SUPPORT EQUIPMENT: Maintenance stand.

ACCESS: Open two (2) quick latches and lift access door, door is retained by clip springs

REMOVAL:
1. Remove coaxial connector
2. Loosen two equipment tie downs
3. Remove unit

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System checked using test equipment and base station.

TEST EQUIPMENT: AN/URM-101
Electrical power.

CLOSE UP: Close access door

ANALYST'S OPINION: A maintenance stand is needed for removal of the unit, considering the high failure rate the unit should be located at ground level.

WORK UNIT CODE 71301 ITEM TACAN Receiver/Transmitter AIRCRAFT A-4M

LOCATION: CNI Nose Compartment

SUPPORT EQUIPMENT: Maintenance stand

ACCESS: Open two quick release latches and lift access door (door is retained by spring clips).

REMOVAL:
1. Remove coaxial cable.
2. Loosen equipment tie downs.
3. Remove unit from rack.

INSTALLATION: Reverse of removal.

FUNCTIONAL CHECK: System functional test using test set and ground base station.

TEST EQUIPMENT: AN/URM-101
Electrical power

CLOSE UP: Close access panel and secure.

ANALYST'S OPINION: The installation, access and removal/replacement of the unit is considered good. The requirement for a maintenance stand is off-set by the ease in gaining access to the unit.

WORK UNIT CODE 71431 ITEM TACAN Receiver/Transmitter AIRCRAFT A-7

LOCATION: Right Hand Avionic Bay

SUPPORT EQUIPMENT: None

ACCESS: Open eight quick release fasteners and lower bay door

REMOVAL:
1. Remove coaxial connectors
2. Remove safety wire from hold down bolts and loosen bolts
3. Remove TACAN from mount

INSTALIATION: Reverse of removal

FUNCTIONAL CHECK: Functional test is accomplished using test equipment. Operational test of system is made using base station.

TEST EQUIPMENT: AN/URM-101
Electrical Power

CLOSE UP: Close bay door and secure

ANALYST'S OPINION: The installation removal/replacement and access to the unit is excellent. Maintenance on the unit can be accomplished at ground level without support equipment.

WORK UNIT CODE 67170 ITEM TACAN, Receiver/Transmitter AIRCRAFT F-4

LOCATION: CNI Compartment

SUPPORT EQUIPMENT: Small maintenance stand or step stool

ACCESS: Loosen six captive screws and remove access door.

REMOVAL:
1. Remove safety wire and loosen wing bolt securing R/T unit
2. Remove R/T unit from mount

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Operational test is accomplished using local base station and/or test equipment

TEST EQUIPMENT: AN/ASM-23
Electrical Power

CLOSE UP: Replace access door and secure

ANALYST'S OPINION: The installation, access and removal/replacement of the unit is considered very good. Functional test is common with other aircraft installations. The need for a special type stand (step stool) may pose a problem because of availability,

WORK UNIT CODE: 71431 ITEM TACAN R/T AIRCRAFT F-8

LOCATION: Left Equipment Bay

SUPPORT EQUIPMENT: Maintenance stand is required

ACCESS: Loosen 19 panel fasteners, lift door and install holding bracket.

REMOVAL:
1. Remove coaxial connector
2. Remove two hold down screws
3. Remove unit from mount

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System is functionally checked using base station and/or test equipment

TEST EQUIPMENT: TS/105/APM
Electrical Power

CLOSE UP: Secure equipment bay

ANALYST'S OPINION: The location of the unit, the requirement for a maintenance stand and the number of fasteners on the panel impair the accessibility to the unit. The installation and the functional test of the system is common with other aircraft. The frequent removal of the unit warrants that it be located at a more accessible location.

WORK UNIT CODE 713CO ITEM TACAN Receiver Transmitter AIRCRAFT F-14

LOCATION: LH Forward Avionics Bay

SUPPORT EQUIPMENT: Work Stand

ACCESS: Loosen 29 Calfax fasteners securing access panel
Swing panel open and insert holding bar

REMOVAL:
1. Loosen 2 self locking hold down fasteners securing RT unit
2. Slide RT from mount and remove from aircraft

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform BIT check and operational check with local stations

TEST EQUIPMENT: Electrical Power

CLOSE UP: Secure access panel

ANALYST'S OPINION: The access to the unit is considered as fair because of the number of panel fasteners that must be loosened and the need for a maintenance stand. The removal/replacement and functional test of the system is common to most aircraft installations. Access to the unit could be improved by employing quick release latches.

WORK UNIT CODE 718Y1 ITEM TACAN Receiver/Transmitter AIRCRAFT AV-8

LOCATION: Right Hand Avionic Bay (Upper Shelf)

SUPPORT EQUIPMENT: None

ACCESS: Remove 22 fasteners securing aircraft panel
Remove access panel

REMOVAL:
1. Disconnect coaxial connectors
2. Remove safety wire
3. Loosen retaining nuts securing unit
4. Slide R/T unit from mount

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: A "BIT" check is made to check TACAN unit and a system operational check is made using the base station.

TEST EQUIPMENT: Electrical Power

CLOSE UP: Replace access panel and secure

ANALYST'S OPINION: Accessibility to the unit is considered fair because of the number of fasteners on the panel and the requirement to remove the panel from the aircraft. The "BIT" feature of the equipment is an excellent means of checking the unit.

SYSTEM: 72 Radar Navigation System

NOMENCLATURE: Radar Altimeter

	72361		72361		72361		72361
	72363		72362		72362		72362
WUC: A-4:	72364	A-6:	72364	A-7:	72364	F-4:	72364
	72241		722B1		722B1		
F-8:	72242	F-14:	722B5	AV-8:	722B2		

GENERAL OBSERVATIONS: Three components of the Radar Navigation System were observed and are summarized here: The receiver/transmitter (R/T) unit, the switching unit, and the indicator. The R/T and switching units are matched items and both must be removed if one fails. To accommodate this, the two units are generally mounted together to allow removal as a single item. The indicator is mounted in the cockpit and, except for the AV-8 installation, has generally good access.

DESIRABLE FEATURES: 1. The A-4 radome neatly solves the matched set problem by packaging the R/T and switching units in the quickly removable altimeter radome. The whole package is small enough to remove and handle as a single item allowing build-up and matching in the shop. 2. Other aircraft have mounted the two units together allowing removal of both through a single access. 3. Built-in-test (BIT) is used to good advantage to simplify checkout tasks in the F-4, F-14 and AV-8. 4. The A-4, A-7, F-4 and AV-8 have the units located to permit access while standing on the deck.

UNDESIRABLE FEATURES: 1. Shop matching of the units is undesirable because it always involves removal of one good unit along with a bad one. O-level effort (except for the A-4) is therefore increased signifi-

SYSTEM: 72 Radar Navigation System

NOMENCLATURE: Radar Altimeter

UNDESIRABLE FEATURES: (Cont.)

cantly. 2. Although most of the R/T and switching units are mounted on a single rack or bracket, they must be removed from that mounting unit for dispatch to the shop. It would be preferable for the mount and both units to have a definition as a single WRA and be handled without O-level disassembly. 3. Bolting through a floor into another compartment, as in the F-14, creates need for extra access. In this case, the gun installation further inhibits removal. An intermediate mount is needed which can be bolted down and from which the unit can be readily removed. 4. The AV-8 indicator requires removal of several adjacent components. This is not only time consuming in itself, but imposes additional maintenance risk and functional check requirements.

ADDITIONAL REMARKS: 1. When it is not possible to avoid shop matching of units, these units should be accumulated and identified as a single component or WRA. 2. Built-in-test proves its value in reducing functional checkout effort.

WORK UNIT CODE: 72361/72364 ITEM: Radar Altimeter R/T Unit & Switching Unit AIRCRAFT: A-4

LOCATION: Bottom of Left Wing

SUPPORT EQUIPMENT: None

ACCESS: None.

REMOVAL:
1. Remove aft bolt securing radome
2. Lower aft portion of unit and move forward to disengage guide pins
3. Disconnect connectors and remove radome with units installed.

INSTALLATION: Reverse of removal.

(Note: The R/T and switching units are packaged as a unit with the radome.)

FUNCTIONAL CHECK: System functional check is accomplished using test equipment.

TEST EQUIPMENT: AN/APM-99
Electrical power

CLOSE UP: None.

ANALYST'S OPINION: The installation of the R/T and switching unit in one assembly (radome) simplifies maintenance since both units must be removed from the aircraft and matched in the shop. Installation and access to the equipment are considered very good.

WORK UNIT CODE 72361/72364 ITEM Radar Altimeter AIRCRAFT A-6

LOCATION: Lower Tail Area

SUPPORT EQUIPMENT: Maintenance Stand

ACCESS: Remove 18 panel fasteners, acft panel hinges down.

REMOVAL:
1. Disconnect cables
2. Remove four screws to remove mounting plate on which both the transmitter and switching unit are mounted on.
3. Remove four screws to remove each unit from plate

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System is checked using test set to determine proper operation (acft panel must be closed for test).

TEST EQUIPMENT: AN/APM-199 delay line
Electrical power

CLOSE UP: Close panel and secure 18 panel fasteners

ANALYST'S OPINION: The hard mounting of both the transmitter and switching units is a common type of aircraft installation. However, in this aircraft the mounting plate is secured to shock mounts of a support plate. This type installation was required because the units are located in a high vibration area. Accessibility to the units is considered acceptable. The removal/replacement of the units is somewhat degraded because of the double mounting provisions. The close proximity of the units and the antennae does simplify the functional system test.

WORK UNIT CODE 72301/72304 ITEM RADAR ALTIMETER RCVR/TRANSMITTER AIRCRAFT A-7

LOCATION: Aft. Gear Bay

SUPPORT EQUIPMENT: None

ACCESS: Loosen 25 camloc fasteners and remove access panel

REMOVAL:
1. Remove electrical connectors from both units
2. Remove safety from hold down bolts
3. Loosen hold down bolts
4. Remove each unit from the mounts

(Note: The recv/trans. and switching unit are removed and matched in the shop)

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: The system is checked by "self-test," operational test of the system is accomplished by using a test set

TEST EQUIPMENT: AN/APM-199
Electrical power

CLOSE UP: Replace access panel and secure

ANALYST'S OPINION: The accessibility to the unit is degraded because of the 28 camloc fasteners and the requirement to remove the access panel. However, the removal/replacement of the unit is good since all maintenance can be accomplished at ground level.

WORK UNIT CODE: 72361/72364 ITEM: RADAR ALTIMETER RECV/TRANS & SWITCHING UNIT AIRCRAFT: F-4

LOCATION: Left Fuselage above Ground Power Receptical

SUPPORT EQUIPMENT:
None

ACCESS:
Remove forty-one stress fasteners and remove access panel

REMOVAL:
1. Remove electrical connector from both units.
2. Remove six bolts securing switching unit rack to the aircraft and remove assembly.
3. Remove four bolts securing switching unit to the rack and remove unit.
4. Remove four bolts securing recv/trans unit rack to the aircraft and remove assembly.
5. Remove four bolts securing recv/trans unit to the rack and remove unit.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: The system functional check is accomplished using test equipment.

TEST EQUIPMENT:
AN/APM-199
Electrical power

CLOSE UP: Replace access panel and secure

ANALYST'S OPINION: Although the maintenance task can be accomplished at ground level, the accessibility to the system is degraded because of the 41 fasteners and the requirement to handle the access panel. Also, the method used to install the system components, in the aircraft, adds considerable time to the removal/replacement task. System components must be mounted on a bracket and then the bracket installed in the aircraft. This assembly and disassembly complicates what is normally considered a simple removal and replacement task.

WORK UNIT CODE 72241/72242 ITEM RADAR ALTIMETER SYSTEM AIRCRAFT F-8

LOCATION: Left Equipment Bay

SUPPORT EQUIPMENT: Maintenance stand

ACCESS: Loosen 19 panel fasteners, lift door and install door bracket

REMOVAL:
1. Disconnect electrical connectors
2. Remove thumb screws securing units
3. Remove units from mounts.

(Note: The transmitter and amplifier are removed as a set and matched in the shop)

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System functional check is accomplished using test equipment.

TEST EQUIPMENT: AN/APM-66
Electrical power

CLOSE UP: Close access panel and secure

ANALYST'S OPINION: The removal/replacment of the system components is considered a simple task. The requirement for a maintenance stand degrades the overall accessibility to the system.

WORK UNIT CODE: 7228l ITEM: Radar Altimeter Receiver Transmitter AIRCRAFT: F-14

LOCATION: Left Hand Avionics Compartment

SUPPORT EQUIPMENT: Work Stand

ACCESS: Loosen 17 Calfax fasteners securing access panel.
Swing access panel open and insert holding bar.
Loosen 24 Calfax fasteners securing lower access panel and remove panel from aircraft.

REMOVAL:
1. Disconnect 4 coaxial connectors.
2. Disconnect 1 electrical connector.
3. Cut safety wire and remove 4 bolts securing RT unit to the equipment shelf.
4. Remove RT unit from aircraft.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform system self test.

TEST EQUIPMENT: Electrical power unit

CLOSE UP: Replace access panels and secure

ANALYST'S OPINION: The location, accessibility, and the installation of the receiver transmitter is considered unacceptable. Two aircraft panels must be opened/removed to gain access for the removal and replacement of the unit. Access to the bolts, securing the unit to the shelf, is gained through the lower compartment (gun area). Also, the access to the two inboard bolts, securing the unit, is restricted by the gun barrels. This installation and the removal/replacement feature could be improved by using a flat mounting tray, secured to the shelf, from which the unit can be easily removed and replaced. This would eliminate the removal of the lower access panel and simplify the maintenance task. The functional test of the system is common to all APN-194(V) installations.

WORK UNIT CODE 722B1 ITEM RADAR ALTIMETER RECV/TRANSMITTER AIRCRAFT AV-8

LOCATION: Left Hand Avionic Bay (lower equipment rack)

SUPPORT EQUIPMENT: None

ACCESS: Loosen 22 fasteners and remove access panel.

REMOVAL:
1. Disconnect electrical connectors.
2. Loosen retaining nuts and slide unit out to clear guide pins and lift up.
3. Loosen two captive nuts and remove connector from the interface unit.
4. Pull connector through the R/T mount.
5. Remove rack, with R/T attached, from the aircraft.
6. Remove bolts securing R/T unit to the mount.
7. Remove R/T.

FUNCTIONAL CHECK: System functional test is accomplished using "BIT."

TEST EQUIPMENT: Electrical power

CLOSE UP: Replace access panel and secure.

ANALYST'S OPINION: Access to the unit could be improved by providing quick release fasteners and a hinged access panel. Installation of the unit should be changed to allow its removal without having to disconnect the interface connector and assemble the R/T unit on the mounting rack before installation. Current installation does complicate the removal/replacement action.

WORK UNIT CODE 72363 ITEM Height Indicator ID-1051/APN-141 AIRCRAFT A-4

LOCATION: Cockpit Instrument Panel

SUPPORT EQUIPMENT: Cockpit ladder

ACCESS: Open canopy.
Remove bypass/audio switch bracket.

REMOVAL:
1. Remove four bolts that secure indicator to panel.
2. Pull indicator from panel and disconnect cable.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System test using test equipment.

TEST EQUIPMENT: USM-199
Electrical power

CLOSE UP: Replace bypass/audio switch bracket
Close canopy

ANALYST'S OPINION: The installation of the indicator is considered normal, however, modification made to the aircraft added the bypass/audio switch. It is unfortunate that the bracket was placed in front of the indicator.

WORK UNIT CODE 72362 ITEM RADAR ALTIMETER INDICATOR AIRCRAFT A-6

LOCATION: Cockpit Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL: 1. Remove four screws that secure indicator to panel.
2. Slide indicator out of panel and disconnect cable.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System checked using test equipment

TEST EQUIPMENT: AN/APM-199 delay line
Electrical power

CLOSE UP: Close canopy

ANALYST'S OPINION: The installation, removal, and replacement of the indicator is very simple.

WORK UNIT CODE 72362 ITEM APN-141 Height Indicator AIRCRAFT A-7

LOCATION: Cockpit Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL: 1. Remove 3 screws securing indicator to the panel.
2. Remove indicator from panel and disconnect cable.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Self-test and test equipment to perform complete functional test of system.

TEST EQUIPMENT: APM-199
Electrical power

CLOSE UP: Close canopy

ANALYST'S OPINION: The installation, removal, and replacement of the indicator is a simple task.

WORK UNIT CODE 72362 ITEM RADAR ALTIMETER INDICATOR AIRCRAFT F-4J

LOCATION: Forward cockpit instrument panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL: 1. Remove four screws securing indicator to the panel.
2. Remove indicator from the panel and disconnect cable.

Note: If the electrical cable is too short, the glare shield must be removed to gain access for removal of the connector.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform system "BIT" check

TEST EQUIPMENT: Electrical power

CLOSE UP: Close canopy

ANALYST'S OPINION: The installation, removal, and replacement of the indicator is common with other aircraft. The "BIT" feature does eliminate the requirement for test equipment and simplifies the task.

WORK UNIT CODE 722B5 ITEM Height Indicator ID1763/APN-194(V) AIRCRAFT F-14

LOCATION: Left Hand Cockpit Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Remove 3 screws securing indicator to instrument panel.
2. Slide indicator out from panel.
3. Disconnect electrical connector.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform system self test.

TEST EQUIPMENT: Electrical power

CLOSE UP: Close canopy

ANALYST'S OPINION: The removal and replacement of the indicator is simple. The self-test feature simplifies the maintenance task.

WORK UNIT CODE 722B2 ITEM RADAR ALTIMETER INDICATOR AIRCRAFT AV-8

LOCATION: Cockpit Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy
Remove Nav. Control Panel - no electrical disconnect - position out of way
Loosen one high torque screw on central warning indicator and position out of way.

(See Continuation Sheet)

REMOVAL:
1. Disconnect electrical connector.
2. Remove three screws securing indicator to panel.
3. Remove indicator.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform self test of Radar Altimeter System.
Thoroughly inspect all components removed for proper installation.

TEST EQUIPMENT: Electrical power

CLOSE UP: Replace all instruments and equipment removed to gain access.
Close canopy.

ANALYST'S OPINION: The accessibility to the indicator is completely unacceptable. Removal of the indicator is considered a major maintenance task when compared with other aircraft installations. The removal of flight instruments for access to the indicator only increases the possibility of inducing malfunctions to other systems on the aircraft. Major improvement should be made in the access to the indicator.

CONTINUATION SHEET:

WORK UNIT CODE 722B2 ITEM Radar Altimeter Indicator AIRCRAFT AV-8

ACCESS: (Continued)

Remove two screws securing glare shield under central warning indicator.
Remove three torque screws and one nut on fuel jettison panel.
Remove three bolts securing the right side of the instrument panel.
Pull instrument panel out to provide access required.

SYSTEM: 72 Radar Navigation

NOMENCLATURE: Doppler Radar

WUC: A-4: 72381, 72382, 72384 A-6: 72381 A-7: 73A31, 73A32, 73A33 F-4: _____

F-8: _____ F-14: _____ AV-8: _____

GENERAL OBSERVATIONS: Except for antennas, the items were universally well installed with rapid replacement accommodated by quick release equipment fasteners and easy access. Antennas require excessive time for access, otherwise good. Built-in-test is a positive help. The F-4, F-8, F-14 and AV-8 are not equipped with Doppler Radar.

DESIRABLE FEATURES: 1. Built-in-test adequately checks installation and eliminates extra test equipment. 2. Rack and panel mounting (A-7) eliminates cable routing problems and speeds installation and removal.

UNDESIRABLE FEATURES: 1. Too many screws involved in gaining access to antennas. Quick release fasteners (SPF, etc.) would greatly reduce task time. 2. Location of equipment is important. The A-4 antenna is too high (requires stand) while the A-7 antenna is too low (confined work space). 3. Console mounted items require maintenance of proper routing of the many cables under the panel to avoid trapping the slack in a control box's cable. Outside access to the console interior is a great help if slack is lost. Otherwise several other systems must be disturbed to free the box.

SYSTEM: 72 Radar Navigation

NOMENCLATURE: Doppler Radar

ADDITIONAL REMARKS: 1. Expand development and use of rack and panel mounting.

2. If function and airframe configuration dictate location in an undesirable area, the design should be altered to retain good maintenance characteristics (i.e. alternate access, improved fasteners, etc.).

WORK UNIT CODE 72381 ITEM DOPPLER RADAR R/T AIRCRAFT A-4M

LOCATION: Nose Section

SUPPORT EQUIPMENT: Work Stand

ACCESS: Open two quick release fasteners and lift access panel.

REMOVAL:
1. Loosen two equipment bolts and remove unit.
2. Remove waveguide and electrical connections.
3 Remove unit

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System is checked using system self-test.

TEST EQUIPMENT: Electrical power

CLOSE UP: Close access panel and secure

ANALYST'S OPINION: The installation, removal, and replacement of the unit is good. The requirement for a maintenance stand is acceptable.

WORK UNIT CODE 72382 ITEM Doppler Radar Antenna AIRCRAFT A-4M

LOCATION: Nose Section

SUPPORT EQUIPMENT: Maintenance Stand

ACCESS: Remove 40 screws to drop radome.

REMOVAL:
1. Remove waveguide connection.
2. Remove cables.
3. Remove four bolts securing the unit and lower antenna from aircraft.

INSTALLATION:
1. Align guide pins and engage rack.
2. While holding antenna in place, insert bolts.
3. Connect waveguide and cables.

FUNCTIONAL CHECK: System checked using "BIT"

TEST EQUIPMENT: External Electrical Power

CLOSE UP: Replace radome by securing 40 screws.

ANALYST'S OPINION: Installation of antenna is a tedious job. One man must hold unit while another inserts bolts. Bolt heads are difficult to reach with a standard wrench (no special offset wrench is available). Extreme care is required to avoid damage to waveguide and waveguide connector while positioning and securing the unit.

WORK UNIT CODE 72384 ITEM Doppler Control Box AIRCRAFT A-4

LOCATION: Right Cockpit Console

SUPPORT EQUIPMENT: Cockpit ladder

ACCESS: Open canopy

REMOVAL: 1. Loosen 4 dzus fasteners
2. Lift control box out of console
3. Disconnect cable

INSTALLATION: Reverse of removal.

FUNCTIONAL CHECK: System checked using Built-In-Test

TEST EQUIPMENT: External Electrical Power.

CLOSE UP: Close canopy

ANALYST'S OPINION: Good installation. Proper routing of cables under the console must be maintained in order for sufficient slack to exist to disconnect the control box. No exterior access is available if slack inadvertently lost. The Built-in-Test simplifies checkout greatly.

WORK UNIT CODE 72381 ITEM Doppler Radar R/T AIRCRAFT A-6

LOCATION: Aft Equipment Platform

SUPPORT EQUIPMENT: None

ACCESS: Open three latches and lower aft compartment door.

REMOVAL:
1. Remove connectors.
2. Loosen two thumb screws securing unit.
3. Remove unit out of the rack.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System check not accomplished at the NARF

TEST EQUIPMENT: Nomenclature of test set unknown.

CLOSE UP: Close aft compartment door and latch 3 fasteners.

ANALYST'S OPINION: The installation, access and removal/replacement of the unit is very good. The maintenance task can be accomplished at ground level. Some problem is enccuntered with a coaxial cable routed in front of the unit.

WORK UNIT CODE 73A31 ITEM DOPPLER RADAR R/T AIRCRAFT A-7

LOCATION: Right Avionic Bay

SUPPORT EQUIPMENT: None

ACCESS: Open eight quick release fasteners and lower access panel.

REMOVAL: 1. Remove two latches securing unit.
2. Remove unit from mounting rack (rack and panel).

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform self-test of system

TEST EQUIPMENT: Electrical power

CLOSE UP: Close access panel and secure.

ANALYST'S OPINION: The installation, access, and the removal/replacement of the unit is very good. All maintenance actions can be accomplished at ground level without the need for support equipment.

WORK UNIT CODE 73A32 ITEM Antenna, Radar AIRCRAFT A-7

LOCATION: Bottom of aircraft, immediately aft of nose wheel well

SUPPORT EQUIPMENT: None

ACCESSIBILITY: Remove radome (65 screws)

REMOVAL:
1. Disconnect 1 cable
2. Disconnect waveguide (4 screws)
3. Remove 4 bolts
4. Remove antenna

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Self Test

TEST EQUIPMENT: External Electrical Power

CLOSE UP: Install radome

ADDITIONAL REMARKS: Close proximity of fuselage to deck make working on this device inconvenient and uncomfortable. Fewer screws or stress panel fasteners in redome would help. Most of the task time is involved in gaining access. Built-in-test is a help.

WORK UNIT CODE 73A33 ITEM APN-190 Control Indicator AIRCRAFT A-7

LOCATION: RH Instrument Console

SUPPORT EQUIPMENT: None

ACCESSIBILITY: Open canopy

REMOVAL:
1. Loosen 4 captive bolts
2. Lift box clear of console
3. Disconnect 1 connector

INSTALLATION: Reverse of removal.

FUNCTIONAL CHECK: Self-Test

TEST EQUIPMENT: External Electrical Power or test on next engine run.

CLOSE UP: Close canopy

ADDITIONAL REMARKS: Good installation. Outside access is available if cables in console are inadvertently routed to prevent sufficient slack to clear console for electrical disconnect. Built-In-Test eliminates test boxes.

BOMB NAVIGATION AND WEAPONS CONTROL SYSTEMS

RADAR ANTENNA/TRANSMITTER/ POWER SUPPLY

RADAR INDICATORS AND CONTROLS

SWEEP GENERATOR/PROCESSOR

TACTICAL COMPUTER AND CONTROL

HEAD-UP DISPLAY

INERTIAL MEASUREMENT

BOMB NAVIGATION AND WEAPONS CONTROL SYSTEMS

CONTENTS

COMPONENT	A-4	A-6	A-7	F-4	F-8	F-14	AV-8
Radar Antenna/Transmitter/ Power Supply	N/A	7434H 7434B 72451 7434E	73A11 73A12 73A13	7424A 7424N 7424L 74245 74257 74251 74241	74453	74A61 74A15 74A1C	N/A
Radar Indicators and Controls	N/A	724EC 72X1E 72Y1R	73A15 73A1D	7425B 7424C 7424B 7424E 7425E	74456	74A53 74A51	739W6
Sweep Generator/Processor	N/A	72457	73A16	N/A	N/A	N/A	N/A
Tactical Computer and Control	N/A	N/A	73A21 73A22	N/A	N/A	73A46 74A52	N/A
Head-Up Display	N/A	72911	73A41 73A42	N/A	N/A	69182	739Z1 739X2
Inertial Measurement	N/A	73457 73455 73453	73A53 73A51 73A54	N/A	N/A	734H1 734H2	739W1 739W8

SYSTEM: 73 Radar

NOMENCLATURE: Radar Antenna/Transmitter/Power Supply

WUC:	A-4:		A-6:	7434H 7434B 72451 7434E	A-7:	73A13 73A12 73A11	7424A/N/L/5 71257 F-4: 74251, 74241
	F-8:	74453	F-14:	74A61 74A15 74A1C	AV-8:		

GENERAL OBSERVATIONS: This category combines the radar antenna/receiver, radar transmitter, and radar power supply. In general, once access has been attained, all the units were easily removed. The antennas were heavy and bulky and required two men for removal. All the units required an operational test, either internal BIT or with test sets. The antennas and transmitters additionally need waveguide pressurization. The A-4 and AV-8 installations were not studied.

DESIRABLE FEATURES: 1. The radome installation of all three radar components in the A-6 and A-7 provided the quickest, easiest access of all the aircraft. Consolidation of system components in a quickly opened area facilitates replacement and system trouble shooting. The A-7 radar installation is especially good with its swing out feature allowing even better access to rear mounted components. 2. The built-in-test capabilities of all the F-14 units, the A-7 power supply, and the F-4 antenna receiver simplify checkout procedures. The usefulness as a maintenance tool of BIT can't be over estimated. The F-14 BIT was slightly degraded because of the additional cooling equipment needed to ground operate the radar. 3. The F-4's use of hydraulic quick disconnects on the antenna/receiver speeds the removal.

SYSTEM: 73 Radar

NOMENCLATURE: Radar Antenna/Transmitter/Power Supply

UNDESIRABLE FEATURES: 1. Access to the F-14 components and the F-4 power supply was hampered by too many fasteners on the access panel. The F-14 utilizes Calfax quick release fasteners, but an improvement can be made using latch type fasteners or fewer Calfax. The F-4 installation uses too many stress panel fasteners. 2. The F-8 power supply has been placed in an extremely poor place - behind the seat. This requires canopy disconnection and seat removal to gain access. This is a most undesirable arrangement and turns a relatively simple, quick removal into a major maintenance task. 3. The requirement to partially remove the unit to disconnect connectors, as in the F-4 power supply, should be avoided. Optimum design dictates disconnections prior to moving unit to avoid damage to wire harnesses and connectors and to eliminate a time consuming two step removal. 4. The A-6 radome compartment mounted APQ-112 antenna requires mounting bolts be inserted by a second man from inside the nose wheel well. Mounting of units should be accomplished from the front of the unit and from within the same access. 5. Lack of a handling fixture on the A-6 antenna receiver causes alignment problems upon installation. The time consuming boresighting requirement would be eliminated by use of a fixture to maintain relative mounting adjustments. Additionally, because the antenna receivers in general tend to be heavy, the use of a handling fixture eases the removal.

SYSTEM: 73 Radar

NOMENCLATURE: Radar Antenna/Transmitter/ Power Supply

ADDITIONAL REMARKS: Inherent to the design of the forward looking radar is the nose installation of the antenna receiver. Since this is the primary purpose of the easily accessable radome compartment, design of the overall system should effectively utilize this space for as many related system components as possible. Use of a swing out mount, as on the A-7, provides better access to the radome bulkhead. Effective utilization of the bulkhead could help lessen the weight of the antenna by moving components off the unit. Built-in-test, acknowledged as a maintenance time reducer especially adaptable to avionics, should be utilized wherever possible.

WORK UNIT CODE: 7434H ITEM Power Supply AIRCRAFT A-6

LOCATION: Nose radome

SUPPORT EQUIPMENT: None

ACCESS: Loosen four bolts (2 on each side) and open radome by using hydraulic pump

REMOVAL:
1. Open equipment latch and lower equipment rack
2. Remove electrical connectors
3. Remove pressure line
4. Remove four bolts
5. Remove unit

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System functional test is required

TEST EQUIPMENT: Electrical power

CLOSE UP:

Close radome

ANALYST'S OPINION: Very good installation. Access to the unit, opening of the radome, can be accomplished using a hand-hydraulic pump in the nose wheel well, hand pump in the cockpit or aircraft power. The complete maintenance tack, removal/replacement, is easy. The system operational check accounts for most of the manhours expended.

WORK UNIT CODE 7434B ITEM Radar Transmitter AIRCRAFT A-6

LOCATION: Nose Radome

SUPPORT EQUIPMENT: None

ACCESS: Loosen two bolts on each side of radome
Open radome by using hydraulic pump

REMOVAL:
1. Open latch and lower right equipment rack (rack lowers to about chest level)
2. Remove connectors and waveguide
3. Loosen four knurl knobs
4. Remove unit

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System run-up

TEST EQUIPMENT: Aircraft power

CLOSE UP:
Close radome
Secure four bolts

ANALYST'S OPINION: Very good installation. Ability to lower the equipment rack overcomes the height problem. The radome is large, high, and heavy, but this is accommodated very well by the hydraulic opening feature.

WORK UNIT CODE 72451 ITEM Radar Antenna AIRCRAFT A-6

LOCATION: Nose Radome

SUPPORT EQUIPMENT: Maintenance Stand

ACCESS: Loosen two bolts on each side of radome
Open radome by using hydraulic pump

REMOVAL:
1. Remove electrical cables
2. Disconnect pressure line
3. Disconnect waveguide
4. Remove four bolts securing antenna
5. Remove antenna (two man task)

INSTALLATION: Reverse of removal.

FUNCTIONAL CHECK: Complete system run-up and boresight check

TEST EQUIPMENT: Electrical power

CLOSE UP: Close radome and secure

ANALYST'S OPINION: Removal/installation features could be improved if a handling fixture were designed to hold and align the antenna during the installation/removal procedure. The NARF has fabricated bolts which are used as guide pins to align the antenna during the installation.

WORK UNIT CODE: 7434E ITEM: APQ-112 Antenna AIRCRAFT: A-6

LOCATION: Nose Radome Area

SUPPORT EQUIPMENT: None

ACCESS: Loosen four bolts (2 on each side of radome) open radome by using hydraulic pump.

REMOVAL:
1. Disconnect cables and waveguide
2. Remove four bolts (installed from the nose wheel well area)
3. Remove antenna

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Functionally check system and check boresight alignment

TEST EQUIPMENT: Line radar checkout unit
Electrical power

CLOSE UP: Close radome and secure bolts

ANALYST'S OPINION: Removal and installation of the antenna is undesirable. The antenna mounting bolts are inserted from the wheel well area. This requires the specialist to hold the antenna in place while the bolts are inserted. The installation should be modified to accommodate installing the mounting bolts from the front of the unit.

WORK UNIT CODE 73A11 ITEM Antenna Receiver AIRCRAFT A-7

LOCATION: Nose radome area

SUPPORT EQUIPMENT: Work Stand or step stand if available

ACCESS: Open two latches securing radome
Open radome and secure holding bar

REMOVAL:
1. Disconnect electrical connectors
2. Disengage waveguide connection
3. Remove six bolts securing unit to the mount
4. Remove antenna receiver

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Accomplish system pressure check
Perform system self-test and an operational check of the system

TEST EQUIPMENT: Electrical Power

CLOSE UP: Close radome and secure

ANALYST'S OPINION: The removal of the antenna receiver is a rather easy task when one considers its design complexity compared with other aircraft systems. Care must be exercised in handling of the unit during the removal/replacement task to insure damage is not incurred to the antenna disk and other microwave components.

WORK UNIT CODE 73A12 ITEM Radar Transmitter AIRCRAFT A-7

LOCATION: Nose radome

SUPPORT EQUIPMENT: Work stand or small step stand

ACCESS:
1. Release two latches and open radome
2. Install locking bar

REMOVAL:
1. Remove two bolts on the front of the R/T unit
2. Remove air pressure line
3. Disconnect electrical connectors
4. Disconnect waveguide
5. Swing out forward assembly
6. Remove bolts securing R/T to power supply programmer
7. Remove R/T unit

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform self-test and operational checkout of the system
Pressure check system

TEST EQUIPMENT: Electrical power
Pressure source

CLOSE UP: Close radome and secure

ANALYST'S OPINION: The installation and access to the unit is good. Removal and replacement of the unit is not complicated. The requirement to swing out the forward assembly for access to the rear of the unit is acceptable considering the installation.

WORK UNIT CODE 73A13 ITEM APQ-126 Power Supply Programmer AIRCRAFT A-7

LOCATION: Nose radome section

SUPPORT EQUIPMENT: Work Stand or small step stand

ACCESS: Release two latches and lift radome - install holding bar

REMOVAL:
1. Loosen two bolts and position (install) sway braces on mount
2. Pull two pip-pins and swing out radar assembly
3. Remove electrical connectors
4. Loosen 6 bolts and remove unit from assembly

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform unit/system "BIT" check and operational check of system

TEST EQUIPMENT: Electrical power

CLOSE UP: Close radome and secure latches

ANALYST'S OPINION: Location of the unit/system assembly is good. Easy access to the unit is provided by swinging out the assembly on its mount. Space provided behind the radar assembly is somewhat limited and does somewhat hamper the removal/replacement action. The "BIT" test provides a quick check of the unit's performance, however, a system operational check is recommended.

WORK UNIT CODE: 7424A/N/L/5/57 ITEM: Radar Power Supply AIRCRAFT: F-4

LOCATION: Left Hand Nose Section Radar Compartment

SUPPORT EQUIPMENT: Work Stand

ACCESS: Remove 49 stress screws securing access
Remove access panel

REMOVAL:
1. Remove 4 allen screws securing power supply
2. Pull power supply out to gain access to connectors
3. Remove snap-on air line connection
4. Disconnect 2 electrical connectors. One (high current) is difficult to connect or disconnect - lots of torque required.
5. Remove power supply from aircraft

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform unit "BIT" check

TEST EQUIPMENT: Electrical power
Air Conditioning

CLOSE UP: Close access panel and secure

ANALYST'S OPINION: The installation is considered acceptable. Access to the unit could be improved by using quick release panel fasteners and a hinged panel. Access to the connectors is limited causing some problem in removing/replacing the high-current connectors. Also, moving the unit out to gain access to the connectors caused some strain on the connectors which could, after repeated removals, induce interface problems in the system.

WORK UNIT CODE 74251/74241 ITEM Radar Antenna AIRCRAFT F-4

LOCATION: Radar Compartment

SUPPORT EQUIPMENT: Work Stand

ACCESS: Open radome (loosen four fasteners)
Open radome and secure cable

REMOVAL:
1. Disconnect two hydraulic lines (quick disconnect fittings)
2. Disconnect electrical connectors
3. Disconnect two waveguides
4. Disconnect two coaxial connectors
5. Remove three bolts securing antenna to aircraft
6. Remove nut on upper stud (2 men must hold antenna)
7. Slide antenna off stud and remove from aircraft (2 men required)

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform unit "BIT" check
Perform pressurization check

TEST EQUIPMENT: Air pressure cart
Electrical power
Hydraulic power source
Air conditioning

CLOSE UP: Close radome and secure

ANALYST'S OPINION: The installation, access, removal, and replacement of the antenna is good. Quick disconnect on the hydraulic lines are ideal for this installation. The functional check of the system is simplified by the dependability of the system "BIT."

WORK UNIT CODE 74453 ITEM AIQ-124 Power Supply AIRCRAFT F-8

LOCATION: Unit is located behind the ejection seat

SUPPORT EQUIPMENT: Equipment needed to remove seat and support equipment to hold canopy.

ACCESS: Canopy actuator must be disconnected and canopy opened to a 73 degrees position.
The pyrotechnics must be disconnected and the seat removed.

REMOVAL:
1. Remove six screws securing unit to mounting bracket.
2. Disconnect one electrical connector.
3. Remove unit.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Radar system operational check

TEST EQUIPMENT: None

CLOSE UP: Replace seat
Connect pyrotechnics
Connect canopy actuator
Close canopy

ANALYST'S OPINION: The access to the unit is not acceptable. This installation has generated a simple remove/replacement action into a major maintenance task. Unit should be relocated to preclude removal of the ejection seat.

Note: At some facilities, the canopy is removed when the seat is taken out of the aircraft.

WORK UNIT CODE 74A61 ITEM PP 6773/AWG-9 Power Supply AIRCRAFT F-14

LOCATION: Left Hand Forward Nose Section Avionics Bay

SUPPORT EQUIPMENT: Work Stand

ACCESS: Loosen 29 Calfax fasteners securing access panel
Swing panel open and insert holding bar

REMOVAL:
1. Disconnect electrical connectors
2. Loosen 1 hold down fastener securing power supply
3. Slide power supply from rack and remove from aircraft

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform BIT function of AWG-9 system

TEST EQUIPMENT: Electrical power
Cooling air
Servo air

CLOSE UP: Close access panel and secure

ANALYST'S OPINION: Installation is good. The "BIT" function simplifies the functional check of the unit. However, the amount of support equipment needed to accomplish this generates additional manhours and prolongs the maintenance task.

WORK UNIT CODE 74A15 ITEM T1224/AWG-9 Transmitter AIRCRAFT F-14

LOCATION: Right Hs Forward Electronics Bay

SUPPORT EQUIPMENT: Work Stand

ACCESS: Loosen 27 Calfax fasteners securing access panel
Swing panel open and insert holding bar

REMOVAL:
1. Disconnect 2 high power connectors
2. Disconnect 4 coax connectors
3. Disconnect 4 electrical connectors
4. Disconnect 2 waveguide connections
5. Remove 2 latching bolts securing transmitter
6. Remove transmitter from aircraft (2 men required)

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform BIT function of AWG-9 system and radar operational test.

TEST EQUIPMENT: Electrical power
Cooling air
Servo air

CLOSE UP: Close access panel and secure

ANALYST'S OPINION: The access to the unit is acceptable. The weight of the unit (approx 180 lbs) does pose a problem in removal/replacement and could result in external damage to the unit (removal/replacement is a two men task). Also, weight of the unit may exceed human factors and other MIL standard requirements.

WORK UNIT CODE 74A1C ITEM R1785/AWG-9 Radar Receiver AIRCRAFT F-14

LOCATION: Right Hand Forward Electronics Bay

SUPPORT EQUIPMENT: Work Stand

ACCESS: Loosen 27 Calfax fasteners securing access panel
Swing panel open and insert holding bar

REMOVAL:
1. Disconnect 2 waveguide connectors
2. Disconnect 3 coax connectors
3. Disconnect 3 electrical connectors
4. Remove 2 hold down bolts securing radar receiver
5. Remove radar receiver from aircraft

INSTALLATION: Reverse removal procedure

FUNCTIONAL CHECK: Perform BIT function of AWG-9 system and radar operational test

TEST EQUIPMENT: Electrical power unit
Air conditioning
Servo air

CLOSE UP: Close access panel and secure

ANALYST'S OPINION: The number of panel fasteners and the location of the unit in the aircraft degrades the accessibility. Quick release panel fasteners would reduce the access time. Removal/replacement of the receiver is good and the "BIT" feature simplifies the system functional test.

SYSTEM: 74 Weapons Control

NOMENCLATURE: Radar Indicators and Controls

WUC: A-4: _____ A-6: 724EC, 72X1E, 72Y1R A-7: 73A15, 73A1D F-4: 7425B, 7424C, 7424B, 7424E, 7425E

F-8: 74456 F-14: 74A53, 74A51 AV-8: _____

GENERAL OBSERVATIONS: The AV-8 and AV-4 aircraft are not equipped with forward looking radar. It must be noted also that although these items are all summarized in the 74 system for convenience, the A-7 system WUCs are found in 73 and the A-6 codes in 72. The 74 system was selected for accumulation because of the preponderance of aircraft using that coding. All items summarized are cockpit mounted and require opening no access panels.

DESIRABLE FEATURES: 1. The A-6 and A-7 airplanes use rack and panel mounting which makes removal easier. The A-6 installation makes use of a handle to provide good control during removal and installation. The large connector on this unit requires considerable force to engage or release and the handle assists in this. 2. Except for the A-6, control units are easily removed with minor problems seen in the A-7 and F-4.

UNDESIRABLE FEATURES: 1. The A-6 radar control appears to be too large for instrument panel mounting. Its bulk and weight are difficult to handle in the constricted space in the cockpit. The extractor mechanism helps, but handling this heavy package in the cockpit involves some risk. 2. The otherwise excellent A-7 installation of the control requires moving the throttle with attendant risk of introducing

SYSTEM: 74 Weapons Control

NOMENCLATURE: Radar Indicators and Controls

UNDESIRABLE FEATURES: (cont.)

fuel into the engine. 3. The F-4 installations are also good except for rather short cabling. Whether this is caused by design or previous repairs is unknown. 4. The F-4 indicator requires boresighting to align the radar with the gun sight.

ADDITIONAL REMARKS: Rack and panel mounting of large units with many pinned connectors require handles and devices to help make and break the connections. Without these features, much of the virtue of rack and panel is lost.

WORK UNIT CODE 724EC ITEM Azimuth Range Indicator AIRCRAFT A-6

LOCATION: Cockpit Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Remove three bolts securing unit to instrument panel.
2. Remove indicator from instrument panel.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Operate System

TEST EQUIPMENT: electrical power

CLOSE UP: Close canopy

ANALYST'S OPINION: Good installation. The handle provided on the indicator simplifies removal of the rack and panel mounted indicator.

WORK UNIT CODE: 72X1E ITEM: Radar Indicator Az. Range AIRCRAFT: A-6

LOCATION: Cockpit Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Remove three bolts securing unit
2. Remove indicator from instrument panel

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Operate System

TEST EQUIPMENT: Electrical power

CLOSE UP: Close canopy

ANALYST'S OPINION: Very good installation. The handle provided on the indicator simplifies removal of the rack and panel mounted indicator.

WORK UNIT CODE: 72Y1R ITEM: Radar Set Control AIRCRAFT: A-6

LOCATION: Cockpit Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Remove eight bolts securing unit
2. Remove set control by using extractor mechanism to disconnect unit (rack and panel connectors)
3. Pull unit out part way (reposition yourself by straddling the center console)
4. Remove the unit and place it on the seat
5. Hand the unit to another specialist outside the aircraft

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System functional test

TEST EQUIPMENT: Aircraft power

CLOSE UP: Close canopy

ANALYST'S OPINION: The unit is considered too large for a panel mounted unit, this causes problems in handling, removal, and replacement. Standards should be developed to specify weight and size limits for indicators that are mounted on/in the instrument panel. The size and weight of the unit could injure the specialist during removal/installation task.

WORK UNIT CODE 73A15 ITEM Multiple Indicator AIRCRAFT A-7

LOCATION: Cockpit Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open Canopy

REMOVAL: 1. Loosen two screws securing indicator
2. Remove indicator from instrument panel

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform system operational test

TEST EQUIPMENT: None

CLOSE UP: Close canopy

ANALYST'S OPINION: Removal of the indicator is rather difficult. The indicator is a rack and panel mounted unit, consequently, some problem is encountered releasing or removing the indicator. Replacement of the indicator must be done carefully and slowly to insure the connector is properly aligned. Some release mechanism on the indicators would improve the removal task.

WORK UNIT CODE 73A1D ITEM Radar Set Control AIRCRAFT A-7

LOCATION: Left Hand Cockpit Console

SUPPORT EQUIPMENT: None

ACCESS: Open canopy
Move throttle control forward

REMOVAL:
1. Loosen four quick disconnect fasteners
2. Lift control from console
3. Disconnect electrical connector
4. Remove control box

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform system functional test

TEST EQUIPMENT: Electrical power

CLOSE UP: Close canopy

ANALYST'S OPINION: The requirement to move the throttle control (fwd) to gain access to the control box is considered questionable. Movement of the throttle may allow fuel to enter the engine which could cause torching of the engine on start. It is suggested that a blank panel be installed between the control box and the throttle control.

WORK UNIT CODE: 7425B/7424C/7424B ITEM Command Indicator AIRCRAFT F-4

LOCATION: Center of instrument panel forward cockpit

SUPPORT EQUIPMENT: None

ACCESS: Open canopy
Remove six screws securing sun shield and remove shield
Remove one bolt on the R.H. & L.H. aft sun shield and remove

REMOVAL:
1. Remove two bolts on side of indicator
2. Remove three electrical connectors on L.H. side of indicator
3. Lower safety latch and slide indicator out
4. Remove indicator from aircraft (unit is given to specialist outside of aircraft)

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform system "BIT" check and boresight gun sight

TEST EQUIPMENT: Boresight test fixture/boresight kit
Hydraulic unit
Air Conditioner
Electrical power

CLOSE UP: Replace sun shields
Close canopy

ANALYST'S OPINION: Removal and replacement of the indicator is another easy task. The requirement to boresight the gun system and the additional ground support equipment needed to accomplish the functional test add considerable time to the maintenance task. Aft seat indicators follow essentially the same removal procedure as the forward cockpit indicators.

WORK UNIT CODE: 7424E/7425E ITEM Radar Control Set AIRCRAFT F-4J

LOCATION: Aft cockpit, lower Left Hand Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Loosen six captive screws securing panel
2. Slide control out slightly and disconnect three cables
3. Remove control from aircraft

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform system "BIT" check

TEST EQUIPMENT:
Electrical power
Air conditioning
Hydraulic unit

CLOSE UP: Close canopy

ANALYST'S OPINION: Equipment installation is acceptable. Unit cable harness should be longer; this would provide more access to the connectors. Use of rack and panel installation would simplify the removal/replacement task.

WORK UNIT CODE 74456 ITEM AZIMUTH RANGE INDICATOR AIRCRAFT F-8

LOCATION: Cockpit instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy
Remove access panel

REMOVAL:
1. Remove two bolts securing unit
2. Remove high voltage and video cables
3. Pull indicator forward and remove the main connector
4. Remove unit from instrument panel

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Accomplish system operational check

TEST EQUIPMENT: Electrical power

CLOSE UP: Replace access panel and secure
Close canopy

ANALYST'S OPINION: Installation is considered acceptable. Additional access to the main connector would improve the removal/replacement action. Frequent repair of the main connector shortens the cable length to a point that the specialist must blind mate the connector.

WORK UNIT CODE: 74A53 ITEM: IP-1111/AWG-9 Detail Data Display AIRCRAFT: F-14

LOCATION: Aft Cockpit Instrument Panel

SUPPORT EQUIPMENT: Work Stand

ACCESS: Open canopy

REMOVAL:
1. Remove two bolts
2. Release curtain secured by 14 snap fasteners
3. Disconnect three electrical connectors
4. Disconnect three coaxial connectors
5. Depress equipment release latch & remove display from instrument panel
6. Hand indicator to specialist outside of aircraft

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform system "BIT" check

TEST EQUIPMENT:
Cooling air
Servo air
Electrical power

CLOSE UP: Close canopy

ANALYST'S OPINION: The installation is good. The indicator is rather easy to replace (maintenance specialist likes the installation). A rack and panel type mounting would reduce replacement time slightly.

WORK UNIT CODE: 74A51 ITEM: C9035/AWG-9 Sensor Control AIRCRAFT: F-14

LOCATION: Aft cockpit Left Hand Console

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Loosen 6 fasteners securing the control to the console
2. Slide control from console
3. Disconnect 2 electrical connectors

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform BIT check and operational test of AWG-9 system

TEST EQUIPMENT:
Electrical power unit
Air conditioning
Servo air

CLOSE UP: Close canopy

ANALYST'S OPINION: The installation of the sensor control is good and the removal/replacement can be accomplished in a minimum amount of time. Incorporation of an expanded "BIT" check would reduce the functional checkout time of the system.

WORK UNIT CODE 73906 ITEM Navigator Control AIRCRAFT AV-8

LOCATION: Lower RH Side of Instrument Panel.

SUPPORT EQUIPMENT: Ladder

ACCESS:

Open canopy.

REMOVAL:

1. Loosen 2 fasteners securing the NDC control to the panel.
2. Slide control forward.
3. Disconnect 2 electrical connectors.
4. Remove control from aircraft.

INSTALLATION: Reverse of removal.

FUNCTIONAL CHECK: Perform "BIT" and normal alignment of INS.

TEST EQUIPMENT: Electrical Power

CLOSE UP: Close canopy.

ANALYST'S OPINION: Good irstallation. The access, removal, replacement and functional test of the control is a rather easy task. The job can be accomplished from the cockpit but is much easier done while standing on a ladder or stand. NARF has a very convenient ladder to use around the airplane.

SYSTEM: 73 Radar

NOMENCLATURE: Sweep Generator/Processor

WUC: A-4: _____ A-6: 72457 A-7: 73A16 F-4: _____

F-8: _____ F-14: _____ AV-8: _____

GENERAL OBSERVATIONS: The two generators studied were quite different in the accessibility of their installation. The A-6 installation was excellent while the A-7 must be judged fair. A system functional check was required in both cases.

DESIRABLE FEATURES: 1. The convenient A-6 radome location was further complimented by the ability to lower the equipment rack to ground working level. This combination allows the mechanic to replace the video processor quickly and effortlessly.

UNDESIRABLE FEATURES: 1. The sweep generator on the A-7 is poorly located. A work stand and removal of one 21 fastener access panel are required to reach the generator. The six connecting cables are bulky and also hamper the removal. Three of the cables hang over the unit. They must be properly stowed in order to clear the removal path. These cables are frequently damaged during removal.

ADDITIONAL REMARKS: Consideration during design must be given to location. It is realized that all components cannot be placed at waist level, however, design effort should strive for this optimum either by direct aircraft waist level placement or by allowing for equipment racks to be lowered as in the A-6. Where waist level location or lowered equipment racks are not feasible, design should be such that the removal is not obstructed.

WORK UNIT CODE 72457 ITEM Video Processor AIRCRAFT A-6

LOCATION: Nose Radome

SUPPORT EQUIPMENT: None

ACCESS: Loosen four bolts and open radome by using hydraulic pump

REMOVAL:
1. Open latch and lower equipment rack.
2. Remove electrical cables
3. Remove bolts securing unit to rack

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System functional check

TEST EQUIPMENT: Aircraft power

CLOSE UP: Close radome and secure four bolts

ANALYST'S OPINION: This is a very good installation. The hydraulic radome opener and the ability to lower the equipment rack very nicely overcome the height problem inherent in this airplane.

WORK UNIT CODE: 73A16 ITEM: APQ-126 Sweep Generator AIRCRAFT: A-7

LOCATION: Left side of aircraft (aft of cockpit)

SUPPORT EQUIPMENT: Work Stand

ACCESS: Loosen 21 fasteners and remove access panel

REMOVAL:
1. Disconnect six (6) connectors.
2. Remove two hold down bolts

INSTALLATION: Reverse removal procedure

FUNCTIONAL CHECK: Perform self-test and accomplish a system functional test

TEST EQUIPMENT: External electric power

CLOSE UP: Replace access panel and secure

ANALYST'S OPINION: Accessibility to the Sweep Generator is not as ideal as in the A7 waist high avionics bays. The six harnesses somewhat hamper the removal of the unit and are subject to damage after repeated removals. Removal of the unit can be improved by rerouting the three harnesses that are routed in front of the unit.

SYSTEM: 73 Bombing and Navigation System

NOMENCLATURE: Tactical Computer and Control

WUC: A-4: _____ A-6: _____ A-7: 73A21 73A22 F-4: _____

F-8: _____ F-14: 74A46 74A52 AV-8: _____

GENERAL OBSERVATIONS: This summary includes the tactical computer and its cockpit control. Once access has been attained, the removal of the units was straight forward. Only the A-7 and F-14 were investigated.

DESIRABLE FEATURES: 1. Built-in-test of the F-14 alleviates the test set program loading of the A-7. This simplifies the checkout as well as reducing the maintenance time necessary for the removal. The F-14 BIT was slightly degraded because of the additional cooling equipment needed to operate the computer. 2. Both computer installations make use of rack and panel connectors which facilitates removal. Both installations use jackscrews to guide and mate the connector to prevent connector pin damage. This is a positive feature to incorporate, when utilizing rack and panel connectors. The F-14 jackscrew is slightly better requiring no tools to operate.

UNDESIRABLE FEATURES: 1. Removal of adjoining control panels to gain access to the A-7's computer control's connectors is undesirable. Design of cable length and flexibility should be such that no additional systems be disturbed to gain access. 2. Access to the F-14 computer was hampered by too many fasteners on the access panel. The F-14 utilizes Calfax quick release fasteners, but an improvement can be made using latch type fasteners or fewer calfax.

SYSTEM: 73 Bombing and Navigation System

NOMENCLATURE: Tactical Computer and Control

ADDITIONAL REMARKS: Very little improvement can be made on the computer installations as they come close to being ideal. As with any console installation, care should be given during design to provide sufficient cable and wire slack to allow disconnections without disturbing other installations.

WORK UNIT CODE: 73A21 ITEM ASN 91 Tactical Computer AIRCRAFT A-7

LOCATION: Left Hand Avionics Bay

SUPPORT EQUIPMENT: SM-395

ACCESS: Release eight quick release fasteners and lower bay door

REMOVAL:
1. Remove two bolts securing unit (jack screw type)
2. Remove Tactical Computer

INSTALLATION:
1. Reverse removal procedure
2. Load OFP into computer using SM-395

FUNCTIONAL CHECK:
Perform self test on tactical computer
Perform operational test to verify OFP inputs

TEST EQUIPMENT:
SM-395
External electric power

CLOSE UP: Close bay door and secure

ANALYST'S OPINION: Accessibility to the unit is excellent. The use of a rack and panel connector improves the removal action. However, care must be taken when the unit is installed to insure proper guidepin and connector alignments.

WORK UNIT CODE 73A22 ITEM Tactical Computer Control AIRCRAFT A-7

LOCATION: Right Hand Console Area

SUPPORT EQUIPMENT: None

ACCESS: Open canopy
Remove TACAN control
Remove IMS control
Remove ARA-63 control

REMOVAL:
1. Loosen six captive screws
2. Disconnect three connectors (specialist must reach under the control to disconnect cables)
3. Remove tactical computer control

INSTALLATION: Reinstall in reverse order of removal

FUNCTIONAL CHECK: Perform a self test and an OTP checkout of the tactical computer control

TEST EQUIPMENT: Loader Verifier SM-395
External electric power

CLOSE UP: Reinstall TACAN control
Reinstall IMS control
Reinstall ARA-63 Control Close canopy

ANALYST'S OPINION: Removal of the control is complicated by the requirement to remove adjacent controls to gain access to the connectors. The problem is caused primarily by the short cable length and the stiffness of the cables. What would normally be considered an easy task is now complicated by disturbing other system's operational connectors.

WORK UNIT CODE 74A46 ITEM CP1113/AWG-9 Digital Computer AIRCRAFT F-14

LOCATION: Right Hand Avionics compartment below NFO cockpit

SUPPORT EQUIPMENT: Work Stand

ACCESS: Loosen 33 Calfax fasteners
Swing panel open and insert holding bar

REMOVAL:
1. Loosen hand crank 10-15 turns to release computer
2. Remove computer from aircraft

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform BIT function

TEST EQUIPMENT: Electrical power
Cooling air
Servo air

CLOSE UP: Stow holding bar and secure panel

ANALYST'S OPINION: Access to the computer should be improved. The requirement for a maintenance stand and the number of fasteners on the aircraft panel detracts from the overall installation. Use of a hand crank for the removal/installation of the unit is considered an excellent feature. This simplifies the maintenance tasks and reduces connector damage associated with the installation.

WORK UNIT CODE 74A52 ITEM C9036/AWG-9 Computer Control AIRCRAFT F-14

LOCATION: Left Hand Console, Aft Cockpit

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Loosen 6 fasteners
2. Slide control out from console
3. Disconnect 2 electrical connectors

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform BIT check and limited operational check

TEST EQUIPMENT:
Servo air
Electrical power
Air conditioning

CLOSE UP: Close canopy

ANALYST'S OPINION: This is a good installation. The auxilliary support equipment requirements to perform BIT is the only bad feature of the overall maintenance task.

SYSTEM: 73 Bombing Navigation System

NOMENCLATURE: Head-Up Display

WUC: A-4: _____ A-6: 72911 A-7: 73A41 / 73A42 F-4: _____

F-8: _____ F-14: 69182 AV-8: 739Z1 / 739X2

GENERAL OBSERVATIONS: The A-4, F-4, F-8 and F-14 aircraft HUD installations were not evaluated. The A-6 indicator was included in this series but is not representative of a head-up display. The A-7 installation was considered good while the AV-8 must be considered as poor. Each system included a "BIT" or "self-test" feature as a means of testing the unit. They also required a limited functional test to determine proper system interface.

DESIRABLE FEATURES: The A-7 aircraft uses rack and panel mounting which improves its removal and does not require special tools for removal. Access to the A-7 HUD does not require removal of any operational components. The removal and replacement of the electronics units is considered an easy task on each airplane.

UNDESIRABLE FEATURES: The AV-8 removal is complicated by the number of actions required in gaining access to and in removing the unit. In all aircraft, the awkward size and complexity of the unit presents some risk in handling the unit in the limited space of the cockpit. The number of fasteners and the requirement to remove and handle an access panel on the F-14 and AV-8 airplanes are features that should be improved.

SYSTEM: 73 Bombing Navigation System

NOMENCLATURE: Head-Up Display

ADDITIONAL REMARKS: The design of each cockpit limits any improvements that can be made to the installation of the unit and the location of the unit is dictated by the operational requirements. Considering these factors and the fact that the size and weight is a result of the unit design, each HUD installation is considered unique to that aircraft.

WORK UNIT CODE: 72911 ITEM: Analog Display AIRCRAFT: A-6

LOCATION: Cockpit Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Remove three screws securing the unit
2. Remove unit from panel (a handle is provided for removal and handling of equipment).

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Functional check by operation of Weapon Systems and Radar.

TEST EQUIPMENT: Aircraft power

CLOSE UP: Close canopy

ANALYST'S OPINION: This is a good installation. The handle designed on the unit improves the removal and installation features of the equipment. Removal/replacement is a simple task.

WORK UNIT CODE 73A41 ITEM HEAD UP DISPLAY AIRCRAFT A-7

LOCATION: Upper Instrument Panel

SUPPORT EQUIPMENT: None

ACCESS: Open canopy

REMOVAL:
1. Remove insulating cover
2. Remove glare shield
3. Remove two mounting screws securing unit
4. Remove unit from rack and panel mount

INSTALLATION: Reverse removal procedure

FUNCTIONAL CHECK: Perform a self test and a limited system operational check

TEST EQUIPMENT: External electric power

CLOSE UP: Close canopy

ANALYST'S OPINION: The glare shield removal adds an extra step in the removal actions but in general this is an excellent installation for a unit this size and complexity.

WORK UNIT CODE 73A42 ITEM Signal Data Processor AIRCRAFT A-7

LOCATION: Left Hand Avionic Bay

SUPPORT EQUIPMENT: None

ACCESS: Open eight quick release fasteners and lower bay door

REMOVAL:
1. Remove two electrical connectors
2. Remove two screw type hold downs
3. Slide unit out of rack

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform a system self-test

TEST EQUIPMENT: Electrical power

CLOSE UP: Close avionic bay door and secure

ANALYST'S OPINION: Access, removal, and replacement of the unit is very good. Maintenance can be accomplished at ground without the use of support equipment.

WORK UNIT CODE 69182 ITEM CV2755/AVA12 Analog Display Converter AIRCRAFT F-14

LOCATION: Left Hand Mid Section Avionics Bay

SUPPORT EQUIPMENT: Work Stand

ACCESS: Loosen 30 Calfax fasteners securing panel
Remove access panel from aircraft

REMOVAL:
1. Disconnect 5 electrical connectors
2. Remove 2 hold down bolts securing unit
3. Slide converter from aircraft

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform an on-board master test check (BIT), Instrument function

TEST EQUIPMENT: Electrical power unit

CLOSE UP: Replace panel and secure

ANALYST'S OPINION: The use of BIT as a functional test improves the overall installation. Access could be improved by having quick release fasteners and a hinged panel. The location of the unit is too high off the ground. This is, however, typical of all equipment installed on the aircraft.

WORK UNIT CODE: 7392l ITEM: Pilot Display Unit AIRCRAFT: AV-8

LOCATION: Upper Center Instrument Panel

SUPPORT EQUIPMENT: Cockpit ladder.
PDU adapter tool.

ACCESS: Open canopy
Remove three screws securing fuel warning caution panel and move panel to the side.
Remove two bolts securing connector bracket, bracket is positioned to the side. (See Continuation Sheet)

REMOVAL:
1. Disconnect clamp holding display recorder wire harness.
2. Disconnect the electrical connector.
3. Remove two bolts securing the front of the PDU.
4. Lift up the center glare shield.
5. Using a special tool, loosen two captive bolts securing the rear of the PDU.
6. Pull PDU forward to gain access to the two electrical connectors at the rear of the PDU and remove.
7. Slide PDU from mount and remove from aircraft.

INSTALLATION: Reverse of removal.

FUNCTIONAL CHECK: Perform "BIT" test 1 and 2.
Perform functional test in the V/STOL position to verify display patterns.

TEST EQUIPMENT: Electrical power.

CLOSE UP: Replace components and hardware removed to gain access.
Close canopy.

ANALYST'S OPINION: The removal of the PDU is complicated by the number of individual steps required in the removal and in gaining access to the unit. The use of a rack and panel installation would provide some improvement in the removal/replacement tasks.

CONTINUATION SHEET:

WORK UNIT CODE 739Z1 ITEM Pilot Display Unit AIRCRAFT AV-8

ACCESS: (cont.)

Slide out defroster vents from LH and RH side of display unit.
Remove RH side of instrument panel.

WORK UNIT CODE: 739X2 ITEM: Display Waveform Generator AIRCRAFT: AV-8

LOCATION: Left Hand Avionic Bay

SUPPORT EQUIPMENT: None

ACCESS: Loosen 30 fasteners securing panel
Remove access panel from aircraft

REMOVAL:
1. Disconnect two electrical connectors
2. Loosen equipment retaining nuts
3. Slide unit out of equipment rack

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform "BIT" check on HUD system

TEST EQUIPMENT: Electrical power

CLOSE UP: Replace access panel and secure

ANALYST'S OPINION: Remove and replacement of the unit is good. Maintenance can be accomplished at ground level without the use of support equipment.

SYSTEM: 73 Bomb Navigation

NOMENCLATURE: Inertial Measurement

WUC:	A-4:		A-6:	73457 73455 73453	A-7:	73A51 73A54	F-4:
	F-8:		F-14:	734H1 734H2	AV-8:	739W1 739W8	

GENERAL OBSERVATIONS: The A-4, F-8 and F-4 were not considered in this evaluation. Except for needing a maintenance stand, the installation on the A-6 and F-14 is good. The installation on the A-7 is fair and the AV-8 must be considered poor. Removal of the system power supply and the functional testing of the system are common on all aircraft.

DESIRABLE FEATURES: After access, the removal of the IMU system components on each airplane is an easy task. The "BIT" or "self-test" design feature provides a means to make a quick check of the unit/system performance before any prolonged operational test (weapon system interface) is accomplished.

UNDESIRABLE FEATURES: Access to the IMU, on the AV-8 airplane, requires complete removal of the aircraft nose cone. This removal is considered a major maintenance task because it involves other systems installed in the nose cone, increases manpower requirements and adds ground operating time on the airplane. On the A-7, the power supply must be removed for access to the IMU.

ADDITIONAL REMARKS: The complexity of the IMU, the various weapon systems it interfaces with and its operational requirements which dictate location on the aircraft create a demand to insure unrestricted access to the unit and rapid removal and replacement.

WORK UNIT CODE 73457 ITEM Inertial Control Box AIRCRAFT A-6

LOCATION: Right Hand Cockpit Console

SUPPORT EQUIPMENT: None

ACCESS: Open canopy.

REMOVAL:
1. Loosen 4 dzus fasteners.
2. Remove unit from console.
3. Disconnect cable.

INSTALIATION: Reverse of removal.

FUNCTIONAL CHECK: System run-up.

TEST EQUIPMENT: Aircraft power.

CLOSE UP: Close canopy.

ANALYST'S OPINION: Installation of the control box simplifies removal/replacement of the unit. The installation is common with other console mounted equipment.

WORK UNIT CODE 73455 ITEM CN-695/ASN-31 Gyroscope AIRCRAFT A-6

LOCATION: Fillet area above engine

SUPPORT EQUIPMENT: Maintenance Stand

ACCESS: Loosen 15 panel fasteners and remove panel

REMOVAL:
1. Remove five cables
2. Loosen two knurl knobs
3. Remove unit

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System run-up

TEST EQUIPMENT: Aircraft power

CLOSE UP: Replace panel

ANALYST'S OPINION: Removal/replacement of the unit is good. This new location is considerably better than the initial location in the nose wheel well. It has made the removal/replacement a rather simple task.

WORK UNIT CODE 73453 ITEM Inertial Power Supply AIRCRAFT A-6

LOCATION: Right Side of Nose Wheel Well

SUPPORT EQUIPMENT: None

ACCESS: Remove splash cover.
Disconnect nose wheel well door linkage.

REMOVAL:
1. Disconnect three plugs.
2. Loosen two knurl knobs securing unit.
3. Remove unit from mount.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Complete system check out.

TEST EQUIPMENT: Aircraft power.

CLOSE UP: Close splash cover.
Connect door linkage.

ANALYST'S OPINION: Unit is relocated on A-6E. The system functional check should be improved. At present you cannot determine proper operation of the power supply. Fail light will come on if the power supply has no output, however, if voltages are below normal other system malfunctions will occur without illuminating the light.

WORK UNIT CODE 73A51 ITEM Inertial Measurement Unit AIRCRAFT A-7

LOCATION: Left Hand Avionics Bay

SUPPORT EQUIPMENT: None

ACCESS: Open eight quick release fasteners and lower bay door
Remove inertial power supply

REMOVAL: 1. Disconnect four electrical connectors
2. Remove cables from cable clamp
3. Remove two bolts securing unit in mount
4. Slide unit from mount

INSTALLATION: 1. Reverse of removal
2. Insert data parameters into the tactical computer

FUNCTIONAL CHECK: Perform self-test on the inertial measurement system
Accomplish weapon system operational test

TEST EQUIPMENT: Electrical power

CLOSE UP: Reinstall inertial power supply
Close bay door and secure

ANALYST'S OPINION: The removal and replacement of the IMU is a rather easy task. However, access to the unit is a feature that is undesirable since it requires removal of the inertial power supply. Caution must be exercised in handling the equipment and in properly mating the connectors. The functional check of the system is time consuming but necessary to assure that the corrected data parameters have been entered into the computer.

WORK UNIT CODE 73A53 ITEM ASN-90 Inertia Measurement Unit Set Control AIRCRAFT A-7

LOCATION: Right Hand Instrument Console

SUPPORT EQUIPMENT: None

ACCESS: Open canopy.

REMOVAL:
1. Remove four camloc fasteners.
2. Lift control from the console.
3. Disconnect electrical connector.

INSTALLATION: Reverse of removal.

FUNCTIONAL CHECK: Perform a self test and an operational checkout on the ASN-90 IMS.

TEST EQUIPMENT: SM-395.
External Elctrical Power

CLOSE UP: Close canopy.

ANALYST'S OPINION: The removal/replacement of the control is easy and common with other console mounted controls.

WORK UNIT CODE 73A54 ITEM Inertial Power Supply AIRCRAFT A-7

LOCATION: Left Hand Avionics Bay

SUPPORT EQUIPMENT: None

ACCESS: Open 8 quick release fasteners and lower bay door.

REMOVAL:
1. Remove two hold down bolts securing the unit.
2. Disconnect electrical connectors.
3. Remove power supply from aircraft.
4. Remove heading repeater module (HRM) from the power supply.

INSTALLATION:
1. Install HRM on new power supply
2. Reverse of removal.

FUNCTIONAL CHECK: Perform system operational checkout and BIT function.

TEST EQUIPMENT: External electrical power.

CLOSE UP: Close avionics bay door and secure.

ANALYST'S OPINION: The Inertial Power Supply (Adapter Power Supply) has an ideal location in the avionics bay for good access and simple removal tasks. Retaining the original HRM is a design feature that negates a compass swing requirement.

WORK UNIT CODE 734H1 ITEM Inertial Measurement Unit AIRCRAFT F-14

LOCATION: Left Hand Forward Fuselage Compartment

SUPPORT EQUIPMENT: Work Stand

ACCESS: Loosen 29 Calfax fasteners
Open access panel and position holding bar

REMOVAL: 1. Disconnect three electrical connectors.
2. Remove two allen head bolts securing the unit
3. Remove the unit from the mount.

INSTALLATION: Reverse of removal
(1.) Unit mounting bolts (allen heads) must be tightened to specific torque setting
(2.) IMU parameters must be entered into the computer

FUNCTIONAL CHECK: Perform system "BIT" test plus IMU alignment & drift run

TEST EQUIPMENT: Electrical power
Air conditioning
Servo air

CLOSE UP: Close access panel and secure

ANALYST'S OPINION: Removal and replacement of the unit is good. The extended functional test is common with other aircraft systems and necessary to insure proper operation.

WORK UNIT CODE: 734H2 ITEM PP-6188/ASN-92(V) Power Supply AIRCRAFT F-14

LOCATION: RH Side of Aircraft Below Refueling Probe

SUPPORT EQUIPMENT: Work Stand

ACCESS: Loosen 10 Calfax fasteners securing access panels.
Remove panel from aircraft.

REMOVAL:
1. Remove 2 hold down screws securing power supply.
2. Disconnect 3 electrical connectors.
3. Remove power supply from aircraft.

INSTALLATION: Reverse of removal.

FUNCTIONAL CHECK: Perform INS alignment and drift check.
Perform AWG-9 BIT check.

TEST EQUIPMENT. Electrical Power
Air Conditioning Unit
Servo Air

CLOSE UP: Replace access panel and secure.

ANALYST'S OPINION: Removal/replacement of the unit is good. Location of the unit is acceptable.

WORK UNIT CODE: 739W1 ITEM Inertial Platform AIRCRAFT AV-8

LOCATION: Right side of nose compartment

SUPPORT EQUIPMENT: Work Stand
Special spanner wrench

ACCESS: Remove nose cone
Open canopy

REMOVAL: 1. Disconnect two electrical connectors
2. Remove two bolts securing the platform
3. Slide the unit out of the mounting rack

INSTALLATION: Reverse of removal

Note: Installation of nose cone requires one man to pull back on control stick to position the pitch shutter in the "up" position.

FUNCTIONAL CHECK: Perform an INS "Normal" alignment
Perform leak test on pitot and static system
Functionally test camera systems

TEST EQUIPMENT: Electrical power
Leak tester

CLOSE UP: Replace nose cone

ANALYST'S OPINION: After access to the unit, the removal and replacement task is easy. The major portion of the time is expended gaining access to the unit (removal/replacement of the nose cone). Functional test of those systems in the nose cone also prolongs the maintenance task.

WORK UNIT CODE 739W8 ITEM Power Supply AIRCRAFT AV-8

LOCATION: Left Hand Avionic Bay

SUPPORT EQUIPMENT: None

ACCESS: Loosen panel fasteners and remove access panel.

REMOVAL:
1. Loosen nuts securing the unit and the mount.
2. Slide power supply out of rack.

INSTALLATION: Reverse of removal.

FUNCTIONAL CHECK: Perform a "BIT" check and align the INS systems.

TEST EQUIPMENT: Electrical Power

CLOSE UP: Replace access panel and secure.

ANALYST'S OPINION: Installation, removal and replacement of the unit is good. Functional test is common with other aircraft systems.

ECM SYSTEMS

ALQ-100/ALQ-126 COUNTERMEASURE SET [redacted]

ALR-45/ALR-50 COMPONENTS [redacted]

ECM SYSTEMS

CONTENTS

COMPONENT	A-4	A-6	A-7	F-4	F-8	F-14	AV-8
ALQ-100/ALQ-126 Countermeasure Set	76731	76731	767L1	76731	76731	76731	N/A
ALR-45/ALR-50 Components	N/A	763L1 763L3	763W1 763L1 763L3	763L1 763L3 763W1	N/A	763W1 763L1	N/A

SYSTEM: 76 Electronics Countermeasures Systems

NOMENCLATURE: ALQ-100/ALQ-126 Countermeasure Set

MUC: A-4: 76731 A-6: 76731 A-7: 767L1 F-4: 76731

F-8: 76731 F-14: 76731 AV-8: _____

GENERAL OBSERVATIONS: The ALQ-100, observed in all aircraft except the A-7 and AV-8 and the ALQ-126 observed in the A-7 are grouped together because of the similarities in installation and function. The AV-8 is not equipped with ECM. The dominant characteristic of this unit is its weight (approximately 185 pounds). Installations differed primarily by the manner that this weight is accommodated. Most installations are the result of ECP action and existence of other systems already installed limited the availability of space to install an item of this size. The resulting compromise provides much less than optimum locations in several airplanes.

DESIRABLE FEATURES: The A-7E airplane stands out as superior in access to the unit. The ALQ-100 was part of the A-7E basic design which allowed placing it in a convenient location that was accessible from deck level and permitted it to be handled without support equipment. The A-6 and F-14 are positioned to allow removal without hoisting; however, maintenance stands are required which are very inconvenient when weight and bulk of the unit are considered.

UNDESIRABLE FEATURES: The primary fault with this set is the weight of about 185 pounds, yet to perform its function, this amount of material is required. The A-4, F-4, and F-8 were unable to handle this unit as

SYSTEM: 76 Electronics Countermeasures Systems

NOMENCLATURE: AIQ-100/ALQ-126 Countermeasure Set

UNDESIRABLE FEATURES: (Cont.)

an ECP without placing very high in the airplane. Hoisting equipment is required and in some cases, the hoist must reach far over the wing root area.

ADDITIONAL REMARKS: Adding major items to an airplane already built generally compromises maintainability included in the basic design as well as the added unit. Not much can be done about this and to arrive at an acceptable economical installation is an achievement.

WORK UNIT CODE 76731 ITEM AIQ-100 ECM R/T AIRCRAFT A-4

LOCATION: Upper Avionic Compartment

SUPPORT EQUIPMENT: Hoist
Maintenance stand

ACCESS: Remove eight panel fasteners on each side of the compartment and remove both panels.

REMOVAL:
1. Disconnect electrical connectors (2 men)
2. Remove unit from rack and disassemble unit in compartment (2 man task - one on each side of the compartment).
3. Remove unit from aircraft.

(NOTE: Special GSE is designed to handle and position the unit over the wing area. GSE was not available for evaluation).

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Transmitter unit is checked using "BIT". System antennae are checked using test equipment.

TEST EQUIPMENT: 31-016717-02, 31-016718-02, 31-014826-01 and Electrical Power

CLOSE UP: Replace aircraft panel and secure

ANALYST'S OPINION: The location, removal and replacement of the unit is considered bad. The unit must be positioned over the wing area, using a handling fixture similar to an overhead crane, and then removed. The installation and removal of the unit requires it be disassembled and assembled in the compartment. This is an example of the heaviest avionics unit (185 lbs.) being installed in the highest compartment in the aircraft.

WORK UNIT CODE 76731 ITEM AIQ-100 Receiver/Transmitter AIRCRAFT A-6

LOCATION: Left side of aft tail section

SUPPORT EQUIPMENT: Maintenance stand

ACCESS: Loosen 44 panel fasteners and remove aircraft panel.

REMOVAL: 1. Disconnect three connectors and 3 coaxial cables.
2. Loosen two knurl knobs.
3. Remove unit (unit is mounted at a 15° upward slope).

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: The unit is checked using built-in-test. The system is functionally checked by checking each antenna.

TEST EQUIPMENT: TS-AIM-66
ASM-45B
AIM-140
Electrical power

CLOSE UP: Replace aircraft panel and secure.

ANALYST'S OPINION: The installation, removal, and replacement of the R/T unit is good. However, considering the weight of the unit (approx 185 lbs) it should be located at ground level or in the aft avionic compartment.

WORK UNIT CODE 767L1 ITEM ALQ-126 RECEIVER/TRANSMITTER AIRCRAFT A-7

LOCATION: Right Hand Avionic Bay

SUPPORT EQUIPMENT: None

ACCESS: Open eight quick release fasteners and lower panel.

REMOVAL:
1. Remove six coaxial connectors.
2. Remove four cable connectors.
3. Remove two screw type fasteners
4. Remove unit

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Unit is checked using self-test.

TEST EQUIPMENT: Electrical power

CLOSE UP: Close access panel and secure.

ANALYST'S OPINION: The installation, access, removal, and replacement of the unit is good. Unit can be replaced at ground level without the use of support equipment.

WORK UNIT CODE 76731 ITEM ALQ-100 Receiver/Transmitter AIRCRAFT F-4J

LOCATION: Upper Equipment Bay (Upper Dorsal Area)

SUPPORT EQUIPMENT: Hoist
Work Stand

ACCESS: 1. Loosen 42 fasteners securing access panel
2. Open panel and install holding bar
3. Remove data link converter and mount from access panel

REMOVAL: 1. Remove coaxial and electrical connectors
2. Remove two bolts securing the R/T in the mount
3. Attach hoist support sling to unit bracket
4. Remove unit from aircraft

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform unit self-test
Perform operational test of system
Perform interface check

TEST EQUIPMENT: Antenna coupler set
AIM-66
AIR-45 high power test set
Electrical power

CLOSE UP: Replace items removed to gain access
Close panel and secure

ANALYST'S OPINION: The location, access and removal/replacement of the unit is considered bad. This is another example of the heaviest avionic unit (185 lbs.) being installed in the highest compartment in the aircraft

WORK UNIT CODE 76731 ITEM AIQ-100 Receiver Transmitter AIRCRAFT F-8

LOCATION: Unit is located in the CNI Compartment behind the cockpit.

SUPPORT EQUIPMENT: Maintenance stand is required.
NARF specialists use overhead crane.

ACCESS: Remove 15 fasteners and remove access panel

REMOVAL:
1. Disconnect electrical connectors
2. Remove bolts securing unit
3. Attach overhead crane lifting device to the unit
4. Remove unit from the mount

FUNCTIONAL CHECK: Perform system self-test

TEST EQUIPMENT: Unknown

CLOSE UP: Replace aircraft panel

ANALYST'S OPINION: The location, removal and replacement of the unit is bad. The R/T unit is located in the highest aircraft compartment and the installation of the unit requires it to be lifted out of the mounting rack. The overhead crane is used to prevent injury to specialists that may attempt to remove the unit and to preclude damage to the airframe (unit weighs approx. 185 lbs.). This is a good example of the heaviest unit in avionics being installed/located in the highest aircraft compartment.

WORK UNIT CODE 76731 ITEM AIQ-100 Receiver Transmitter AIRCRAFT F-14

LOCATION: RH Avionics Compartment Below NFO Cockpit

SUPPORT EQUIPMENT: Work stand

ACCESS: Loosen 33 Calfax fasteners
Swing panel open and insert holding bar

REMOVAL:
1. Loosen 2 nut type fasteners securing unit
2. Disconnect 4 coax connectors
3. Disconnect 4 electrical connectors
4. Using 2 men, slide RT unit out of aircraft and on to stand.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform system self test and functional check.

TEST EQUIPMENT: AN/ALM-66 Test Set
RF Antenna Coupler

CLOSE UP: Stow holding bar and secure aircraft panel

ANALYST'S OPINION: The location of the unit is not considered acceptable. The AIQ-100 receiver/transmitter is approximately 185 lbs. probably the heaviest avionic unit in the aircraft, and should be located at ground level. The requirement for a maintenance stand increases the possibility of damaging the unit during installation/removal and could cause injury to the specialist.

SYSTEM: 76 Electronics Countermeasures System

NOMENCLATURE: ALR-45/ALR-50 Components

MUC:	A-4:		A-6:	763L1 763L3	A-7:	763W1 763L1 763L3	F-4:	763L1 763L3 763W1
	F-8:		F-14:	763W1 763L1	AV-8:			

GENERAL OBSERVATIONS: This summary aggregates the ALR-45 detector and pulse analyzer and the ALR-50 reciever. The AV-8 and A-4 do not have the equipment installed. The equipment in the F-8 was not observed. ALR-45 detectors were constrained in location by functional requirements which tended to inhibit access. The analyzers allowed more freedom of location and were generally good. The ALR-50 installations fell short of desirable installations for various reasons. Built-in-test is a significant help in checking the component: however, test equipment is required for system checkout.

DESIRABLE FEATURES: 1. Built-in-test is a help in confirming a good component installed. Its value is degraded somewhat by lack of system BIT. 2. ALR-45 analyzers were generally mounted in accessible places and easy to remove. The detectors were reasonably easy to remove but location constraints inhibit access by requiring fairly large stressed access panels. 3. The equipment is small and light and easily handled.

UNDESIRABLE FEATURES: 1. The F-4, ALR-45 analyzer required further disassembly after removal. In the same airplane, the ALR-50 installation was very poor. Several large items had to be removed to gain access. (NARF technicians estimated replacement times at 5 hours). 2. The A-7 ALR-50 was mounted sideways in the compartment. Visual access

SYSTEM: 76 Electronics Counte measures System

NOMENCLATURE: AIR-45/ALR-50 Com onents

UNDESIRABLE FEATURES: (Cont.)

tc connectors is poor and crossed connections can easily happen.

3. The A-6 ALR-45 detector checkout is awkward. The unit must be hooked into the circuit but cannot be installed in the pod in order to make adjustments during checkout. 4. As mentioned above, detector location required stressed access panels. Roughly, 50 screws were required in all of them.

ADDITIONAL REMARKS: Often with sophisticated equipment such as ECM, it is not possible to achieve optimum locations because of the functional requirements of the unit. Such appears to be the case with the ALR-45 detectors. Airframe structural requirement can, as in this case, prohibit the traditional quick access associated with avionics installations unless the weight penalties associated with quick access is accepted.

WORK UNIT CODE: 763L1 ITEM TS 3053/ALR-45 Pulse Analyzer AIRCRAFT A-6

LOCATION: Right side of the Aft Equipment Compartment

SUPPORT EQUIPMENT: None

ACCESS: Open three latches and lower compartment door

REMOVAL:
1. Remove four connectors
2. Remove two wing nuts securing unit
3. Remove unit from rack

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: System checked using test equipment

TEST EQUIPMENT: AN/ALM-105
Electrical power

CLOSE UP: Close aft equipment compartment door and secure

ANALYST'S OPINION: Good installation. The location of the equipment eliminates the need for a maintenance stand. Removal/replacement of the unit is easy.

WORK UNIT CODE 76313 ITEM ALR-45 Amp. Detector AIRCRAFT A-6

LOCATION: Two in each wing pod

SUPPORT EQUIPMENT: Maintenance stand

ACCESS: Remove wing pod by removing 60 screws

REMOVAL:
1. Disconnect cables
2. Remove installation bar securing the amplifier
3. Remove unit

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Functional check is made using test equipment. Amplifier must be connected but not installed in the aircraft in order to make adjustments.

TEST EQUIPMENT: ALM-105
Aircraft power

CLOSE UP: Replace wing pod and secure.

ANALYST'S OPINION: Accessibility to the unit is considered bad. Equipment should be modified to provide access to the adjustments after the unit is installed. Current method used to functionally check system is considered unacceptable. The requirement for 60 screws in the access panel is undesirable, but is dictated by functional constraints on location.

WORK UNIT CODE: 763W1 ITEM: ALR-50 Radar Receiver AIRCRAFT: A-7

LOCATION: Right Hand Avionics Bay

SUPPORT EQUIPMENT: None

ACCESS: Loosen fasteners and remove access panel
Remove ARA-50 amplifier (AM-3624/ARA-50)(2 coax connectors, & two screw type fasteners)
(See Continuation Sheet)

REMOVAL:
1. Disconnect seven (7) connectors
2. Disconnect three (3) plugs
3. Disconnect two (2) screw type hold down fasteners
4. Remove receiver

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform an operational test on the ALR-50 Radar Receiver
Operational check of all equipment removed

TEST EQUIPMENT: External electric power

CLOSE UP: Replace components removed

ANALYST'S OPINION: This installation has too many connectors and some can be connected wrong. The receiver is mounted side ways and provides poor visual access. Removal of two components for access is considered very poor. This installation involves an apparent high maintenance risk.

CONTINUATION SHEET:

WORK UNIT CODE: 763W1 ITEM: AIR-50 Radar Receiver AIRCRAFT: A-7

ACCESS: (Cont.)

Remove ARR-69 receiver (R-1286/ARR-69) (1 plug, 1 coax and 2 screw type hold-down fasteners).

WORK UNIT CODE 763L1 ITEM ALR-45 Electrical Pulse Analyzer AIRCRAFT A-7

LOCATION: Left Hand Avionics Bay

SUPPORT EQUIPMENT: None

ACCESS: Open eight quick release fasteners and lower door

REMOVAL:
1. Disconnect electrical connectors
2. Remove One (1) hold down bolt
3. Remove unit

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform ALR-45 electrical pulse analyzer self test

TEST EQUIPMENT: External electric power

CLOSE UP: Close bay door and secure

ANALYST'S OPINION: Good installation. Unit can be removed at ground level and the unit self test simplifies the functional test of the equipment.

WORK UNIT CODE: 763L3 ITEM: ALR-45 Amp. Detector AIRCRAFT: A-7

LOCATION: Nose Inlet Area

SUPPORT EQUIPMENT: Work Stand

ACCESS: Remove one panel (36 screws)
Remove one panel (20 screws)
Remove mount (8 screws)

REMOVAL:
1. Remove coaxial connector
2. Remove electrical connector
3. Remove unit from aircraft

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform a self-test on the amplifier detector

TEST EQUIPMENT: Electrical power

CLOSE UP: Replace and secure all removed panels

ANALYST'S OPINION: The overall installation, access, and removal/replacement of the unit is acceptable considering the fact that the location of the detector close to the antenna is required to meet the operational requirements. The number of fasteners are required because of the location of the panel.

WORK UNIT CODE: 763L1 ITEM: TS-3053/ALR-45 Elect. Pulse Analyzer AIRCRAFT: F-4

LOCATION: Lower fuselage utility compartment

SUPPORT EQUIPMENT: None

ACCESS: Remove 69 stress fasteners and let panel swing down

REMOVAL:
1. Remove four screws securing cable tray.
2. Remove one cable clamp.
3. Disconnect four electrical connectors.
4. Remove four bolts and remove cover.
5. Remove four bolts securing bracket and analyzer.
6. Remove bracket and analyzer from aircraft.
7. Remove bracket from analyzer (8 screws).

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform unit "BIT" check and operational check using high power test set

TEST EQUIPMENT: ALR-45 High Power Test Set
Electrical power

CLOSE UP: Replace access panel and secure

ANALYST'S OPINION: The access, removal, and replacement of the installation is degraded because of the number of fasteners on the access panel and the requirement to dismantle (disassemble and assemble) hardware. The removal task could be simplified by using a standard equipment mount.

WORK UNIT CODE 7631-3 ITEM ALR-45 Amp. Detector AIRCRAFT F-4

LOCATION: Right Hand section of tail

SUPPORT EQUIPMENT: High lift stand

ACCESS: Remove 62 stress screws from access panel and remove panel

REMOVAL:
1. Remove two bolts securing amplifier to bracket
2. Disconnect two coaxial and two electrical connectors
3. Position (twist) amplifier to allow removal of two filters
4. Remove four bolts securing filters
5. Remove amplifier assembly from aircraft
6. Remove ten screws securing amplifier cover
7. Remove six nuts securing amplifiers (2 each) together
8. Remove amplifiers

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform unit self-test and operational test using high power test set.

TEST EQUIPMENT: ALR-45 High Power Test Set
Electrical power

CLOSE UP: Replace access panels and secure

ANALYST'S OPINION: The overall installation, access, removal, and replacement of the unit are acceptable. The equipment operating requirements dictate equipment locations. The number of fasteners are required because of the location of the panel.

WORK UNIT CODE 763W1 ITEM R-1764/ALR-50 Radar Receiver AIRCRAFT F-4

LOCATION: Upper Equipment Bay (upper dorsal area)

SUPPORT EQUIPMENT: Hoist
Work Stand

ACCESS: Loosen fasteners and open access panel
Remove data link receiver
Remove ALQ-100 Receiver Transmitter
(See Continuation Sheet)

REMOVAL:
1. Disconnect nine coaxial connectors.
2. Disconnect two electrical connectors.
3. Loosen two nuts securing unit.
4. Slide receiver to the right and remove from aircraft.

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform unit "BIT" check and check system operation using high power test set and system test set
Perform a system operational test of all systems removed or disconnected

TEST EQUIPMENT: ALR-45 high power test set
Test equipment needed to check systems removed
Electrical power

CLOSE UP: Replace all items/components removed for access

ANALYST'S OPINION: The access to the unit is completely unacceptable. The equipment installed in the compartment must be removed and the compartment dismantled to gain access to the unit. What should be considered a simple removal/replacement is actually a major maintenance action (removal/replacement is estimated to take five hours). Relocation of the ALR-50 receiver is more than warranted.

CONTINUATION SHEET:

WORK UNIT CODE 763W1 ITEM R-1764/ALR-50 Radar Receiver AIRCRAFT F-4

ACCESS: (Continued)

Remove three radar computers
Disconnect ALQ-100 waveguide in two locations
Remove equipment rack
Open canopy

WORK UNIT CODE: 763L1 ITEM: TS-3053( )/ARL-45 (V) Pulse Analyzer AIRCRAFT: F-14

LOCATION: L.H. Mid Section Avionics Bay

SUPPORT EQUIPMENT: Work Stand

ACCESS: Loosen 29 Calfax fasteners
Remove panel from aircraft

REMOVAL:
1. Disconnect 4 electrical connectors
2. Remove hardware securing ground strap
3. Loosen bolt securing pulse analyzer
4. Remove pulse analyzer from aircraft

INSTALLATION: Reverse of removal

FUNCTIONAL CHECK: Perform unit "BIT" check and operational test using high power test set

TEST EQUIPMENT: ALR-45 High Power Test Set
Electrical Power

CLOSE UP: Replace access panel and secure

ANALYST'S OPINION: The removal and installation of the unit is acceptable. The access to the unit could be improved if quick release fasteners were used in the access panel and the panel were hinged. The "BIT" feature simplifies testing of the unit after replacement.

WORK UNIT CODE 763W1 ITEM R-1764/ALR-50(V) Radar Receiver AIRCRAFT F-14

LOCATION: LH Mid Section Avionics Bay

SUPPORT EQUIPMENT: Work Stand

ACCESS: Loosen 29 Calfax fasteners. Remove fin cap from aircraft.
Remove panel from aircraft.
Remove TS-3053( )/ALR-45(V) pulse analyzer.
Remove 10 screws securing fin cap.

REMOVAL:
1. Disconnect 5 coax connectors.
2. Disconnect 3 electrical connectors.
3. Loosen 2 hold down bolts securing the receiver.
4. Remove receiver from aircraft.

INSTALLATION. Reverse of removal.

FUNCTIONAL CHECK: Perform unit "BIT" check and check systems operation using high power test set.

TEST EQUIPMENT: AIR-45 High Power Test Set
Electrical Power

CLOSE UP: Replace items/components removed for access
Replace access panel and secure

ANALYST'S OPINION: The removal and replacement of the unit is acceptable. The removal of a unit to gain access is always considered bad. However, in this case, the unit removed is part of the system being worked on and does not require testing of another system.